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Invasive Plant Treatments

Draft Supplemental Environmental Impact Statement

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Deschutes and Ochoco National Forests, Crooked River National Grassland

Deschutes, Jefferson, Klamath, Lake, Crook, Wheeler, and Grant Counties, Oregon

Draft Supplemental Environmental Impact Statement

Deschutes and Ochoco National Forests and Crooked River National Grassland

Deschutes, Jefferson, Crook, Klamath, Wheeler, and Grant Counties, Oregon

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Abstract: This Draft Supplemental Environmental Impact Statement (DSEIS) contains the Forest Service's proposal for treatment of Invasive Plants within the Deschutes and Ochoco National Forests and the Crooked River National Grassland. It also contains two alternatives to that proposal including a "No Action" alternative.

The overall purpose of and need for action is to reduce the extent of specific invasive plant infestations at identified sites, and to protect areas not yet infested from future introduction and spread of invasive plant species from these sites. As a connected action, there is sometimes a need to restore treatment sites with non-invasive vegetation to prevent the re-infestation of those sites. There is a need to provide a mechanism to allow quick detection and response to spreading invasive plant infestations.

The basis for accomplishing this project is contained in Federal Laws, Forest Service Policy Directives, The Deschutes National Forest Land and Resource Management Plan (1990) as amended, and the Ochoco National Forest and Crooked River National Grassland Land and Resource Management Plan (1989) as amended. Analysis will tier to the R6 Invasive Plant Program Final Environmental Impact Statement (USFS 2005a).

Three alternatives were analyzed in this DSEIS:

1. A No-Action Alternative, which does not meet the purpose and need, but forms a basis for comparison with the action alternatives. No Action includes any invasive plant treatments approved in previous NEPA documents.

2. The Proposed Action, which was designed to address the Purpose and Need with the treatment of about 1,892 inventoried weed sites across the Forests and Grassland with integrated prescriptions that combine the use of herbicides with mechanical, manual, and cultural control methods. An early detection/rapid response strategy is also included.

3. An alternative designed to address the Purpose and Need in the same manner as the Proposed Action, with an emphasis on reducing the risk of herbicides entering the water.

The issues studied in this DSEIS include: Concerns associated with chemical herbicides and their effects on human health and the environment, a desire to see the Forest Service utilize the methods necessary to implement effective treatment (i.e. more herbicides used where they are the most effective treatment, and to avoid delay), concerns for economics when choosing

methods of treatment, concerns with impacts to water quality and fish from applying herbicides and other treatment methods, concerns with impacts to non-target vegetation and wildlife from applying herbicides.

The preferred alternative, Alternative 2, is designed to meet the Purpose and Need in this way:

It allows for the effective treatment across 52,015 acres of Project Area Units, which accounts for 1,892 inventoried invasive plant sites totaling about 14,500 acres, plus the areas around and in between them having a high potential of being infested.

The treatments identified are expected to be effective in reaching the objectives (e.g. eradicate, control, suppress, contain) of the sites and will lead to a reduction in the use of herbicides over time.

It provides a framework for annual implementation planning, early detection/rapid response of new infestations, and monitoring.

Reader's Guide

This Draft Supplemental Environmental Impact Statement (DSEIS) contains information about project proposals that will address the problems posed by invasive plants that compromise our ability to manage native ecosystems, and will adopt new treatment strategies for invasive plants made available for use in Region 6 by the R6 Invasive Plant Program Final Environmental Impact Statement (USFS 2005a).

The information in this DSEIS is organized to facilitate consideration of the environmental effects by the public, and by the Forest Supervisors of the Deschutes and Ochoco National Forests, who are responsible for deciding whether or not to implement the Proposed Action or alternatives to this proposal.

Understanding the structure of this document is important to an overall understanding of the information required in an EIS. The following provides an overview of the components of this document.

Executive Summary: The summary of the Draft SEIS provides a brief overview of the Purpose and Need for action, the Key Issues studied herein, and a comparison of the three alternatives.

Table of Contents: A table of contents is presented at the beginning of the document. Lists of tables, figures, and appendices is included.

Chapter 1 – Purpose and Need: Chapter 1 describes the Purpose and Need for the proposal, and the Proposed Action. It includes Management Direction for the project, and the Decision Framework. Public Involvement and the Issues generated by public comments are explained here.

Chapter 2 – Alternatives: Chapter 2 includes a description of the alternative development process, and discussions on alternatives and actions considered but eliminated from detailed analysis. The focus of this chapter is Alternatives Considered in Detail, including the No Action (Alternative 1), the Proposed Action (Alternative 2), developed by the Forest Service that drove analysis for this project, and one additional alternative developed by the Forest Service, Alternative 3, which responds to the issue of fish and water quality. The measures incorporated to reduce impacts (Project Design Features) are documented in this chapter. The final section of this chapter includes a summary of data and a comparison of alternatives considered in detail, in a table format.

Chapter 3 – The Affected Environment and Environmental Consequences: Chapter 3 describes current physical, biological, and social and economic environments within the area of influence of the Proposed Action (termed the Project Area Units). This information provides the baseline for assessing and comparing the potential impacts of the action alternatives. In addition, this chapter provides a comprehensive scientific and analytical comparison of the potential environmental impacts of Alternatives 2 and 3 relative to the No Action Alternative. In order to facilitate comparison of information provided, this chapter is organized and subdivided into resource areas/disciplines in a manner appropriate to the affected environment for this area.

Chapter 4 – List of Preparers and Coordination: Chapter 4 lists the individuals, Federal, State and local agencies and tribes that the Forest Service consulted during the development of this FEIS. It also discloses the distribution of the document including Federal Agencies, federally recognized tribes, State and local governments and organizations representing a wide range of views. The references, glossary, and index are in the last part of this chapter.

Appendices: The appendices provide more detailed information to support the analyses presented in the EIS.

Additional documentation, including more detailed analyses of project area resources, may be found in the project planning record located at Deschutes National Forest Headquarters in Bend, Oregon.

Appendix A – Table of Project Area Units with Species Present, Objectives, and Treatment

Appendix B – Treatment Options and Common Control Measures

Appendix C – Management Direction and Compliance with Forest Plan

Appendix D – Herbicide Information and PDF Crosswalk

Appendix E – Revegetation Planning and Implementation; Excerpts from 2003 Draft Guidelines for Revegetation

Appendix F – Project Implementation and Monitoring

Appendix G – Deschutes and Ochoco National Forests Invasive Plant Species Prevention Practices

Appendix H – Fisheries Analysis by Watershed and Tabular Data

Appendix I – Watershed Information

List of Frequently Used Acronyms

AI	Active Ingredient
APHIS	Agricultural Plant Health and Insect Service
BCF	Bioconcentration Factor
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EDRR	Early Detection / Rapid Response
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
HQ	Hazard Quotient
HUC	Hydrologic Unit Code
IDT	Interdisciplinary Team
INFISH	Inland Native Fish Strategy
IWM	Integrated Weed Management
NEPA	National Environmental Policy Act
NF	National Forest
NFMA	National Forest Management Act
NMFS	National Marine Fisheries Service
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NOI	Notice of Intent
NOAA	National Oceanic and Atmospheric Administration
NPE	Nonylphenol Polyethoxylate
NRIS	Natural Resource Information Systems
NWFP	Northwest Forest Plan
ODA	Oregon Department of Agriculture
OHV	Off Highway Vehicle
OR	Oregon
PACFISH	Pacific Fish Strategy
PAU	Project Area Unit
PDF	Project Design Feature
PNW	Pacific Northwest
RHCA	Riparian Habitat Conservation Area
ROD	Record of Decision
RR	Riparian Reserve
SHPO	State Historic Preservation Office
TES	Threatened, Endangered, Sensitive
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCM	Water Concentration Model

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Executive Summary

This section is a brief summary of the contents of the Draft Supplemental Environmental Impact Statement (per 40 CFR §1502.12). The full DSEIS begins with Chapter 1, page 12.

Introduction

The Responsible Officials of this EIS propose to adopt new treatment strategies for invasive plants located on land within the nearly 2.5 million acres which make up the Deschutes and Ochoco National Forests (Forests) and the Crooked River National Grassland (Grassland). The Project Area Units are located in Deschutes, Jefferson, Crook, Klamath, Lake, Wheeler and Grant Counties in Oregon, and encompass approximately 52,015 acres of National Forest System lands. Approximately 14,547 acres of the Project Area Units are currently infested and targeted for treatment. However, the spread of invasive plants is unpredictable and actual locations of target species are likely to change over time.

The Proposed Action was developed to utilize the new tools and management techniques advanced in *Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants*, *Final EIS* (USFS 2005a), and Record of Decision (USFS 2005b).

Background

Invasive plants are currently damaging the ecological integrity of lands within and outside these administrative units. The current situation of invasive plants on the Deschutes and Ochoco National Forests and Crooked River National Grassland is described in Chapter 3.3. Despite management direction introduced to all Land and Resource Management Plans in Region Six by the *Record of Decision (ROD) for Managing Competing and Unwanted Vegetation* (USFS 1988a), and the 1989 Mediated Agreement, invasive plants continue to increase and occupy previously uninfested areas, including Wilderness. Invasive plants spread at a rate of 8-12 percent annually (USFS 2005a) affecting all land ownerships, including National Forest System lands. The 1988 ROD specified and limited the tools available for the treatment of competing and unwanted vegetation, but did not provide administrative mechanisms for adopting new technologies. Herbicides approved for use by the Forest Service at that time were developed before 1980. Since then, new herbicides have been developed and registered for use that have advantages for controlling invasive plants, such as greater selectivity, greater efficacy, reduced application rates, and lower toxicity to people and animals. As noted above, the 2005 Record of Decision for the Pacific Northwest Region Invasive plant Program, Preventing and Managing Invasive Plants allows the use of new herbicides and imposes standards and guidelines that must be followed in the treatment and prevention of invasive plants on National Forest System lands.

Desired Future Conditions

Healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the Forests and Grassland. Invasive plants do not jeopardize the ability of the National Forests to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventive actions, and the success of restoration efforts.[1] Applicable Forest Plan goals and objectives are listed in Chapter 1.5.1.

Purpose and Need

There is a need to reduce the extent of specific invasive plant infestations at identified sites, and to protect uninfested areas from future introduction and spread of invasive plant species from these sites. This EIS is intended to address the problems posed by invasive plants across the three-million acre planning area of the Deschutes and Ochoco National Forests and Crooked River National Grassland ("Forests"). This document follows new management direction and proposes the use of new tools made available for use in Region 6 by the R6 Invasive Plant Program Final Environmental Impact Statement (USFS 2005a).

Invasive plants create a host of adverse environmental effects which are harmful to native ecosystem processes. Examples of these effects include: displacement of native plants; reduction in functionality of habitat and forage for wildlife, fish, and livestock; loss of threatened, endangered, and sensitive species habitat; increased soil erosion and reduced water quality; alteration of physical and biological properties of soil, including reduced soil productivity; changes to the intensity and frequency of wildfires; budget impacts that limit or reduce land management opportunities due to high costs or dollars spent for controlling invasive plants; and loss of recreational opportunities.

There is a need to provide a mechanism to allow quick detection and response to changing invasive plant infestations. Invasive plant infestations change in size and move; even the most complete inventories will never identify all infested areas. The Forest Service needs the flexibility to treat expanded and/or newly identified invasive plant sites in a timely manner. New infestations and new species are usually high priority for treatment. To facilitate this flexibility, there is a need to provide a mechanism to allow early detection and quick response to changing invasive plant infestations in a cost-effective manner that complies with environmental policy.

Public Involvement

Ongoing public involvement occurred throughout this NEPA process. This project was included in the Schedule of Proposed Actions distributed by the Deschutes and Ochoco National Forests and Crooked River National Grassland since the Winter 2003 issue. On February 23, 2004 the original Notice of Intent (NOI) to prepare an Environmental Impact Statement to document and disclose the potential environmental effects of proposed invasive plant treatment activities on the Ochoco and Deschutes National Forests and CRNG appeared in the Federal Register (Volume 69, No. 35/February 23, 2004 on page 8174). Due to the extensive length of time between that publication in the Federal Register and the initiation of the analysis for this project, a Revised Notice of Intent was published Friday, October 21, 2005 in Volume 70, No. 203 on page 61244. Both NOIs called for public comment. Information on the proposal was posted on a project website - http://www.fs.fed.us/r6/invasiveplant-eis/site-specific/DES/.

On August 19, 2005 a scoping letter describing the project proposal was sent to over 700 individuals, organizations, tribes, and other agencies. It explained the February, 2004 scoping efforts and the reasons for again inviting public comment. It introduced the Proposed Action, summarized the Purpose of and Need for the proposal, and invited interested parties to submit written, facsimile, or electronic comments. A comment form was provided that could be filled out and mailed back to the Forests.

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[1] This Desired Future Condition Statement became part of the Deschutes, Ochoco, and Crooked River National Grassland Land and Resource Management Plans with the Pacific Northwest Region Invasive Plant Program Record of Decision (USFS 2005b, page 2 and Appendix 1).

A public comment period on the Draft Environmental Impact Statement commenced on February 2, 2007. The Forest Service received comments from 17 individuals, organizations, and agencies. These comments were considered during completion of this FEIS. Responses to substantive comments are available on the web site. More information on the public involvement activities and consultation is available in Chapter 2 and Chapter 4.

Issues

The following issues were identified through public scoping and internal evaluation and are studied in detail in this EIS and used to compare the alternatives. These issues are discussed in Chapter 1, Section 1.8.

Water & Aquatic Species - The public expressed concern about potential impacts to water quality and fish, primarily centered around risks of using herbicides in riparian areas. Alternative 3 was developed to compare the proposed action with an alternative that responds to this issue by imposing more restrictions on herbicide use near water.

Treatment Effectiveness - The public and other agencies and organizations expressed a strong desire to see the Forest Service utilize the methods necessary to make substantial progress in effective treatment of invasive species. This was mostly expressed as a desire to see more herbicides used where they are the most effective treatment, and to avoid delay which could allow further spread. These comments were often tied to the concept of prevention as well.

Effects to Native Vegetation and Non-target Plants - Native plant communities are at risk from the invasive plant species which can overtake and degrade habitat. Sensitive plant species and plants utilized for cultural purposes can be impacted by the treatments intended to control invasive species. On the whole, native plants are expected to benefit through reclaimed or protected habitat.

Social/Economic Considerations - The public wants to see economics considered when choosing methods of treatment. The different treatment methods vary in how much they cost to implement; and therefore, how much can be completed in any year. Labor-intensive methods such as hand pulling can be more expensive. Some members of the public would also like to see the Forest Service take the opportunity to provide jobs in rural areas by considering manual and mechanical methods of treatment.

Human Health – Worker and Public Exposure to Herbicides – The public expressed concerns about the use of herbicides and what kinds of effects they may have on human health, either through drinking water, through direct contact by forest workers, eating contaminated special forest products, or recreationists coming into contact with contaminated vegetation. There is concern about long-term and cumulative effects to humans from the use of herbicides. Some believe that the potential cost to human health is too high and other methods should be used to control invasive plants.

Other Issues analyzed – The EIS also analyzes effects of treatments on wildlife, cultural resources, designated or special interest areas, soil, rangeland resources, scenery and recreation values. These are discussed further in Chapter 3.

Alternatives

In addition to the No Action Alternative (Alternative 1), the interdisciplinary team developed one additional action alternative to the Proposed Action (Alternative 2).

Alternative 1: No Action – This alternative is legally required and forms the basis for comparison against the action alternatives. Under this alternative, there would be no change in current management direction or in the level of ongoing management activities within the Project Area

Units. Only invasive plant sites already authorized for treatment under previous NEPA documents would continue to be treated. New sites would not be treated under this alternative. This alternative is described in Chapter 2.3.1.

Alternative 2: Proposed Action – This alternative was described in the Notice of Intent published in the Federal Register on October 21, 2005. It was created using the most current inventory of invasive plant sites. This alternative proposes to address problems posed by invasive plants that compromise our ability to manage native ecosystems on the Forests and Grassland. New management direction and tools made available for use in Region 6 will be utilized. Analysis will tier where appropriate to the *R6 Invasive Plant Program Final Environmental Impact Statement* (USFS 2005a). The following objectives are identified for each of the approximately 1,892 known invasive plant sites that span approximately 14,547 acres of the Forests and Grassland: Eradication, Control, Suppression, and Containment. This alternative is described in Chapter 2.3.2 and is the Forest Service preferred alternative.

Alternative 3 – This alternative proposes to meet the same objectives as stated in the Proposed Action, but intends less risk of impact from herbicides in riparian areas near water. Certain herbicides would not be allowed for use, and treatment methods to apply herbicides would be limited. Mechanical treatment methods that may cause increased sediment would not be allowed in this alternative. This alternative is more fully described in Chapter 2.3.3.

Alternatives are compared in the table on the following page.

Summary of Environmental Consequences

Comparison of the Alternatives Based on How Each Responds to the Issues. This is a summary of information presented in detail in Chapter 3.

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
Treatment Effectiveness			
Acres Approved for Treatment	2,204	52,015 acres	52,015
Number of Herbicide Formulations Available	3 ONF, 4 DNF	10	10; 7 in riparian areas
Acres of Invasives in 2014	13,640	7.767	8,519
Ability to Respond Quickly and General Effectiveness	Least effective in controlling invasive plants: fewer acres treated and options most limited; No EDRR to limit spread of new sites.	Most effective alternative in controlling invasive plants. 10 herbicides available for use; allows more broadcast; EDRR increases effectiveness.	More effective than Alternative 1, but less than Alternative 2. 7 herbicides available near water; 10 everywhere else; EDRR increases effectiveness. No effective treatment of riparian species, will continue to have adverse impacts.
Social/Economic Aspects			
Total cost for all sites' first year of treatment	Sites already covered by NEPA documentation have already had the first year of treatment	$2,205,290	$2,518,490
Acres treated in first year based on current budget		Broadcast herbicide: 996,500 Spot/hand herbicide: 968,750 Manual: 240,040	Broadcast herbicide: 790,400 Spot/hand herbicide: 1,472,750 Manual: 255,340
Jobs required based on acres treated by method in first year		88	112
Average cost per acre	Manual $340 Herbicide $100 - $250	Manual $340 Herbicide $100 - $250	Manual $340 Herbicide $100 - $250

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
Water and Aquatic Species			
Herbicide Treatments near Perennial Waterbodies	Deschutes NF – not allowed within 100 feet. Ochoco NF - some sites remaining from 1,045 acres of Treatment Areas in '98 EA	1,518 invasive plant site acres proposed for herbicides within 300 feet. 724 acres proposed within 100 feet. 230 acres within 10 feet	1,288 invasive plant site acres proposed for herbicides within 300 feet. Broadcast spraying not allowed within 300 feet. 494 acres proposed within 100 feet. 0 acres within 10 feet
Effects for Federally Listed and Region 6 Sensitive Fish Species	No direct impacts to fisheries or aquatic invertebrates from continuing treatments. Potential for indirect effects where riparian areas not treated. Invasives prohibit native vegetation which provides shade from becoming established.	Major impacts prevented with PDFs. Potential risk for effects to bull trout and redband trout from herbicide treatments near water. No measurable effects from manual, mechanical and cultural methods except in Metolius River where cover would be reduced.	Major impacts prevented with PDFs. Reduced risk of herbicide residue washing into streams. Reduced risk of direct overspray to water. Effective control of ribbongrass not possible. Invasives would continue to degrade habitat. No measurable effects from manual mechanical and cultural methods except in Metolius River where cover would be reduced.
Human Health and Public Notification			
Worker Safety	No Significant Impact (FONSI) from ongoing treatments (previous NEPA determination)	Project design features eliminate plausible harmful exposure scenarios.	Same as Alt. 2
Drinking Water	No Significant Impact (FONSI) from ongoing treatments (previous NEPA determination)	Project design features eliminate plausible harmful exposure scenarios.	Same as Alt. 2
Public Health	No Significant Impact (FONSI)	Project design features	Same as Alt. 2

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
	from ongoing treatments (previous NEPA determination)	eliminate plausible harmful exposure scenarios.	
Native Plant Communities			
Effects to Federally Listed Plant Species	No Effect	No Effect	No Effect
Effects to Sensitive Plant Species	Invasive plant sites would continue to expand causing further degradation of native plant habitats and potential loss of additional rare plants. Less risk of non-target effects from herbicide. Highest risk to Sensitive plants from loss of habitat.	PDFs will minimize or eliminate any short-term effects to native vegetation. Some individual plants may be impacted by treatments in short term (1-5 years), but there will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. More herbicide options help plan treatments that minimize non-target effects.	PDFs will minimize or eliminate any short-term effects to native vegetation. Some individual plants may be affected in short term (1-5 years) but there will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. Restrictions on broadcast spraying (within riparian reserves) will further minimize potential short-term impacts to non-target veg. Riparian native plants will continue to be impacted by rhizomatous invasive plant species that are difficult to control without the use of herbicides.
Effects to other Rare and Uncommon Species	Low potential risk to individual plants from non-target effects of herbicide. Highest risk to species from loss of habitat.	Individual plants could be harmed in short-term. Low risk that herbicide treatments would impact individual plant species. In long term, rare and uncommon plant species will benefit from treatment effectiveness.	Individual plants could be harmed in short-term. Low risk that herbicide treatments would impact rare and uncommon plant species. Broadcast restrictions may reduce potential impacts to non-vascular plants in riparian zone. In long term, these plant species will benefit from treatment effectiveness.

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
Summary Effects to Native Vegetation	Native vegetation will continue to be impacted by invasive plants. Less risk of damage to individual native plants from herbicides. Long-term risk to native vegetation from spread of invasive plants.	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Native plant habitats will benefit from invasive plant treatments.	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Native plant habitats will benefit from invasive plant treatments. Riparian native plants may continue to be impacted by rhizomatous invasive plant species.
Wildlife			
Threatened/Endangered Species: Spotted Owl and Bald Eagle	No direct adverse effects from ongoing treatment.	Potential for disturbance from noise, but minimized with PDF; no impact to habitat. No plausible effects from herbicide.	Potential for disturbance from noise, but minimized with PDF; no impact to habitat. No plausible effect from herbicide.
Sensitive Species: Pygmy rabbits, sage grouse, harlequin duck, yellow rail, spotted frogs and Crater Lake tightcoil snail.	No direct adverse effects from ongoing treatments.	Some potential harm to individuals; no risk to populations.	Some potential harm to individuals; no risk to populations.
Sensitive Species: California wolverine, Pacific fisher, grebes, bufflehead, upland sandpiper, American peregrine falcon, gray flycatcher, tricolored blackbird	No direct adverse effects from ongoing treatment.	No Impacts	No Impacts
Management Indicator Species	No adverse effects from disturbance or herbicide exposure	Effects from disturbance are avoided with seasonal restrictions No adverse effects from disturbance or herbicide	Effects from disturbance are avoided with seasonal restrictions No adverse effects from disturbance or herbicide exposure

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
		exposure	
Wildlife Habitat	Highest risk of habitat loss.	Lowest risk of habitat loss.	The risk of habitat loss is lower than Alternative 1 and higher in riparian areas than Alternative 2.

Chapter 1

Purpose and Need

Chapter 1 PURPOSE AND NEED FOR ACTION

Changes Between FEIS and DSEIS:

Minor editing occurred in Chapter 1. Public involvement section updated.

1.1 Background

Invasive Plants are defined here as "non-native plants whose introduction does or is likely to cause economic or environmental harm or harm to human health." (Executive Order 13112). Invasive plants are distinguished from other non-native plants by their ability to spread (invade) into native ecosystems.

The Responsible Officials of this EIS propose to treat invasive plants located across land within the nearly 2.5 million acres which make up the Deschutes and Ochoco National Forests and the Crooked River National Grassland (Forests). The 289 Project Area Units are located in Deschutes, Jefferson, Crook, Klamath, Lake, Wheeler, and Grant Counties in Oregon, and encompass approximately 52,000 acres of National Forest System lands. Within these units are 1,892 known and mapped invasive plant sites on the Forests and Grassland covering about 14,500 acres. However, the spread of invasive plants is mostly unpredictable and actual locations of target species are likely to change over time.

Invasive plants are currently damaging the ecological integrity of lands within and outside these administrative units. Invasive plants are currently spreading at a rate of 8 – 12% annually (USFS 2005a, Asher and Dewey 2005) and are moving across and between National Forest System and other lands. The R6 2005 ROD (USFS 2005b) replaced management which was guided by the 1988 ROD and 1989 Mediated Agreement (USFS 1988a). The R6 2005 ROD standards are intended to increase treatment options and improve prevention across the Forests.

The 1988 ROD specified and limited the tools available for the treatment of competing and unwanted vegetation, but did not provide administrative mechanisms for adapting new technologies. Herbicides approved for use by the Forest Service at that time were developed before 1980. Since then new herbicides have been developed and registered for use that have advantages for controlling invasive plants, such as greater selectivity, less harm to desired vegetation, reduced application rates, and lower toxicity to animals and people.

The Proposed Action was developed to utilize the new tools and management techniques advanced in *Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants*, Final EIS (USFS 2005a), and Record of Decision (USFS 2005b) to address the many new sites that have been inventoried in the years since the last Forest-wide invasive plant control projects were completed in 1998.

The previous Chief of the Forest Service has identified invasive species as one of the Four Threats to the Nation's Forests and Grasslands:

"These are species that evolved in one place and wound up in another, where the ecological controls they evolved with are missing. They take advantage of their new surroundings to crowd out or kill off native species, destroying habitat for native wildlife. Where cheatgrass takes over, for example, the range loses forage value for deer and elk. We are losing our precious heritage—at a cost that is in the billions." Dale Bosworth, 2004.

For more information on the Forest Service Invasive Species Program, see http://www.fs.fed.us/invasivespecies/index.shtml.

As directed by the Forest Service Manual 2080, the Forests are applying the principles of Integrated Weed Management (IWM). IWM is an interdisciplinary pest management approach by which one selects and applies a combination of management techniques that, together, control a particular invasive plant species or infestation efficiently and effectively, with minimum adverse impacts to non-target organisms.

This EIS incorporates by reference (as per 40 CFR 1502.21) the project record, including specialist reports and other technical documentation used to support the analysis and conclusions of this EIS. Analysis was completed for botany, water quality, fisheries, soils, wildlife, cost effectiveness, human health, heritage resources, recreation, scenery, and range. Separate biological evaluations and/or biological assessments were completed for botanical species, aquatic species, and terrestrial wildlife species as part of the consultation process with the National Marine Fisheries Service and the US Fish & Wildlife Service. Biological Opinions will be issued for aquatic species prior to making a decision. The project record is located at the Ochoco National Forest headquarters in Prineville, Oregon.

1.2 Desired Future Condition

By meeting the Purpose and Need for this project, the Forests and Grassland should be able to achieve the desired future condition integrated into the Deschutes and Ochoco Land and Resource Management Plans through implementation of the Pacific Northwest Region Invasive Plant Program ROD (USFS 2005b) or "R6 ROD." The following is the desired future condition statement:

In National Forest lands across Region Six, healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the region. Invasive plants do not jeopardize the ability of the National Forests 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.

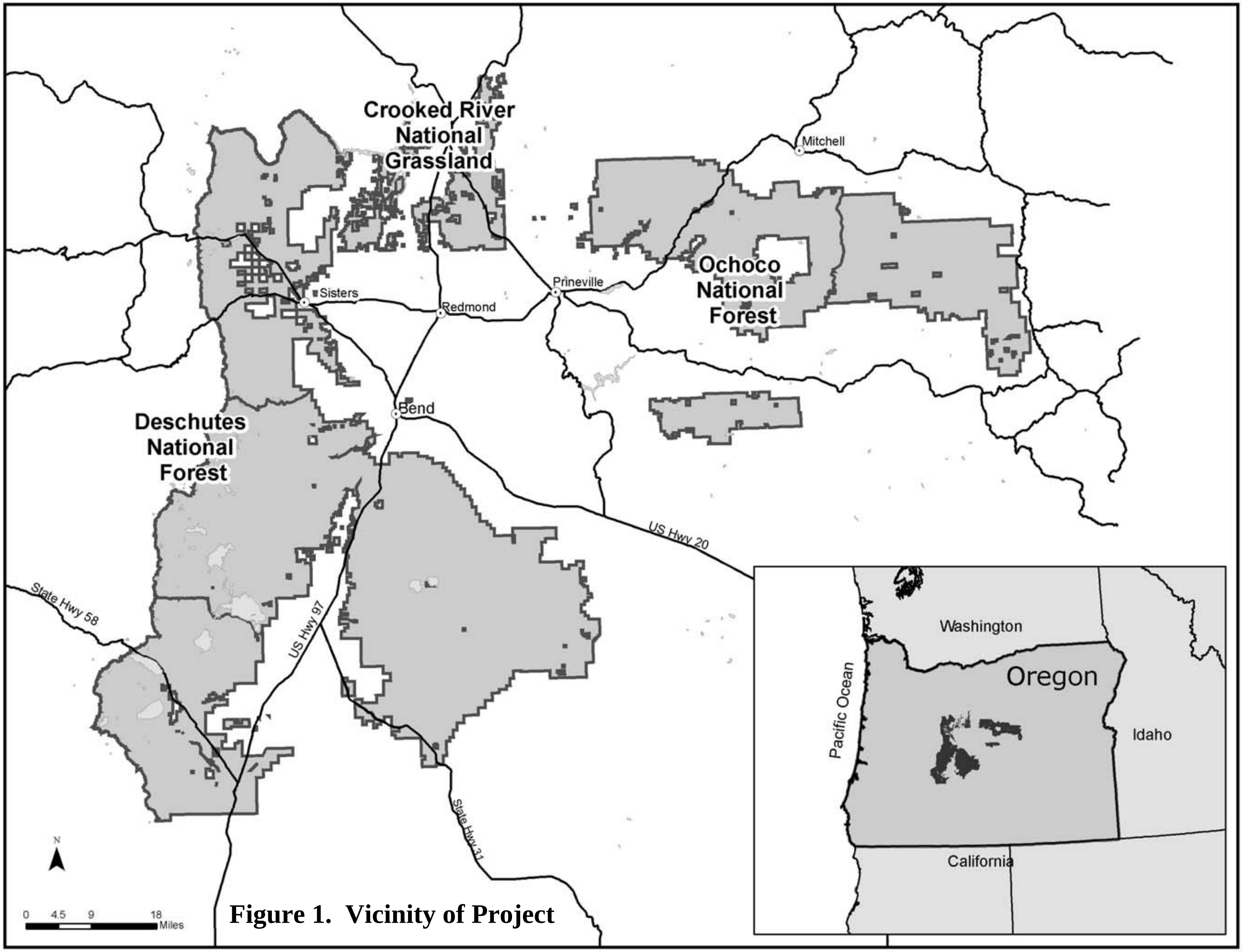


Figure 1. Vicinity of Project

1.3 Purpose and Need

The purpose of this project is to control invasive plants in a cost-effective manner that complies with environmental standards. The Forest Service is responding to the underlying need for timely suppression, containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The focus of this project-level EIS is on *treatment* of invasive plants.

This project will address the problems posed by invasive plants that compromise our ability to manage native ecosystems across the three-million acre planning area of the Deschutes and Ochoco National Forests and Crooked River National Grassland ("Forests"). This EIS tiers to analysis in the *Pacific Northwest Invasive Plant Program Final Environmental Impact Statement* (USFS 2005a) and follows new management direction and tools made available for use in Region 6 with the Record of Decision (ROD). The R6 ROD provided an updated approach to invasive plant management, including standards for the use of new herbicides. This EIS will consider the new herbicides and methods of treatment allowed in the region. According to current inventories on the Forests, there are at least 1,892 individual locations of invasive, non-native plants.

The Forests are currently authorized to treat only a small percentage of known sites (about 6% of known sites are authorized for herbicide treatment), and have gained experience with many of the invasive plant species now found in the planning area. Despite the local successes in the control of some sites (see, for example, page 94), invasive plants continue to increase and occupy new areas.

There is a need to eradicate, control, or contain the invasive plants at identified sites because these infestations displace native plants; harm fish and wildlife habitat; and degrade natural areas on the Forests. Invasive plant sites that occur along roads are readily spread into other areas by vehicles. Infestations occur in or near special areas such as Newberry National Volcanic Monument, along the banks of the Metolius River, and in the Black Canyon Wilderness. The native plant communities and function at these sites needs to be restored.

There is also a need for protection from future establishment and spread from these sites. Existing infestations have a high potential to expand onto neighboring lands, and further degrade forests and grassland because infested areas represent potential seed sources. Without action, invasive plant populations will continue to grow and spread, further compromising our ability to manage for healthy functioning ecosystems.

In addition, the Forest Service needs the flexibility to treat expanded and/or newly identified invasive plant sites in a timely manner. To facilitate this flexibility, there is a need to provide a mechanism to allow quick detection and rapid response to changing invasive plant infestations. Weed infestations change in density and location; even the most complete inventories will never identify all infested areas. New infestations and new species are usually high priority for treatment. The Forest Service needs the ability to treat expanded and/or newly identified invasive plant sites in a cost-effective manner that complies with environmental policy.

1.4 Proposed Action

The Forest Service has a Proposed Action when the agency agrees to move forward with a proposal to authorize, recommend, or implement an action (CFR 1508.23). The Proposed Action is presented in detail in this FEIS Chapter 2.

The Proposed Action Alternative would implement invasive plant treatments across 1,892 weed sites on the Deschutes and Ochoco National Forests and Crooked River National Grassland. Currently the inventoried weed sites span about 14,547 acres. Treatments would span about the next 15 years. Invasive plant sites were grouped spatially into **project area units** (PAUs). Each PAU is expanded for potential spread or to account for uninventoried weeds. These project area units total

52,015 acres. Table 1 identifies the number of invasive plant sites and acres of PAUs that are within each administrative unit of the Forests and Grassland.

Table 1. Project Area Unit Acres and Invasive Plant Sites by Administrative Unit. See Section 3.3 for a characterization of the invasive plant sites across the Forests.

District	Number of Inventoried Invasive Plant Sites	Acres of Invasive Plant Sites*	Project Area Unit Acres
Bend/Fort Rock Ranger District	350	1,604	12,469
Crescent Ranger District	49	1,080	1,892
Sisters Ranger District	272	4,320	10,579
Total Deschutes National Forest	**671**	**7,004**	**24,940**
Crooked River National Grassland	153	6,061	11,522
Lookout Mountain Ranger District	713	487	8,680
Paulina Ranger District	355	995	6,873
Total Ochoco National Forest	**1,221**	**7,543**	**27,075**
Combined Total	**1,892 Weed sites**	**14,547 acres**	**52,015 acres**

*Acres of invasive plant sites is greater than the actual area infested because the mapping takes in areas of sites that could be sparsely populated with invasive plants or patchy.

Under the Proposed Action, invasive plants on National Forest System lands would be treated with a combination of manual, mechanical, biological, and herbicide methods, and restoration. Treatments may include a combination of methods such as hand pulling, cutting, mowing, weed whacking, tilling, assorted biological controls, selective/hand herbicide applications, spot herbicide spraying, and broadcast herbicide spraying.

Site specific treatment prescriptions would be implemented to meet control objectives (suppress, contain, control, eradicate), the values at risk from invasive species, the biology of particular invasive plant species, proximity to water and other sensitive resources, and the size of the infestation. These factors may change over time. Appendix A displays the control objectives associated with mapped infestations, as well as the preferred treatment method. A variety of invasive plant species would be treated (See Table 9 for those currently inventoried).

Treatment of the approximately 14,547 acres of current infestations would span the next 1 to 15 years, approximately. Infested areas would be treated with an initial prescription, and retreated in subsequent years, depending on the results, until control objectives are met. Herbicide treatments are part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries.

The Proposed Action would also allow for treatment of infestations that are not currently inventoried through an early detection/rapid response (EDRR) strategy and annual implementation planning. Ongoing inventories would confirm the location of new specific invasive plants and monitoring would evaluate the effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, and remain within the scope of effects analyzed in this

EIS, while flexible enough to adapt to changing conditions over time. See pages 38-39 for more on EDRR.

A connected action of this Proposed Action is the restoration of treatment sites with desirable vegetation to prevent the re-infestation of those sites. The restoration objectives may be passive (allowing plants on site to fill in a treated area) or active restoration (including revegetation from existing vegetation, or any combination of seeding, planting, and mulching). The majority of sites on the Forests will not require active restoration, because invasive plants have not yet displaced native vegetation to the point that passive restoration cannot be accomplished. See pages 37-38 and Appendix E for more on restoration/revegetation.

This project does *not* include herbicide application directly to water, aerial application of herbicides, use of any pesticides other than herbicides, treatment of aquatic invasive plants (floating and submerged), or treatment of native vegetation.

1.5 Management Direction

The Federal Noxious Weed Act of 1974, as amended (7 U.S.C 2801 et seq.) requires cooperation with State, local, and other Federal agencies in the application and enforcement of all laws and regulations relating to management and control of noxious weeds (a summary of this act can be viewed at: http://ipl.unm.edu/cwl/fedbook/fedweed.html). This Act directs the Secretary of Agriculture to develop and coordinate a management program for control of undesirable plants which are noxious, harmful, injurious, poisonous, or toxic on Federal lands under the agency's jurisdiction, to establish and adequately fund the program, to complete and implement cooperative agreements and/or memorandums, and to establish Integrated Weed Management to control or contain species identified and targeted under cooperative agreements and/or memorandums.

U.S. Forest Service Manual 2080 directs the Forest Service to use an integrated weed management approach to control and contain the spread of noxious weeds on National Forest System (NFS) lands and from NFS lands to adjacent lands (USFS 1995a).

Integrated weed management is an interdisciplinary pest management approach by which one selects and applies a combination of management techniques that, together, control a particular invasive plant species or infestation efficiently and effectively, with minimum adverse impacts to non-target organisms. Integrated weed management is typically species- and site-specific, and includes education, preventive measures, early detection of infestations through inventory and mapping, and combinations of treatment methods as needed to effectively control the target species.

Executive Order 13112 (1999) directs federal agencies to reduce the spread of invasive plants. Invasive species have been identified by the current Chief of the Forest Service as one of the four threats to ecosystem health (see p. 7).

In 1998, the U.S. Forest Service developed a noxious weed strategy for noxious weeds and nonnative plants that provides short- and long-term emphasis and action items in five areas of Integrated Weed Management: prevention and education; control; inventory, mapping, and monitoring; research; and administration and planning (USFS 1998c).

The Forest Service Guide to Noxious Weed Prevention Practices provides management guidance in the form of goals along with prevention practices (USFS 2001a). Forest Service policy identifies prevention of the introduction and establishment of noxious weed infestations as an agency objective. This Guide provides a comprehensive directory of weed prevention practices for use in Forest Service planning and wildland resource management activities and operations. Based on this guide, the Forests prepared *Deschutes and Ochoco National Forests and Crooked River National Grassland Invasive Species Prevention Practices*, included here as Appendix G.

In October 2004, the Chief of the Forest Service released a National Strategy and Implementation Plan for Invasive Plant Species Management – part of the President's Healthy Forest Initiative. It focuses on four key elements: preventing invasive species before they arrive; finding new infestations before they spread and become established; containing and reducing existing infestations; and rehabilitating and restoring native habitats and ecosystems (see www.fs.fed.us/foresthealth/publications/Invasive_Species).

This EIS process and documentation has been completed according to direction contained in the National Forest Management Act (NFMA), the National Environmental Policy Act (NEPA), and the Council on Environmental Quality regulations, Clean Water Act, and the Endangered Species Act. The project is consistent with all applicable Federal, State and local laws. This EIS tiers to the Deschutes National Forest Land and Resource Management Plan Final Environmental Impact Statement and Record of Decision (1990) and incorporates by reference the accompanying Land and Resource Management Plan (LRMP, also called the Forest Plan) (1990), as amended by the Northwest Forest Plan (1994) where appropriate, and INFISH/PACFISH (1995) where appropriate; the Ochoco National Forest and Crooked River National Grassland Final Environmental Impact Statement and Record of Decision, (1989) and incorporates by reference the accompanying Land and Resource Management Plan (LRMP, also called the Forest Plan) (1989), as amended by INFISH (1995) and PACFISH (1995).

The Inland Native Fish Strategy (INFISH) was intended to be interim direction to protect habitat and populations of resident native fish and to provide for options for management. The INFISH delineated RHCAs where riparian-dependent resources receive primary emphasis. These RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems.

PACFISH (Pacific Fish) was intended for the implementation of interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California.

1.5.1 Regional Policy and Forest Plan Direction

To build on the National Forest Service Strategy for Noxious Weed and Nonnative plants, the Pacific Northwest (PNW) Region issued a strategy for National Forests in Oregon and Washington that identifies priority actions for all organization levels (USFS 1999f).

In 2004, the Forest Service PNW Regional Office issued a Policy for Invasive Plant Prevention that directs National Forests and the National Scenic Area to complete environmental analysis for treating invasive plants (as funding allows), conduct timely treatment of priority infestations, develop invasive plant prevention practices, analyze the potential risks of ground-disturbing activities on the introduction and spread of invasive plants and design and incorporate prevention measures for these activities, and document this analysis in project files (USFS 2004c).

Invasive plant management direction contained in Land and Resource Management Plans of the Deschutes and Ochoco National Forests and Crooked River National Grassland has been amended by the recently published *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* Record of Decision (USFS 2005b). This site-specific FEIS follows new Standards and Guidelines as outlined in the regional document. The regional Record of Decision also releases the USDA Forest Service from direction provided by the 1988 Environmental Impact Statement and 1988 Record of Decision for Competing and Unwanted Vegetation, and the associated 1989 Mediated Agreement for invasive plant management.[2] The 2005 R6 ROD added

[2] *The Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants Record of Decision (2005)* applies to invasive plant management and prevention only, and does not affect other parts of the 1988 Record of Decision and 1989 Mediated Agreement that apply to unwanted native vegetation management.

goals, objectives, and standards for invasive plant management by amending the Deschutes and Ochoco National Forests' LRMPs.

The goals and objectives specific to invasive plant treatment include:

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.

<u>Objective 1.3</u>	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.
<u>Objective 1.4</u>	Use an integrated approach to treating areas infested with invasive plants. Utilize a combination of available tools including manual, cultural, mechanical, herbicides, biological control.
<u>Objective 1.5</u>	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 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.

<u>Objective 3.1</u>	Avoid or minimize public exposure to herbicides, fertilizer, and smoke
<u>Objective 3.2</u>	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.

<u>Objective 4.1</u>	Maintain water quality while implementing invasive plant treatments.
<u>Objective 4.2</u>	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.
<u>Objective 4.3</u>	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.

Invasive Plant Treatment Standards and Guidelines added to the LRMPs from the R6 Invasive Plant Program ROD:

#11 Prioritize infestations of invasive plants for treatment at the landscape, watershed or larger multiple forest/multiple owner scale.

#12 Develop a long-term site strategy for restoring/revegetating invasive plant sites prior to treatment.

#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.

#14 Use only APHIS and State-approved biological control agents. Agents demonstrated to have direct negative impacts on non-target organisms would not be released.

#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 plan.

#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.

#18 Use only adjuvants (e.g. surfactants, dyes) and inert ingredients reviewed in Forest Service hazard and risk assessment documents such as SERA, 1997a, 1997b; Bakke, 2003.

#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.

#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.

#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).

#22 Prohibit aerial application of herbicides within legally designated municipal watersheds.

#23 Prior to implementation of herbicide treatment projects, National Forest system 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.

Additional Forest Plan Standards and Guidelines that apply to this project can be reviewed in Appendix C. This direction is contained in the Forest Plans:

- Deschutes National Forest Land and Resource Management Plan (1990)
- Ochoco National Forest & Crooked River National Grassland Land and Resource Management Plan (1989)
- Forest Plan Amendments from the Ochoco National Forest and Crooked River National Grassland Weed Environmental Assessment and Decision Notice (1995)

The Forest Plan Management Areas are listed in the following table.

Table 2. Management Areas of the Deschutes and Ochoco NF and Crooked River National Grassland where Mapped Invasive Plant Sites or Project Area Units occur.

Deschutes National Forest	Ochoco National Forest / Crooked River National Grassland
Deer Habitat	Deep Creek Recreation Area
Dispersed Recreation	Deschutes River Scenic Area
Bald Eagle	Developed Recreation
Experimental Forest	Eagle Roosting Area
Front Country Seen	Facilities
Front Country Unseen	General Forage
General Forest	General Forest
Intensive Recreation	General Forest Winter Range
Metolius Black Butte Scenic	Haystack Reservoir
Metolius Heritage	Metolius Winter Range - Deer
Metolius Old Growth	North Fork Crooked River Scenic Corridor
Metolius Special Forest	North Fork Crooked River Rec Corridor
Metolius Scenic View Retention Foreground	Old Growth
Metolius Scenic View Partial Retention	Old Growth Juniper
Metolius Wildlife/Primitive	Research Natural Area
Oregon Cascade Recreation Area	Rim Rock Springs Wildlife Area
Old Growth	Whychus Creek Management Area
Osprey Management Area	Summit Trail Preservation Corridor
Newberry National Volcanic Mon	Summit Trail Partial Visual
Moffit Butte Special Interest Area	Summit Trail Visual Retention Corridor
Lava River Cave Special Interest Area	U.S. Highway 26 Visual Corridors
Davis Lake Special Interest Area	Visual Management Corridors (Partial)
Wire Meadow Special Interest Area	Visual Management Corridors (Retention)
Scenic View Retention Foreground	Wilderness - Black Canyon
Scenic View Partial Retention Foreground	Wilderness – Bridge Creek
Scenic View Partial Retention	Wilderness – Mill Creek
Wilderness	Winter Range
Deschutes River – Scenic Segment	Winter Range - Antelope

Deschutes National Forest	Ochoco National Forest / Crooked River National Grassland
Deschutes River – Rec. Segment	Lookout Mountain Rec. Area - Top
Metolius River – Scenic Segment	Bandit Springs Rec. Area
Metolius River – Rec. Segment	Steins Pillar Rec. Area
Whychus Creek – Scenic Segment	Hammer Creek Wildlife/Rec. Area
Crescent Creek – Rec. Segment	Rock Creek/Cottonwood Creek Roadless
Wake Butte Special Interest Area	
Winter Recreation	
Cultus River RNA	
Scenic View Retention Middleground	

Northwest Forest Plan

The Northwest Forest Plan is applicable west of the owl range line, on the Deschutes National Forest only.

Late Successional Reserves (LSRs) – Eleven LSRs were designated on the Deschutes National Forest by the Northwest Forest Plan. LSR Assessments considered the noxious weed conditions within each LSR and some included general recommendations for treatment. Applicable standards and guidelines are listed in Appendix C. Impacts to species that occur in LSRs from implementation of proposed invasive plant treatments are discussed in the wildlife section.

Watershed analysis (WA) is a component of the Aquatic Conservation Strategy (ACS) of the Northwest Forest Plan. Recommendations from WA documents were considered in project planning. The WA documents on the Deschutes National Forest note the presence of invasive plants and the recommendations were considered during design of this project. The ACS objectives are assessed in relation to the proposed activities in Chapter 3.6.

Prevention Guidelines

The Forests and Grassland have prepared a list of Invasive Plant Species Prevention Practices, included in this FEIS as Appendix G. Implementation of these prevention practices will minimize the introduction of invasive plants and facilitate the integration of invasive plant management practices into resource programs. These prevention practices will help the Forests and Grassland meet the Goals 1 and 2 of the Forest Plan.

1.6 Decision Framework

The Forest Supervisors for the Deschutes National Forest, and the Ochoco National Forest and Crooked River National Grassland are the Responsible Officials for this EIS. They will be making the following decisions:

Will the Invasive Plant Project be implemented as proposed, as modified by an alternative, or not at all? What mitigation measures and monitoring will be required with implementation of the project?

The Responsible Officials will base their decisions on review of the environmental impact statement, and the following factors: 1) How well the alternative meets the need for action; 2) The potential for treatments to affect the environment; and 3) The economic efficiency of the treatments.

1.7 Public Involvement

Ongoing public involvement occurred throughout this NEPA process. This project has been included in the *Schedule of Projects for the Deschutes and Ochoco National Forests and the Prineville District of the BLM* since the Summer 2003 issue. On February 23, 2004 the original Notice of Intent (NOI) to prepare an Environmental Impact Statement to document and disclose the potential environmental effects of proposed invasive plant treatment activities on the Ochoco and Deschutes National Forests appeared in the Federal Register. The original Notice of Intent appeared in Federal Register Volume 69, No. 35/February 23, 2004 on page 8174. Due to the length of time between that publication in the Federal Register and the initiation of the analysis for this project, a Revised Notice of Intent was published Friday, October 21, 2005 in volume 70, No. 203 on page 61244. Both NOIs called for public comment. Information on the proposal was posted on a project website, which has since moved to the following address: http://www.fs.fed.us/r6/invasiveplant-eis/site-specific/DES/.

On August 19, 2005 a scoping letter describing the project proposal was sent to over 700 individuals, organizations, tribes, and other agencies. It explained the February, 2004 scoping efforts and the reasons for again inviting public comment. It introduced the Proposed Action, summarized the purpose of and need for the proposal, and invited interested parties to submit written, facsimile, or electronic comments. A comment form was provided that could be filled out and mailed back to the Forests.

The Forest Service received 28 responses. The largest number of comments addressed treatment effectiveness, urging that the project go forward in a timely manner. Prevention and monitoring were suggested for long-term site goals. A large number of comments expressed concern for social and economic factors, stating that inter-agency as well as partnerships with private groups with the same goals be explored for the sake of saving time and money. Effects on human health and non-target species from herbicides were other concerns realized through this process. Implementing herbicide application methods that reduce the threat to forest workers and those who use the forest, as well as the forest environment, including wildlife, soils, water, and aquatic biota were advised. Still others felt that herbicides should not be used at all. Issues generated from this public input facilitate project design development, alternative development, effects analysis of the alternatives, and selection of a preferred alternative.

Due to the complexity of the Proposed Action, the Forest Service has initiated additional public involvement activities during the analysis phase of this project: An update of the EIS process was sent to the mail list in February 2006 to describe the alternatives being considered; the interdisciplinary team arranged field trips and meetings with experts involved in noxious weed control and the application of herbicides (for example, from the Oregon Dept. of Agriculture and County Weed Departments); the interdisciplinary team met with representatives of the Sierra Club and Friends of the Metolius to discuss ribbongrass along the Metolius River; the Deschutes Provincial Advisory Committee was kept up to date by briefings on February 27, 2006 and June 7, 2006; The IDT met with the natural resource staff of the Confederated Tribes of the Warm Springs in May 2006; information and maps have been posted and updated on the Forests' internet site as well; the IDT leader met with representatives of the Crook County Natural Resources Committee in March 2007.

A 45-day public comment period began February 2, 2007. Results of the comment period are described in Appendix I of the FEIS. Consultation activities are described in Chapter 4.

A Final EIS and Record of Decision were released in January 2008. Following an administrative appeal, the ROD was withdrawn and the Forests began work on this Supplemental EIS. A Notice of Intent to prepare a Supplemental EIS was published in the Federal Register on October 21, 2008 (Vol. 73, No. 204, p. 62461).

1.8 Issues

The Forest Service compiled an initial list of issues based on comments from the public, organizations, agencies, tribes, and local state and federal governments. The following section summarizes issues identified through the scoping process and discusses how they are addressed in the EIS analysis. Most issues are resolved through project design features, adherence to standards and guidelines and the appropriate laws and regulations, and by consistency with decisions made in the *Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants* Record of Decision (2005b). Some issues vary by alternative design.

The Council on 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 may be eliminated from further analysis when the issue is outside the scope of the Proposed Action; is already decided by law, regulation, Forest Plan, or other higher level decision; is clearly not relevant to the decision to be made; or is conjectural and not supported by good scientific or factual evidence. Non-significant issues are part of the project record.

Treatment Effectiveness

The public and other agencies and organizations expressed a strong desire to see the Forest Service utilize the methods necessary to make substantial progress in effective treatment of invasive species. This was mostly expressed as a desire to see more herbicides used where they are the most effective treatment, and to avoid delay which could allow further spread. The Proposed Action and Alternative 3 allow herbicide use across the project area. The alternatives vary in the formulations and application methods that are allowed in riparian areas, which will impact effectiveness. All other aspects of the alternatives are the same.

The indicators used to measure this issue will be:

- The number of herbicide formulations available for use;
- Acres of invasive plants remaining in Year 2014; the ability to respond quickly to new populations under each alternative; and
- A general assessment of effectiveness of invasive plant treatments.

Effects to Native Vegetation and Non-Target Plants

Invasive plant treatments, especially herbicides, may harm non-target plants, including culturally significant, threatened, endangered and sensitive species or rare and uncommon species. Different herbicides have varying degrees of potency and selectivity (e.g., some herbicides affect certain plant families more readily than others), and application methods vary in the potential for off-site effects. As invasive plants decrease, native plants are expected to benefit through increased available habitat. The application of Project Design Features in each action alternative ensure this project is compliant with invasive plant treatment Standard #19, which directs the Forest Service to minimize or eliminate negative effects to non-target species.

Indicators for this issue include:

- The number of invasive plant sites and acres that can be treated;
- The number of herbicide formulations available for each alternative;
- The ability to quickly respond to new invasive plant populations;
- Summary of treatment effects

Social/Economic

The public wants to see economics considered when choosing methods of treatment. The different treatment methods vary in how much they cost to implement; and therefore, how much can be completed in any year. Some in the public want to see herbicides used because of cost. Manual and mechanical treatments, such as hand pulling will generally be more costly but at the same time would likely provide more jobs because of the labor involved. Some members of the public would also like to see the Forest Service take the opportunity to provide jobs in the rural areas by considering manual and mechanical methods of treatment. The indicators used to measure this issue will be:

- An estimated cost of completing treatments;
- The number of acres that can be treated under each alternative in a year, given a certain budget; and
- The number of jobs that would be associated with each alternative in a year.

Invasive plants do not respect the boundaries between federal and privately-owned lands. Where invasive plants occur along boundary lines, there is the risk of them spreading to private property. The public does not want to see their efforts at control negated by spread from Forest Service lands. The action alternatives do not vary on this issue; both include treatment of existing sites along the Forest boundary. Annual implementation planning and prioritization will consider the location of invasive plant sites relative to private property and whether or not investments in control have been made.

Water & Aquatic Species

The public expressed concern with impacts to water quality and fish. Some suggested that herbicide use in riparian areas should be avoided. Herbicides pose a risk of causing mortality or other effects to fish and aquatic species (such as algae, aquatic plants or aquatic insects that fish depend on for food and cover) if water is contaminated by herbicide drift, ground water recharge, washing into streams, or an accidental spill near fish habitat. Manual and mechanical treatments can impact water quality, fish, and other aquatic species by causing sediment, and disturbing riparian structure. Removal of vegetation along streams (such as reed canary grass) can increase erosion and sedimentation or reduce streambank stability, shade, and cover for fish.

This issue is addressed with project design features and by complying with standards and regulations. This project proposes no direct application of herbicides to water. Buffers and restrictions on the application method ensure that adverse effects to non-target species will be minimized or eliminated.

Alternative 3 was developed to provide an even more cautious approach to invasive plant treatment within the riparian areas. The indicators used to measure this issue will be:

- Acres of treatment by treatment method within aquatic buffers;
- Acres of treatment by treatment method within 100 feet of fish-bearing streams and 303(d) listed streams;
- Amount and type of treatment near potable water sources; and
- Effects determinations will be made for Regional Forester Sensitive and federally-listed fish species in the biological assessment process.

Human Health – Public and Worker Exposure to Herbicides

The public expressed concerns about the use of herbicides and what kinds of effects they may have on human health, either through drinking water, through direct contact by forest workers, or contamination of drinking water or eating contaminated special forest products, or recreationists coming into contact with contaminated vegetation. There is concern about long-term and cumulative effects to humans from the use of herbicides. Some believe that the potential cost to human health is too high and other methods should be used to control invasive plants.

This issue is addressed with project design features and by complying with standards and guidelines. Alternatives do not vary on this issue. Both include precautions to avoid scenarios of concern. The indicator used to analyze this issue is the occurrence of exposures of concern for the public or workers.

Effects to Wildlife

There is potential for disturbance to wildlife during implementation, and treatments may also disturb certain habitat components. Wildlife may contact herbicides or ingest invasive plants that have been treated with herbicide and become sick or die. This issue is generally addressed through adherence to invasive plant treatment standards and implementation of Project Design Features that are intended to further reduce the risk of adverse effects. Indicators used in the analysis are:

- Potential for herbicide contact and effects to the following species: threatened, endangered, and sensitive wildlife species (TES); rare and uncommon species; management indicator species (MIS), birds of conservation concern, and landbirds.
- Potential for disturbance and trampling from machinery or people.

Effects to Soil

Invasive plants provide ground cover that could be disturbed by treatments. Herbicide use may harm soil organisms or soil biology. The existence of invasive plants also can negatively affect soils. Effects are based on soil types and the properties of individual herbicides. This issue is addressed through adherence to Forest Plan invasive plant treatment standards. Project design features listed in Chapter 2 were adopted in order to minimize potential adverse effects. The alternatives do not vary on this issue, except where treatments are within aquatic buffers. Indicators used in the analysis are:

- Potential for toxicity to microbes from herbicides.
- Effects to soil productivity
- Potential for soil erosion from herbicide, manual, or mechanical treatments

Rangeland Resources

Invasive plants can degrade rangelands and some species are toxic to livestock. The treatment of invasive plants has the potential to effect non-target species and livestock. Chapter 3.11 discusses the potential effects of invasive plants and their treatment

Cultural Resources

Chapter 3.12 evaluates and discloses the effects of the alternatives on historic and prehistoric cultural resources. Potential effects are limited to the burning and disking activities.

Scenic and Recreation Values

Because much of the National Forest lands in the project area have high scenic quality and provide areas for the recreating public, the potential for invasive plant treatments to affect these values is discussed in Chapter 3.13

Congressionally Designated Areas and Other Areas of Special Interest

Invasive plant treatments occur within and near specially designated areas. These areas usually have certain values that need to be protected. Chapter 3.14 assess the amount of type of treatment within Wilderness, OCRA, Wild and Scenic River Corridors, Research Natural Areas, Newberry National Volcanic Monument, and Inventoried Roadless Areas.

Chapter 2
Alternatives

Chapter 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Chapter 2 Changes between FEIS and DSEIS:

- The Early-Detection / Rapid-Response (EDRR) Strategy has been changed to include an upper limit on the maximum amount of herbicide treatment that could occur within a year in riparian areas and a maximum amount of treatment of any kind across the Forests. The description of the EDRR implementation within the associated Appendix F has also been updated.
- The Project Design Feature section has been updated and now includes more information on the source of the PDFs. PDFs for the protection of drinking water have been improved. A 10-foot buffer for spot spraying glyphosate and aquatic imazapyr has been added to Table 16.

2.1 Introduction

Chapter 2 describes and compares alternatives considered for invasive plant treatment on the Deschutes and Ochoco National Forests and Crooked River National Grassland. Alternatives were developed by the Interdisciplinary Team to address the key issues. Three alternatives are analyzed in detail. Both action alternatives meet the purpose and need for action in varying degrees.

The descriptions of the alternatives in Chapter Two are derived from a detailed project database of existing invasive plant inventories. The project area was divided into treatment areas, called project area units (PAUs), that were classified by the type of site (e.g., roads, administrative sites, meadows) and assessed for 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 2005 R6 Invasive Plant FEIS. A primary outcome of the site-specific analysis is development of project design features so that invasive plant treatments minimize adverse effects to non-target plants and animals (treatment standards 19 & 20 – see page 15).

Precision of Information and Adjustments

Quantifiable measurements, such as acres and miles, and mapped unit boundaries used to describe the alternatives and effects are based on the best available information. Information used in designing the alternatives was generated from a mix of field reconnaissance, global positioning system (GPS) technology, the NRIS database[3], and the expertise of the invasive plant coordinators on the Forests and Grassland.

Ongoing adjustments to field based information have been made during the course of planning this project and is subject to change over time. Ongoing inventory will continue to be updated regarding the location, extent, and species distribution of invasive plants.

[3] The National Resource Information System (NRIS) is a set of databases that contain resource information needed to support the business of managing national forests and grasslands. NRIS holds data on vegetation, soil and geology, air and water, animal life and social and economic data. Information on local invasive plant infestations is gathered and entered into NRIS by specialists on the Forests and Grassland, including site monitoring data.

2.2 Alternative Development

The interdisciplinary team used the issues described in Chapter 1 to refine the proposed action, an alternative to the proposed action, and to develop Project Design Features (PDFs) that minimize or eliminate potentially adverse effects. Aside from No Action, the alternatives do not drop any treatment areas from consideration; rather, they specify alternative means of controlling the invasive species, or require additional PDFs. Also see Alternatives and Project Design Features Not Considered in Detail later in this Chapter.

2.3 Alternatives Considered in Detail

2.3.1 Alternative 1 – No Action

This alternative is required by law and serves as a baseline for comparison of the effects of the alternatives. Under Alternative 1, there would be no change in the level of ongoing management activities within the project area. No Action means that additional herbicides permitted by the R6 2005 ROD would not be available for use.

Under the No Action alternative, the Forests and Grassland would continue to treat invasive plant species as authorized under existing NEPA documents, which is only about 6% of currently inventoried invasive plant sites. As approved by NEPA decisions, approximate acres treated on average over the last several years are shown in Table 3. Details on the areas treated each year are available from the Forests and Grassland Noxious Weed Program Manager.

Invasive plant treatments have been previously authorized under the following NEPA decisions:

- Ochoco National Forest and Crooked River National Grassland, Integrated Weed Management Environmental Assessment and Decision Notice (1995) allowed the Forest Service to treat 34 noxious weed sites with a mix of manual, biological, and herbicide treatments. It also amended the Ochoco/Grassland LRMP to include programmatic direction for Forest Plan desired future conditions, goals, objectives, and standards and guidelines for noxious weed management. Herbicides approved for use at that time under the (1988) Record of Decision for the Guide to Conducting Vegetation Management Project in the Pacific Northwest Region and selected for use on the Ochoco were dicamba, picloram, and glyphosate.
- Ochoco National Forest and Crooked River National Grassland, 1998 Integrated Noxious Weed Management Environmental Analysis and Decision Notice analyzed and authorized intensive weed management on 72 sites, with herbicide, manual, and/or biological control. Based on monitoring results from the weed sites treated under the 1995 EA, the 1998 expanded the area where herbicides could be used. Only dicamba, picloram, and glyphosate were proposed.
- Deschutes National Forest Noxious Weed Control Environmental Assessment and Decision Notice (USFS 1998a) authorized treatment at 98 noxious weed sites on 901 acres with manual treatment, 27 sites on 149 acres with biological agents, 1 site on 5 acres with prescribed burning, and 40 sites on 476 acres with herbicides. Only dicamba, picloram, glyphosate, and triclopyr were proposed.
- Turnpike Pit Medusahead Control, Environmental Assessment and Decision Notice (2005c) authorized herbicide treatment (glyphosate) of medusahead at the Turnpike Pit material source

(used for the extraction of rock and gravel) and require monitoring of the site (Paulina Ranger District, Ochoco NF).

On the Forests and Grassland, most of the herbicide treatments are accomplished through agreements with Crook, Deschutes, and Jefferson counties and the Oregon Department of Agriculture. The Ochoco National Forest also has agreements with Wheeler and Grant Counties for weed inventory and treatment.

The following table displays the annual average acres treated during the time period 2000 to 2004 for herbicides on the Deschutes; 2003 to 2005 for herbicides on the Ochoco and Grassland; and 2003 to 2005 for manual treatments on the Ochoco.

Table 3. Average acres treated annually by method under existing NEPA documents.

	Deschutes NF	Ochoco NF	Crooked River NG	Total
Herbicide	82	85	108	275
Mechanical	0	0	0	0
Manual	555	663	47	1,265
Biocontrol	15	35	5	55
			Total	1,595

Other invasive plant control activities occur on the Forests: The Oregon Department of Transportation applies herbicides along the right-of-way of State Highway 26 that passes through National Forest System land and the Grassland. BPA and TransCanada (formerly PGT) have treated their facilities on special use permit areas in the past.

Biocontrol[4] agents that have been released consist of the Canada thistle gall fly (*Urophora cardui*) and the Canada thistle stem boring weevil (*Ceutorhynchus litura*). 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. The completed Environmental Impact Statements are available at: http://www.aphis.usda.gov/ppq/enviro_docs/index.html.

Under the No Action Alternative, the Forests would continue to implement prevention measures, and are required to comply with the standards for prevention practices included in the Invasive Plant ROD (USFS 2005b); however, the new treatment methods analyzed in the Invasive Plant FEIS would not be authorized for use in the project area. The Invasive Plant FEIS (USFS 2005a) predicts that the rate of spread of invasive plants would slow from implementing the prevention practices; however, prevention alone is insufficient to reach desired future conditions because of the extent of existing infestation. As a result, the infestations on the Forests and Grassland would continue to expand. Invasive plants not included in the earlier EAs would continue to expand; manual treatments cannot keep pace with the growth of the larger sites. No Forest Plan amendment is required to implement this alternative.

2.3.2 Alternative 2 – Proposed Action

Alternative 2 would treat 1,892 inventoried weed sites across the Forests and Grassland with integrated prescriptions that generally combine the use of herbicides with mechanical, manual, and

[4] Biological control is the deliberate use of natural enemies (parasites, predators, or pathogens) to reduce invasive plant densities. Insects released as biological controls generally feed on one portion of the plant; leaves, roots or seeds. Biological controls are therefore most effective when there is more than one insect control for each plant species.

cultural control methods. The Proposed Action utilizes new tools made available through the Invasive Plant FEIS and ROD (2005), new herbicides in particular. An early detection/rapid response strategy is included for newly discovered infestations of invasive plants. Section 2.3.4 continues the description, with elements common to both action alternatives, such as treatment caps, EDRR, and implementation planning.

Project Area Units

Invasive plant treatments are proposed for 1,892 individually mapped invasive plant sites. Mapped invasive plant sites[5] cover approximately 14,547 acres and are aggregated into 289 project area units. The project area units (PAUs) incorporate from one to ten weed sites and are delineated to include the weed sites, uninfested or uninventoried space in between sites, and allow for expected spread (along road systems, for example). They are delineated based on our current inventory, the site types (e.g. roads), and susceptibility for invasion.

These PAUs total approximately 52,015 acres, substantially larger than the current estimate infested acres. Invasive plants are likely to spread within the PAUs, so the Affected Environment sections of Chapter 3 and project design features below address the range of resource conditions within the PAUs. Effects analysis and project design features consider the resource conditions in the entire Unit, not just the area where an infestation has been mapped. Only acres actually infested with invasive species would be treated in any given year.

When weed sites are mapped, a boundary is drawn around an area of infestation, usually in the field with a hand-held Global Positioning Unit. The actual number, density, and distribution of the plants will vary. Some are patchy, some are dense, and some are single plants scattered widely in the site. Therefore, mapped weed sites incorporate more land than what is actually infested, and therefore more than what will actually be treated for invasive species. This is important because the estimate of effects in this EIS is based on the mapped weed site and thus can be considered the current maximum treatment scenario.

Appendix A includes the "Project Area Table" which lists all project area units, the invasive species present, and proposed control measures for each species. Refer to project area Maps 1-5 at the end of this chapter for locations of the units. Larger-scale maps are available at the Deschutes or Ochoco National Forest headquarters offices in Bend and Prineville, or on the internet at http://www.fs.fed.us/r6/invasiveplant-eis/site-specific/DES/maps/. Figure 2 on the next page displays a map showing a representative area with the information available from Appendix A regarding known invasive plant sites and proposed treatments.

Each project area may contain several species of invasive plants and will therefore involve more than one treatment. Treatments are usually a combination of methods, such as herbicide/manual or cultural/manual.

[5] The invasive plant inventory is one component of the Natural Resource Information System (NRIS) that the Forest Service uses to maintain natural resource data. Further information about the inventory can be obtained by visiting http://www.fs.fed.us/emc/nris/ftp/invasives/Terrav12_overview.pdf. The terms "weed" and "weed site" if used in this document refer to invasive plants and invasive plant sites; these terms are sometimes used interchangeably. The term "noxious weed" has a legal definition, see Glossary.

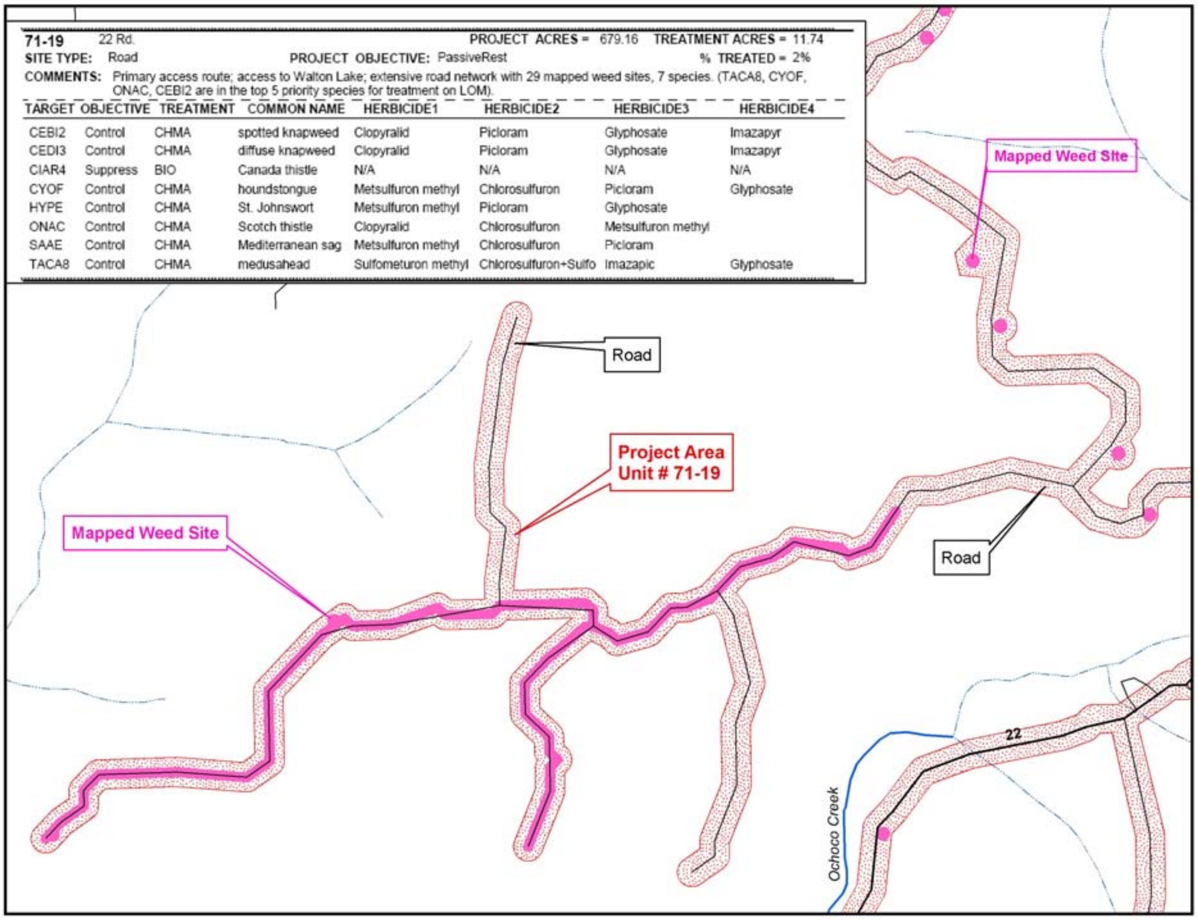


Figure 2. Representative Project Area Unit and Data from Project Area Summary Report, Appendix A of this EIS.

The PAUs were also given a site "type." Table 4 and Figure 3 show that disturbed areas, such as along roads, are the most common place to find invasive plants on the Deschutes & Ochoco National Forests.

Table 4. Site Type Descriptions for Project Area Units (PAUs).

Site Type	Project Area Unit Acres	% of Project Areas
Rec. Site, Admin. Site, Summer Home	70	**< 1 %**
Forest	8,850	**17 %**
Wildfire Area	1,296	**2.5 %**
Meadow, Wetland, Floodplain, Lakeside or Streamside	3,103	**6 %**
Other (e.g. quarry, utility)	890	**1.7 %**
Roadside	36,198	**70 %**
Road along stream	1,288	**2.4 %**
Trail	321	**< 1 %**
	52,015	

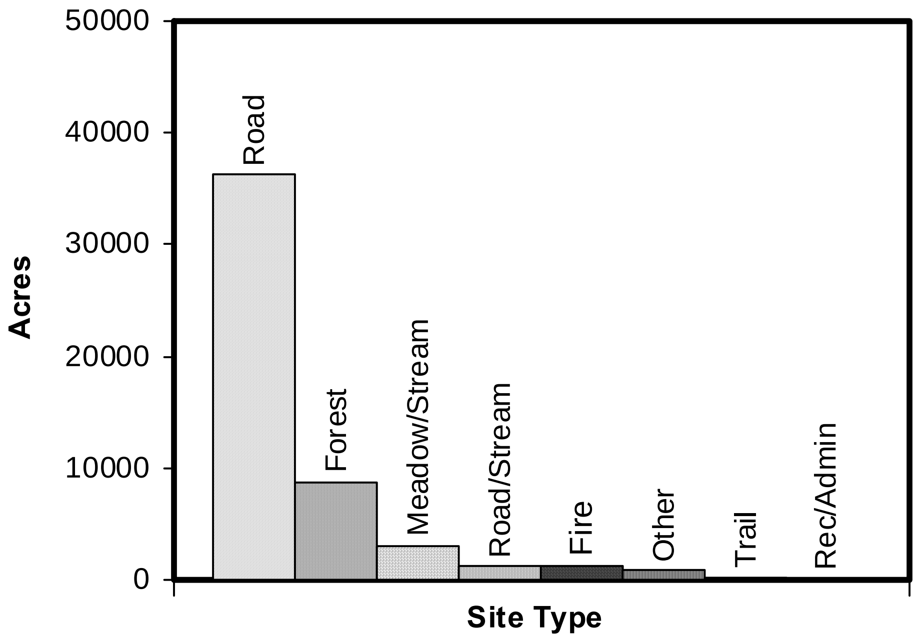


Figure 3. Acres of Project Area Units by Grouped Site Types. Disturbed areas, such as along roads, are the most common place to find invasive plants.

Treatments

Each invasive plant site in the inventory is assigned a treatment method and objective (Listed by Project Area Unit in Appendix A). Project Design Features (PDFs) and buffers (see below) would be applied to the treatments depending on the location of the target species at the time of treatment. Various factors are considered when determining the appropriate treatment (also referred to as prescription, or control method) for invasive plant species. These factors include:

- Target invasive plant species and its biology (e.g. mode of reproduction)
- Aggressiveness of the species and how quickly it may spread
- Population size and density
- Site type (e.g. riparian, upland, disturbed roadside)
- Site accessibility
- Desired plant species to maintain on the site

Each project area may contain several species of invasive plants and will therefore involve more than one treatment. Treatments are a combination of methods, such as herbicide/manual or cultural/manual. The following table is intended to summarize the extensive amount of data in the Project Area Unit Table of Appendix A.

Table 5. Treatment methods applied within project area units, Alt. 2. This information summarizes the treatments that may be applied within project area units. This is a simplification of the prescription, as the order, timing, and application method will vary by site.

Treatment Method	Mapped Invasive Plant Site Acres	Project Area Unit Acres
Herbicide only	393	3,785
Herbicide plus one or more of the following: manual, biological, cultural, mechanical, fire	13,421	44,443
Manual only	706	3,635
Manual plus biological	0.5	19
Biological only	23	116
Cultural only	3	17
Total	14,546.5	52,015

The most common prescription is herbicide/manual (occurring within 154 Project Area Units), which means an initial application of herbicide would be followed up with either additional herbicide and manual treatments or just manual treatments. If pre-implementation site visit shows that the invasive plant site is small and can be efficiently and effectively hand-pulled, then the treatment would revert to manual.

The treatments applied within each project area would be modified by Project Design Features (PDFs), which are intended to minimize or eliminate potential adverse impacts (detailed in Section 2.4). PDFs define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources.

Appendix B provides more detailed information on the strategies that are known to work best for the species inventoried on the Forests (such as timing of treatments, herbicide options).

Table 6. Summary of Treatment Methods Combinations that will occur across Project Area Units, Sorted by Site Type, Alt. 2

Site Type	Treatment Method	Project Area Unit Acres*
Rec. Site, Admin. Site, Summer Home	Herbicide, Manual	70
Forest	Biological Only	0.75
	Herbicide Only	346
	Herbicide plus one or more of the following: manual, cultural, biological, mechanical	8,028
	Manual Only	475
Wildfire Area	Biological Only	16
	Herbicide, Manual	1,280
Meadow, Wetland,	Biological Only	17.5

Site Type	Treatment Method	Project Area Unit Acres*
Floodplain, Lakeside or Streamside	Herbicide plus one or more of the following: manual, mechanical, cultural	3,004
	Manual only	81
Other (e.g. quarry, utility)	Herbicide Only	48
	Herbicide, Manual	842
Roadside	Biological Only	82
	Herbicide Only	3,292
	Herbicide plus one or more of the following: manual, cultural, biological, mechanical	29,802
	Manual Only	2,930
	Manual plus biological	19
Road/Stream	Herbicide plus one or more of the following: manual, cultural, biological, mechanical, fire	1,288
Trail	Herbicide Only	100
	Herbicide plus manual	72
	Manual Only	149

*Acres could occur in more than one category of site type which would account for the slight difference in total PAU acres shown in Table 5.

The amount of treatment within a unit is based on the occurrence of mapped invasive plant sites, which totals about 14,547 acres across the Forests and Grassland. The amount of invasive plant sites in a PAU can be considered the maximum amount of area that would be treated in a year; however, the actual amount would likely be less, and would be based on priorities and budget. See Chapter 3.10.2 for what a typical budget could accomplish given the costs per acre per treatment type.

2.3.3 Alternative 3

Alternative 3 was developed to respond to issues surrounding the effects to aquatic organisms. **The areas proposed for invasive plant treatments are the same as Alternative 2 (see description of Project Area Units, page 26-27), but differ in the prescriptions for treatments within riparian areas.**

Buffers along streams are based on general riparian reserve and riparian habitat conservation areas (see Table 7). A 300-foot buffer will apply to all perennial streams, all fish bearing streams and all perennial lakes, ponds, and reservoirs. The 300-foot width used for Alternative 3 is based on Riparian Reserve and RHCA widths within the project area and is large enough to encompass all riparian areas along perennial streams and lakes. Within the buffers listed in Table 7, treatment methods are restricted as follows:

- The following herbicides would not be allowed within the aquatic buffers because they are considered high risk to fish: triclopyr, picloram, or sethoxydim.

- Broadcast spraying would not be allowed within these buffers or along road segments that are within 300 feet of perennial streams or lakes to reduce risk of drift into water.
- Machinery or equipment that could cause substantial sedimentation would not be allowed within the buffers or along roads where they are within 300 feet of a perennial stream or lake to limit risk of sedimentation.
- In addition, there would be no herbicide application allowed within the definable channel of intermittent streams when they are dry or within 10 feet of perennial or fish bearing streams, rivers, lakes, ponds or reservoirs and intermittent streams when flowing. Ten feet is approximately three times the average spray width for spot spray applications so is sufficient to account for any overspray. (Under Alternative 2, invasive species that are below the high water mark could be treated with herbicides as water levels drop seasonally). This will impact treatment on approximately 230 acres on perennial streams, springs, or lakes and approximately 30 acres on intermittent streams.
- Appendix A shows the prescription for each PAU. The limitations of Alternative 3 would mean that for certain PAUs, the prescription would be modified. For example, herbicide may not be allowed if the site is near water and the treatment would revert to manual.

Table 7. Width of Aquatic Buffers applied in Alternative 3. Restrictions on Treatment Methods within these buffers are listed above.

Classification	Aquatic Buffers for Alt. 3
Class 1	300
Class 2	300
Class 3	300
Class 4	Bankfull
Wetlands	150
Lakes	300
Ponds	300
Reservoirs	300
Springs	300

The following table displays how much of the National Forest System land falls within the buffers identified for Alternative 3 (i.e. how much of the project area will be different under Alternative 3 than under Alternative 2) as well as how much of that is included in mapped invasive plant sites and Project Area Units (PAUs). A total of 8,671 acres of PAUs and 2,016 acres of mapped invasive plant sites are included in the aquatic buffers across the Forests and Grassland. These areas are subject to the restrictions listed on the previous page, and are therefore the areas where the two action alternatives differ.

Table 8. Project Area Units and Mapped Invasive Plant Sites within Alternative 3 Aquatic Buffers.

Subbasin (4th field)	Subbasin Name	Subbasin Acres	Acres of Project Area Units within Aquatic Buffer*	Acres of Infestation within Aquatic Buffer
17070201	Upper John Day River	1,370,836	458	17
17070204	Lower John Day River	2,020,149	453	64
17070301	Upper Deschutes River	1,378,957	3,080	1,091
17070302	Little Deschutes River	672,933	295	195
17070303	S. Fork Crooked River	980,618	943	280
17070304	Upper Crooked River	739,792	1,265	37

Subbasin (4th field)	Subbasin Name	Subbasin Acres	Acres of Project Area Units within Aquatic Buffer*	Acres of Infestation within Aquatic Buffer
17070305	Lower Crooked River	1,204,246	1,454	98
17070306	Lower Deschutes River	1,468,564	424	223
17070307	Trout Creek	442,964	299	11
	Total	*10,279,059*	*8,671*	*2,016*

*See Table 7.

2.3.4 Elements Common to both Action Alternatives

This section describes several elements that are present in each action alternative:

- Species Proposed for Treatment,
- Treatment Methods Considered,
- Annual Treatment Caps,
- Site Restoration/Revegetation,
- Early Detection / Rapid Response Strategy (EDRR),
- Implementation Planning, and
- Forest Plan Amendments.

Invasive Plant Species Proposed for Treatment

There are 32 invasive plant species located across the project area. Some species have been inventoried across both Forests and the Grassland, such as spotted knapweed, while others are known only to one unit, such as ribbongrass. Table 9 shows the distribution of the known invasive species across the districts as well as the first choice herbicide for each species. As long as the treatment methods are similar to those described in this EIS, treatment will not be limited to these species.

Table 9. Number of sites and mapped acreages of invasive plants proposed for treatment on the Deschutes and Ochoco National Forests and Crooked River National Grassland. ***Note:*** A site may contain multiple species; therefore sites and acreages are not cumulative.

Species	District	# Sites	GIS polygon Acres	First choice herbicide	Manual, Biological & Cultural Treatments
Acroptilon repens (Russian Knapweed)	LOM	7	0.2	Picloram	
	PAUL	2	0.8	Picloram	
	CRNG	4	36.6	Picloram	
Arctium minus (Lesser burdock)	LOM	2	0.1	Metsulfuron methyl	
Cardaria draba (Whitetop)	LOM	20	1.6	Chlorsulfuron	
	PAUL	43	10.8	Chlorsulfuron	
	CRNG	12	1.9	Chlorsulfuron	
Cardaria pubescens (Hairy whitetop)	CRE	2	23.0	Chlorsulfuron	

Species	District	# Sites	GIS polygon Acres	First choice herbicide	Manual, Biological & Cultural Treatments
Carduus nutans (Musk thistle)	LOM	1	0.6	Clopyralid	
Centaurea biebersteinii (Spotted knapweed)	BFR	214	1,281	Clopyralid	
	CRE	22	1,813	Clopyralid	
	SIS	101	2,836	Clopyralid	160 ac. manual
	LOM	122	19	Clopyralid	0.7 ac. manual
	PAUL	29	112	Clopyralid	
	CRNG	43	484	Clopyralid	
Centaurea debeauxii ssp. *Thuillieri* (Meadow knapweed)	LOM	1	< 0.1	Clopyralid	
Centaurea diffusa (Diffuse knapweed)	BFR	7	538	Clopyralid	
	CRE	9	1,437	Clopyralid	
	SIS	45	2,363	Clopyralid	311 ac. manual
	LOM	64	12	Clopyralid	0.25 ac. manual
	PAUL	15	8	Clopyralid	
	CRNG	39	831	Clopyralid	
Centaurea solstitialis (Yellow starthistle)	CRE	1	< 0.1	Clopyralid	
	LOM	2	0.1	Clopyralid	
	PAUL	1	1.1	Clopyralid	
	CRNG	1	< 0.1	Clopyralid	
Cirsium arvense (Canada thistle)	BFR	27	182	Clopyralid	
	CRE	20	928	Clopyralid	0.5 ac. manual; 17 ac biological
	SIS	20	85	Clopyralid	
	LOM	293	61	Clopyralid	60.8 ac biological
	PAUL	96	13	Clopyralid	0.4 ac manual; 7.5 ac biological
	CRNG	3	0.2	Clopyralid	0.18 ac biological
Cirsium vulgare (Bull thistle)	BFR	69	346		All manual
	CRE	25	1,159	Clopyralid	1,146 ac manual
	SIS	12	195	Clopyralid	192.5 ac manual
	LOM	8	0.5		All manual
	PAUL	8	0.8	Clopyralid	0.5 ac manual
	CRNG	19	16		All manual
Convolvulus arvensis (Field bindweed)	CRE	3	28	Picloram	
	LOM	9	0.8	Picloram	
	PAUL	1	0.2	Picloram	
	CRNG	14	1.3	Picloram	
Cynoglossum officinale (Houndstongue)	CRE	2	88	Metsulfuron methyl	
	LOM	83	263	Metsulfuron methyl	

Species	District	# Sites	GIS polygon Acres	First choice herbicide	Manual, Biological & Cultural Treatments
	PAUL	101	783	Metsulfuron methyl	14.3 mech; 14.3 fire
Cytisus scoparius (Scotch broom)	BFR	2	0.09	Triclopyr	
	CRE	4	607		All manual
	SIS	15	401	Triclopyr	391.6 ac manual
	LOM	5	0.4	Triclopyr	
	PAUL	1	0.1	Triclopyr	
Dipsacus fullonum (Teasel)	LOM	17	1.2		All manual
	PAUL	6	2.8		All manual
Elymus repens (Quackgrass)	BFR	2	38	Glyphosate	
Euphorbia esula (Leafy spurge)	BFR	1	1	Picloram	
	CRE	1	1.3	Picloram	
	LOM	5	0.1	Picloram	
	PAUL	1	0.08	Picloram	
Hypericum perforatum (St. Johnswort)	BFR	12	28	Metsulfuron methyl	
	CRE	21	1,108	Metsulfuron methyl	
	SIS	78	1,755	Metsulfuron methyl	1,427 ac. manual
	LOM	26	4	Metsulfuron methyl	
	PAUL	9	5	Metsulfuron methyl	
	CRNG	3	0.2	Metsulfuron methyl	
Iris pseudacorus (Yellow flag iris)	SIS	1	0.5	Imazapyr	
Kochia scoparia (Kochia)	CRE	2	0.20	Chlorsulfuron	
	CRNG	2	0.1	Chlorsulfuron	
Linaria dalmatica (Dalmatian toadflax)	BFR	68	132	Picloram	
	CRE	9	230	Picloram	
	SIS	7	111	Picloram	93 ac manual
	LOM	3	0.1	Picloram	
	PAUL	4	1.2	Picloram	
	CRNG	3	0.1	Picloram	
Linaria vulgaris (Butter and eggs)	BFR	1	< 0.1	Picloram	
	CRE	8	439	Picloram	
	LOM	4	0.3	Picloram	
Melilotus officinale (Yellow sweet clover)	CRE	2	.01		Manual
Onopordum acanthium (Scotch thistle)	BFR	2	1	Clopyralid	
	CRE	3	243	Clopyralid	12.5 ac manual
	SIS	-	-	Clopyralid	
	LOM	8	0.8	Clopyralid	

Species	District	# Sites	GIS polygon Acres	First choice herbicide	Manual, Biological & Cultural Treatments
	PAUL	3	11	Clopyralid	
	CRNG	3	39	Clopyralid	
Phalaris arundinacea (Reed canarygrass)	BFR	14	110	Glyphosate	
	CRE	7	2,188		All cultural
Phalaris arundinacea var. *picta* (Ribbongrass)	SIS	236 patches	1	Glyphosate	
Potentilla recta (Sulphur cinquefoil)	LOM	26	3	Picloram	
	PAUL	20	5	picloram	0.3 ac manual
Rubus discolor (Himalayan blackberry)	PAUL	1	0.8	Triclopyr	
Salvia aethiopis (Mediterranean sage)	LOM	5	16	Metsulfuron methyl	
	PAUL	2	5	Metsulfuron methyl	
Salsola kali (Russian thistle)	BFR	9	267	Chlorsulfuron	
	CRE	2	132	Chlorsulfuron	123.3 ac manual
	SIS	2	9.3	chlorsulfuron	
Senecio jacobaea (Tansy ragwort)	CRE	9	88	Clopyralid	
	LOM	1	< 0.1		Manual
	SIS	11	126		All manual
Taeniatherumcaput-medusae (Medusahead)	SIS	2	6	Sulfometuron methyl	
	LOM	33	14	Sulfometuron methyl	
	PAUL	13	6.7	Sulfometuron methyl	
	CRNG	25	4,756	Sulfometuron methyl	
Bromus tectorum[1] (Cheatgrass)		--	--	--	
Ventenata dubia[1] (North Africa grass)		--	--	--	

Deschutes National Forest: *BFR = Bend/Ft. Rock District; CRE = Crescent District; SIS = Sisters District.* ***Ochoco National Forest****: LOM = Lookout Mountain District; PAUL = Paulina District. CRNG = Crooked River National Grassland.*

[1] Cheatgrass and North Africa grass are not currently proposed for specific treatment within this EIS. However, these species may be considered for control and revegetation under the EDRR strategy where the population meets the criteria outlined under the Implementation Planning section of this chapter.

Invasive Plant Treatment Methods Considered in this EIS

The following table lists the various treatment methods that have been approved for use in the Region. These methods are employed in the action alternatives. In many cases, these methods are most effective when used in combination with one another, as well as in combination with prevention activities in accordance with Integrated Weed Management principles. The location and size of the infestation, environmental factors, management objectives, and treatments costs all factor into the choice of treatment method(s). Non-herbicide methods (e.g. hand pulling, digging) are preferred for treating sites that are small, accessible, and the species is effectively treated by non-herbicide methods.

Table 10. Invasive Plant Treatment Methods Approved for Use in the Region 6 Final Invasive Plant EIS and Considered in this EIS. These treatments are frequently used in combination according to integrated invasive plant management and as described in Appendix B.

Type Treatment	Description	Comments
Manual	A non-mechanized approach, such as hand pulling and digging with tools such as a shovel or hoe to remove plants or cut off seed heads.	Depending on the species & size of infestation, manual treatments can be labor intensive and must be repeated several times throughout the growing season for at least several years (until the seedbank is exhausted). For some species, such as spotted knapweed, this may be the preferred method when populations are small and easily accessible.
Mechanical	The use of any mechanized approach to control or eliminate invasive plants. Includes mowing, weed whacking, road brushing, or root tilling methods to reduce plant cover and root vigor. Also can reduce biomass so less herbicide is used.	Mechanical treatments are currently proposed for 4 species: reed canarygrass (weed whacking to reduce biomass in order to use less herbicide), Canada thistle (either to reduce biomass to use less herbicide or to mow/weed whack plants to reduce vigor), St. Johnswort (same as Canada thistle). See Appendix A, Table A-2 for list of PAUs.
Biological	The release of insects or plant pathogens that are proven natural control agents of specific weed species. The insect or plant pathogen attack and weaken targeted weed species and reduce its competitive or reproductive capacity. Biological controls are used for reducing dense infestations of a weed species covering large areas.	This method also depends on the population distribution and type of site. In this project area, biocontrols are primarily used on knapweeds, Canada thistle, bull thistle, St. Johnswort, and toadflaxes. Redistribution of biological control agents would be expected to occur regardless of this decision (same as No Action alternative) and must comply with LRMP standards. Agents used must be APHIS and State approved. Refer to Appendix B for more information.
Cultural	This category involves various methods (such as the use of grazing animals, addition of fertilizer/soil amendments, competitive planting, mulching, covering area with black plastic). For this project, the only cultural method being proposed is solarization, also called tarping. Will work best on small areas.	Covering infestations with black plastic may shade/kill rhizomes, but is not efficient for use on large areas.
Chemical (Herbicide)	Use of herbicides to kill plants and/or prevent seeds from germinating. Methods include spot spraying, wicking, boom broadcast, and stem injection. Spot spraying – targets individual plants and is usually applied with a backpack sprayer. Sometimes	None of the alternatives propose aerial herbicide application. Regional Final Invasive Plant EIS Standards 15-23 apply to herbicide treatments. Project Design Features further reduce potential impacts from herbicides. Broadcast application of herbicide would be considered for situations warranted by the density (70-80 percent cover) and/or the distribution of invasive plants (for

Type Treatment	Description	Comments
	also applies using a hose off a truck-mounted or ATV-mounted tank. Directed hand application – (wicking, wiping, cut stump, basal bark, etc.) – involves precise application to stems or foliage of target plants. This is used in sensitive areas, such as near water, to minimize herbicide residues on the soil or in the water. Stem injection –technique may be used on yellow flag iris; currently being used on Japanese knotweed in western OR & WA. Boom broadcast – involves using a hose and nozzle from a tank mounted on a truck or ATV. Herbicide is applied to cover an area of ground rather than individual plants. This method is used when the weed is dense enough that it is difficult to discern individual plants and the area to be treated makes spot spraying impractical.	instance, continuous along a road), unless limited by PDFs and/or buffers. Considering other restrictions, herbicide applications would be timed as best as practical to coincide with the best appropriate period of plant development to ensure maximum effectiveness, and herbicides would be applied at the lowest effective rate. The latest technology used by applicators allows for precise application of the herbicides, even with boom spray equipment. Table 9 displays the first choice herbicides for the inventoried invasive plant sites. Clopyralid is prescribed most often in the project area, because it is the first choice herbicide for a number of species that are widespread on all Districts in the project area (e.g. knapweed) and it is a very selective herbicide.
Prescribed Fire	Using fire to kill invasive plants, stimulate seed germination, or to remove dead plant material (thatch).	Extremely dense houndstongue patches on the Paulina Ranger District will be burnt to reduce cover and stimulate seed germination before spraying the area with herbicides.

The following table displays the biological control agents that will be used on Canada thistle and St. Johnswort sites in the planning area. These agents may already be present on the Forests or Grassland.

Appendix B, Table B-3 displays the biological control agents currently released across the planning area. Additional releases of these agents would be expected to occur regardless of this decision and in compliance with Standard 14.

Table 11. Biological Agents for Species Proposed for Biological Control.

Invasive Plant	Common Name Biocontrol Agent	Scientific Name Biocontrol Agent
Canada thistle (*Cirsium arvense*)	Canada thistle stem weevil	*Ceutorhynchus litura*
	Canada thistle stem gall fly	*Urophora cardui*
St. Johnswort (*Hypericum perforatum*)	St. Johnswort root borer	*Agrilus hyperici*
	St. Johnswort moth	*Aplocera plagiata*
	Klamath weed beetle	*Chrysolina hyperici*
	Klamath weed beetle	*Chrysolina quadrigemina*
	St. Johnswort gall midge	*Zeuxidiplosis giardi*

Herbicides

The R6 2005 FEIS, and Appendix D of this FEIS list the commercial herbicide names and risks inherent to using these herbicides. Risk assessments for these herbicides are available online at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml and some herbicide labels are available at http://www.fs.fed.us/foresthealth/pesticide/labels.shtml. Herbicides are the most effective treatment for many of the invasive plants that will be treated under this EIS (R6 2005 FEIS). Table 9 displays the herbicide that is the first choice for invasive species treatments in each alternative. Appendix D displays detailed information about herbicides proposed for use in each PAU. Also see Chapter 3.2 for more information on herbicides.

Table 12 displays the herbicide ingredients that may be used in both action alternatives as well as the lowest, typical, and highest application rates.

Table 12. Application rates analyzed in Forest Service Risk Assessments. The "typical application rate" is the rate used in each of the Risk Assessments, and is usually based on an overall average of the amount of product used in all Forest Service applications in 2001. The "highest application rate" is the highest Forest Service application rate reported in 2001.

Active Ingredient (a.i.)	Lowest Application Rate (lb a.i./acre)	Typical Application Rate (lb a.i./acre)	Highest Application Rate (lb a.i./acre)
Chlorsulfuron	0.0059	0.056	0.25
Clopyralid	0.1	0.35	0.5
Glyphosate	0.5	2	7
Imazapic	0.031	0.13	0.19
Imazapyr	0.03	0.45	1.25
Metsulfuron Methyl	0.013	0.03	0.15
Picloram	0.1	0.35	1.0
Sethoxydim	0.094	0.3	0.38
Sulfometuron Methyl	0.03	0.045	0.38
Triclopyr	0.1	1.0	10

The surfactant known as nonylphenol polyethoxylate surfactant (NPE) was also analyzed at the following rates: low 0.167, typical 1.67, and high 6.68.

A goal of the Forests is to minimize the use of picloram across the planning area because of its persistency. Therefore, picloram will only be applied if there is no other effective herbicide available for the target species and where it is prescribed, its use falls under additional layers of precaution (e.g. PDF #12, 46, 48, 56, 67, Table 15). Specific instances where these PDFs have been applied to existing invasive plant sites are listed in Table 15.

Table 9 shows the number of sites of each species and the first choice of herbicide proposed, based on efficacy of the herbicide on that species, as per recommendations from the local State and County weed specialists. Resource conditions at a site may make the first choice ineffective or in conflict with Project Design Features, so other effective herbicides are listed. Clopyralid is prescribed as first choice on the majority of sites in the project area.

Appendix B provides additional information on the range of methods that are effective in treating target species in the project area. No single management technique is perfect for all weed control situations; the Forest Service follows the integrated weed management approach to achieve effective and practical treatment at each site. The analysis in Chapter 3 considers the range of treatment options on the range of site conditions that exist in the PAUs.

Treatment Caps

Treatments of all kinds shall not exceed 16,000 acres per year during the expected 15 years that the Record of Decision will be in effect. This cap allows an approximately 10 percent addition to the proposed quantity of treatment of known sites. Defining this acreage "cap" allows the analysis in the EIS to proceed within well-defined parameters. It also provides the public with useful information about the potential extent of proposed treatments, including those implemented through EDRR. Realistically, it is expected that actual treatment would be substantially less than 16,000 acres, considering budget and what has been treated in recent years. Assuming a constant budget of $250,000 per year, about 10% of the infested sites could be effectively treated each year.

Herbicide treatment (for existing sites as well as future treatment under EDRR) is subject to an annual limit: for treatments above bankfull, but still within the aquatic influence zone, herbicide application is limited to 10 acres per year per 1.5 miles of stream, within any 6th field subwatershed. The aquatic influence zone is defined as the inner half of a riparian reserve or riparian habitat conservation area on Class 1, 2, 3 and 4 streams and lakes and wetlands. Treatments below bankfull would be restricted to 1.0 acre per year within any 6th field subwatershed.

These caps apply only to treatment on National Forest System lands of the Deschutes and Ochoco National Forests and the Crooked River National Grassland. To comply with the cap and track the acres of herbicide application within a 6th-field watershed each year, the prioritized list of infestations and prescription estimates the acreage in advance. Spray reports are required from Contractors on a monthly basis, allowing comparison to estimated and actual acreage. Adjustments would then be made to stay within the cap.

Site Restoration/Revegetation

Revegetation with carefully selected plant materials is a critical component of integrated weed management strategies. Commonly used control tactics, such as manual or herbicide treatments, may eliminate or suppress invasive species in the short term, but the resulting gaps in vegetation and bare soil create open niches that are susceptible to further invasion by the same or other undesirable plant species (Erickson et al. 2003).

Determining the need for active restoration/revegetation versus passive restoration (allowing plants on site to fill in a treated area) is the first step when addressing this need (USFS 2005a). Passive restoration depends on re-colonization from the existing seedbank and from plant propagules dispersed from surrounding sources, as well as native species from within the invasive plant site. Passive restoration may be appropriate where treated sites leave relatively little bare ground or along less-disturbed roadsides where adjacent native vegetation can provide adequate seed source to recolonize treated areas. Passive restoration will also occur on sites proposed for treatment with selective herbicides. For example, use of clopyralid on spotted knapweed within bitterbrush habitats would selectively treat the knapweed and would not harm the bitterbrush.

In some situations, native plant seeds in the soil seedbank can establish following invasive plant treatments on highly disturbed sites. For example, after three years of treating spotted knapweed with a broadleaf selective herbicide on Highway 97 (high use transportation route), monitoring demonstrated the areas became dominated by sheep fescue (*Festuca ovina* var. *rydbergii*). We hypothesize that the seeds existed in the soil and were able to germinate with reduced competition from spotted knapweed.

Active revegetation is a long-term commitment that may best be focused on highest priority areas that are either ecologically unique, or to provide competition for highly aggressive invasive plant species. Active restoration is much like gardening – it requires long-term annual maintenance to control invasive plants in order to ensure successful revegetation. A three-year revegetation study of invasive plant sites on the Deschutes National Forest found that germination and establishment of native seeds was very slow and the small seedlings are slow-growing (Hurd 2005). This project found that native seeding in arid environments will require much more than three years of funding and time to monitor in order to see results. See Appendix E for more on revegetation planning.

Each Project Area Unit was evaluated for whether to allow for passive restoration from adjacent native plant communities or take an active role in revegetating the treated area. Many of our invasive plant sites are within or adjacent to native plant communities that will provide seeds and propagules to recolonize the invasive plant site following treatments. Nine Project Area Units have been selected for active revegetation (See Page 45 of Appendix A). Some areas were selected for their ecological importance and to out-compete aggressive invasive plant species (e.g., ribbongrass sites along the Metolius River and reed canarygrass sites in Big Marsh and Trout Creek Swamp); other areas were selected because revegetation is a critical step in rehabilitating degraded sites where the native plant component is lost and the invasive plant species is highly aggressive (e.g., medusahead and houndstongue sites on Paulina District).

In some cases, active restoration is not the preferred choice due to the nature of the site. Examples include continually disturbed areas, such as road shoulders that are frequently maintained, active gravel pits, and river banks that are prone to annual scouring; or areas that are not naturally vegetated, such as mid-channel gravel bars. The majority of sites in the project area are roadside and do not require active revegetation (Table 4).

Revegetation will involve site preparation, such as raking to prepare a seed bed to promote seed germination, planting of seeds and/or propagules (depending on the species, this is done either in early spring or late fall to take advantage of available moisture), vigilant treatment of invasive plants as they germinate from the existing seedbank, and monitoring the results. In some cases, a follow-up seeding/planting may need to be done.

Early Detection-Rapid Response Strategy

The Early Detection/Rapid Response (EDRR) strategy coupled with prevention guidelines and an annually-updated inventory, will allow us to maintain our invasive plant-free areas in an invasive plant-free condition. Under the EDRR approach, included in both Alternatives 2 and 3, new or previously undiscovered infestations outside of PAUs would be treated using the range of methods described in this EIS, and according to the Project Design Features listed later in this Chapter. The nature of invasive plant species makes this a necessary component of the Forests' treatment program. In addition, the NEPA process does not allow for rapid response; infestations may grow during the time it takes to prepare new NEPA documentation

The intent of the EDRR approach is to treat new infestations when they are small so that the likelihood of adverse effects from treatment is minimized, *and* the invasives plants will do less ecological damage. Recent work by Mehta et al (2007) finds that early detection and rapid response increases managers' chances to successfully restore invasive plant sites. EDRR is also among the most cost-efficient and effective ways of reducing the costs of invasive species (Oregon State University 2009). We are assuming that new infestations will be similar to current infestations. For instance, the majority of weed sites occur along roads and that will probably be the case into the near future. We also expect that the impacts of similar treatments would be predictable. The precise location or timing of the treatment may be unpredictable; however, project design features – intended to minimize or eliminate adverse effects that could occur – keep effects within those disclosed for the current inventory. Annual treatment caps also keep effects within those disclosed for the current inventory.

The EDRR approach 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 below is intended to ensure that effects are within the scope of those disclosed in this EIS so that a new environmental assessment or environmental impact statement need not be prepared; new situations that may have different effects would be subject to further NEPA analysis. Appendix F includes a list of triggers to guide the interdisciplinary team in their assessment of whether particular treatments prescribed under EDRR will be within the scope of this EIS. This strategy would follow the design of the alternative chosen (i.e. if Alternative 3 were selected, the riparian restrictions described under Alternative 3 would apply to future treatments under EDRR).

The **Implementation Planning** process (see next section) is the means by which the selected alternative is properly implemented and *serves as the framework for the EDRR approach.* As treatments are applied to currently undetected invasive plants, project design features would be applied (to situations/conditions similar to those analyzed in the EIS) to eliminate or minimize adverse effects. The EDRR strategy is also subject to annual treatment caps for riparian areas and watersheds. Uncertainty is addressed through monitoring and adaptive management.

Implementation Planning

This section outlines the process that would be used to ensure that the selected alternative and EDRR process are properly implemented. This process integrates the strategies outlined in this EIS and also satisfies pesticide use planning requirements in the Forest Service Handbook (FSH 2109.14). As prioritization takes place across the Forests and Grassland to make the best of the budget, high priority sites would be most likely to be effectively treated, but other infestations would continue to spread until they could be effectively treated. Implementation planning includes annual treatment of both known sites and newly discovered sites.

Annually, an invasive plant assessment review team will be assembled to review the treatments that will be done each year and ensure appropriate PDFs and buffers are applied. Pesticide Use Proposals will be prepared for herbicide use. ***Appendix F** goes in to more detail on the process outlined here:*

1. **Convene team to review the annual program.** The range of effective treatments would be reviewed for sites prioritized for treatment each year. Prescriptions would be developed for new detections and added to the maps and database (see Appendix A for information captured in the database).

2. **For new detections,** ensure that there are no unique features or treatment needs beyond the scope of the selected alternative. Newly discovered sites considered for treatment under EDRR must meet certain requirements:

   - The species at the site is an invasive plant species meeting the definition in Chapter 1, Section 1.1.
   - An effective treatment has been analyzed in this EIS and approved in the Record of Decision.
   - The site does not have any unique features and is similar in size, condition, and physical setting, as one of the treatment areas analyzed in this EIS.
   - Treatment of the site is consistent with the Deschutes and Ochoco Forest Plans, as amended.

3. **Apply Project Design Features** and buffers as appropriate and ensure the annual caps for invasive plant treatment across the Forests and for herbicide treatment in riparian areas are applied (see p. 39). This step applies to new detections and known sites listed in Appendix A.

4. **Coordination and Notification.** Appropriate notification ensures that the adjacent landowners, partners, the general public, regulatory agencies and Tribes are aware of proposed invasive plant treatments. See Appendix F for process when EDRR treatments “may affect” federally-listed species.

Monitoring

Two types of monitoring would be conducted to assure compliance: implementation monitoring and effectiveness monitoring. Implementation monitoring determines whether treatments were carried out according to the implementation plan, prescriptions, and PDFs. These strategies were designed to respond to the issues and lessen the effects to the associated resource. See Appendix F for more detailed information on the implementation plan and monitoring strategy.

Implementation

Implementation monitoring of invasive plant treatments is a two-step process. Each infestation is given a priority as required by the 2005 R6 FEIS. Deciding what and where treatments should occur first is a crucial step to implementing the invasive plant program. This is the basis for building the implementation plan to effectively and economically meet land management goals. From the prioritized list, prescriptions are determined and appropriate PDFs are assigned. This allows many safeguards to be in place before control measures begin. For example, treatment caps are in place to protect water and aquatic species. To comply with the cap and track the acres of herbicide application within a 6th-field watershed each year, the prioritized list of infestations and prescription estimates the acreage in advance. Spray reports are required from Contractors on a monthly basis, allowing comparison to estimated and actual acreage. Adjustments would then be made to stay within the cap.

The second step of implementation monitoring is reviewing the treatments on the ground to determine whether PDFs and prescriptions were followed. This often occurs concurrently with inspections of work in progress. Forest Service personnel regularly work with Contractors, volunteers and youth crews to ensure compliance with objectives and project design. In addition, a minimum of 50% of all treatment areas are monitored each year, allowing adaptive measures to be taken quickly if implementation monitoring shows non-compliance.

Effectiveness

Effectiveness monitoring is used to determine if objectives and desired conditions in the Forest LRMPs, 2005 R6 Preventing and Managing Invasive Plants ROD, and this Invasive Plant Treatments EIS are being achieved in a timely manner. Effectiveness of treatment and effectiveness of project design features will be monitored.

Discussions of past monitoring results of the invasive treatments allowed by the 1998 EAs can be found in Chapter 3 in the Treatment Effectiveness and Native Vegetation Sections of this document. This monitoring provided the framework for assumptions made about treatment effectiveness, and will also help prioritize future long-term monitoring.

A monitoring framework is provided by the R6 2005 ROD, to help Forests determine if actions are taking place as described in the EIS, and if progress towards the desired future condition is occurring. Effectiveness monitoring for individual treatments is critical to fine tuning prescriptions to local conditions. Treatment areas will likely be monitored several times because multiple treatments are generally necessary to control invasive plants and restore desired vegetation. Forest Service policy requires annual reporting of treatment effectiveness in the database “FACTS.” FACTS protocols require at least half of all treatment areas to be visited and treatment effectiveness and efficacy reported.

The effectiveness monitoring strategy would be prioritized based on the issues, and on determining the effectiveness of PDCs, particularly long-term changes to both upland and riparian native plant communities. Treatments within Research Natural Areas would be included in the strategy, focusing on changes in plant communities, such as species composition and abundance. In addition, effectiveness monitoring would explore the effects to aquatic species habitat and non-target vegetation. Frequency and extent of monitoring would depend on yearly funding, with the top priority issues and treatment sites being accomplished first.

A protocol for monitoring effectiveness of measures intended to protect federally listed species is being developed jointly by the Forest Service, Pacific Northwest Region, and National Marine Fisheries Service. This strategy would be used to monitor high priority treatments within habitat of our listed species such as steelhead trout on the two Forests, and bull trout on the Crooked River National Grassland. Refer to Appendix F for the Monitoring Framework and the interim process to follow until the Region 6 Invasive Plant Monitoring Plan is in effect (estimated June 2009).

Forest Plan Amendments

The invasives treatment project is utilizing new tools made available to the Region with the R6 2005 ROD. In particular, the proposed action involves the use of several herbicides. Two standards and guidelines in the Ochoco National Forest and Crooked River National Grassland Land and Resource Management Plan (Forest Plan) discourage the use of herbicide treatments. The Forest Service proposes removing both of these standards to allow, where appropriate, careful and targeted herbicide use to treat invasive plants as part of an integrated weed management program and according to treatment standards provided in the *Invasive Plant Program Preventing and Managing Invasive Plants Record of Decision* (USFS 2005b). This change will reconcile our Forest Plan with the new direction provided in the regional ROD, which was developed with consideration of the scientific literature regarding invasive plant treatment and prevention.

Table 13. Proposed Amendment, Ochoco National Forest Land and Resource Management Plan.

<table>
<tr><th>Forest Plan</th><th>Scope</th><th>Current Standard and Guideline</th><th>Proposed Change</th></tr>
<tr><td>Och/CRNG 1995 Weed EA/DN</td><td>Forest-wide Direction</td><td>Use chemical treatments only when other methods have proven ineffective or impractical. Adhere to EPA regulations and herbicide label restrictions.</td><td rowspan="2">Standards would be removed from the LRMP because they are not consistent with new LRMP standards and we would use herbicides to treat invasive plants according to the new standards provided by the Pacific Northwest Region: Preventing and Managing Invasive Plants Record of Decision (2005).</td></tr>
<tr><td>Och/CRNG 1995 Weed EA/DN</td><td>Grassland-wide Direction</td><td>Use chemical treatments only when other methods would be ineffective or impractical.</td></tr>
</table>

2.4 Project Design Features Common to all Action Alternatives

Project design features (PDFs) were developed to reduce some of the potential adverse impacts the various treatments may cause. PDFs define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources. For PDFs involving herbicides, these are an added layer of caution to the already-regulated and approved use of these herbicides (see Figure 5, p. 86). All PDFs are required for both Action Alternatives, except where specifically noted in the following list. Many of the PDFs also apply to implementation of the current invasive plant treatment program (No Action) where pertinent. PDFs are not optional and are incorporated in the effects analysis.

The application of these PDFs are based on site-specific resource conditions within the Project Area Units, including (but not limited to) the current invasive plant inventory, the presence of certain non-target or species of local interest and their habitats, proximity to water and potential for herbicide delivery to water, and the social environment. These PDFs are the result of interdisciplinary work since 2003 and are being applied to invasive plant treatment projects across the Pacific Northwest Region of the Forest Service. PDFs related to herbicide use are based on careful consideration of previous invasive plant treatment projects, field experience, consultation with regulatory agencies, and scientific reasoning (Desser 2008).

The effectiveness of the PDFs is addressed throughout Chapter 3. In some cases, the PDFs eliminate an herbicide exposure of concern, for instance, by limiting the rate or method of herbicide application. In other cases, the PDFs reduce the potential for herbicide exposure to have an effect. The source of PDFs is provided in the list below. Appendix D, which describes basic characteristics of each herbicide, including hazard and risk characterization, also provides a cross-reference to this list of PDFs.

These PDFs were developed with the understanding that they will be applied to new detections under the EDRR strategy as well as known sites. The PDFs provide sideboards to ensure that the effects of treating new sites are similar to the effects of treating existing sites.

For emphasis, some design features include herbicide label guidance and Forest Plan standards. Not all Forest Plan standards or label directions are repeated here; however, they will be followed.

Purpose	Project Design Feature	Source/Comments
Pre-Project Planning – To ensure project is implemented appropriately		
1.	The nature of invasive plant management requires ongoing project review and evaluation. The location of invasive plants in relation to various environmental components (i.e. plant species of local interest, special forest product gathering areas) is likely to change over the life of the project, thus animal species/habitats of concern, watershed and aquatic resources of concern (sensitive soils, streams, lakes, wetlands, high risk roadsides, municipal watersheds, domestic water sources), places where people gather, and range allotment conditions would be confirmed prior to treatment and appropriate design features would be applied. Apply PDFs (including Terms and Conditions from consultation with regulatory agencies) depending on site conditions.	This approach follows several previous NEPA documents. Implementation Planning discussed in Appendix F.
To Prevent Spread of Invasives from Treatment Activities or Re-Introduction on a Treated Site		
2.	Vehicles and equipment (including personal protective clothing) used for invasive plant treatment activities would be cleaned prior to entering National Forest land.	Deschutes & Ochoco Forest Plan Standard (standard #2 from 2005 R6 ROD)
3.	Where practical, thoroughly clean and inspect all equipment and clothing before moving off treatment areas.	This is a common measure used to prevent spread.
4.	All invasive plants that are manually excavated after flower bud stage will be bagged and properly disposed of at an approved facility (e.g. landfill).	This is a common measure used to prevent spread.
5.	When applying herbicides, protect non-target vegetation whenever practical in order to minimize the creation of exposed ground and the potential for re-infestation. Minimize means reducing to the lowest level practical.	To reduce further invasive plant infestation at the treated site.
Coordination with other Landowners, Agencies – to ensure neighboring landowners are fully informed about nearby herbicide use and to increase the effectiveness of treatments on multiple ownerships		

6. The Forest Service would work with owners and managers of neighboring lands to respond to invasive plants that infest multiple ownerships. Treatments within 100 feet of Forest boundaries, including lands over which the Forest has right-of-way easements, would be coordinated with adjacent landowners.

6.1 Cooperators within the National Forest System will be informed of any proposed treatments within their areas of interest (such as the PNW Research Station for treatments within or adjacent to Research Natural Areas).

To increase effectiveness of treatments on multiple ownerships and ensure neighbors are fully informed of nearby herbicide use.

7. Herbicide use within 1000 feet (slope distance in source area) of known domestic surface water intakes for in-home use would be coordinated with known water user or manager.

1000 feet selected to respond to public concern. Herbicide use as proposed will not contaminate drinking water supplies.

8. Municipal watershed agreements would be followed. Coordination with water boards, managing agencies or associations, would occur as required and herbicide use or application method may be excluded or limited in some areas.

See existing municipal agreements.

To Ensure Effective, Safe, and Proper use of Herbicides and to Limit Potential Adverse Effects on People and the Environment

Field Operations / Worker Safety

9. Herbicides would be used in accordance with label instructions, except where more restrictive measures are required as described below. Herbicide applications will only treat the minimum area necessary to meet site objectives. Herbicide formulations would be limited to those containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Herbicide application methods include wicking, wiping, injection, spot, and broadcast, as permitted by the product label and these Project Design Features. The use of triclopyr is limited to spot and hand/selective methods. Herbicide carriers (diluents) added by the applicator are limited to water and/or specifically-labeled vegetable oil.

Deschutes & Ochoco LRMP Standard (standard #16 of 2005 R6 ROD); Pesticide Use Handbook 2109.14

Limits potential for adverse effects on people and the environment.

10. Herbicide use would comply with standards in the *Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants* ROD (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.

2005 R6 ROD

Limits potential adverse effects on people and the environment.

11. Workers will use appropriate personal protective clothing and equipment at all times during application. Traffic control and signing during invasive plant-treatment operations will be used as necessary to ensure safety of workers and the public.

Label and MSDS requirements. Reduces potential for workers to be exposed.

12. Follow label advisory for effective rate. Lowest effective rates would be used. Additional limits on application rates are as follows:

Spot herbicide applications would not exceed application rates for the following herbicide:

- Sulfometuron methyl would not exceed 0.2 lb ai/ac.

Broadcast application would not exceed application rates for the following herbicides:

- Picloram at any rate higher than 0.5 lb. a.i./acre.

Limiting the application rate for these active ingredients will ensure their use stays below thresholds of concern for workers, the public, fish, and other aquatic organisms; these rates are based on results of the Risk Assessments.

	• Sulfometuron methyl at any rate higher than 0.12 lb a.i. /acre. • NPE surfactant at any rate greater than 0.5 lb a.i./acre.	
13.	Use selective spray techniques, or other targeted application techniques when practical and effective (cut stump, basal spray, etc.).	To further reduce the amount of herbicide applied per acre.
14.	Favor salt/acid formulation of triclopyr over the ester formulation of triclopyr wherever equally or more effective.	Garlon 3A has less concern for human health
15.	Herbicide applications would occur when wind velocity is between two and eight miles per hour. The less than 2 mph standard is to avoid spraying during inversions. During application, weather conditions would be monitored periodically by trained personnel.	Typical measure to reduce drift so that herbicide use is avoided during inversions or windy conditions.
16.	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., use a nozzle diameter to produce a median droplet diameter of 200-800 microns, with an objective of >500 microns.	Label advisory. These are typical measures to reduce drift. 500 micros minimum selected because this isze is modeled to eliminate adverse effects to non-target vegetation 100 feet further from broadcase sites (see Ch. 3 for details).
17.	No spraying would occur if measurable precipitation is occurring or is predicted to occur within 24 hours within the given treatment area, or as label directs. Local conditions to be monitored by the licensed applicators.	Label instruction. Reduces potential for runoff and ensures effective treatment of target vegetation.
18.	Choose transportation routes with fewer stream crossings, less traffic, and fewer blind curves. Use a guide vehicle when more than one vehicle is traveling to the site, or when large quantities or other circumstances dictate.	To reduce likelihood of spills.
19.	A spill cleanup kit would be available whenever herbicides are transported or stored.	To contain any accidental spills. Source: FSH 2109.

20. The lisenced applicator is responsible for the immediate cleanup of all spills. 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 300 feet of surface water.
- Ensure safe disposal of herbicide containers.

Source: FSH 2109.14

Reduce likelihood of spills and to contain any spills. Reduce potential for adverse effects from accidental spills.

21. Estimate and limit the daily quantity of herbicides to be transported to treatment sites.

To reduce potential for spills.

22. Spray equipment would be calibrated prior to seasonal start-up and periodically throughout the season to assure accuracy in applications.

To ensure proper application of herbicide.

23. Minimize traffic in riparian reserves/RHCAs where appropriate.

To minimize trampling, protect riparian habitat, and prevent potential invasive plant spread in riparian areas. Width incorporates aquatic influence zone.

24. Exact fueling sites will be identified prior to implementation of the project, and would be at least 150 feet from lakes, wetlands, or stream channels.

To minimize risk of fuel entering water. Width incorporates aquatic influence zone.

25. Some sites may only be reached by water or by crossing streams on foot. The following measures would be used to prevent a spill during water transport.

- Herbicide would be carried in 1 gallon or smaller plastic containers. The containers would be wrapped in plastic bags and then sealed in a dry-bag. The dry bag would be secured to the watercraft.
- Personnel applying herbicide by hand or with a backpack sprayer, or personnel manually pulling or grubbing invasive plants, would avoid, to the extent possible, standing or walking in wetted streams or other water bodies.

To reduce potential for spill in water.

Public Health / Public Notification

26.	The public would be notified about upcoming herbicide treatments via the local newspaper, Forest Service website, fliers, individual notification, or posting signs.	Standard #23, R6 2005 ROD. To ensure no inadvertent public contact with herbicides.

Public Health / Municipal Watersheds

27.	Broadcast application of herbicides will not occur in municipal watersheds without consulting the water agency/association. Herbicide application will be to individual plants by spot spraying, stem injection, or dabbing. Invasive species treatments other than manual (hand pulling) and biological (insects) will be coordinated with the municipal department in charge of the water system.	To ensure neighbors are informed; meet requirements of existing municipal agreements.
28.	Herbicides will not be applied within 100 feet of the municipal water intake or within 100 feet of the stream for the first 600 feet above the intake.	To respond to public concern. Herbicide use as proposed for this project would not contaminate drinking water supplies.

Public Health / Other Drinking Water Sources

29.	No herbicide will be applied within 100 feet of a known domestic wells or 200 feet of a domestic spring box. No broadcast application of herbicides or use of picloram or clopyralid will occur within 200 feet of a known domestic well or spring box.	To respond to public concern. Based on label advisories and other state drinking water regulations.
29.1	Well and spring box locations needing field verification will be delineated before herbicides are applied within 0.25 mile of approximate point of use. The no herbicide use area for springs may be adjusted to reflect the field verified recharge area.	To prevent accidental overspray of domestic wells and springs.
30.	The special use permit holder or agency department of record (e.g. recreation or facilities) responsible for the well or spring box will be notified prior to application of herbicides and will mark the diversion point so it can be avoided by the applicator and permittee can modify their use if so desired.	To ensure users are informed and implementation follows PDF #29.

Public Health / Recreation or other High Use Sites

31.	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, Forest Service contact information, and when the areas may be reentered.	Reduces conflicts and ensures no inadvertent public contact with herbicides.
32.	When possible and treatment will still be effective, timing of treatments within high use recreation sites will avoid the normal high use period between June 15 and September 15, (peak use is in July and August).	To reduce conflicts with forest users.
33.	For herbicide use within 100 feet of high-use recreation sites, selective application methods at typical or lower rates of application will be used.	To reduce drift in areas of high use.
34.	Gathering areas, campgrounds, and administrative sites may be closed during and immediately after triclopyr application to eliminate accidental exposures. Extent of closure would be dependent on nature of herbicide used.	To reduce conflicts with forest users.
35.	Limit the number of people, machineries, the number of entries, and by using light-weight machinery within 100 feet of recreation sites.	To reduce impacts to recreation areas by minimizing trampling and soil disturbance and visual impacts.

Public Health / Special Forest Products Including Cultural Use Plants

36.	Do not apply NPE surfactant at any rate greater than 0.5 lb a.i./acre in known areas of wild food collection. Favor other classes of surfactants wherever they are expected to be effective.	To protect public/worker health. Rate is below thresholds of concern for workers, the public, fish, and other aquatic organisms; rate based on results of SERA Risk Assessments.
37.	In areas of known special forest product or other wild foods collection application of triclopyr will be limited to direct application to target vegetation only; do not exceed FS typical rate (1.0 a.i./acre); favor salt/acid formulation of triclopyr over the ester formulation of triclopyr wherever it is expected to be effective.	To eliminate scenarios where people could be exposed to harmful doses of triclopyr.
38.	Popular berry and mushroom picking areas would be posted or otherwise marked where treatment with herbicides is occurring during harvest seasoon.	From Appendix Q of R6 2005 FEIS. Eliminates any scenario where people may be exposed to herbicide.
39.	Special forest product gathering areas may be closed for a period of time to minimize inadvertent public contact with herbicide occurs.	To eliminate scenarios where people could be exposed.
40.	Special forest product gatherers would be notified about current herbicide treatment areas when applying for their permits. Such information would be provided in multi-lingual formats depending on the known clientele for the forest.	To ensure no inadvertent public contact with herbicide.
41.	Avoid using herbicides where cultural use plants are present during their season of collection, where possible (mostly spring and early summer for root plants and late summer to fall for berries). Fiber and medicinal plants may have different harvest seasons. This measure applies to known collecting areas. Annually consult with American Indian tribes so members can be notified prior to gathering cultural plants. When plants are identified by tribes, buffer as for botanical special status species.	To ensure no inadvertent public contact with herbicide occurs and so that cultural use plants are fully protected.
To Protect Soils, Water Quality, Fisheries and Aquatic Organisms		
42.	Oregon Department of Fish and Wildlife (ODFW) Guidelines for Timing of In-Water Work Periods will be followed or negotiated with ODFW for pulling invasive plants located below the bankfull channel or ordinary high water mark. The ODFW in water work timing guidelines can be found at: http://www.dfw.state.or.us/lands/inwater.	To reduce potential for causing negative impacts to fish and fish habitat. In-water work periods used because it is when water levels are lowest, so potential delivery to surface water is lowest.
43.	Use only aquatic formulations or low aquatic risk herbicides on soils with seasonally high water tables, where label restrictions allow. Land types in treatment areas identified as having a high water table during parts of or all of the year would be field-checked; treatment methods would be modified based on ground conditions.	Source: SERA Risk Assessments; R6 2005 FEIS and Fisheries Biological Assessment. To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern.
44.	POEA and NPE surfactants would not be used in applications within 100 feet of surface water, wetlands or along roads with ditches that feed into streams.	Protects aquatic organisms. Width is more conservative than the effective buffer (45 feet) identified by Berg (2004).
45.	Do not use clopyralid or metsulfuron methyl on high porosity soils (texture class 3 or 4) where there is a potential for contamination of surface or groundwater (such as where water table is high).	Label advisory. To reduce potential for contamination of surface or groundwater.
46.	No more than one application of picloram or sulfometuron methyl would occur on a given area in a calendar year, except to treat areas missed during	To reduce potential for accumulation in soil. Based on

	the initial application.	label restriction.
47.	Do not use chlorsulfuron on soils with high clay content (texture class 1).	Label advisory. To avoid excessive herbicide runoff.
48.	Do not use picloram and/or sulfometuron methyl on soils with a high clay content (texture class 1); shallow and unproductive soils; or acidic soils unless other methods are not available or feasible.	Label advisory. To avoid excessive herbicide runoff; reduce potential for entering surface and/or ground water, or to accumulate in soil.
49.	Ester formulation of triclopyr is not allowed within 150 feet of any water body or stream channel. Outside of the 150 foot distance, the salt (aquatic) form of triclopyr is preferred over the ester form of triclopyr wher eit is effective.	To protect aquatic organisms. Width based on aquatic influence zone. Lower risk herbicides are preferred where effective; protections of terrestrial wildlife and human health.
50.	Apply erosion control measures and native revegetation (*e.g.*, mulching, native grass seeding, planting) where detrimental soil disturbance or de-vegetation may result in the delivery of measurable levels of sediment to federally listed fish species' critical habitat.	Common measures to minimize sedimentation.
51.	Implement Mixture Analysis identified in Regional Fisheries Biological Assessment for tank mixtures proposed. The sum of Hazard Quotients (HQ) for tank mixtures shall not exceed 1, and no more than three herbicides may be mixed.	R6 2005 ROD and Fisheries Biological Assessment
52.	All herbicide storage, chemical mixing, refilling and post-application equipment cleaning is completed at least 300 feet from live water, domestic wells, or domestic spring boxes, and in such a manner as to prevent the potential contamination of any riparian area, perennial or intermittent waterway, ephemeral waterway, wetland, or drinking water.	To prevent water contamination. 300 feet includes largest Riparian Reserve /RHCAs. Incorporates Washington State wellhead protection protocol.
53.	Limit the number of workers and the number of entries in areas within 100 feet of streams.	To minimize trampling in riparian areas and fish habitat.
54.	Use of herbicides within 100 feet of perennial waterbodies only allowed up to the typical application rate. For use of herbicides within 10 feet of any waterbodies, only hand application (e.g. wicking/wiping) is allowed; except for treatment of above-ground *Phalaris* and *Iris* species, for which spot spray could occur to the edge of water.	Further protects aquatic organisms by reducing amounts of herbicide applied near waterbodies available to runoff.
55.	Hand pulling of invasive plants adjacent to streams known to contain spawning steelhead populations would be prohibited within the bankfull channel from February 15th to July 15th. Pulling of invasive plants adjacent to streams known to contain spawning bull trout populations would be prohibited within the bankfull channel from August 15th to May 15th.	To reduce disturbance to Threatened/Endangered fish during spawning.
Alternative 2 Only		
56.	Use selected buffers and application methods from Table 16 below for application of herbicides. Buffers can be increased on a site specific basis if analysis determines that characteristics such as soils, slope, groundwater depth, etc indicate high potential for the contamination of groundwater or surface waters. Forest Service personnel will identify any steps necessary to identify riparian areas prior to implementation of herbicide application. This may involve flagging, particularly in listed fish habitat. Forest Service specialists will work closely with herbicide applicators to ensure project design features are implemented.	Based on label advisories and SERA risk assessments. Buffers correspond to herbicide characteristics. Demonstrates compliance with Standards #19 and 20. To reduce likelihood that herbicides will enter surface waters in concentrations of concern.

Alternative 3 Only

57.	Use selected buffers and application methods from Table 17 for application of herbicides. Buffers can be increased on a site specific basis if analysis determines that characteristics such as soils, slope, groundwater depth, etc suggest high potential for the contamination of groundwater or surface waters. Forest Service personnel will identify any steps necessary to identify riparian areas prior to implementation of herbicide application. This may involve flagging, particularly in listed fish habitat. Forest Service specialists will work closely with herbicide applicators to ensure project design features are implemented.	Based on label advisories, SERA risk assessments. Demonstrate compliance with Standards #19 and 20. To reduce likelihood that herbicides will enter surface waters in concentrations of concern.
58.	Picloram, triclopyr, sethoxydim and herbicides with NPE or POEA surfactants will not be applied within 300 ft of streams, lakes, and wetlands. Aquatic approved glyphosate and aquatic approved imazapyr will be allowed in RR/RHCA areas.	Alt. 3 allows lower risk herbicides near water.
59.	No application of any herbicides within the high water mark of intermittent streams, lakes, ponds, wetlands, or reservoirs. The high water mark is defined as bankfull or an area above the water surface where non aquatic vegetation is established.	Further protection of aquatic organisms by reducing potential for contamination in water.
60.	No broadcast spraying within 300 feet of all perennial water sources or on road segments within 300 feet of perennial waterbodies.	This will minimize/eliminate any potential for herbicide drift or runoff entering water sources. Source of 300 ft: NWFP
61.	No application of any herbicides within 10 feet of the water’s edge of perennial sreams, rivers, lakes, ponds, wetlands, or reservoirs.	Further protection of aquatic organisms by reducing potential for contamination in water.
62.	No mechanical treatment within 300 feet of all water sources or on road segments that are within 300 feet of perennial waterbodies.	This will minimize/eliminate potential for additional fine sediments to enter waterbodies through soil disturbance and bare soil exposure. Source of 300 feet: NWFP

To Ensure the Protection of Threatened, Endangered, Sensitive (TES) or other Rare and Uncommon Plant Species

63.	Surveys will be conducted for Threatened, Endangered, and Sensitive Plants and other rare and uncommon plants prior to invasive plant treatments **if**: 1) the area has not already been surveyed for these species; **and** 2) if the area contains likely habitat for any of these species; **and** 3) if the proposed treatments are likely to have a negative impact to individual plants. Surveys will be conducted in the area within 100 ft. from where broadcast application of herbicides is planned and within 35 ft. for all other treatment types (herbicide spot spray, manual, etc.). If species of concern are located, then project design feature 64 will be applied.	Forest Service Manual 2670; 35 foot distance more conservative than Marrs et all (1989). To ensure sensitive species are protected and surveys are conducted when appropriate.
64.	Within TES and other rare and uncommon plant populations, prior to herbicide treatments where there are potential effects from the herbicide, a USDA Forest Service Botanist will identify the steps that need to be taken to protect the TES plants. This may involve avoiding these plant populations or individuals (i.e., identify/map areas around sensitive plant populations that must be avoided, or flagging individual sensitive or rare plants), and/or altering treatments (e.g., switching from herbicide to manual treatments within and adjacent to a TES plant population). Forest Service Botanists will	Standard practice by Deschutes & Ochoco botanists for managing rare plants per Forest Service Manual 2620. To ensure appropriate steps are taken during implementation to protect sensitive plants.

	work closely with herbicide applicators to ensure project design features are implemented, will monitor and document the results, and use adaptive management to refine treatments as needed to adequately protect TES and other rare and uncommon plants.	
65.	For manual treatments within TES plant populations, a Forest Service Botanist will instruct workers in the proper identification of plant species to be avoided and will monitor the manual treatments to ensure that individual TES plants are protected.	Involvement of professional botanists to ensure that TES and other rare plants are not pulled or otherwise damaged during manual treatments. Standard practice on the Forests.
66.	Forest Service Botanists will determine buffers are needed to protect TES and other rare and uncommon plant species from herbicide spraying. The need for buffers will depend on the species to be protected, the invasive plant species to be treated, and the type of treatment that would be used. If buffers are determined to be needed, the buffer widths in PDF 67 will be employed.	Standard practice on the Forests. To ensure protection of TES and other rare and uncommon plants.
67.	**Protection buffer widths for TES and other rare and uncommon plant species.** *Greater than 100 feet:* All treatments permitted. All herbicides are permitted. *100 to 35 feet:* No herbicide broadcast spraying. Spot spray and other selective herbicide techniques can be used. *Between 35 and 0 feet:* No use of chlorsulfuron, imazapic, imazapyr, metsulfuron methyl, picloram, and sulfometuron methyl permitted. Clopyralid, sethoxydim, and triclopyr may be conducted if plant is not susceptible to these selective herbicides. Spot spray of glyphosate may be used if conducted when rare plant is shielded or covered. For herbicide treatment, use protective measures such as low-pressure spot-spray, directed spray applications, backpack applications, and/or protective barrier to prevent herbicide residues from impacting these species.	Minimize likelihood of herbicides inadvertently reaching TES and other rare and uncommon plants. Buffer distances based on Thistle (2006) and Marrs et al. (1989).
68.	In order to protect TES and other rare and uncommon plants in saturated or wet soils at the time of application, do not use picloram or imazapyr due to their mobility.	Label advisories to reduce potential for runoff and effects to non-targets.
69.	Use selective herbicide applications (e.g. backpack, spot spray) of sulfonylurea herbicides (chlorsulfuron, sulfometuron methyl, and metsulfuron methyl) for one to two years after a wildfire. Dry powdery soils following wildfire are susceptible to wind erosion and transport of applied herbicide.	To reduce potential for wind transport, providing protection to non-target plants.
70.	Do not apply imazapic to areas treated within the previous 18 months with chlorsulfuron, metsulfuron methyl, sulfometuron methyl, or imazapyr in areas where reseeding of susceptible species is to occur.	To avoid damage to non-target plant species.
71.	When using sulfonylurea herbicides (chlorsulfuron, metsulfuron methyl, and sulfometuron methyl), use lowest application rates that will still be effective and do not use within 50 feet of known Sensitive, or rare plant species and other unique plant species identified by Forest Service botanists for protection.	To protect non-target vegetation from drift effects including wind erosion. More conservative than Mars et al (1989).
To Ensure Protection of Heritage Resources		
72.	Avoid disking or plowing in eligible or unevaluated archaeological sites. Refer to implementation plan for avoidance measures in specific Project Area Units.	To protect cultural resources.
73.	Avoid burning where unevaluated or known significant historic materials are present.	To protect cultural resources.

To Ensure Protection of Range Resources

74. Permittees will be made aware of annual treatment actions at the permittee annual operating plan meetings and/or if requested, notified in advance of spray dates.

The range label restrictions are included in herbicide info table (Appendix D to FEIS).

75. Protection Buffer Widths apply to permanent water sources used for livestock watering, such as water troughs associated with spring developments, reservoirs, trick tanks, and other sources developed for range use and listed as a range improvement. Temporary watering developments such as watersets will have no restrictions except when in use and as needed to follow label restrictions.

Greater than 100 feet: All treatments permitted.

100 to 10 feet: All treatments, except broadcast spraying permitted.

For herbicide treatment, use protective measures such as low-pressure spot-spray, directed spray applications, backpack applications, and/or protective barrier to prevent herbicide residues from impacting these species.

Less than 10 feet: No broadcast spraying permitted.

The measure will also protect wildlife that may use stock watering sources.

76. Some of the approved herbicides have use restrictions associated with domestic livestock that will be followed on public rangelands as listed in Grazing Restrictions Table, Appendix D

Label restrictions.

To Protect Wildlife

Northern Spotted Owl

77. Disturbing work activities (i.e. chainsaw, heavy equipment, etc) will not take place within 1/4 mile of the nest site or activity center of all known pairs or resident singles between March 1 and September 30. If activities occur within the nesting period, further consultation is required. The boundary of the 1/4-mile area may be modified by the District Wildlife Biologist based on topographic breaks or other site-specific information (generally, a 125-acre area will be protected). This condition may be waived in a particular year if nesting or reproductive success surveys reveal that spotted owls are non-nesting or that no young are present that year. Waivers are valid only until March 1 of the following year.

Please note: there is no seasonal restriction on the use of roadside broadcast sprayers, as they fall within ambient noise levels.

To minimize or eliminate disturbance as required by the Programmatic BA; distance is known to reduce sound levels and therefore disturbance.

Source: Livezey 2003, USFWS 2005.

Disturbance/disruption distances for Northern spotted owls during the breeding period (March 1 – September 30):

Activity	Disturbance distance	Disruption Distances	
	Breeding period (March 1 – September 30)	**Spotted owl critical breeding period** (March 1 – July 15)	**Remainder of the spotted owl breeding period** (July 16 – September 30)
Use of Chainsaws	440 yards (0.25 mile)	65 yards	0 yards
Use of heavy equipment	440 yards (0.25 mile)	35 yards	0 yards

Northern Bald Eagle

78. Invasive plant treatment activities that cause disturbance in excess of base levels that were occurring in 2001 will not take place within 1/4 mile non line-of-sight or 1/2 mile line-of-sight of known bald eagle nests between January 1 and August 31. This condition may be waived in a particular year

To minimize or eliminate disturbance as required by Programmatic BA and National Bald Eagle Guidelines

	if nesting or reproductive success surveys reveal that bald eagles are non-nesting or that no young are present that year. Waivers are valid only until January 1 of the following year.	(USFWS 2007).
79.	Project activities that have potential to disturb bald eagle winter roosts, shall be restricted within 400 m of the roosting area from November 1 to April 30th.	To minimize or eliminate disturbance. Source: Programmatic BA.

Greater Sage Grouse

80.	Do not use NPE-based surfactants in areas where sage grouse may forage (consult with District wildlife biologist).	To eliminate risk of exposure. Biologist consult is to determine areas where grouse forage. Source: BE for Des/Och Invasive Plant EIS
81.	Human activities within 0.3 mile of leks will be prohibited from the period of one hour before sunrise until four hours after sunrise and one hour before sunset until one hour after sunset from February 15 – May 15.	To avoid disturbance that may interrupt males while they are strutting on leks. Source: USFS 203, Connelly et al. 2000.
82.	Do no conduct any vegetation treatments or improvement project in breeding habitats from February 15 – June 30.	To avoid disturbance during breeding season. Source: USFWS 2003, Connelly et al. 2000.

Oregon and Columbia Spotted Frog

83.	Avoid broadcast spraying of NPE-based surfactants, in or within 100 feet of occupied spotted frog habitat or suitable wetland habitat. Coordinate treatment methods, timing, and location with local Biologist prior to implementation.	To minimize or eliminate risk of exposure. Source: BE for Des/Och Invasive Plant EIS.

American Peregrine Falcon

84.	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 minimize or eliminate disturbance during breeding season. Source: J. Pagel, unpublished data.
85.	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.	Source: J. Pagel, unpublished data.
86.	Season 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	Source: J. Pagel, unpublished data.

	which indicates that late nesting and fledging would occur.	
87.	Protection of nest sites shall be provided until at least two weeks after all young have fledged.	To protect fledglings. Source: J. Pagel, published data.
88.	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.	To minimize risk of exposure to hexachlorobenzene (HCB). Source: J. Pagel, unpublished data.
Wetland Habitat (yellow rail, tricolored blackbird)		
89.	Avoid broadcast or spot spraying of NPE-based surfactants in or adjacent to suitable breeding habitat	To eliminate risk of exposure. Source: BE for Des/Och Invasive Plant EIS.
Yellow Rail		
90.	At known breeding sites, no disturbance between May 15 and September 15, unless local biologist evaluates sites to modify permitted disturbance dates.	To avoid disturbing nesting birds of crushing nests or eggs. Source: Popper & Stern 2000; J. Kittrell, pers. com.
91.	Do not use NPE-based surfactants in known breeding or foraging areas.	To eliminate risk of exposure. Source: BE for Des/Och Invasive Plant EIS.
Pygmy Rabbit		
92.	Activities in suitable burrowing habitat for pygmy rabbits will be restricted to one or two persons within suspected burrow areas, no heavy equipment, and manual or herbicide techniques only.	To minimize chances of burrow collapse from individuals walking in burrow areas. Source: professional judgment.
93.	Do not use NPE-based surfactants in areas where pygmy rabbits may forage.	To eliminate risk of exposure. Source: BE for Des/Och Invasive Plant EIS.
Raptors and Great Blue Heron		
94.	Active nest sites should be protected from disturbance above ambient levels during the dates specified. Local biologist will determine appropriate distances for planned operations prior to implementation. • Golden eagle February 1 – August 15 • Osprey April 1 – August 31 • Red-tail hawk March 1 – August 31 • Northern goshawk March 1 – August 31 • Cooper's hawk April 15 – August 31 • Sharp-shinned hawk April 15 – August 31 • Prairie falcon March 1 – August 1 • Great gray owl March 1 – June 30 • Great blue heron March 1 – August 31	To minimize or eliminate disturbance to nesting raptors and herons. Source: Deschutes LRMP.
To Protect Air Quality		
95.	All prescribed burning operations would be coordinated with the Oregon State Department of Environmental Quality and the Oregon State Department of Forestry through the State of Oregon smoke management program.	State requirement
96.	Burn areas adjacent to private land would be patrolled following ignition and daily thereafter until the prescribed fire manager determines there is no threat to private land.	Standard precaution for prescribed burning

97.	Site-specific information (including fuels loads) about all prescribed burning units would be entered into the State of Oregon's regional smoke management database, along with observations of environmental conditions taken during burn implementation. This information would be used to determine the amount of emissions produced, and ensure compliance with Oregon smoke management guidelines and the annual limitation on emissions entered into with the other Oregon Blue Mountain Forests.	State requirement

Table 14. Project Area Unit-Specific Project Design Features for Fisheries.

Watershed Name and Number	Project Area Number	Species Affected	Project Design Feature
Willow Creek 1707030602	75-20	Redband trout	Use clopyralid or aquatic glyphosate in place of picloram to treat Russian knapweed
Willow Creek 1707030602	75-24	Non Native Fish	Use clopyralid or aquatic glyphosate in place of Picloram to treat Russian knapweed
Upper Trout Creek 1707030701	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil weed populations.
Lower Whychus 1707030108	75-56	Steelhead Bull Trout Redband Trout	Use of clopyralid, and sulfometuron to treat medusahead, and diffuse knapweed restricted to 10 acres per year in canyons where slopes exceed 10 % and within 300 ft of perennial water.
Odell Lake 1707030102	12-02 12-16	Bull Trout Redband Trout	The use of chlorsulfuron is not allowed. The use of picloram is only allowed up to the typical application rate.
Upper Metolius 1707030109	All	Bull Trout Redband Trout	Use of triclopyr for treatment of Scotch broom is only allowed up to the typical application rate.
Bridge Creek 1707020403	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Mountain Creek 1707020113	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Rock Creek 1707020114	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Upper Middle John Day 1707020113	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Lower SF John Day 1707020113	All	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Dry Paulina Creek 1707030309	72-15 72-37	Redband Trout	No scarifying, burning or fire line construction within 50 feet of intermittent channels in areas selected for this treatment.

Herbicide use buffers provide a way to minimize the likelihood of herbicides inadvertently reaching a habitat of concern, such as a fish-bearing stream. Neil Berg's 2004 Monitoring report compiled monitoring results for broadcast herbicide treatments given various buffers along waterbodies. Results showed that indeed buffers lower the concentration of herbicide in streams adjacent to broadcast treatment areas. Berg found 45 feet to be an effective buffer width to minimize herbicide concentration in streams from broadcast applications, and that increasing buffer widths over this has diminishing returns. However, given higher risk associated with certain herbicides, increased buffer widths are to be implemented in treatments on the Deschutes and Ochoco National Forests to provide an increased level of caution. For example, in Alternative 2 there is no broadcast application of herbicide within 100 feet of perennial streams, except for aquatic formulations of glyphosate and imazapyr; alternative 3 allows no broadcast within 300 feet of streams). The R6 2005 FEIS showed that certain herbicides broadcast within 50 feet of streams or wetlands could result in herbicides reaching concentrations in streams above a threshold of concern for fish and other aquatic organisms.[6] The less mobile, persistent, or potentially toxic to the aquatic environment that an herbicide is, the closer to the stream that it may be used.

[6] Under even worst-case scenarios without additional buffers, herbicide use according to R6 Standards would not result in herbicide concentrations in streams above a threshold of concern for drinking water (R6 2005 FEIS).

Table 15. Minimum Buffers (ft) for Herbicide Applications near streams, lakes, wetlands, used in Alternative 2.

Herbicide	Perennial stream			Seasonal intermittent stream			Lake/Wetland		
	Broadcast spray	Spot-spray	Hand	Broadcast spray	Spot-spray	Hand	Broadcast spray	Spot-spray	Hand
Clopyralid	100	15	bankfull	50	15	*bankfull	100	15	*bankfull
Chlorsulfuron	100	50	bankfull	50	50	bankfull	100	50	bankfull
Aquatic Glyphosate	50	**10	0	15*	**10	*0	*50	**10	*0
Glyphosate	300	100	50	100	50	50	300	100	50
Imazapic	100	15	bankfull	15	15	*bankfull	100	15	*bankfull
Aquatic Imazapyr	50	**10	0	50*	**10	*0	*50	**10	*0
Imazapyr	100	50	15	100	50	bankfull	100	50	bankfull
Metsulfuron Methyl	100	15	bankfull	15	*15	*bankfull	100	15	*bankfull
Picloram	300	100	50	100	50	50	300	100	50
sethoxydim	300	100	50	100	50	50	300	100	50
Sulfometron Methyl	100	15	bankfull	50	15	bankfull	100	50	bankfull
Aquatic Triclopyr-TEA	X	15+	0	X	*15+	*0	X	*15+	*0
Triclopyr-BEE	X	150	150	X	50	50	X	50	50
Tank Mixtures	Use greatest buffer identified above.								

*If channel/wetland is dry there is no buffer.
**Buffer of 10 feet for spot spray except for treatment of emergent vegetation which could occur to edge of water.
+Follow up with EPA consultation.
X No broadcast spray of this herbicide allowed within buffer.

Table 16. Minimum buffers (ft) for herbicide applications in Alternative 3 that can be used within 300 feet of water. No broadcast spraying would be allowed within buffers and no herbicide would be allowed within 10 feet of buffers.

Herbicide	Perennial stream or river		Seasonal intermittent stream		Perennial Lake/Wetland		Seasonal Lake/Pond/Wetland	
	Spot-spray	Hand	Spot-spray	Hand	Spot-spray	Hand	Spot-spray	Hand
Clopyralid	15	10	15	bankfull	15	10	15	bankfull
Chlorsulfuron	50	10	50	bankfull	50	10	50	bankfull
Aquatic Glyphosate	10	10	bankfull	bankfull	10	10	bankfull	bankfull
Imazapic	15	10	15	bankfull	15	10	15	bankfull
Aquatic Imazapyr	10	10	bankfull	bankfull	10	10	bankfull	bankfull
Imazapyr	50	15	50	bankfull	50	10	50	bankfull
Metsulfuron Methyl	15	10	15	bankfull	15	10	15	bankfull
Sulfometron Methyl	15	10	15	bankfull	50	10	15	bankfull
Aquatic Triclopyr-TEA	15*	10	15*	bankfull	15*	10	15*	bankfull
Tank Mixtures	Use greatest buffer identified above.							

*Follow up with EPA consultation.

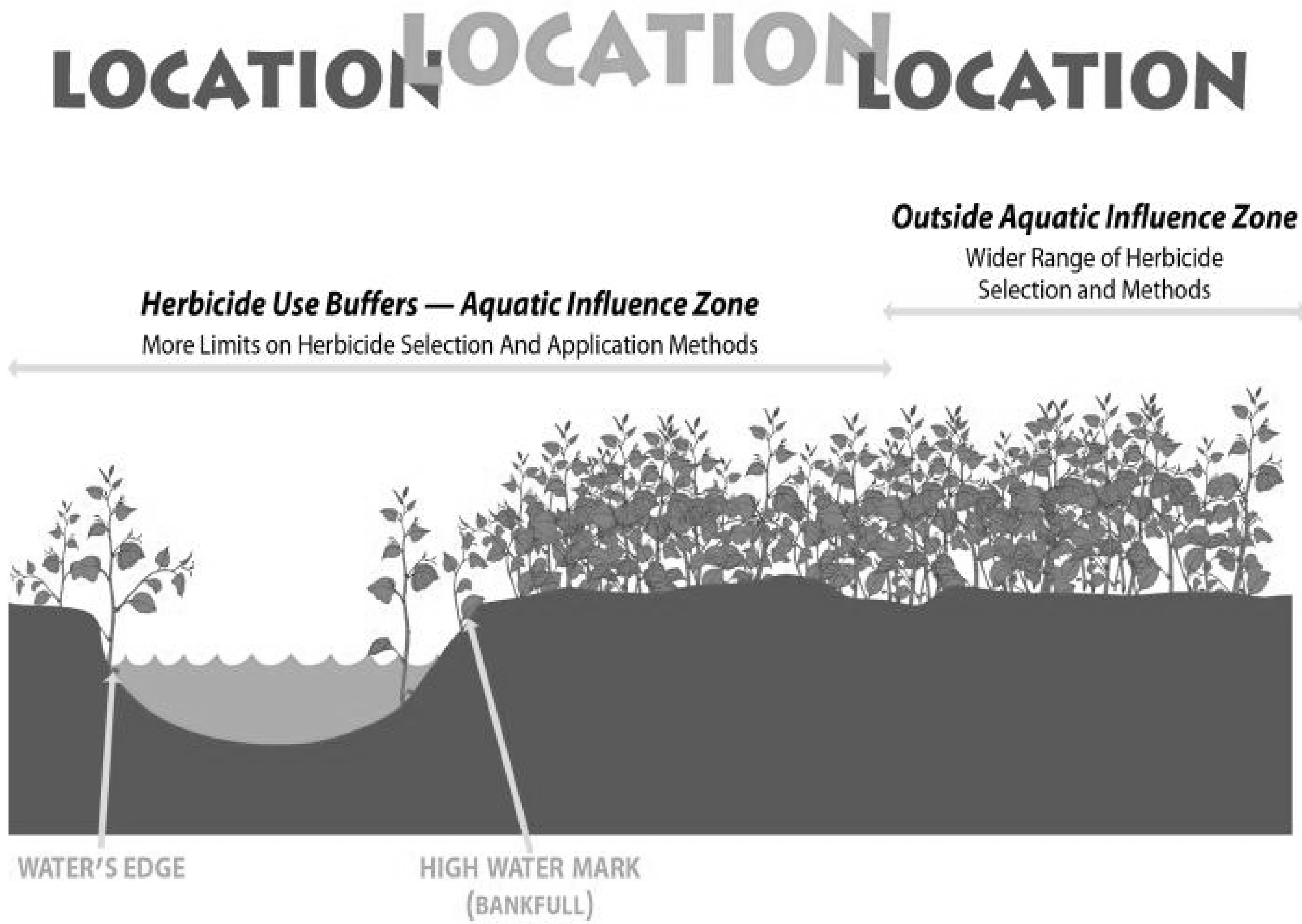


Figure 4. This picture shows where "water's edge", "high water mark" and "bankfull" lie for use in herbicide selection and application methods.

2.5 Alternatives Not Considered in Detail

Use Methods Other Than Herbicides

Some public comments showed a concern over the use of herbicides and suggested that we utilize other methods instead. This approach would not meet the purpose and need for action (timely treatment of invasive plant sites to meet the associated strategies of eradicate, control, contain, or suppress), for the following 3 reasons:

1) Limits Effectiveness and Ability to Meet Purpose and Need

Effectiveness of treatments depends on the tools available. Alternatives that limit the variety of tools also limit the effectiveness of treatments (R6 FEIS p. 4-15). The Regional Forester considered making available to the Forests a more limited list of herbicides (R6 Invasive Plant Program ROD) but concluded that, based on analysis in the Regional Invasive Plant Program FEIS, it would restrict treatment effectiveness and increase costs. The Regional Forester's decision to approve 10 herbicides is expected to reduce the extent and rate of spread of invasive species, as well as reduce the use of herbicides over time (FEIS p. 4-25, ROD p. 9 and Appendix 2-1). The approved herbicides also pose low risks to humans and non-target organisms. Our site-specific treatment plan for the Deschutes and Ochoco NF and Crooked River NG employs these herbicides as part of an integrated weed management approach where the local conditions, objectives, and concerns are assessed so that treatment is effective, adverse effects are minimized or eliminated, and the Forests and Grassland would realize a reduction in the use of herbicides over time. The purpose and need could not be met without the use of herbicides.

For some invasive plant sites, the size of the population and/or nature of the invasive species require the application of herbicides for effective treatment. For example, houndstongue is rapidly expanding and threatens much of the Ochoco National Forest. Manual treatment of houndstongue over the last several years has cost tens of thousands of dollars, but has not been enough to stem the continued threat, as smaller satellite infestations continue to appear.[7] Herbicides are necessary to control this invasive plant. For some invasive plants such as ribbongrass, manual and mechanical treatment is difficult and often ineffective regardless of the size of the population (see Chapter 3.3 for more information on effectiveness of treatments).

2) Similar to No Action

NEPA decisions have approved use of herbicides on 40 sites on the Deschutes National Forest (USFS 1998a), 72 sites on the Ochoco National Forest and Crooked River National Grassland (USFS 1998b), and one medusahead site on Paulina District, Ochoco National Forest (USFS 2005). These 113 sites represent only 6% of the total number of currently mapped sites (1,892). The No Action alternative would allow continued use of herbicides on these sites, but because these sites were approved for herbicide application 8 to 10 years ago, there have been ongoing treatments, and the amount of herbicide used at the sites has declined. The earlier NEPA documents also approved sites for manual or mechanical treatment. If No Action were selected, future manual and mechanical treatments that haven't already been approved would likely be categorically excluded from NEPA documentation. A

[7] Public comments suggested that volunteer labor is available to control the existing invasive plant populations. The work of manual weed pulling is extremely time-consuming, difficult, and uncomfortable work. Based on past experience, the Forest Service cannot depend entirely on the availability and willingness of the public to volunteer repeatedly and consistently to do the work required to control or eliminate many of the species/sites. Even large organized and advertised events, such as "Let's Pull Together," are primarily an educational tool that is meant to foster awareness amongst the populace, not an attempt to eradicate weed populations (Howard 2007, personal communication).

"No Herbicide" alternative is very similar to the No Action alternative based on the scale of the currently approved program, which is being considered in this EIS. Environmental consequences and effectiveness of manual or mechanical treatments are discussed in Chapter 3.

3) Public Concern and Issue over Toxics Addressed in Project Design

Public comments expressed concern about potential adverse effects to humans from releasing herbicides into the environment. This issue is addressed by following label instructions, following regional Forest Plan standards for herbicide use, and by using appropriate application methods. Public notification, buffers around water intakes, and other project design features minimize potential for exposure. Both action alternatives incorporate measures to protect the public above and beyond the label instructions.

Restricted Herbicide use across Planning Area

Due to public comments and concerns surrounding the release of herbicides into the environment, the interdisciplinary team looked at two ways to restrict herbicide use across the project area: (1) Use herbicides as a tool of last resort, or (2) use herbicides only on highest priority sites.

The R6 2005 FEIS[8] analyzed an alternative that would focus more on prevention and make herbicides a tool of last resort (USFS 2005a). The analysis of that alternative need not be repeated in this EIS (40 CFR 1502.20). The Regional Forester decided in 2005 (USFS 2005b) to not select that alternative or a region-wide standard that would make herbicides a treatment of last resort. She explained that such a standard would deviate from integrated weed management principles that are part of Forest Service manual direction (FSM 2080.5).

As with the regional Record of Decision, the interdisciplinary team recommends that using herbicides as a tool of last resort in the project area would not be consistent with Integrated Weed Management (IWM) principles (see pages 8 and 12). That option, therefore, was not analyzed further in this EIS.

Also, only using herbicides at high priority sites would be difficult because priorities will likely change due to changed conditions, new sites, or new species. Although some sites/species may not be the highest priority on the landscape, they may be best treated with herbicides; this would lead to some invasive plant sites not being effectively treated, potentially allowing them to spread and would not meet this project's purpose and need. This option was therefore not analyzed further in the EIS.

As noted above under "Use Methods Other Than Herbicides," in order to address concerns over human health and exposure to herbicides, the interdisciplinary team developed project design features (PDFs) and built them into the action alternatives. These PDFs are an added layer of caution to the already-regulated and approved use of these herbicides. Section 2.4 details these project-specific features. Some people expressed concern about the effects of herbicides on human health. Section 3.2 discusses the layers of caution integrated into herbicide use and 3.8 discloses the expected health effects of the alternatives. 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 exposure of concern might occur.

[8] The R6 2005 FEIS is available at http://www.fs.fed.us/r6/invasiveplant-eis/FEIS.htm

No herbicide use within Riparian Reserves or Riparian Habitat Conservation Areas

Public comments included concerns about the use of herbicides in riparian areas and near water. Prohibiting the use of herbicides in Riparian Reserves or Riparian Habitat Conservation Areas (RR/RHCAs) would not meet the purpose and need for action. The issue has been addressed through PDFs, and the development of Alternative 3. Alternative 3 is designed to address concerns about the aquatic environment and is based on scientific evidence of how herbicides can reach water when applied nearby. For example, because broadcast application can increase the risk of herbicides drifting through the air and reaching water, Alternative 3 prohibits broadcast within 300 feet of perennial streams and lakes which will encompass riparian areas and beyond in most cases (see p. 276). Although the proposed action is not expected to have significant effects to the aquatic environment, Alternative 3 provides a comparison of a more restricted approach.

Certain invasive plant species are invasive in the riparian areas, such as ribbongrass, reed canarygrass, and yellow iris. These invasive plants are not likely to be controlled effectively with non-herbicide methods. As demonstrated in the analysis for Alternative 3, there is a reduction in the effectiveness with the restrictions in place. Based on what we know about the riparian species, eliminating herbicides altogether would render control of them infeasible. Some species that occur within Riparian Reserves/RHCAs can be in populations of such size or number that objectives could not be met with non-herbicide methods alone (e.g. houndstongue in the Dry Paulina subwatershed). Eliminating the herbicide treatment option would allow these invasives to persist throughout the forest. This is contrary to the purpose and need of controlling known sites and preventing them from spreading further.

Analysis in the Region 6 Invasive Plant Program FEIS discloses the effects of non-herbicide methods on fish, wildlife, and plants (USFS 2005a, Appendix J). According to the FEIS these methods could have more impacts in riparian areas than herbicides. For example, pulling, digging, or grubbing invasive plants can cause soil disturbance, with the potential for soil to move through erosion. The R6 FEIS expected that manual and mechanical treatments would cover relatively small areas and that utilizing these methods in larger areas could lead to increased erosion and stream sedimentation. In the case of some weed sites in the project area, if herbicides were not allowed the manual treatments would take place over much larger areas.

The proposed action and Alternative 3 address the issue of aquatic concerns, while allowing careful and appropriate application of herbicides where it is required to meet site objectives of eradicate, control, contain, or suppress. Refer to sections 3.6 and 3.7 for expected impacts to the riparian areas and aquatic organisms.

No Herbicide Use in Municipal Watersheds

An alternative was considered that would respond to the issues of human health and general toxicity of herbicides by not allowing any use of herbicides within municipal watersheds. There are three municipal watersheds in the planning area: Mitchell, Bend, and Sisters. There are also community water systems (such as Crescent) and other uses of water that originate on Forest Service land for personal consumption. There are currently very few known invasive plant sites within the municipal watersheds. This alternative was eliminated from detailed study because the following project design features were incorporated into the action alternatives in order to address the issue: coordination and agreement with departments managing municipal water systems, restriction on broadcast application, and buffers around water intakes.

Prohibit Biological Control

Some members of the public expressed concern over the use of biological control agents in our invasive plant treatment project. The concerns centered on risks to non-target species. Other commenters felt that biocontrol should be a larger part of our program because of the benign nature of the treatment method.

An alternative that did not allow the use of biological control agents was eliminated from further study because biological control agents authorized by the State and approved for use in Region 6 have been extensively researched and screened prior to release in the United States. Additionally, the Forest Service will be conducting annual review of research and monitoring data regarding biocontrol, and providing current information to the Forests to incorporate in annual implementation planning (Bulkin, pers. comm. 2006).

Certain populations of some invasive plants necessitate the need for biological agents as a starting point to reduce invasive plant populations to a more manageable level, particularly in sensitive areas or where populations of a species are very large in size or the number of sites in an area. For example, Canada thistle sites on the Ochoco NF are so expansive that biocontrol is the only cost-effective method available at this time to get them to a more manageable size.

Maximize Worker Jobs

Because it takes more people to remove weeds by hand than it does to treat them with herbicides, manual treatment prescriptions would theoretically provide more jobs. Some public comments suggested that the Forest Service take this approach in our invasive plant treatment project. This would not meet our purpose and need for action. As with the discussion under "Use Methods other than Herbicides" there is ample evidence that relying on non-herbicide methods alone will not be effective in meeting objectives at the hundreds of weed sites across the Forests and Grassland.

Maximize Cost Efficiency

The converse to the "Maximize Worker Jobs" approach, public comments suggested that we could be most effective and efficient by utilizing herbicides as much as possible. One of the new Forest Plan goals provided by the R6 ROD states "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." (USFS 2005b, p. Appendix 1-2). The proposed action described earlier in this chapter is consistent with the goals and is the most cost effective. The herbicides approved for use in the region have been selected for use across the Forests and Grassland according to where they would be most effective (refer to Appendix A and D). Sensitive ecosystems are protected and adverse effects are minimized by adhering to Forest Plan standards and locally-designed project design criteria.

Focus on Education and Prevention

Focusing on prevention and education rather than treatment would not meet the purpose and need for action. The purpose and need includes timely treatment of invasive plant sites and early control of new sites. Prevention alone is outside the scope of this EIS. The R6 2005 FEIS analyzed an alternative that emphasizes prevention. It would have increased emphasis on reducing conditions related to land uses and activities on National Forest System lands that contribute to invasive plant introduction, establishment, and spread. Herbicide use was a "tool of last resort" in this alternative. The current project-level EIS does not need to repeat the analysis per 40 CFR 1502.20: 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.

Prevention is an important component of invasive plant management and is an ongoing consideration in managing National Forests, regardless of the decision resulting from this EIS. Executive Order 13112 (1999) requires federal agencies to prevent the introduction of invasive species as well as promote education on invasive species. Newly adopted goals, objectives, and standards in the R6 2005 ROD (USFS 2005b) address both the prevention and treatment aspects of integrated weed management. This direction applies to all alternatives, including No Action. In 2004 the Regional Forester directed National Forests in the region to develop local invasive plant prevention practices. These are included in this FEIS as Appendix G. When assessing the effectiveness of the alternatives in this EIS, it is assumed that prevention standards and guidelines will be implemented. The Deschutes and Ochoco National Forests and Crooked River National Grassland also have an active education and outreach program.

In addition to requiring federal agencies to prevent the introduction and spread of invasives, the Executive Order also directs us to detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner. The need for this project is focused on treating currently known populations of invasive plants and responding quickly to newly detected sites. Scientific literature supports timely and appropriate treatment of invasive plants and restoration of native plant communities as important tools for effective integrated weed management (R6 FEIS, Ch. 3). Recent work by Mehta et al (2007) finds that early detection and rapid response increases managers' chances to successfully restore invasive plant sites. For these reasons the alternative of prevention alone was not considered in detail.

2.6 Alternative Comparison

This section provides tables that summarize and compare the alternatives by the activities proposed, and how each responds to the issues and the related effects on the issue indicators.

Table 17. Comparison of Alternative Components

	Alt. 1	Alt. 2	Alt. 3
Allows broadcast spraying of herbicides within 300 feet of perennial waterbodies	DES – Yes OCH – No	Yes	No
Allows herbicide use within 10 feet of perennial waterbodies	DES – No OCH – Yes	Yes	No
Allows triclopyr, sethoxydim, and picloram within 300 feet of perennial waterbodies	DES – No OCH – Yes (Picloram)	Yes	No
Allows Herbicide use in Intermittent Channels when Dry	Yes	Yes	No
Includes approved biological releases	Yes	Yes	Yes
Includes an Early Detection – Rapid Response Strategy	No	Yes	Yes
Includes Restoration and Adaptive Management through Monitoring	Limited testing	Yes	Yes

Table 18. Comparison of the Alternatives Based on How Each Responds to the Issues. This is a summary of information presented in detail in Chapter 3.

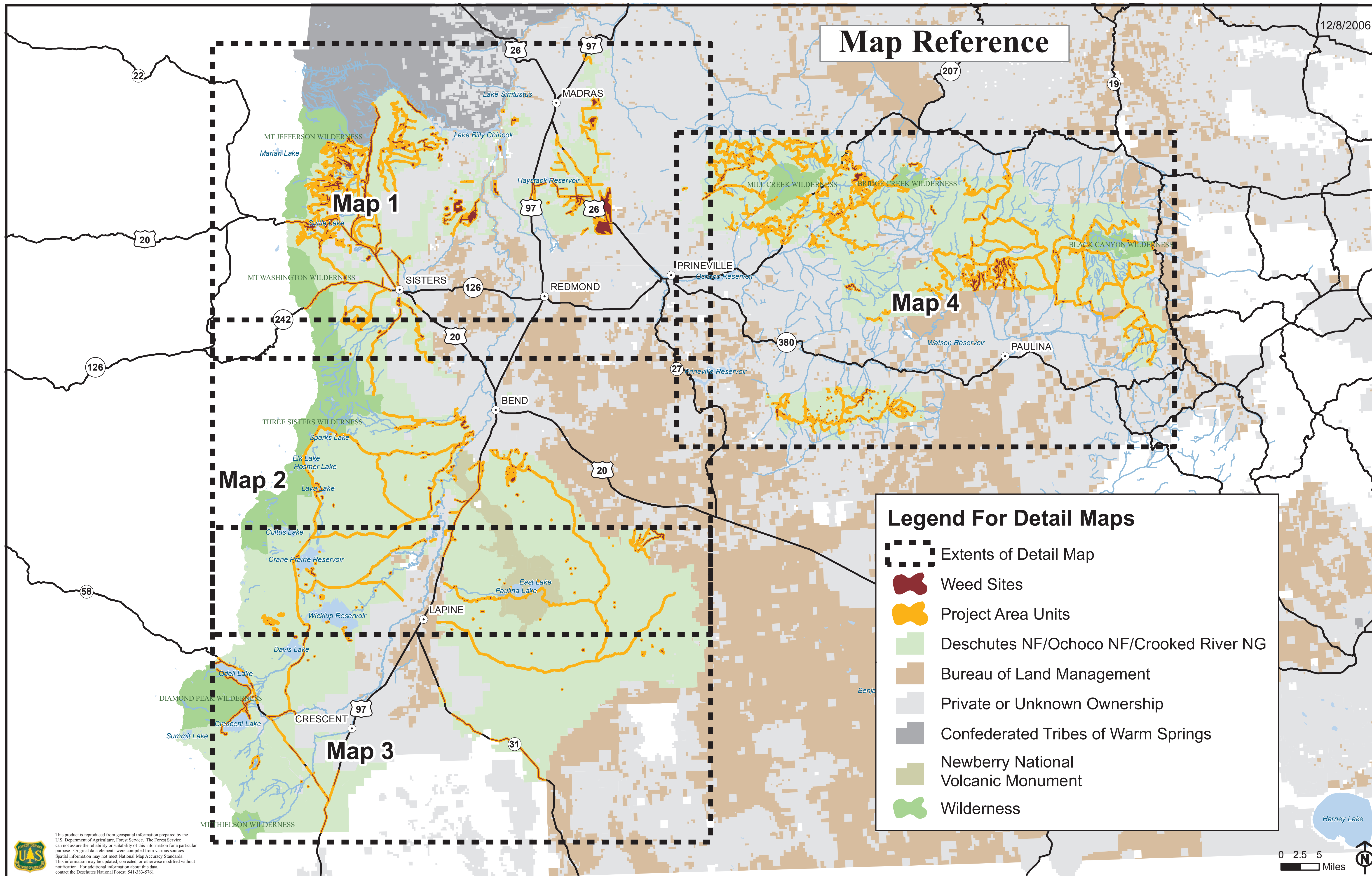
Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
Treatment Effectiveness			
Acres Approved for Treatment	2,204	52,015 acres	52,015
Number of Herbicide Formulations Available	3 ONF, 4 DNF	10	10; 7 in riparian areas
Acres of Invasives in 2014	13,640	7.767	8,519
Ability to Respond Quickly and General Effectiveness	Least effective in controlling invasive plants: fewer acres treated and options most limited; No EDRR to limit spread of new sites.	Most effective alternative in controlling invasive plants. 10 herbicides available for use; allows more broadcast; EDRR increases effectiveness.	More effective than Alternative 1, but less than Alternative 2. 7 herbicides available near water; 10 everywhere else; EDRR increases effectiveness. No effective treatment of riparian species, will continue to have adverse impacts.
Social/Economic Aspects			
Total cost for all sites' first year of treatment	Sites already covered by NEPA documentation have already had the first year of treatment	$2,205,290	$2,518,490
Acres treated in first year based on current budget		Broadcast herbicide: 996,500 Spot/hand herbicide: 968,750 Manual: 240,040	Broadcast herbicide: 790,400 Spot/hand herbicide: 1,472,750 Manual: 255,340
Jobs required based on acres treated by method in first year		88	112
Average cost per acre	Manual $340	Manual $340	Manual $340

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
	Herbicide $100 - $250	Herbicide $100 - $250	Herbicide $100 - $250
Water and Aquatic Species			
Herbicide Treatments near Perennial Waterbodies	Deschutes NF – not allowed within 100 feet. Ochoco NF - some sites remaining from 1,045 acres of Treatment Areas in '98 EA	1,518 invasive plant site acres proposed for herbicides within 300 feet. 724 acres proposed within 100 feet. 230 acres within 10 feet	1,288 invasive plant site acres proposed for herbicides within 300 feet. Broadcast spraying not allowed within 300 feet. 494 acres proposed within 100 feet. 0 acres within 10 feet
Effects for Federally Listed and Region 6 Sensitive Fish Species	No direct impacts to fisheries or aquatic invertebrates from continuing treatments. Potential for indirect effects where riparian areas not treated. Invasives prohibit native vegetation which provides shade from becoming established.	Major impacts prevented with PDFs. Potential risk for effects to bull trout and redband trout from herbicide treatments near water. No measurable effects from manual, mechanical and cultural methods except in Metolius River where cover would be reduced.	Major impacts prevented with PDFs. Reduced risk of herbicide residue washing into streams. Reduced risk of direct overspray to water. Effective control of ribbongrass not possible. Invasives would continue to degrade habitat. No measurable effects from manual mechanical and cultural methods except in Metolius River where cover would be reduced.
Human Health and Public Notification			
Worker Safety	No Significant Impact (FONSI) from ongoing treatments (previous NEPA determination)	Project design features eliminate plausible harmful exposure scenarios.	Same as Alt. 2
Drinking Water	No Significant Impact (FONSI) from ongoing treatments (previous NEPA	Project design features eliminate plausible harmful exposure scenarios.	Same as Alt. 2

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
	determination)		
Public Health	No Significant Impact (FONSI) from ongoing treatments (previous NEPA determination)	Project design features eliminate plausible harmful exposure scenarios.	Same as Alt. 2
Native Plant Communities			
Effects to Federally Listed Plant Species	No Effect	No Effect	No Effect
Effects to Sensitive Plant Species	Invasive plant sites would continue to expand causing further degradation of native plant habitats and potential loss of additional rare plants. Less risk of non-target effects from herbicide. Highest risk to Sensitive plants from loss of habitat.	PDFs will minimize or eliminate any short-term effects to native vegetation. Some individual plants may be impacted by treatments in short term (1-5 years), but there will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. More herbicide options help plan treatments that minimize non-target effects.	PDFs will minimize or eliminate any short-term effects to native vegetation. Some individual plants may be affected in short term (1-5 years) but there will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. Restrictions on broadcast spraying (within riparian reserves) will further minimize potential short-term impacts to non-target veg. Riparian native plants will continue to be impacted by rhizomatous invasive plant species that are difficult to control without the use of herbicides.
Effects to other Rare and Uncommon Species	Low potential risk to individual plants from non-target effects of herbicide. Highest risk to species from	Individual plants could be harmed in short-term. Low risk that herbicide treatments would impact individual plant species.	Individual plants could be harmed in short-term. Low risk that herbicide treatments would impact rare and uncommon plant

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
	loss of habitat.	In long term, rare and uncommon plant species will benefit from treatment effectiveness.	species. Broadcast restrictions may reduce potential impacts to non-vascular plants in riparian zone. In long term, these plant species will benefit from treatment effectiveness.
Summary Effects to Native Vegetation	Native vegetation will continue to be impacted by invasive plants. Less risk of damage to individual native plants from herbicides. Long-term risk to native vegetation from spread of invasive plants.	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Native plant habitats will benefit from invasive plant treatments.	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Native plant habitats will benefit from invasive plant treatments. Riparian native plants may continue to be impacted by rhizomatous invasive plant species.
Wildlife			
Threatened/Endangered Species: Spotted Owl and Bald Eagle	No direct adverse effects from ongoing treatment.	Potential for disturbance from noise, but minimized with PDF; no impact to habitat. No plausible effects from herbicide.	Potential for disturbance from noise, but minimized with PDF; no impact to habitat. No plausible effect from herbicide.
Sensitive Species: Pygmy rabbits, sage grouse, harlequin duck, yellow rail, spotted frogs and Crater Lake tightcoil snail.	No direct adverse effects from ongoing treatments.	Some potential harm to individuals; no risk to populations.	Some potential harm to individuals; no risk to populations.
Sensitive Species: California wolverine, Pacific fisher, grebes, bufflehead, upland	No direct adverse effects from ongoing treatment.	No Impacts	No Impacts

Issue and Indicator ↓	Alternative 1	Alternative 2	Alternative 3
sandpiper, American peregrine falcon, gray flycatcher, tricolored blackbird			
Management Indicator Species	No adverse effects from disturbance or herbicide exposure	Effects from disturbance are avoided with seasonal restrictions No adverse effects from disturbance or herbicide exposure	Effects from disturbance are avoided with seasonal restrictions No adverse effects from disturbance or herbicide exposure
Wildlife Habitat	Highest risk of habitat loss.	Lowest risk of habitat loss.	The risk of habitat loss is lower than Alternative 1 and higher in riparian areas than Alternative 2.



Map Reference
12/8/2006
Map 1
Map 2
Map 3
Map 4
MADRAS
SISTERS
REDMOND
PRINEVILLE
BEND
PAULINA
LAPINE
CRESCENT
Lake Simtustus
Lake Billy Chinook
Haystack Reservoir
Marion Lake
Suttle Lake
Ochoco Reservoir
Prineville Reservoir
Watson Reservoir
Sparks Lake
Elk Lake
Hosmer Lake
Lava Lake
Cultus Lake
Crane Prairie Reservoir
Wickiup Reservoir
East Lake
Paulina Lake
Davis Lake
Odell Lake
Crescent Lake
Summit Lake
Harney Lake
MT JEFFERSON WILDERNESS
MT WASHINGTON WILDERNESS
THREE SISTERS WILDERNESS
DIAMOND PEAK WILDERNESS
MT THIELSON WILDERNESS
MILL CREEK WILDERNESS
BRIDGE CREEK WILDERNESS
BLACK CANYON WILDERNESS
22
20
126
242
26
97
20
126
27
380
207
19
58
97
31
Legend For Detail Maps
Extents of Detail Map
Weed Sites
Project Area Units
Deschutes NF/Ochoco NF/Crooked River NG
Bureau of Land Management
Private or Unknown Ownership
Confederated Tribes of Warm Springs
Newberry National Volcanic Monument
Wilderness
0 2.5 5
Miles
N
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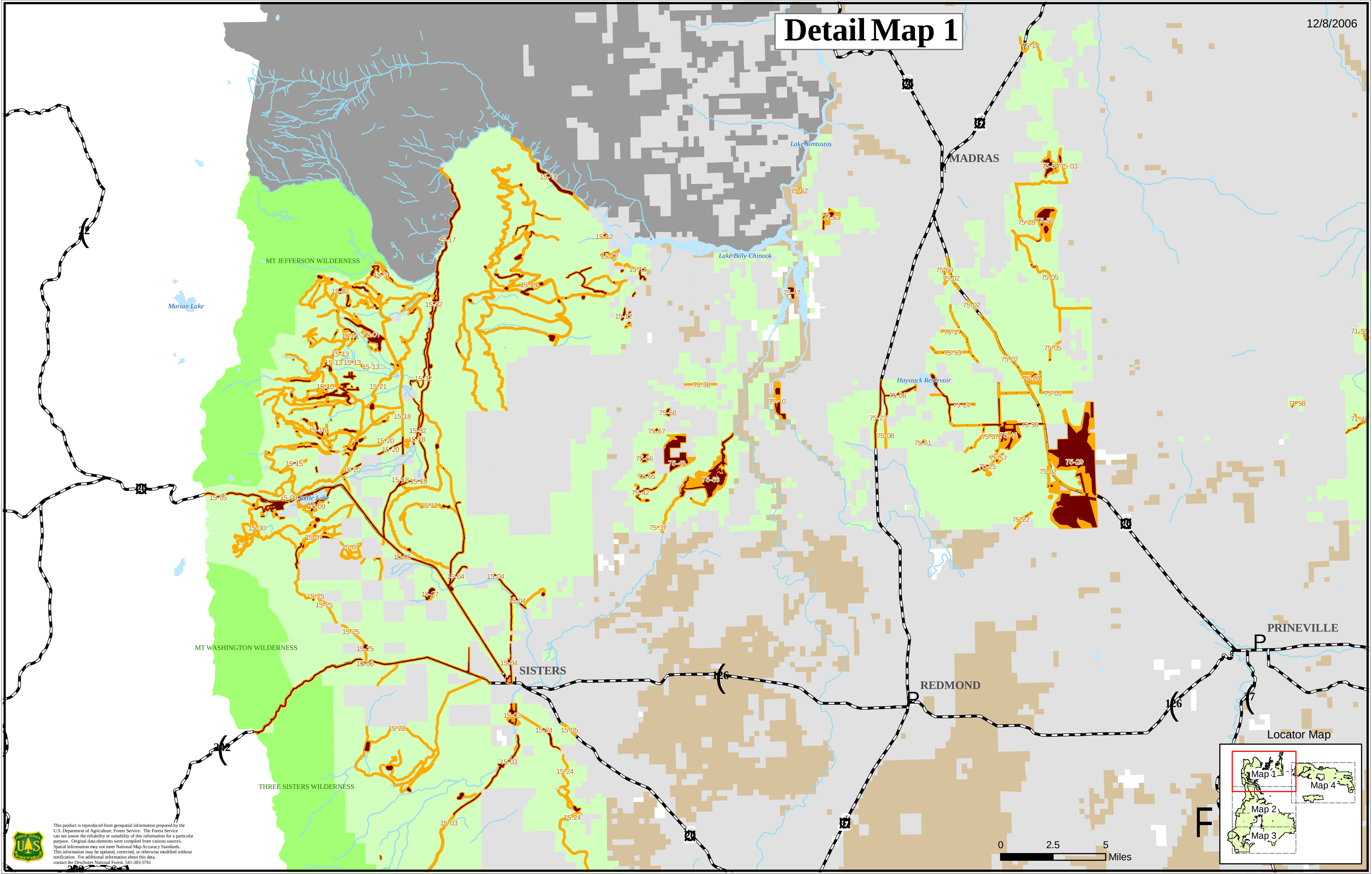
Detail Map 1
12/8/2006
MADRAS
SISTERS
REDMOND
PRINEVILLE
Lake Simtustus
Lake Billy Chinook
Haystack Reservoir
Marian Lake
Suttle Lake
MT JEFFERSON WILDERNESS
MT WASHINGTON WILDERNESS
THREE SISTERS WILDERNESS
Locator Map
Map 1
Map 2
Map 3
Map 4
0
2.5
5
Miles
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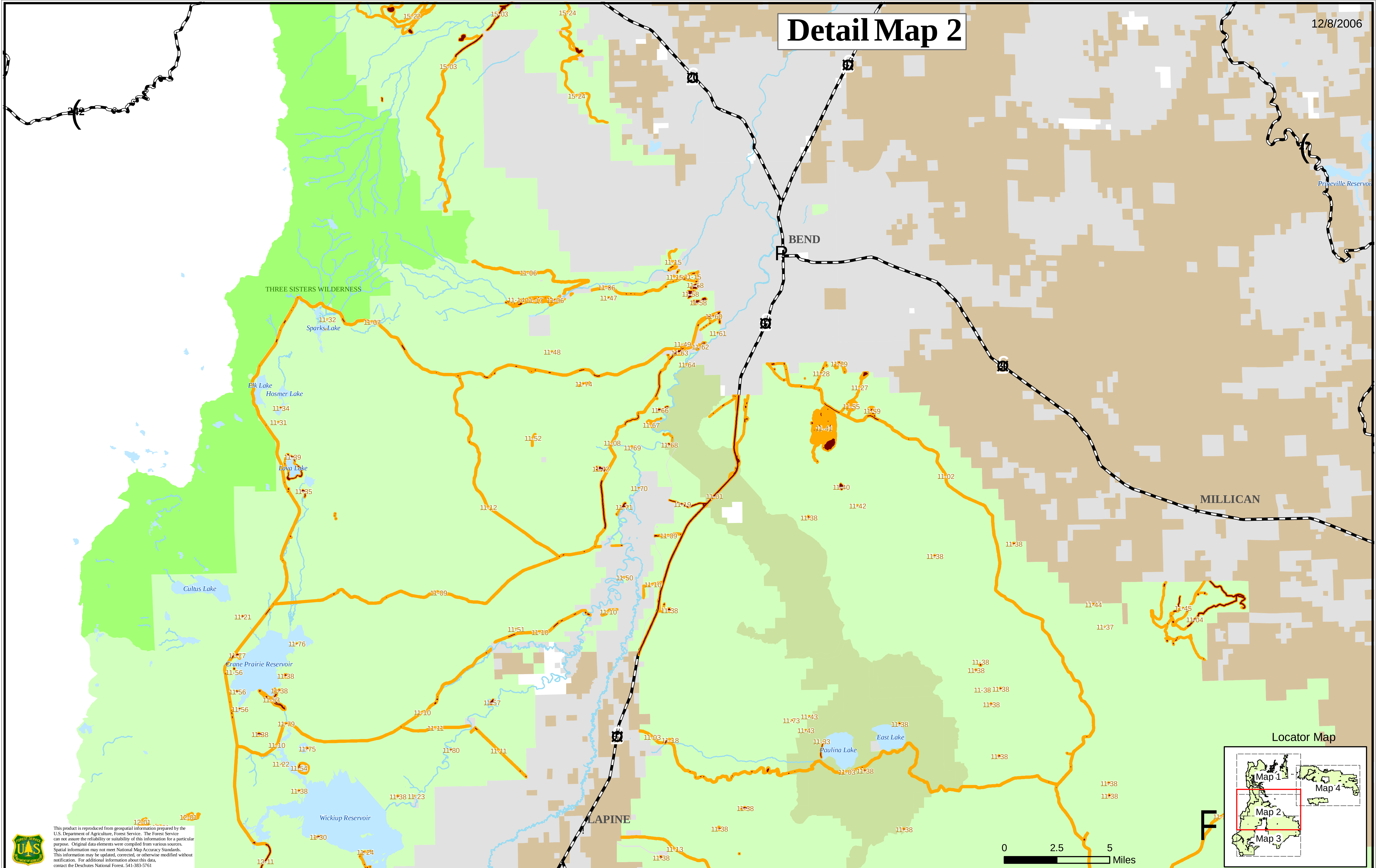

Detail Map 2
12/8/2006
BEND
MILLICAN
LAPINE
THREE SISTERS WILDERNESS
Sparks Lake
Elk Lake
Hosmer Lake
Lava Lake
Cultus Lake
Crane Prairie Reservoir
Wickiup Reservoir
Paulina Lake
East Lake
Prineville Reservoir
Locator Map
Map 1
Map 2
Map 3
Map 4
0
2.5
5
Miles
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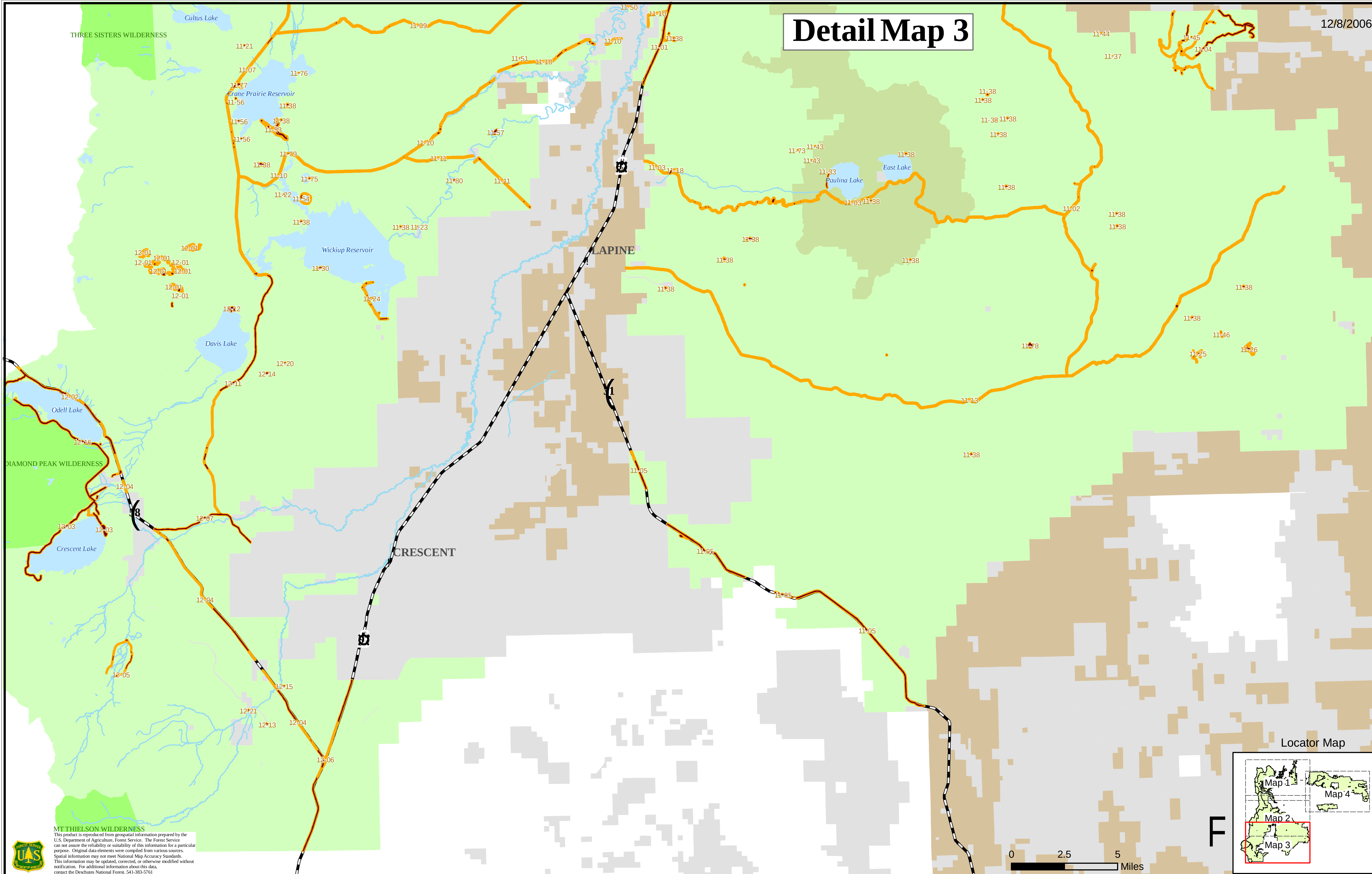
Detail Map 3
12/8/2006
Cultus Lake
THREE SISTERS WILDERNESS
Crane Prairie Reservoir
Wickiup Reservoir
Davis Lake
Odell Lake
DIAMOND PEAK WILDERNESS
Crescent Lake
LAPINE
CRESCENT
Paulina Lake
East Lake
MT THIELSON WILDERNESS
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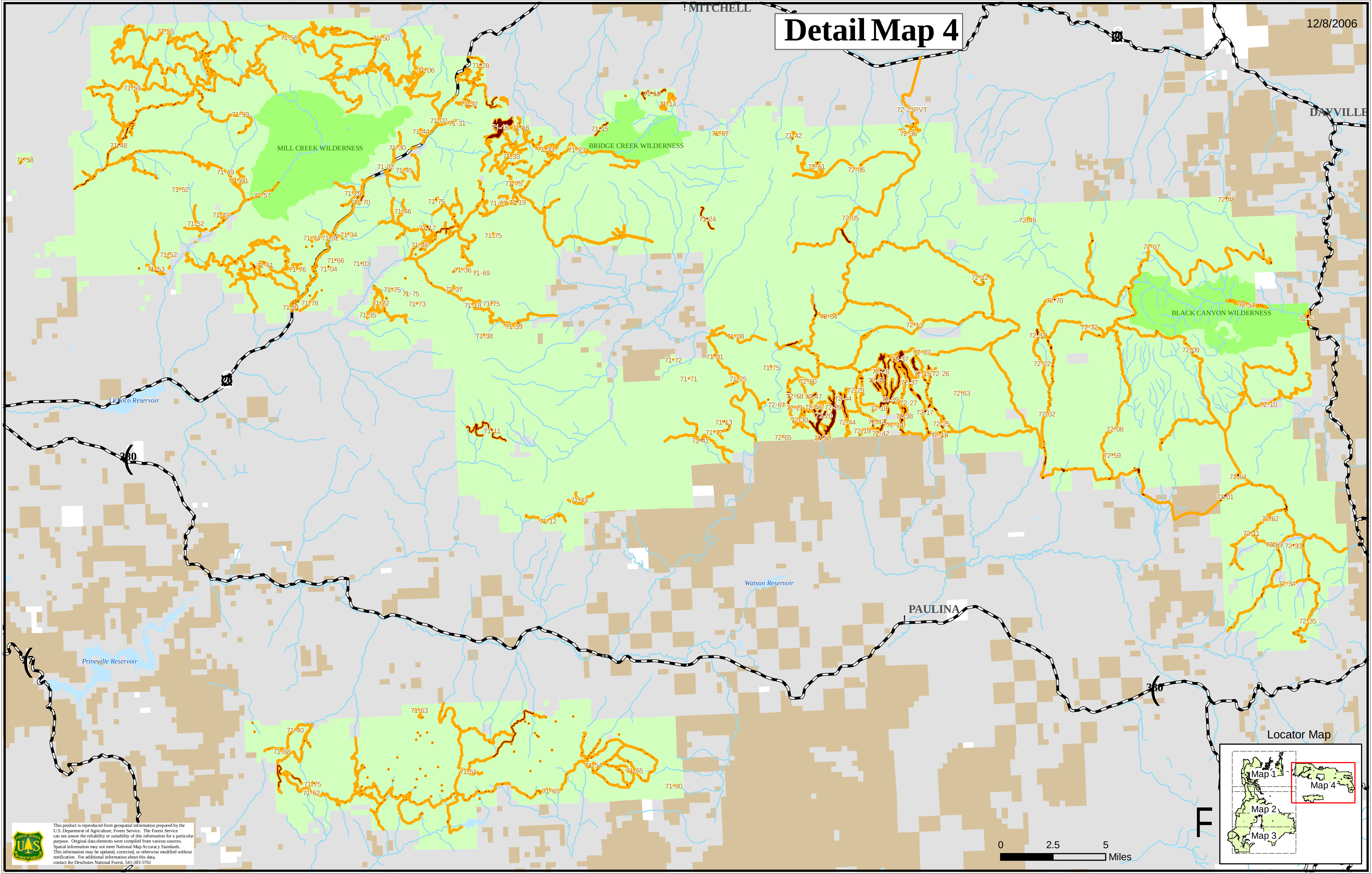
Locator Map
Map 1
Map 2
Map 3
Map 4



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Chapter 3

Affected Environment and Environmental Consequences

Chapter 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

- **Chapter 3 Changes Between FEIS and DSEIS:**

This supplemental EIS includes additional clarifying statements about the use of Project Design Features to reduce or eliminate effects from the proposed treatments. The direct, indirect, and cumulative effects discussions in all sections have been updated to more thoroughly describe the expected effects or why there are no cumulative effects expected. General and minor edits are made throughout.

3.1 Introduction

Chapter 3 of this EIS summarizes the physical, biological, social, and economic environments of the affected project area (existing conditions) and the potential changes to those environments due to implementation of the alternatives discussed in Chapter 2 (environmental consequences). It also presents the scientific and analytical basis for the comparison of alternatives presented. For ease in presentation and comparison, the analysis discussions are separated into individual resources areas.

Biological Evaluations (BE) have been prepared in compliance with the requirements of Forest Service Manual (FSM) 2670, 2671, FSM W.O. Amendments 2600-95-7, and the Endangered Species Act (ESA of 1973, as amended. A Biological Assessment (BA) has been prepared in compliance with the requirements of Forest Service Manual (FSM) 2630.3, FSM 2672.4 and the Endangered Species Act of 1973 (Subpart B: 402.12, Section 7 Consultation, as amended) on actions and programs authorized, funded, or carried out by the Forest Service to assess their potential for effect on threatened and endangered species and species proposed for federal listing (FSM 2670.1).

The effects of treatment are assessed for the entire unit. The amount of treatment within a unit is based on the occurrence of mapped weed sites, which totals about 14,547 acres across the Forests and Grassland. The amount of weed sites in a unit can be considered the maximum amount of area that would be treated in a year; however, the actual amount would likely be less, and would be based on priorities and limited by budget.

3.1.1 The Planning Area

The entire planning area involves nearly 3 million acres of National Forest and Grassland in Central Oregon, and lies within 55 fifth-field watersheds (see Appendix I). Land in these watersheds is divided amongst the National Forest system, Confederated Tribes of the Warm Springs Reservation, Bureau of Land Management, State of Oregon, private timberlands and agricultural lands, and other private holdings.

The Inventory of invasive plant sites on the Deschutes and Ochoco National Forests and Crooked River National Grassland (Forests) amount to approximately 0.5 % of the National Forest System lands in Central Oregon.

3.1.2 Treatment Assumptions & Scenarios

The analysis in this chapter of the EIS is based on the assumption that none of the treatments would be considered 100 percent effective immediately after the initial entry. While initial entries in year one are estimated to eliminate 80 – 95% percent of the invasive plants at a site, maintenance entries would be required in either year one or in subsequent years.

The following assumptions were made about treatment scenarios.

- 80% effectiveness is assumed at each treatment area after each year. For example, if 1000 acres are treated in year 1 and the treatment is 80% effective, 200 acres would need to be treated in year 2. If 200 acres are treated in year 2 and the treatment is 80% effective, 40 acres would need to be treated in year 3.
- Herbicide methods would precede non-herbicide methods in most cases, because non-herbicide treatments will be most effective when populations have been substantially reduced through herbicide treatment. In some cases, manual, mechanical, and prescribed fire methods precede herbicide treatment.
- The treatments are required to recur for at least five years. Even though a site may be cleared of invasive plants before five years, the scenario used for analysis assumes a worse-case.
- Table A.1 of Appendix A lists the herbicides that would be effective on a particular site from first choice to fourth choice. It is assumed that the first choice herbicide would be used unless resource conditions warrant moving to the next choice (annual implementation plan will list these situations). Herbicides would generally be applied at or below typical application rate, and in no instance exceed rates allowed by label requirements or Project Design Features (Table 12). In project area units (PAUs) that list several species present, the infestations are most often distinct and application of more than one herbicide is not likely to occur on the same place at the same time.

This project would be implemented over the next 15 years approximately, as funding allows, until no more treatments were needed, or until conditions have changed sufficiently to warrant this EIS outdated. Site-specific conditions are expected to change within the life of the project: 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.

In most cases, herbicide treatment would precede manual or non-herbicide because the non-herbicide treatments will be most effective when populations have been substantially reduced through the use of herbicides. In some cases, manual and mechanical treatments would occur in advance of herbicide treatments. The most ambitious treatment scenario for analysis purposes would be for all sites to have an initial treatment in the first year. In reality, the amount to be treated in any year is estimated to be approximately 10% of the inventoried sites. The benefits and adverse impacts of treatment are likely to be less than predicted for the most ambitious scenario because funding and other constraints would limit the amount treated in any one year.

Year 1, Most Ambitious Scenario

- Total Acres Treated: 14,547[9]
- # of Sites Treated: 1,892
- Acres Treated with Herbicide: 13,814
- Acres Treated with Non-Herbicide: 732
- Percentage of Treatments that are Non-Herbicide: 5%
- Active Restoration- roughly 263 acres

[9] The amount of acres is calculated from the inventoried invasive plant site coverage in GIS. This figure does not account for the variation in density or patchiness of the sites, so is an overestimation of the actual area covered by invasive plants and therefore the area actually treated with herbicides or other methods.

Relationship to Early Detection-Rapid Response Strategy

All action alternatives include the ability for Forest Service land managers to approve treatments on currently unknown invasive plant sites while incorporating Project Design Features (see Appendix F). The premise of early detection-rapid response analysis approach is that treatments of new infestations in accordance with methods and design features defined in this project-level EIS will have similar effects to treatments of known sites.

If treatments are begun at an ambitious pace, early detection/rapid response would tend be a smaller part of the program in the future. If initial treatments are not ambitious, over time, early detection-rapid response could be expected to become a larger part of the annual program. The treatment caps described on page 39 mean that treatment across the project area will not exceed 16,000 acres per year.

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 and Appendix F ensure that the plausible adverse effects of treating currently unknown infestations would be within the scope of those disclosed here. Section 3.8 provides further reasoning about how PDFs minimize or eliminate adverse effects to all non-target organisms.

3.1.3 Basis for Cumulative Effects Analysis

The Council on Environmental Quality (CEQ) regulations for the implementation of NEPA define cumulative effects as 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…" 40 CFR 1508.7. Cumulative effects are discussed where there is an effect to the environment which results from the incremental effect of the action when added to other past, present, or reasonably foreseeable future actions (40 CFR 1508.7).

The cumulative effects considered in this EIS are related to the risks to the human environment associated with herbicide exposure or other invasive plant treatments. The risk of adverse effects of invasive plant treatments have been minimized by the Project Design Features (PDFs) described in Chapter 2.4, and therefore the potential for cumulative effects is minimal. Refer to Appendix D for information on how specific risks are addressed through PDFs. The Invasive Plant FEIS (USFS 2005a) serves as the basis for the site-specific effects analysis discussed in this EIS.

The effects of herbicide use are mainly limited to the site of application, and governed by the extent of the target species to be treated. Herbicide is only applied where needed. Drift from broadcast treatments is unlikely to harm non-target vegetation more than 20 feet away from treated areas (see discussion pp. 132-133). Spot and hand treatments are far less likely to move off site. Herbicide potential to be delivered to streams is also managed through buffers and PDFs. Only land and roads within the National Forest System will be treated in the action alternatives. The proposed use of herbicides on and off National Forest system lands could result in additive doses of herbicides to workers, the general public, non-target plant species, and/or wildlife; however, risk of adverse effects of the use of the proposed herbicides has been minimized by the Project Design Features, Section 2.4, and although workers, the public, and fish/wildlife may be exposed, multiple exposures do not necessarily result in cumulative adverse effects. The herbicides proposed are water-soluble, are rapidly eliminated from humans and do not concentrate in fatty tissues and do not significantly bioaccumulate (USFS 2005a). Where more than one herbicide may be used in a PAU, the potential for synergistic effects is very low. The Invasive Plant FEIS (USFS 2005a) states "Combinations of herbicides in low doses (less than one tenth of the RfD) have rarely demonstrated synergistic effects."

The mobility and persistence of herbicides was considered in the development of Project Design Features, which also serve to limit the mechanisms by which additive doses of concern to people, wildlife, or fish could occur. All acute or chronic exposures identified in the R6 2005 FEIS as potentially exceeding thresholds of concern would be avoided. Thus, the effects of the use of herbicides within the scope of this project are unlikely to exceed thresholds of concern. This assumes our neighbors' use of herbicide complies with all applicable regulations and laws.

Invasive Plant Treatment across the Watersheds

An accurate accounting of all acres of invasive plant treatment in the watersheds is not available. In 2007, the State of Oregon began requiring Pesticide Use Reporting to a centralized database (http://www.oregon.gov/ODA/PEST/purs_index.shtml). Reporting requirements apply to those who use pesticides in the course of business or any other for-profit enterprise, to government entities, and for use in locations intended for public access. The program is funded through June 2009 when it may expire. The 2007 Pesticide Use Report shows that the greatest percentage of pesticide application in the state (84.7%) is for agriculture. The report also shows that of the top five pesticides by pound reported in Oregon, fumigants account for the majority (42%); whereas herbicide accounts for only 9% (ODA 2008). In the Deschutes Basin, glyphosate is one of the top five active ingredients. This is the only active ingredient from the list that is also approved for use on the National Forest and included in the proposed action.

The Invasive Plant FEIS (USFS 2005a) estimated that invasive plant control occurs on over 1.25 million acres in Oregon and Washington, with over 90 percent of the control through the use of herbicides. Even the highest estimates of herbicide use on the National Forests would account for less than three percent of the total land treated with herbicides in Oregon and Washington (USFS 2005a, p. 4-1). The ODA 2007 Pesticide Use Report showed that pesticide use (by pound) in the Deschutes and John Day Basins combined amounted to 2% of the reported use in Oregon.

Invasive plant management in the watersheds being analyzed for water resources (Section 3.6) is accomplished by the counties, private individuals, and federal agencies. The Prineville District of the Bureau of Land Management (BLM) controls weeds as authorized under their 1996 Integrated Weed Management EA. The maximum amount of area treated in one year is 1,000 gross acres. This fluctuates yearly depending on budgets. The BLM issued a Record of Decision in September 2007, "Vegetation Treatment Using Herbicide on BLM Lands in 17 Western States," a programmatic document approving the use of 17 herbicides and proposing to treat 45,000 acres in Oregon (35,000 on the east side, 10,000 on the westside). The BLM is now preparing a draft Vegetation Treatment EIS covering the states of Oregon and Washington, which will analyze site specific effects of herbicide treatments on noxious weeds, invasive plants, and native vegetation at selected sites (e.g. campgrounds). Public scoping has been initiated and the EIS is expected to go out for comment sometime in 2011. It is too early in their process to know an exact amount that will be treated on BLM lands within watersheds shared by the Deschutes and Ochoco National Forests.

The cumulative effects analysis assumes that legal use of herbicides is occurring on all other ownerships, including BLM. Risk Assessments consider chronic exposure that would result from ongoing exposure from multiple sources. The effects of our project are limited in time and space, it is not expected that we will contribute to cumulative adverse effects with BLM or the public's use of herbicide. We will coordinate adjacent projects with the BLM. The more tools the BLM has the more likely for synergistic beneficial effects from treatments adjacent to ours for reducing invasive plant populations.

Counties are responsible for controlling noxious weeds along county roads and other county property outside of and within National Forest System lands. They also work with conservation districts and watershed councils to control noxious weeds on private property.

The Confederated Tribes of the Warm Springs and Bureau of Indian Affairs released a Vegetation Management Noxious Weed Control Plan and Assessment in 2005 that proposed manual, mechanical, biological, prescribed burning, as well as herbicide treatments. The plan is designed to treat and control invasive plants on the Reservation over the next five years. The amount of herbicide to be used on tribal lands is not available.

Land management activities tend to be more intensive on state and private lands than on adjacent National Forest System (NFS) lands. The NFS lands are generally in the upper portions of the affected watersheds. The largest use of herbicides in the planning area is on agricultural lands below the Forest boundary. Nonpoint sources of herbicides in streams and groundwater result from the agricultural use (USGS 2006). More information on agricultural herbicide use in contained in the analysis file.

Past and ongoing treatment of invasive plants on the Deschutes and Ochoco National Forests and Crooked River National Grassland are authorized under the decisions described in Chapter 2 (No Action Alternative). Additionally, recent wildfires have prompted invasive plant control through Burned Area Emergency Rehabilitation (BAER). Monitoring and/or hand pulling of invasive plants has been recommended by BAER teams for the recent fires including Eyerly (2002), Davis (2003), B&B (2003), Black Crater (2006), Lake George (2006), and Maxwell (2006).

The use of herbicides for treating unwanted vegetation (other than invasive plants) has been analyzed on the Deschutes National Forests under the following recent project: 18 Fire Competing Vegetation Project (20 units treated with spot application of granular hexazinone, beginning 2007, decision signed). The actions proposed in this project to do not overlap the invasive plant sites intended for treatment in this EIS. The effects analysis for this project indicated that the expected effects of the hexazinone applications will not extend beyond the immediate treatment areas. Hexazinone has a low risk of lateral transport of residues and application rates are applied to minimize the amount of herbicide residue left on the target plants. Additionally, the treatment of unwanted vegetation would not overlap in time with the proposed invasive plant treatments.

The effects of our project are so limited in time and space that we will not contribute to cumulative adverse effects with BLM or anyone else's use of herbicide.

3.2 Herbicides, Adjuvants, Surfactants and Inert Ingredients

Herbicide Risk Assessments

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. The R6 2005 FEIS used the herbicide risk assessments displayed in Table 20 to evaluate the potential for harm to non-target plants, wildlife, human health, soils and aquatic organisms from the herbicides considered for use on the Deschutes and Ochoco National Forests and Crooked River National Grassland.

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 to which SERA had clearance. Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to characterize the risk of adverse effects to non-target organisms.

The risk assessments considered worst-case scenarios including accidental exposures and application at maximum label rates. 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. Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available.

Table 19 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.

Table 19. Risk Assessments for Herbicides and Surfactants Considered in this EIS

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 04-43-17-01b
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 and Other Surfactants	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, Bakke (2002, 2003) and 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).

Information on adjuvants and surfactants is tiered to the R6 2005 FEIS and incorporates updated information from *Analysis of Issues Surrounding the Use of Spray Adjuvants with Herbicides* (Bakke 2007) and the *Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications* (Bakke 2003, Bakke 2007).

The Forest Service maintains a Pesticide management and Coordination website that contains human health and ecological risk assessments; pesticide use policy information; pesticide labels; material safety data sheets; and reports on pesticide use across National Forest System lands: http://www.fs.fed.us/foresthealth/pesticide.

Nonylphenol Polyethoxylate (NPE)

The primary ingredient in many of the non-ionic surfactants used by the USDA Forest Service when applying herbicides is a compound known as nonylphenol polyoxylate (NPE). A separate risk assessment (Bakke 2003b) for NPE surfactants was completed because concerns have been expressed about toxicity of the chemical components and breakdown products of NPE surfactants. NPE surfactants are appropriate for some applications where the herbicide label requires the addition of a surfactant. NPE surfactants may also improve efficacy in other herbicide applications where addition of a surfactant is optional. In some, but not all of these situations, there are alternative surfactants that would be effective that do not contain NPE (USFS 2005a). The typical application rate of NPE for USDA Forest Service, Pacific Northwest Region is 1.67 pounds per acre (USFS 2005a).

Incomplete or Unavailable Information

Risk assessments have a high degree of uncertainty in interpretation and extrapolation of data. Uncertainty may result from a study design, questions asked (and questions avoided), data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Due to data gaps, assessments rely heavily on extrapolation from laboratory animal tests (USFS 2005a).

Regardless of disadvantages and limitations of ecological and human health risk assessments, risk assessments can determine (given a particular set of assumptions) whether there is a basis for asserting that a particular adverse effect is possible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA 2007). Further, a risk assessment has only been completed on one surfactant type (NPE) (Bakke 2003, 2007). Limited information on other surfactants, adjuvants, and inert ingredients is available in Bakke (2003, 2007) and various risk assessments. Since risk assessments have not been completed for most surfactants, adjuvants and inert ingredients, information regarding the toxicity and effects of these chemicals is largely unavailable.

For risk assessments considering adjuvants, surfactants and inert ingredients in herbicide mixtures, the information within the risk assessment may not be complete. SERA (2007) discusses how the risk assessments apply generally accepted scientific and regulatory methodologies to encompass these uncertainties in predictions of risk. SERA risk assessments identify and evaluate incomplete and unavailable information that is potentially relevant to human health and ecological risks. Each risk assessment identifies and evaluates missing information for that particular herbicide and its relevance to risk estimate. Such missing information may involve any of the three elements needed for risk assessments: hazard, exposure, or dose-response relationships. A peer-review panel of subject matter experts reviewed the assumptions, methodologies and analysis of significance of any such missing information. SERA addresses and incorporates the findings of this peer review in its final herbicide risk assessment.

Herbicide Toxicology Terminology

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

Aquatic Label: Some herbicides are labeled by EPA for direct application in water. While no direct application would occur in any alternative for this project, treatment of emergent invasives in standing water or dry stream beds may involve use of such formulations to meet label requirements. Aquatic labeled herbicides are not necessarily less hazardous to aquatic organisms than other herbicides, but have been more extensively tested (however, aquatic labeled herbicides are less hazardous to aquatic organisms than their terrestrial formulations). Aquatic labeled herbicides would not be favored over effective non-aquatic labeled herbicides that pose lower risk to aquatic organisms, assuming compliance with label advisories.

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).

Exposure Scenario: The mechanism (for example, by skin or ingestion) 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 observable adverse effects to an organism. The No-observed-adverse-effect level (NOAEL) is the exposure level at which there are no statistically or biologically significant differences in the frequency or severity of any adverse effect in the exposed or control populations.[10] When a hazard quotient is less than 1, risk is extremely low for any observable adverse effects due to the particular exposure scenario, and it is considered below the threshold of concern. Exposure scenarios are very conservative and therefore the risk characterization or threshold of concern is sufficiently protective. This level was further reduced in the R6 2005 FEIS to add a margin of safety to the risk assessment process for Threatened and Endangered species.

Hazard Quotient (HQ): The Hazard Quotient (HQ) is the amount of herbicide or additives to which an organism may be exposed (dose) divided by the exposure threshold of concern (No Observable Adverse Effect Level – NOAEL). An HQ less than or equal to 1 indicates an extremely low level of risk. A HQ below 1 indicates a level below a threshold of concern.

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.

No Observable Adverse Effect Level (NOAEL): Exposure level at which there are no statistically or biologically significant differences in the frequency or severity of any adverse effect in the exposed or control populations.

No Observed Effect Concentration (NOEC): Synonymous with NOEL.

No Observed Effect Level (NOEL): Exposure level at which there are no statistically or biologically significant differences in the frequency or severity of any effect in the exposed or control populations.

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.

Risk Reduction Framework

Alternatives 2 and 3 incorporate a risk reduction framework to ensure the safe and effective use of herbicides. Figure 5 displays the layers of caution that are integrated into risk reduction framework for herbicide use in the United State Department of Agriculture (USDA) Forest Service, Pacific Northwest Region. First, label requirements, federal and state laws, and the EPA approval process provide an initial level of caution regarding herbicide use. Next, the SERA Risk Assessments (2001, 2003a, 2003b, 2003c, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f) disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label).

[10] The laboratory test include organ/tissue examination/dissection, lethal and non-lethal effects (i.e. behavior changes and weight loss).

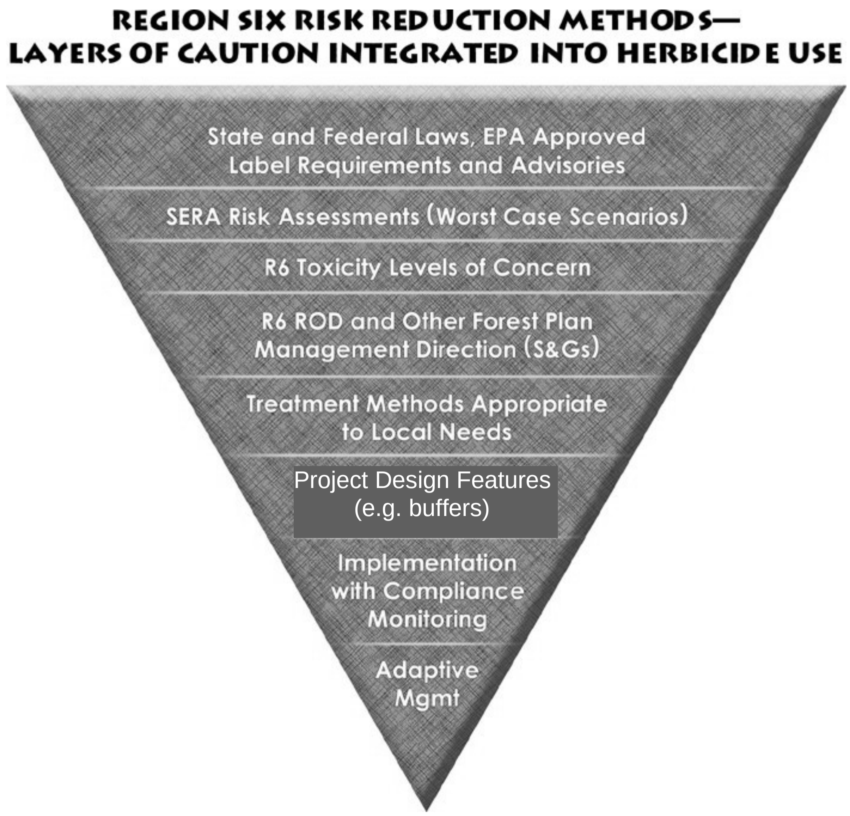

Figure 5. Layers of Caution Integrated Into Herbicide Use

The R6 2005 FEIS included an additional margin of safety by reducing the level of herbicide exposure considered to be of concern to Threatened and Endangered fish and wildlife. The R6 2005 ROD adopted standards to minimize or eliminate risks to people and the environment. This National Forest Site-Specific Invasive Plant Treatment Project is designed to comply with the R6 2005 ROD standards. Finally, the Project Design Features (PDF) further reduce the risks associated with herbicide treatments by eliminating or minimizing as much as possible the impacts to the environment (FEIS, Chapter 2.4).

Figure 4 also depicts how the site-specific situation on the Deschutes and Ochoco National Forests allows for additional layers of caution to be integrated into herbicide use locally:

1. Treatment methods have been limited to those necessary to eradicate, control or contain invasive plants on the Forests or Grassland; higher risk projects such as aerial application and/or broadcast application near wet streams were eliminated from consideration because they are not necessary to meet local invasive plant treatment needs.

2. Project Design Features ensure herbicide exposures under the Proposed Action will not exceed conservative levels of concern for people and botanical, wildlife, and aquatic species of local interest. The analysis throughout Chapter 3 demonstrates that herbicide use even under the most ambitious scenario under the Proposed Action is unlikely to result in exposures of concern. This is true for known infestations as well as those found in the future, because the Project Design Features (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 and adaptive management processes described in Chapter 2 and Appendix F ensure that effective treatments are completed according to PDFs, and undesired effects are indeed minimized.

3.3 Invasive Species and Treatment Effectiveness

3.3.1 Affected Environment

The public, other agencies and organizations expressed a strong desire to see the Forest Service utilize the methods necessary to make substantial progress in effective treatment of the invasive species. This was mostly expressed as a desire to see more herbicides used where they are the most effective treatment, and to avoid delay which could allow further spread. Comments were often tied to the concept of prevention. 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 herbicides.

Invasive Plants

An invasive plant is a non-native plant whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112). Invasive plants are distinguished from other non-native plants in their ability to spread (invade) into native ecosystems. Some species of invasive plants are listed by the Secretary of Agriculture or by the responsible State official as "noxious weeds. This analysis includes all State-listed noxious weeds plus other invasive species that are of concern because of their impacts to ecosystem health. The term "invasive plants" more broadly encompasses all invasive, aggressive, or harmful non-indigenous plant species, whether designated noxious or not.

The consequences of invasive plant infestations can include alteration of the structure, organization, or function of ecological systems (Olson 1999). Invasive plants can increase soil erosion, leading to a disproportionate loss of biologically active organic matter and nitrogen. Invasive plants have the ability to deplete nutrients and water in the soil to levels lower than native plant species can tolerate, allowing invasive plants to out-compete native vegetation. Many invasive plants are early successional species, meaning they colonize areas that have been recently disturbed. Since invasive plants have the ability to deplete available resources to lower levels than native vegetation can tolerate, they can quickly dominate disturbed sites. When invasive plants dominate native plant communities, native plant species diversity is decreased. Invasive plants can out-compete native species because they produce abundant seed, have fast growth rates, have no natural enemies, and are often avoided by large herbivores. Some invasive plants also produce secondary compounds, which can be toxic to native plant species or animals. Weed infestation can therefore lead to a decrease in native plant species, which can alter the ability of wildlife to find suitable edible forage.

Invasive plants create a host of adverse environmental effects that are harmful to native ecosystem processes. Examples of these effects include: displacement of native plants; reduction in habitat and forage for wildlife and livestock; loss of threatened, endangered, and sensitive species; increased soil erosion and reduced water quality; reduced soil productivity; and changes in the intensity and frequency of fires. Invasive plants spread between National Forest system lands to neighboring areas, affecting all land ownerships. The problem is so great that the Chief of the Forest Service has included invasive species as one of the "Four Threats to the Nation's Forests and Grasslands (http://www.fs.fed.us/projects/four-threats/).

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. Roads serve to introduce and establish invasive plants in areas where they were previously unknown, jeopardizing the ecological integrity of native plant communities.

Scope of Problem

Thirty-two invasive plant species are inventoried, mapped and proposed for treatment on the Deschutes and Ochoco National Forests and Crooked River National Grassland (Table 9, page 32). In the past 10 years, nearly 2,000 invasive plant sites have been mapped covering 14,547 gross acres[11] (approximately 0.5% of the 2.3 million acres managed by the Forests and Grassland). Inventories are conducted during project planning, Burned Area Emergency Response, and as field-going personnel, the public, or other agencies provide information on the location of invasive plants.

Additional invasive plant sites likely exist but have not yet been detected by annual inventory and mapping efforts. Some species, such as cheatgrass (*Bromus tectorum*), North Africa grass (*Ventenata dubia*) and Russian thistle (*Salsola kali*) occur in such abundance that many sites have not been mapped. Table 9 lists the 32 species that are currently proposed for treatment in this analysis. Cheatgrass, North Africa grass, and other species would be considered for treatment under EDRR if they fit the criteria listed in Section 2.3.4.

Sites range in size from one plant to numerous plants scattered over large acreages (Table 20). The majority of inventoried sites (1,440 sites; 76% of known sites) are smaller than one acre; 215 sites (11% of known sites) are between 1 and 5 acres in size; 57 sites (3%) are between 5 and 10 acres in size; and 180 sites (10%) are equal to or larger than 10 acres. Table 21 summarizes the mapped number of sites of invasive plant infestations currently inventoried on the Ranger Districts and the Grassland.

The two Forests and Grassland share many of the same invasive plant species, such as spotted and diffuse knapweeds, Canada and bull thistles, St. Johnswort, and Dalmatian toadflax. Yet, there are differences between the units as to which species are especially problematic. Table 9 in Chapter 2 summarizes, by species, the number of sites and mapped gross acres currently proposed for treatment on each District and the Grassland. Medusahead, for example, is most abundant on the Crooked River National Grassland, while it occurs in very low numbers (or at all) on the other units. Though Dalmatian toadflax is established on Bend/Ft. Rock District, it is a new invader on the Grassland and, therefore, a high priority for treatment. Paulina District (Ochoco NF) contains the majority of houndstongue, and treating this species will be complex and require a long-term commitment. Paulina District has little medusahead; therefore, this species is a high priority for treatment before it encroaches onto other sites. Yellow starthistle is a high priority species for treatment on Lookout Mt. District; their one known site has been reduced from 5 acres to < ¼ acre through herbicide and manual treatments that were approved in a 1998 Environmental Assessment (USFS 1998b). Spotted knapweed is well established in the city of Bend, Oregon and road corridors continue to spread this species further onto adjacent Bend/Ft. Rock District (Deschutes NF) lands. Though spotted knapweed is abundant on Sisters District, diffuse knapweed is more abundant on this district compared to other districts in this project area. Crescent District does not have the scale of invasive plant problems like the other units, yet it plays a vital role in early detection and rapid response of new invader species entering our area via major highways (e.g., Highways 97 and 58). In the past few years, individual plants of yellow starthistle, kochia, and hairy whitetop have been found along Highway 97 and 58 and hand-pulled before flowering and setting seed. Two species that are new to our area but not yet established on

[11] Gross acres: the area delineated by the outer perimeter of the weed infestation. The gross area may contain areas of land that are not currently occupied by weeds.

the Forests and Grassland are slender false brome (*Brachypodium sylvaticum*) and orange hawkweed (*Hiereacium aurantiacum*).

Table 20. Range of Invasive Plant Site Sizes.

Size of Infestation	# of Invasive Plant Sites	% of Known Sites
< 1 acre	1,440	76
1 to < 5 acres	215	11
5 to < 10 acres	57	3
= or > 10 acres	180	10
Total	1,892	100%

Table 21. Number of invasive plant sites currently mapped and proposed for treatment within PAUs on the Deschutes and Ochoco National Forests and Crooked River National Grassland.

Forest/Grassland	District	# Sites
Deschutes National Forest		
	Bend/Fort Rock	350
	Crescent	49
	Sisters	272
	Forest Total	***671***
Ochoco National Forest		
	Lookout Mountain	713
	Paulina	355
	Forest Total	***1,068***
Crooked River National Grassland		***153***
	TOTAL FOR PROJECT AREA	***1,892***

Mechanisms of Invasion and Spread

Invasive plant populations increase in acreage at an estimated rate of 8 to 12 percent per year on National Forest System lands in the United States (USFS 1999a, Asher and Dewey 2005). Existing populations of invasive plants could continue to spread at this rate on National Forest System lands as well as on adjacent land under other ownership and management. On National Forest System lands, the LRMP prevention standards and prevention guidelines will reduce this rate (USFS 2005b, Appendix 2-1). Invasive plant infestations tend to occur in disturbed areas. Although the presence of invasive plants is not a new phenomenon, the geographic scope, frequency, and the number of species involved have grown enormously as a direct consequence of expanding transport and commerce, especially in the past 100 years. Invasion occurs when invasive plant species are transported to new, often distant places where they proliferate, spread, and persist. The rapid rate of human expansion accounts for a majority of the long-distance dispersal of newly invading species (USFS 2005a).

Invasive plants have been introduced purposefully and accidentally. Most invasive plants have been introduced for horticultural uses by nurseries, botanical gardens, and individuals (Reichard and White 2001). Introductions through contaminated livestock feed, ornamental landscaping, road stabilization, and erosion control have occurred throughout National Forest System lands and adjacent lands in Oregon and Washington. Commercial landscape nurseries in Oregon and

Washington sell, or once sold, exotic species for domestic landscaping that later were found to be invasive (such as English ivy and purple loosestrife). For instance, we believe that ribbongrass was introduced in the 1930s or 40s by a homeowner on the Metolius River for ornamental purposes. It is still sold today at nurseries and in garden centers of major home improvement stores. And for another example, on June 16, 2005, ODA confiscated 157 one-gallon containers of orange hawkweed being sold at a nursery in Deschutes County, Oregon. This species is quarantined in the State of Oregon and across the United States because it grows very aggressively. It is likely that plants were sold before the confiscation and have been planted in the area. Invasive plant species have been used in seed mixes on National Forest System lands for erosion control, bank stabilization, and burned area rehabilitation (USFS 2005a).

The mechanisms of spread for invasive plants include natural vectors such as birds, insects, or wildlife, and natural forces, such as water and wind. Wind and water in particular are major natural dispersal agents. Disturbance-based vectors are also mechanisms of spread for invasive plants. Invasion and dominance by invasive plants is highly correlated with soil disturbance, but are not limited to disturbed areas (Cox 1999). Invasive plants can readily invade, occupy, and dominate conifer plantations, road prisms, trails and trailheads, mined sites, gravel pits, river corridors, wildlife wallows and bedding areas, and rangelands. Many invasive species could also establish in naturally-occurring small openings. Natural and human induced small-scale and large-scale disturbance creates “safe sites” for invasive plant establishment, and in areas where desirable species are not available to occupy these sites, invasive species could dominate (USFS 2005a). Section 3.1 of the R6 Invasive Plant FEIS describes the many vectors for invasive plant spread, including timber and other vegetation management activities, roads management, livestock grazing, fire and fuels management, recreation and recreation management, and minerals and mining.

Invasive plant inventories indicate most infestations on the Forests and Grassland begin on disturbed areas, such as road shoulders and log landings. The road system throughout the Forests are a primary means of spreading invasive plants, providing vectors for dispersal (e.g., seeds and vegetative reproductive parts of plants attached to vehicles) and disturbed ground for invasive plant colonization and establishment. Seventy-two percent of the PAUs are located along roads. Timber harvest, livestock grazing, road building, and other ground disturbing management activities all contribute to the establishment and spread of invasive plants.

Wildfires also contribute to introduction and spread of invasive plants. [12] Fires often create disturbances that are conducive to invasive plant spread, particularly where competing vegetation is destroyed and soil is exposed. Large fires in Central Oregon involve firefighting resources from across Oregon and other states. Many of the vehicles involved have invasive plant seeds attached to undercarriages and wheels that spread plants along travel routes, in staging areas, within burns, and at incident command posts. Prevention practices now in place are helping to reduce the incidence of fire suppression vehicles spreading weeds (for example, a weed wash station was implemented at Cache Mountain Fire, USFS 2004d).

Often, Burned Area Emergency Response (BAER) teams are used to minimize threats to public safety, property, soil productivity, and water quality caused by large wildland fires. Invasive plants are an environmental threat that BAER teams must address. Monitoring of past fire events indicate that one to two years after fire events, noxious weeds spread about 60 percent in areas where they had already been established (USFS 2003a).

[12] From 1995 to 2004 the Ochoco NF saw 45,342 acres and the Deschutes NF saw 151,342 acres burned in wildfires.

Priority Species

Table 22 lists the highest priority species for treatment on each District and the Grassland. Some species are a priority because they are established on the District and rapidly expanding and invading into native plant and wildlife habitats, while other species are a priority because they are new invaders and need to be controlled before they become established and control becomes more difficult, expensive, and time consuming. Though the species listed in Table 22 are currently the highest priority for treatment, this list can change any time that a new invasive plant species is discovered.

Table 22. Top 5 priority Invasive plant species for each district of the Deschutes and Ochoco National Forests and on the Crooked River National Grassland.

Forest/Grassland	District	1st	2nd	3rd	4th	5th
Deschutes NF	Bend/Ft. Rock	Spotted knapweed	Dalmatian toadflax	Canada thistle	St. Johnswort	Reed canarygrass
	Crescent	Spotted knapweed	Leafy spurge	Dalmatian toadflax	Canada thistle	Reed canarygrass
	Sisters	Diffuse knapweed	Spotted knapweed	St. Johnswort	Scotch broom	Canada thistle
Ochoco NF	Lookout Mt.	Medusahead	Yellow star-thistle	Houndstongue	Scotch thistle	Spotted knapweed
	Paulina	Medusahead	Houndstongue	Spotted knapweed	Scotch thistle	Whitetop
Crooked River National Grassland		Medusahead	Russian knapweed	Dalmatian toadflax	Scotch thistle	Spotted knapweed

Effects of Climate Change on Invasive Species

Global climate change is predicted to alter precipitation and seasonal temperature patterns, as a result of increased levels of atmospheric carbon dioxide (CO_2) and other factors (Mote 2004). Most recent studies on the interaction between climate change and invasive plants conclude that climate change is likely to favor invasive plant species to the detriment of native plant species for individual ecosystems (Chornesky et al. 2005, Climate Change Science Program 2008, Dukes and Mooney 1999, Hellmann et al. 2008, Pyke et al. 2008). In some studies, invasive plant species have demonstrated increased growth rates, size, seed production, and carbon content in the presence of elevated CO_2 levels (Rogers et al. 2008, Rogers et al. 2005, Smith et al. 2000, Ziska 2003). Warming climates may remove elevational barriers to invasive plant distribution that currently exist. For instance, cheatgrass is becoming established in dry forests in the Intermountain West, particularly after wildfires and fuels reduction projects. Native perennial grasses are lost, leaving potential cheatgrass habitat, which can increase fire frequency (Tausch 2008).

Many invasive plants are species that can thrive in the presence of disturbance and other environmental stressors, have broad climatic tolerances, large geographic ranges, and possess other characteristics that facilitate rapid range shifts. Modeling by Kremer shows that lower biomass cheatgrass communities are able to reach equilibrium between productivity and soil water availability under a range of climates without substantial impacts on the hydrologic balance, compared to native plant communities (Kremer et al 1994). The predicted changes in climate are thought to contribute additional stressors on ecosystems, including those on National Forests, making them more susceptible to invasion and establishment of invasive plant species (Joyce et al. 2008).

Likely future conditions may also make management of invasive species more difficult. Some current treatments used on invasive plants may be less effective under various climate change scenarios and/or elevated CO_2 (Hellmann et al. 2008, Pike et al. 2008, Ziska, Faulkner, and Lydon 2004).

Predicting how climate change will affect invasive plants, and invasive plant management, at the local or even regional scale is more difficult to deduce than are these general indications. Anticipated changes in the climate for the Pacific Northwest (e.g. more rain, less snow, warmer temperatures (Mote 2004, Mote et al. 1999, National Assessment Synthesis Team 2000) or elevated C02 may not be realized at a local area, particularly within the time frame of this analysis. Growth of invasive plants under elevated CO2 conditions will also be influenced by environmental conditions such as soil moisture, nutrient availability, and the plant community in which the invasive species occurs (Cipollini, Drake and Whigham 1993; Curtis, Drake, and Whigham 1989; Dukes and Mooney 1999; Johnson et al. 1993; Taylor and Potvin 1997). The complex interaction of multiple and uncertain variables make site-specific predictions speculative.

Relevance for the Proposed Action

Current science is insufficient to precisely determine a cause and effect relationship between climate change and the Proposed Action for the project area. A general conclusion, based on the preponderance of current literature, suggests that "most of the important elements of global change are likely to increase the prevalence of biological invaders" (Dukes and Mooney 1999). The Forest and Grassland landscapes will become more vulnerable to the establishment of invasive plants infestations, actual acreage affected by invasive plants could increase, and control strategies may become more difficult. Recommended management responses to these predictions are early detection (resulting from regularly scheduled monitoring) followed by a rapid response to eradicate initial infestations (Hellmann et al. 2008, Joyce et al. 2008, Tausch 2008).

Given that all alternatives include control of invasive plants with an early detection/rapid response component, and the large uncertainties regarding effects of climate change at any specific location over the time frame of this project, there is insufficient information to discern any meaningful differences between alternatives. All actions are consistent with recommendations for management response in the face of potential influences of climate change on invasive plants.

Background Information

Deschutes National Forest

In 1994, the Deschutes National Forest conducted public scoping and prepared a Categorical Exclusion environmental document to allow manual and biological control of 44 noxious weed sites[13] (the total number of known sites on the Forest at that time) on 1,657 acres (USFS 1994a).

The effectiveness of hand-pulling noxious weed sites varied, depending on the population size, and the ability to consistently and repeatedly treat sites (which depended on access, funding, and available labor). Though manual treatments were effective at some sites, District Weed Coordinators, who manage noxious weed sites on their districts, were unable to keep up with the overall rapid increase and spread of noxious weeds. By 1998, the Deschutes National Forest had 235 known noxious weed sites. In 1998, the Deschutes National Forest analyzed treatments on

[13] The term "noxious weeds" was used by the Forest Service in the past. We now use the term "invasive plant" to refer to all of the species we control, whether they are designated noxious or not.

the highest priority sites and the Decision Notice/Environmental Assessment approved manual treatments on 98 sites covering 901 acres; biological control on 27 sites covering 149 acres, herbicide treatments on 40 sites covering 476 acres; and prescribed burning on one five acre site (USFS 1998a).

Ochoco National Forest/Crooked River National Grassland

In 1995, the Ochoco NF and Crooked River National Grassland completed an Integrated Weed Management Environmental Assessment which approved treatments on 34 treatment areas, mostly along roads (USFS 1995f). Each Treatment Area contained several individual sites and species, for a total of about 304 individual sites on 285 acres. The Forest and Grassland saw a 90% reduction in the number of invasive plants on sites where herbicides were used; however, invasive plants continued to spread into new areas that were not approved for treatments.

Therefore, in 1998, the Ochoco NF and Grassland completed an Environmental Assessment (EA) that approved treatments on 72 sites covering 673 acres (USFS 1998b). Most of these sites occurred along roads, within managed right-of-ways, including road shoulders, pullouts, cut and fill areas, ditch lines, and associated maintenance areas such as gravel dump sites and rock pits. Herbicides were approved for use on sites that had 11+ individual plants. Sites that contain less than 10 weed plants are hand-pulled.

3.3.2 Environmental Consequences, Treatment Effectiveness

Direct and indirect effects are based on the proposed actions within Invasive Plant Project Area Units. Cumulative effects are based on the actions occurring within and adjacent to Project Area Units that, if combined with the proposed action, could have a cumulative effect.

This section focuses on the relative likelihood that the treatment methods approved in each alternative would be effective in reducing invasive plant populations and, therefore, reducing threats to non-target vegetation from invasive plants. Treatment effectiveness increases with the number of treatment options available and the percentage of infested lands that may be treated. Rapid response to newly discovered infestations also increases treatment effectiveness.

General discussion

The effectiveness of an alternative to treat the diverse group of invasive plants depends on the variety of tools available (R6 2005 FEIS, 4-15). Thus, alternatives that limit the variety of tools also limit the effectiveness of treatments. In many cases, treatment methods are most effective when used in combination with one another, as well as in combination with prevention activities in accordance with Integrated Weed Management principles. A study by Brown et al. (2001) showed that a combination of manual or mechanical and herbicide treatments was more effective than herbicides alone when dealing with a persistent species such as spotted knapweed.

Small infestations of some invasive plants could be treated effectively by manual or mechanical methods (Mazzu 2005). The key to effective hand pulling is to remove as much of the root as possible while minimizing soil disturbance (Tu et al. 2001). Generally, species that are annuals or biennials can be effectively treated manually if the populations are small and/or if there are not too many sites. Moderate to large infestations of annual and biennial invasive plant species may be difficult to treat manually, however, because treatments need to be repeated over many years due to dormant seeds that remain viable in the soil for many years. Rhizomatous perennial invasive plant species are also very difficult to treat manually because there is a high likelihood of plants reproducing from vegetative parts (i.e., root or stolon fragments that break off and remain in the soil can revegetate, creating new plants). Brown et al. (2001) found that hand pulling spotted knapweed for two consecutive years was the most expensive treatment and provided less than 60% control of spotted knapweed after two seasons of pulling. They concluded that hand pulling is not an economically viable option on dense and/or large knapweed infestations. Treating moderate to large infestations requires labor-intensive efforts of large workforces. On the Bend/Ft. Rock District, a large infestation of spotted knapweed near the Besson Day Use Area has been hand-pulled for five years, yet the population has not been reduced (Powers 2006, *personal communication*).

The biology of the target invasive plant species must also be considered. Rhizomatous plant species, such as reed canarygrass and ribbongrass, can be especially problematic. Reed canarygrass is difficult to control due to its persistent rhizome system and its ability to reproduce vegetatively (Tu 2004). Herbicide treatment is often recommended for perennial species with rhizomes and/or creeping root systems, such as Canada thistle, leafy spurge, and reed canarygrass. Appendix A of the Botany Report summarizes life cycle, habitat, and mode of reproduction for invasive plant species documented on the Forests and Grassland.

The location and size of the infestation, species biology, environmental factors, management objectives, and treatment costs all factor into the choice treatment method(s) (R6 2005 FEIS). Mazzu (2005) compiled information about treatment options for invasive plant species in the Forest Service's Pacific Northwest Region (Region 6). Mazzu's information was incorporated into Appendix B, which summarizes and discusses treatment options for those invasive species currently documented on the Forests and Grassland. Additional information about effectiveness of various treatment methods can be found in the Regional Invasive Plant FEIS (R6 2005 FEIS, pp. 3-80 to 3-92).

Objectives of Treatment Methods Proposed in EIS

Biological Control **--** Within the analysis area, biological control is proposed where sites are either too large to be sprayed with herbicides, the invasive plant species is so abundant that other methods would not be practical, or the biological control agent is effective on the target plant species and we can reduce or eliminate the need to use herbicides. Biological controls are useful when the control objective is containment (as opposed to eradication). For example, Canada thistle is so abundant on Lookout Mt. District on the Ochoco National Forest that the most efficient treatment method at this time would be biological control. The toadflax stem weevil, *Mecinus janthinus*, is working very well on reducing Dalmatian toadflax infestations; therefore, biological control will be considered for use on Dalmatian toadflax populations throughout this analysis area. Biological control will comply with Regional Standard 14 (R6 2005 ROD).

Cultural Treatments **--** Cultural treatments proposed in this EIS mainly focus on solarization techniques, such as using plastic to cover reed canarygrass and ribbongrass in order to shade out and kill pieces of roots or rhizomes (underground stems that are able to sprout). Solarization coverings may have negative effects on soil microorganisms and do not selectively allow other plants to grow as would a selective hand application of an herbicide. However, in areas such as Big Marsh, solarization of small reed canarygrass sites is proposed only on ditches filled in with material from dikes constructed when ditches were dug in 1940s. Reed canarygrass is well-established and occurs throughout the marsh.

Manual Treatments – Manual treatments proposed in this EIS are mostly on small, easily accessible populations of annual (e.g., yellow starthistle) and perennial tap-rooted (e.g., spotted and diffuse knapweeds) species. The objective of manual treatments is to prevent seed production of invasive plants, which means that each population must be visited several times during the growing season to catch late-germinating plants, and these sites must be treated for many years (depending on the species) to prevent new plants from getting established from the soil seedbank. Houndstongue plants growing within 50 feet of the sensitive Peck's mariposa lily would be hand-pulled. Digging isolated plants or small patches of rhizomatous species can be effective if either all rhizomes are removed or resprouts are consistently and continually removed during the growing season. An example where this might be used would be patches of ribbongrass along edges of the Metolius River (in the water) where the roots are growing on top of cobbles.

Mechanical Treatments -- Mechanical treatments proposed in this EIS are in combination with other treatment methods to increase overall treatment effectiveness. Objectives are to reduce biomass so that less herbicide is used, and/or to stimulate new growth to make herbicides more effective, or to prepare a site for revegetation. For example, successful treatment of reed canarygrass has been to weed-whack plants down to about 4" tall, let the stems grow back for 1-2 months to about 10-12" tall, then do a fall application of aquatic labeled glyphosate (Tu 2005, *personal communication*). This treatment should be repeated the next year and then follow-up planting of intermittent plugs of desirable species. The majority of proposed mechanical treatments involve using a weed-whacker, yet harrowing is proposed at two dense houndstongue sites that would first be burned and treated with herbicide, then harrowed to prepare the sites for revegetation.

Prescribed Fire – In this EIS, prescribed fire is one of several integrated treatments proposed for two highly-disturbed PAUs on Paulina District. The treatment objectives are to prescribe burn houndstongue, which will reduce vegetative cover and stimulate houndstongue germination, then treat with herbicide, then disk the site to prepare for revegetation.

Herbicide Treatments -- The objectives of herbicide treatments are to more efficiently reduce the size of moderate to large infestations of invasive plants to a point at which they can be hand-pulled, to more efficiently treat large expansive areas where invasive plants are continually showing up due to the nature of the site or because manual treatments pose a safety issue, such as along major highways (e.g. Highways 97 and 26); and to effectively control invasive plant species that do not respond to non-herbicide methods. Different herbicides vary in effectiveness and length of control on different invasive plants, and herbicide techniques can vary in effectiveness, environmental effects, and costs. Oregon Department of Agriculture and Crook County weed control specialists provided a list of the preferred herbicides for each of the invasive plant species that currently exist within Invasive Plant PAUs and ranked these according to effectiveness (EIS, Appendix B). For example, clopyralid (the Transline formulation) would be the 1st choice herbicide for spotted and diffuse knapweeds, with picloram, glyphosate, and imazapyr 2nd, 3rd, and 4th choices. Their ratings also considered non-target vegetation effects. Glyphosate was ranked as 3rd or 4th choice for most herbicides (i.e., not the preferred option) because it is non-selective and will kill any plant that comes into contact with the herbicide, and has the potential to leave bare ground. Selective herbicides are more desirable for maintaining as much native vegetation on site as possible.

Combination Treatments – The majority of time a combination of treatment methods is used to treat invasive plant sites. For example, as large invasive plant infestations are reduced in size, the preferred treatment would change from herbicide to manual. In large infestations, such as the Fly Creek area on Sisters, the center of the knapweed population would be treated biologically with insects and a combination of herbicides and manual treatments would be used along the periphery of the population to keep it from spreading further.

The proportion of infested acres that would be treated using herbicides varies between alternatives. Alternatives 2 and 3 differ in herbicide methods that can be used within aquatic buffer zones.

Analysis Methodology for Treatment Effectiveness

Each alternative has been assigned an effectiveness ranking to model the cost of treatment and predicted results over time. The effectiveness ranking is based on the portion of a given invasive plant population that would be killed each year of treatment under the most successful treatment scenario conceivable based on the design of each alternative. See assumptions, below, for more information about effectiveness ranking.

Assumptions for Treatment Effectiveness Analysis

The following assumptions were made about treatment scenarios and used in this analysis:

- Quantifying treatment effectiveness provides a way to compare the alternatives. For comparative purposes, we have to assume a certain amount of effectiveness in a given year. However, – in reality – many variables can affect the outcome of annual treatments. For example, viable seeds may persist for years; we do not know the amount of seed in the seedbank nor how many years it will take to exhaust those seeds.
- The invasive plant program budget remains consistent with the three-year average.
- Treatment scenarios are based on the current three-year average (2,915 acres), which is approximately 20% of the inventoried sites.
- None of the treatments would be 100 percent effective immediately after the initial entry. Maintenance entries would be required in either year one or in subsequent years to deplete the seed bank.
- Under Alternative 1, treatments are assumed to reduce infestation size by 50 percent, reflecting the concepts that some infestations cannot be effectively treated without herbicides, and the need for re-treatment is likely to be greater when herbicides are not available as part of the integrated prescription. Fifty percent is used as an average for both upland and riparian infestations, which reflects the predominant use of manual methods and the fact that some species (e.g. reed canarygrass) are difficult to control with manual methods. Hand pulling is generally not effective on deep-rooted and rhizomatous perennials, and creates disturbance, increasing the susceptibility of re-invasion (USFS 2005a). It also reflects the limitations on the range of herbicide options available under this alternative. Untreated areas would continue to spread unabated.
- The Proposed Action (Alternative 2) was assigned an effectiveness ranking of 80 percent to reflect the wider range of herbicides that would be available, and more sites to use herbicides in combination with non-herbicide methods. The implementation planning process would improve the effectiveness of treatment compared to Alternative 1 by utilizing a greater variety of treatment options. At nine sites, treatments would be accompanied by active restoration. In addition, currently undetected infestations could be treated when small due to the ability to use an Early Detection/Rapid Response strategy, which would improve the effectiveness of a given year's treatment.
- Alternative 3 was assigned effectiveness ranking depending on whether the site is upland or riparian. Upland acres assumes an 80 percent effectiveness ranking on 12,531 acres on which all options are available, and varying effectiveness ranking on 2,016 acres within riparian reserve buffers. Treatment options vary depending on location within the riparian area, application technique, and herbicide available for use. Broadcast spraying within riparian areas would not be allowed, resulting in 70% effectiveness. This is due to less consistent coverage of large infestations. No herbicide control would be allowed on 260 acres of infestation that fall within 10 feet of the stream. This would result in a reduction to 40% effectiveness from manual and cultural control of difficult species such as reed

canarygrass. A further loss of effectiveness would occur on 105 acres of sites where triclopyr, picloram and sethoxydim would not be used, resulting in an average 40% reduction in effectiveness by using less effective herbicides (Alexanian, personal communication).

- An effectiveness ranking of 80% means that it is assumed to be 80% effective at each treatment area after each year. For example, if 1,000 acres are treated in year 1 and the treatment is 80% effective, 200 acres would need to be treated in year 2. If 200 acres are treated in year 2 and the treatment is 80% effective, 40 acres would need to be treated in year 3. The industry standard for herbicide effectiveness in an agricultural setting is 90-95%. Using 80% effectiveness for analysis accounts for the many variables that affect effectiveness, including species, length of time the infestation has been established, and local conditions (e.g. topography, weather, soils). The 80% estimate is based on professional judgment of the County Weed Agents, and the USFS Weed Coordinators, and are a reasonable representation of the treatment effectiveness concepts discussed in the R6 2005 FEIS.
- For Alternatives 2 and 3, herbicide methods would precede non-herbicide methods in most cases, because non-herbicide methods will be most effective when populations have been substantially reduced through herbicide treatment. However in some cases, manual, mechanical, and prescribed fire methods precede herbicide treatment.
- The treatments are required to recur for at least five years. Even though a site may be cleared of invasive plants before five years, the scenario used for analysis assumes a worst case. Therefore, years 2010 through 2014 were used to analyze treatment effectiveness.
- Invasive plant populations will spread at a rate of 10% per year (USFS 2005a).
- Treatment effectiveness increases with the number of treatment options (USFS 2005a).
- Options which have the widest variety of herbicides and herbicide families available for use have the greatest potential to result in effective treatments (R6 FEIS, page 4-20).

Comparison Measures to evaluate Treatment Effectiveness

The indicators used to measure this issue will be:

- Acres of invasive plants remaining in Year 2014
- The number of herbicide formulations available for use
- Allows herbicides to be used within 10 ft. of perennial water bodies
- The ability to respond quickly to new invasive plant populations under each alternative (Early Detection/Rapid Response Strategy)

Treatment Effectiveness Common to All Alternatives

All alternatives strive towards integrated treatments, such as using manual treatment as a follow-up to get plants missed by herbicide spraying, or using a mechanical method, such as weed whacking, on tall stems to reduce biomass and reduce the amount of herbicide used. Herbicide treatment is often followed up by manual or herbicide treatment later in the season to get plants that were missed by the initial herbicide application for several years after invasive plant populations are reduced to the point at which they can be hand-pulled.

The R6 2005 ROD amended all Pacific Northwest Region (Region 6) National Forests Land Management Plans to require they comply with a suite of invasive plant prevention, treatment and restoration standards (R6 2005 ROD, USFS 2005b). In addition to these required standards, the Deschutes and Ochoco National Forests and Crooked River National Grassland have developed Prevention Guidelines to be considered in planning and implementing projects. All three alternatives in this EIS will comply with the LRMP Standards and utilize the Forests and Grassland Prevention Guidelines. If appropriate prevention, and treatment and restoration standards are implemented, it is reasonable to assume that the combined action of these measures will eventually reduce the overall size of invasive plant infestations in Region Six (USFS 2005a, 4-26). This would be the same locally for alternatives 2 and 3.

ALTERNATIVE 1 – NO ACTION

Direct and Indirect Effects for Treatment Effectiveness

Under the No Action Alternative, invasive plant treatments would be limited to areas authorized under existing NEPA documents that were completed in 1998. Since 1998, many additional invasive plant sites have been mapped and, if left untreated, will continue to expand. Under Alternative 1, only 2,204 acres of the 14,547 acres could be treated with herbicide. New areas of invasive plants continue to be introduced every year, as is evident from these figures. Mechanisms of spread are numerous; increasing recreation pressure, especially off-highway vehicle use, animals, roads, and wildfires are some of the major factors in invasive plant introduction and spread (USFS 2005a). Manual and cultural methods of control are not keeping pace with new infestations. The majority of invasive plant sites would not be treated effectively under this alternative.

Herbicide treatments approved in 1998 have been effective in reducing the size of invasive plant populations. Effectiveness has depended on treatment type, population size, site conditions (e.g. compacted soil can reduce the effectiveness of manual treatments), funding and availability of labor. Monitoring has shown that herbicides have been effective at reducing invasive plant populations to a point at which they can be hand pulled. For example, a 5+ acre patch of yellow starthistle was reduced to 1/10th of an acre in four years (1999-2002) of spraying the site with picloram (Lesko 2006). This small site is now annually monitored and individual plants are hand-pulled. Herbicide treatments along Highway 97, a major thoroughfare and vector for spread of invasive plants, have resulted in a reduction of spotted knapweed; 77.7 acres were treated in year 2000; in 2005, only 7.6 acres needed treatment (Langland 2005a). Monitoring has shown a decrease in the number of knapweed plants on the Deschutes National Forest following a combination of herbicide and manual treatments (Table 23) (Grenier 2002).

Table 23. Number of knapweed plants at four plots following a combination of herbicide and manual treatments, Deschutes National Forest.

Year	Hwy 97	Lava Butte	Skyliner Road	Bend Pine Nursery
1999 (data collected prior to herbicide treatment)	3000+	Not treated; plants not counted	Not treated; plants not counted	Not treated; plants not counted
2000 (data at 3 plots collected prior to herbicide treatment)	Data not collected	3,447	1,195	2,651
2001	< 200	20	215	63

Manual treatment has been effective at some invasive plant sites and will continue to be the preferred treatment (e.g., tansy ragwort sites on Crescent District in the Moore Creek timber sale units, PAU 12-01). However, manual treatments have not been effective at other sites, such as Besson Day Use Area on Bend/Ft. Rock District. This area has been pulled for five years and has not reduced the spotted knapweed population, largely due to the population size and compacted soil (Powers 2006, *personal communication*). On Paulina District (Ochoco National Forest), houndstongue is aggressively spreading despite manually treating it since 2000. The combination of expense and length of time for manual treatments results in fewer acres being treated than could be done with herbicides (Mafera 2006, *personal communication*). In smaller populations, manual treatment of houndstongue can be very effective, but there are large sites that are too dense to be practical for manual treatments. Untreated houndstongue sites continue to produce seeds and spread up and down drainages as seeds are transported into new areas by animals and/or winter/spring stream flows.

Alternative 1 (No Action Alternative) would have a heavy reliance on manual treatment because only 113 sites are approved for herbicide use (6% of the total number of currently mapped 1,892 sites). Alternative 1 is limited in scope, with fewer sites treated and fewer herbicide tools available. NEPA decisions have approved use of herbicides on 40 sites on the Deschutes National Forest (USFS 1998a), 72 sites on the Ochoco National Forest and Crooked River National Grassland (USFS 1998b), and one medusahead site on Paulina District, Ochoco National Forest (USFS 2005c). The sites controlled with herbicide are now primarily in a maintenance regime, however many of the sites are continually being re-infested with new plants, especially travel corridors. New infestations of invasive plants are constantly being introduced. For example, along Highway 20 on Sisters District of the Deschutes National Forest, spotted knapweed has been introduced outside the area approved for treatment in the 1998 Environmental Assessment and these infestations would not be treated under the No Action alternative. Recent large wildfires on Sisters District have also resulted in the rapid expansion of spotted knapweed and St. Johnswort. Left unchecked, invasive plant species will continue to expand and infest new areas, reducing the diversity and health of native plant communities.

A limited number of herbicides are available under the No Action Alternative. Only three herbicides are available for use on the Ochoco National Forest and Crooked River National Grassland (dicamba, glyphosate, and picloram). These three herbicides plus triclopyr are available for use on the Deschutes National Forest. The herbicides available under the No Action Alternative do not always provide the best options for the variety of invasive plant species and situations that are present within the Forests and Grassland because they are not as selective or effective on some species as the suite of herbicides proposed for use in Alternatives 2 and 3.

Invasive plant prevention, treatment and restoration standards adopted under the Regional Invasive Plant FEIS (R6 2005 ROD) are expected to reduce the rate of spread of invasive plants across the Pacific Northwest Region. Though the rate of spread may be slowed by incorporating these prevention measures, existing untreated infestations will continue to impact native plants and plant communities. New invasive plant sites mapped since 1998 would not be treated under the No Action Alternative.

Alternative 1 does not incorporate an Early Detection/Rapid Response strategy to treat un-inventoried infestations of invasive plants that were not identified or specified in existing NEPA documents. The absence of this type of strategy would greatly increase the potential for new invasive plant infestations to establish and spread, further impacting native plant communities, altering ecosystem structure and functions (e.g., plant-pollinator relationships, mycorrhizal associations, species diversity and richness, etc.).

Due to the limited ability to treat infestations that have been mapped since 1998, there would be no treatment of invasive species that have recently been identified as problematic. Ribbongrass, a variety of reed canarygrass (*Phalaris arundinacea var. picta*) has become a growing concern as recent surveys indicate this species has spread along the Metolius River. Alternative 1 would not allow treatment of the ribbongrass.

Invasive plants become established despite land ownership. Invasive plants move between land ownerships and administrative units, and treatment effectiveness would be optimized if all owners controlled infestations collaboratively. However, as invasive plants continue to spread and the ability to treat them using herbicide is limited with the No Action Alternative; overall treatment effectiveness with neighboring lands would be reduced.

Using the assumptions discussed above, invasive plant infestations would continue to expand under Alternative 1 (Table 24). In year 2014, we estimate that the currently mapped 14,547 acres would be reduced to 13,640 acres, after five years of control efforts of approximately 2,915 acres per year (12,274 acres in the uplands, and 1,366 acres in riparian areas). This estimate does not account for new infestations that will be introduced over the next five years, just the spread of existing invasive plant sites. It is logical to conclude that spread of existing sites plus new introductions would not result in a reduction of invasive plant populations.

Summary of Treatment Effectiveness for Alternative 1

Alternative 1 is the least effective in controlling invasive plants:

- ***Invasive plants continue to expand.*** By year 2014, the currently mapped 14,547 acres of invasive plants would occupy 13,640 acres after five years of control efforts (Tables 24 and 25).
- ***Herbicide use would be limited -- fewer acres could be treated with herbicides and the number of available herbicides is limited.*** Herbicides are an effective tool for treating some invasive plant species in certain situations. Limited use of herbicides would result in limited treatment effectiveness, resulting in further loss of native plants and habitats. Under Alternative 1, only three herbicides are available for use on the Ochoco National Forest and Crooked River National Grassland (dicamba, glyphosate, and picloram). These three herbicides plus triclopyr are available for use on the Deschutes National Forest.
- ***Limited treatment options for riparian rhizomatous plants***. On the Deschutes National Forest, no herbicides can be used within 10 feet of perennial water bodies under the 1998 EA. Therefore, rhizomatous riparian plant species such as reed canarygrass and ribbongrass will continue to spread because manual treatments are less effective in controlling these species.
- ***No Early Detection/Rapid Response Strategy***. Alternative 1 does not provide a mechanism for quick response to newly discovered invasive plant populations before they become established. Once established, they are more difficult to control and fewer methods are effective.

ALTERNATIVE 2 – PROPOSED ACTION

Alternative 2 proposes to treat inventoried invasive plant populations within 289 Project Area Units. Treatment prescriptions and long-term site objectives have been developed to apply integrated pest management methods, such as combining manual and mechanical methods with the use of herbicides for more effective treatment. Ten herbicides analyzed in the Region 6 Invasive Plant EIS (USFS 2005a) would be available to more effectively control invasive plant infestations. The Proposed Action includes an Early Detection/Rapid Response strategy to treat new or expanding invasive plant infestations where the site conditions and preferred treatment fall within the scope of the proposed action.

Alternative 2 is not as restrictive as Alternative 1 in the use of herbicides, allowing the following in accordance with herbicide label restrictions:

- Herbicide use within 10 feet of perennial streams, lakes/wetlands, and seasonal intermittent streams (limited to application methods as shown in Table 16);
- The use of triclopyr, sethoxydim, and picloram within 300 feet of perennial streams, lakes/wetlands, and seasonal intermittent streams;
- Herbicide use in intermittent channels when they are dry;
- Broadcast spraying of some herbicides closer to perennial streams, lakes/wetlands, and seasonal intermittent streams than allowed under Alternative 3. For example, under Alternative 2, clopyralid could be broadcast sprayed up to 100 feet from perennial streams and lakes/wetlands and up to 50 feet of seasonal intermittent streams.

Direct and Indirect Effects

Of the 3 alternatives, Alternative 2 provides the most options for what, how and where herbicides can be used. This would increase treatment effectiveness by providing more options to gain control over current infestations, therefore reducing further spread. The effectiveness of the method makes a difference in reducing weed spread; it is estimated that herbicides provide an additional 30% plant elimination rate compared to manual methods, which would result in a reduction to 7,767 acres of invasive weeds in the year 2014, as shown in Tables 24 and 25. Our current situation of largely relying on manual treatment has resulted in an increase in invasive plants at sites where manual treatments have not been effective. Invasive plant sites that are not eradicated continue to produce and disseminate seeds.

Treatment effectiveness is also increased when the most successful treatment method can be used in the most efficient way. Some of the most abundant invasive plant species on the Forests and Grassland are spotted and diffuse knapweeds, with hundreds of sites (700+) spread across 1,000s of acres. Of the ten herbicides approved in the R6 2005 FEIS, clopyralid would be the most effective herbicide for spraying knapweeds with the fewest non-target vegetation effects. The selectivity of clopyralid is what reduces the potential effects to non-target vegetation. Clopyralid targets plant species in four plant families: sunflower, pea, nightshade, and buckwheat families. Spotted and diffuse knapweeds occur along roads and in adjacent forest lands, often occurring within 300 feet of perennial streams, lakes/wetlands, and seasonal intermittent channels. Because clopyralid is selective, it can be broadcast sprayed over many common shrubs and plants that would be unaffected by the herbicide, allowing more efficient and effective treatment. Under Alternative 2, clopyralid could be broadcast sprayed up to 100 feet from perennial streams and lakes/wetlands and up to 50 feet of seasonal intermittent streams. Broadcast spraying is actually done in a very selective manner, switching easily and quickly between using a hand application technique to a "selective patch broadcast" method (Langland 2005b, per. comm.; Alexanian 2006, pers. comm.), so that patches of vegetation are only treated if they are occupied almost entirely by invasive plants. This method allows for selective broadcast spraying only where needed, minimizing herbicide use and non-target plant damage, yet increasing treatment efficiency. Increased efficiency will increase treatment effectiveness in the long run. Under Alternative 3, clopyralid could not be broadcast sprayed within 300 feet of these water bodies. Clopyralid could not be used at all under Alternative 1.

Similarly, houndstongue has become a serious problem on the Ochoco National Forest, particularly on Paulina District, where it inhabits both upland and riparian areas, as well as the transition zones in between. Numerous streams and intermittent channels dissect the Ochoco National Forest. Of the three alternatives, Alternative 2 provides increased ability to treat houndstongue because it would allow broadcast spray of metsulfuron methyl on houndstongue up to 100 ft. of perennial streams, lakes and wetlands, and up to 15 feet of seasonal intermittent streams, therefore allowing more efficient treatment of more acres than would be allowed under Alternative 3. Current information suggests that this herbicide would be the most effective option for treating houndstongue (Alexanian 2006, pers. comm.). Alternative 1 does not allow the use of metsulfuron methyl. Alternative 3 would not allow broadcast spray of houndstongue within 300 ft. of any water bodies, including seasonal intermittent streams, which would result in more acres of manual treatment for houndstongue control. Houndstongue can be effectively treated manually; however, as discussed under Alternative 1, the combination of expense and length of time for manual treatments of houndstongue results in fewer acres being treated and increased spread over time. Treatment of this species would be most effective under Alternative 2.

Increased treatment effectiveness would provide more long-term habitat protection to Sensitive plant species. Spotted knapweed grows intermingled with bitterbrush within Peck's penstemon populations. As with bitterbrush; clopyralid could be broadcast sprayed over Peck's penstemon without harming it. Peck's penstemon is in the figwort family which is not targeted by clopyralid. Clopyralid is considerably more selective than the herbicides allowed under the No Action Alternative and would afford more protection to native plant species, including rare plants, while increasing treatment effectiveness.

Under Alternative 2, there are no buffers required for spot or hand applications of the aquatic formulation of glyphosate. This would allow more effective treatment of riparian rhizomatous invasive plant species, such as ribbongrass, which grows along the edges of and on islands within the Metolius River, and reed canarygrass, which grows along the edges of lakes, rivers, streams, and in wetlands. Herbicides have proven to be effective on reed canarygrass (Tu 2005, pers. comm.). In 2008 a ribbongrass hand-pulling demonstration area was completed by the Sisters Ranger District on the Metolius River. Volunteers and Forest Service personnel removed ribbongrass from approximately one acre; the outcome included several findings. Ribbongrass can be removed by hand with time and effort. It takes approximately 5 person hours to remove 1 square foot of ribbongrass, due to the extensive root mass and tillering habit of the plant. In addition, there was a short-term release of sediment into the stream, and plant fragments floated away, providing the means for further infestations to start downstream (Pajutee 2008). Herbicides would curtail the spread of ribbongrass in a shorter time frame and more cost-effective manner.

Alternative 2 also allows treatment of invasive species that are below the high water mark as water levels drop seasonally. Table 26 provides a summary of treatment effectiveness of riparian invasive plant species, and demonstrates that fewer invasive plants would be present five years from now under Alternative 2 than under Alternatives 1 and 3.

In some cases, use of herbicides will be important in achieving successful revegetation of invasive plant sites. A study of Russian knapweed in riparian areas along the Missouri River in eastern Montana found that herbicides are a key component in achieving revegetation success (Henry 2004). Without herbicide treatments before seeding, the researchers had very poor native species establishment. Alternative 2 proposes several revegetation prescriptions (see Appendix A), such as revegetation of Rimrock Springs Dam in Project Area Unit 75-20 after herbicide treatment of Russian and spotted knapweeds and Canada thistle. Treatment and restoration of this very disturbed site would likely be most effective under Alternative 2 due to our ability to use herbicides prior to revegetating the site.

The adoption of an Early Detection/Rapid Response strategy would allow for quick treatment of newly found invasive plant populations, thereby preventing their spread, reducing ecosystem impacts, and greatly increase treatment effectiveness.

Under both Alternatives 2 and 3, the amount of herbicide used would decrease over time at specific sites as invasive plants are controlled. Monitoring has shown that many sites treated with herbicides and/or a combination of herbicides plus manual treatments have reduced invasive plant populations and, therefore, the use of less herbicide at specific sites due to treatment effectiveness (Table 23). Though invasive plant populations can fluctuate yearly and herbicide use can vary from year to year, overall, the amount of herbicide used has decreased over five years of treatment (see Table 34, p. 148).

Using the assumptions discussed above, Alternative 2 would control the most invasive plant infestations (Tables 24 and 25). Based on treating 2,915 acres (3-year average) each year, in year 2014, it is estimated that the currently mapped 14,547 acres would be reduced to 7,529 acres in the uplands and 238 acres in riparian areas, for a total of 7,767 acres.

Table 24. Comparison summary of estimated invasive plant spread for upland acres.

Alternative 1				Alternatives 2 and 3			
Year	Upland Acres Infested	Acres Treated at 50% Effectiveness	Acres Remaining with 10% Spread	Year	Upland Acres Infested	Acres Treated at 80% Effectiveness	Acres Remaining with 10% Spread
2010	12,531	1,178	12,489	2010	12,531	1,884	11,712
2011	12,489	1,178	12,442	2011	11,712	1,884	10,810
2012	12,442	1,178	12,391	2012	10,810	1,884	9,819
2013	12,391	1,178	12,335	2013	9,819	1,884	8,729
2014	12,355	1,178	**12,274**	2014	8,729	1,884	**7,529**

Summary of Treatment Effectiveness for Alternative 2

In summary, Alternative 2 is expected to be the most effective alternative for treating invasive plants, and would move toward the desired future condition at a faster rate and lower cost than the other alternatives:

- ***Effectively control invasive plants.*** Following the assumptions outlined on page 97, we calculate that by year 2014 the current inventory of 14,547 acres of invasive plants would be reduced to 7,529 acres in upland areas (Table 24), 238 acres in riparian areas (Table 25), for a total of 7,767 acres.
- ***All ten herbicides would be available for use.*** Treatment effectiveness would be increased with the ability to select the appropriate and preferred herbicide. On many sites, more selective herbicides will result in effective treatments with fewer effects to non-target plant species.
- ***Allows herbicide use within 10 ft. of perennial water bodies.*** Herbicides could be used to control rhizomatous perennial invasive plants, such as reed canarygrass and ribbongrass. This increases the effectiveness of treatment.
- ***Early Detection/Rapid Response Strategy.*** Treatment effectiveness would be increased through quick response to newly discovered invasive plant populations, controlling them before they spread even further.

ALTERNATIVE 3

Alternative 3 was developed to respond to issues surrounding the effects to aquatic organisms. The areas proposed for invasive plant treatments are the same as Alternative 2, but differ in the prescriptions. Under Alternative 3, a 300-foot buffer will apply to all perennial streams, all fish bearing streams and all perennial lakes, ponds, and reservoirs. Within the buffers, treatment methods are restricted as follows (see Chapter 2 section 2.3.3, Table 17, and PDFs 57-62):

- The following herbicides would not be allowed within 300 ft. of water: Triclopyr, Picloram, or Sethoxydim.
- Broadcast spraying would not be allowed within these buffers or along road segments that are within 300 feet of perennial streams or lakes.
- Machinery or equipment that could cause substantial sedimentation would not be allowed within the buffers or along roads where they are within 300 feet of a perennial stream or lake.
- In addition, there would be no herbicide application allowed within the definable channel of intermittent streams when they are dry or within 10 ft of perennial or fish bearing streams, rivers, lakes, ponds or reservoirs and intermittent streams when flowing. (Under Alternative 2, invasive species that are below the high water mark could be treated with herbicides as water levels drop seasonally). This impacts treatment on approximately 230 acres of perennial streams, springs, or lakes and approximately 30 acres on intermittent streams. Application method is also limited within buffers.

Direct and Indirect Effects

The primary differences between Alternatives 2 and 3 are the herbicide methods that can be applied within 300 ft. of water and the use of herbicides close to water (within 10 ft.).

Alternative 3 restricts broadcast spraying within 300 feet of water bodies because of concerns about potential delivery to streams from drift. Most herbicides can still be applied in Alternative 3, but must be spot sprayed or hand applied. These techniques would be effective in controlling target invasive plants, yet, at many sites, would not be as efficient as broadcast spraying, likely resulting in annual chemical treatment of fewer acres than Alternative 2. Switching to spot and wick application would result in a minimum of 10% reduction in effectiveness, thus 70% versus 80% for Alternative 2, displayed in Table 26. About 260 acres of mapped invasive plant sites could not be treated with herbicides at all because of riparian restrictions under Alternative 3. If fewer acres are treated efficiently and it takes longer to reach target goals of controlling invasive plant populations, then treatment effectiveness would be lessened and existing invasive plant populations left untreated would continue to expand. Based on monitoring results and experiences of the District Weed Coordinators, it is estimated that manual and cultural control of difficult species within the 10’ buffer (approximately 105 acres) would be reduced to 40% effectiveness. The predominant species within 10 feet of water are reed canarygrass, ribbongrass, and Canada thistle, rhizomatous plants with extensive root mass.

Spotted and diffuse knapweeds are some of the most prevalent invasive plant species in central Oregon, and both occur within 300 feet of perennial water bodies and intermittent stream channels. Under Alternative 3, knapweed populations within 300 feet of perennial water bodies could not be broadcast sprayed. Spot spraying of these populations would be an effective treatment, but efficiency would be reduced, requiring more labor-intensive treatments likely resulting in fewer sites treated.

In some situations, treatment effectiveness would be reduced under Alternative 3 because triclopyr, picloram and sethoxydim cannot be used within the 300 ft. buffer. There are species, including sulfur cinquefoil, dalmatian toadflax, and Himalayan blackberry that are most effectively controlled with the above three chemicals. The next choice of herbicide (see Appendix A) results in decreased effectiveness. The reduction in effectiveness is 40%, 30% and 30% respectively, with an overall weighted average of 40% (Alexanian 2009, pers. comm.). This reduction in effectiveness is displayed in Table 26.

The only mapped site of Himalayan blackberry occurs along Cottonwood Creek on Paulina District, growing approximately 50 feet or less from this perennial creek. This site is expanding and, if left unchecked, has the potential to become a very large infestation. Triclopyr is the preferred herbicide for treating Himalayan blackberry (Appendix B). Triclopyr is a selective systemic herbicide for woody and broadleaf species, especially root- or stem-sprouting species (Appendix D). Within the 300 ft. buffer, another herbicide option would be glyphosate, which is a broad spectrum, non-selective herbicide that can kill any plant it touches. Triclopyr would be the more selective option (applied using a cut stump method). The canes of Himalayan blackberry can grow up to lengths of 7 meters in a single season (Mazzu 2005). Once first year canes have arched over and hit ground, daughter plants can develop where cane apices have rooted. This aggressive species is a high priority for treatment with the objective of eradicating it before it spreads further.

Under Alternative 3 Himalayan blackberry would be controlled using aquatic glyphosate, the second choice herbicide. There would be an estimated 30% loss of control effectiveness with this herbicide compared to triclopyr (Alexanian 2009, pers. comm.), which results in more time and expense to treat the site.

Table 25. Comparison summary of estimated invasive plant spread for riparian acres.

Alternative 1			
Year	Riparian Acres Infested	Acres Treated at 50% Effective	Acres Remaining with 10% Spread
2010	2,016	280	1,910
2011	1,910	280	1,793
2012	1,793	280	1,664
2013	1,664	280	1,522
2014	1,522	280	**1,366**

Alternative 2				Alternative 3			
		Acres Treated at 80% Effective		Riparian Acres Infested	Acres Treated at 70% Effective	Acres Treated at 40% Effective	Acres Remaining with 10% Spread
2010	2,016	448	1,725	2,016	195	141	1,848
2011	1,725	448	1,404	1,848	195	141	1,663
2012	1,404	448	1,052	1,663	195	141	1,460
2013	1,052	448	665	1,460	195	141	1,236
2014	665	448	**238**	1,236	195	141	**990**

As describe under Alternative 2, the amount of herbicide used will decrease over time at specific sites as invasive plants are controlled. This would be the same for both Alternatives 2 and 3. Invasive plant populations fluctuate annually due to weather and other variables and more herbicide might be used in one year than in a previous year; however, monitoring has shown that in the long-term (4+ years), herbicide use at treated sites would decrease as invasive plants are controlled.

Using the assumptions discussed above, Alternative 3 would control many more acres of invasive plant infestations than Alternative 1, yet not as many as Alternative 2. In year 2014, it is estimated that the currently mapped 14,547 acres would be reduced to 8,519 acres, as shown by combining the upland and riparian acres in Tables 24 and 25.

Though treatment effectiveness analysis shows that Alternative 3 can be very effective at reducing the number of infested acres, the actual effects related those invasive species growing in the riparian zone (i.e., within the 10 foot no-herbicide buffer) are difficult to describe in acres. These species are difficult to control without herbicides and will continue to expand and impact native riparian habitats.

For example, Alternative 3 does not allow herbicides to be used within 10 feet of perennial or fish bearing streams, rivers, lakes, ponds or reservoirs; therefore, reducing our ability to effectively treat ribbongrass, a rhizomatous invasive plant species that occurs adjacent to the Metolius River. Manual treatment of ribbongrass would be difficult – about 250 clumps of ribbongrass are scattered along ten miles of the Metolius River and many sites are difficult to access, especially those clumps occurring on islands within the river. It would be difficult to consistently and repeatedly hand-pull sprouting stems throughout the growing season. As described under Alternative 2, removing one square foot of ribbongrass takes approximately five hours. Likewise, reed canarygrass is a rhizomatous riparian species that occurs along the edges of streams and lakes that can be difficult to hand-pull. With both species, root fragments left behind have the potential to resprout. Soil solarization could be an option, placing a cover, usually black or clear plastic, over the soil surface to trap solar radiation and cause an increase in soil temperatures to levels that kill plants, seeds, plant pathogens, and insects (Tu et al. 2001). Soil solarization, however, can cause significant biological, physical, and chemical changes in the soil that can last up to two years, and deter the growth of desirable native species (Tu et al. 2001). Other preliminary monitoring results of trial control methods done on the Dodd Fischer property, show that solarization of ribbongrass may be effective except for near the edges of the plastic. All vegetation that is covered, including native plants, are killed using this method (Sussman 2009, pers. comm.).

Soil solarization techniques are being considered for small selective populations of reed canarygrass in Big Marsh on Crescent District, Deschutes National Forest, where herbicides are not desirable due to the presence of rare wildlife and plant species. If a solarization technique were to be used in Big Marsh, it would be limited to disturbed areas created by hydrologists as part of a long-term marsh restoration process; these areas would be revegetated with genetically-local native plant species. At most other reed canarygrass and ribbongrass sites, soil solarization may not be practical due to the expanse of the target invasive populations.

Treatment effectiveness within the 10 ft. no-herbicide riparian zone can also be reduced for tap-rooted species, such as spotted knapweed. Manual pulling of spotted knapweed in riparian areas can be very difficult (Powers 2006, pers. comm.). In some riparian sites, the soil is compacted from heavy recreation use. Some sites are difficult to pull due to the multitude of intertwined roots from other plant species in more densely vegetated riparian areas. The ten foot no-herbicide buffer under Alternative 3 may result in less effective treatment of those riparian sites where these conditions occur.

As described under Alternative 2, the amount of herbicide used will decrease over time at specific sites as invasive plants are controlled. This would be the same for both Alternatives 2 and 3. Invasive plant populations fluctuate annually due to weather and other variables and more herbicide might be used in one year than in a previous year; however, monitoring has shown that in the long-term (4+ years), herbicide use at treated sites would decrease as invasive plants are controlled.

Summary of Treatment Effectiveness for Alternative 3

Alternative 3 is expected to have higher treatment effectiveness than Alternative 1, but lower treatment effectiveness than Alternative 2. Alternative 3 would move toward the desired future condition, but at a slower rate in riparian areas. In summary, under Alternative 3:

- ***Effectively control invasive plants.*** Following the assumptions outlined on page 97, by year 2014 the current inventory of 14,547 acres of invasive plants would be reduced to 7,526 acres in upland areas, as shown in Table 24 (same as Alternative 2), and 990 acres for riparian areas (Table 25) for a total of 8,519 acres.
- ***Ten herbicides would be available for use but three cannot be used within 300 ft. of water.*** As with Alternative 2, treatment effectiveness would be increased more than Alternative 1 with the ability to select the appropriate and preferred herbicide. On many sites, more selective herbicides will result in effective treatments with fewer effects to non-target plant species.
- ***Restrictions on broadcast spraying would reduce treatment efficiency, lowering treatment effectiveness.*** Populations of high priority invasive plants (e.g., spotted and diffuse knapweeds and houndstongue) within 300 ft. of perennial water bodies could not be broadcast sprayed, which may be the most effective treatment (depending on the species and situation). Spot or hand herbicide application methods could still be effective, but would be slower to apply, possibly resulting in treating fewer acres annually (depending on budgets).
- ***Restricts herbicide use within 10 ft. of water.*** This would reduce treatment effectiveness of invasive plants that are difficult to treat with other methods, such as reed canarygrass, ribbongrass, and yellow iris.
- ***Early Detection/Rapid Response Strategy.*** Treatment effectiveness would be increased through quick response to newly discovered invasive plant populations, controlling them before they spread even further.

Cumulative Effects for Treatment Effectiveness for All Alternatives

Cumulative effects are those impacts on the environment which result from the incremental impact of each action when added to other past, present, and reasonably foreseeable future actions. For this analysis, the geographic scope of the cumulative effects analysis is the project area (Deschutes/Ochoco Forests and Grassland). The temporal scope of the analysis is a period of 5 years (2014).

In the past, treatment effectiveness has been adversely affected by the lengthy time between ground-disturbing activities, such as timber harvesting and road building, and the time that NEPA analysis is completed and treatments can be implemented. Human-caused disturbances, such as forest management activities, and natural disturbances, such as wildfires, have created , and will continue to create areas susceptible to invasion by invasive plants. Our inability to quickly respond to these sites (due to lengthy NEPA processes) has contributed to the spread of invasive plants and has limited our treatment to mostly manual control techniques, which takes longer to deplete seed banks and is more costly, which results in fewer acres treated. At the completion of the Forests/Grassland 1998 EAs there were approximately 2,024 acres occupied by invasive species, today there are over 14,000 acres occupied. Over the past 10 years, 12,000 additional acres have been populated with invasives, including new species such as meadow knapweed, ribbongrass, quackgrass, musk thistle and Himalayan blackberry. Many of these sites have gone beyond introduction, and have become established. Although ground-disturbing activities such as timber harvest and road building would continue, Alternatives 2 and 3 would allow quick response to infestations through EDRR, preventing invasive plants from becoming established. The No Action alternative would perpetuate the current situation where new introductions become established, especially species that are not effectively controlled with manual methods, such as medusahead rye.

Prevention measures are in place which should slow the expansion of invasive plants. The Forests and Grassland Land Management Plans were amended in 2005 to include Regional Invasive Plant Standards for prevention, treatment and restoration. All three alternatives in this EIS would comply with these standards, which are intended to reduce the spread of invasive plants and protect and restore healthy ecosystems. Cumulatively, these standards will increase treatment effectiveness by reducing invasive plant spread and the number of new infestations that need to be treated. In addition, all Forest and Grassland projects consider invasive plants during project planning. For each project, an invasive plant risk assessment is developed to assess if the project has a high, moderate or low risk of introducing and spreading invasive plants. Mitigations are developed for each project to reduce identified risks for those activities we have control over such as equipment cleaning and reducing ground disturbance. Invasive plant risk assessments would be completed regardless of the selected alternative. As a result, there would be less risk of new invasive plant introduction, and reduced areas of susceptibility to invasion, however many vectors of spread and introduction, namely wildfire and public vehicle travel, continue to spread invasive plants.

In the reasonably foreseeable future, human and natural disturbances will continue to occur. The cumulative effect of increased disturbance and recreation over time within the Forest and Grassland is driven by increasing human population growth and pressure. Ground- and habitat-disturbing forest management activities, over time (10, 20, 30+ years hence), would continue to create opportunities for invasive plants to establish and spread. Management activities include timber harvest, increased visitor and recreational use, road building, road decommissioning, rock excavation at quarries, maintenance and improvement of existing facilities, construction of new facilities, grazing, fuel reduction treatments, and fire suppression. Demands on the Forest and Grassland are likely to continue to increase over the course of time as a result of steady human population growth in central Oregon. Spread of invasive plants from adjacent private lands onto the Forest and Grassland can be expected. Without effective and rapid treatment, invasive plant populations will increase within the Forest and Grassland over time, altering and degrading increasingly more native plant communities and thereby negatively affecting many ecosystems services and values, such as wildlife and plant diversity, forest and soil health, recreational opportunities, and scenic (viewshed) quality. These cumulative effects are expected to be greater under Alternative 1 because the EDRR strategy is not a part of the alternative.

Forest Service lands closest to cities within central Oregon will continue to be vulnerable to invasive plants. Numerous large infestations of invasive plants, such as spotted knapweed within the Bend city limits, will continue to spread from these areas along major highways (which serve as seed dispersal vectors) onto Forest lands. Recreational forest users coming from these cities are apt to unknowingly carry seeds on cars, off-highway vehicles, mountain bikes, horses, etc. On-going partnerships with State, County and private groups, such as the Sunriver Owner's Association, may help reduce the spread in the long-term, but, current existing infestations will continue to provide seed sources. Treatment effectiveness is highest under Alternative 2 and this would help to reduce the cumulative effects of persistent and continuing invasive plant spread. The Early Detection/Rapid Response Strategy in Alternatives 2 and 3 would allow efficient and effective treatment of new invasive plant populations along major highways, preventing spread onto adjacent forest lands.

The Forest Service land within the geographic scope of the analysis lies mostly in the upper reaches of the watersheds, except for the Grassland, which primarily lies in the lower portion of the Crooked River Watershed. The vast majority of adjacent land to the Ochoco Forest and Grassland is private land; while adjacent to the Deschutes NF to the north and west is primarily other National Forest land or Tribal lands of the Confederated Tribes of the Warm Springs, and private land to the east. The extent of treatment on private land and Tribal land is unknown. It is reasonable to assume that invasive plant spread on private land and other ownership is equal to the 10% estimate for National Forest lands, and is increasing each year. With added sources and vectors of spread from adjacent land, in addition to invasive plants introduced from vehicles, ground disturbance and visitors to the National Forest, invasive plant infestations without the use of herbicide would not result in an overall reduction of acreage, as shown in the effects of the No Action Alternative above.

Wildfires will continue to occur in the future. Many invasive plant species germinate readily after wildfire and, being as they are adapted to colonize disturbed sites, they move rapidly into and across large areas opened up by fire. Early Detection/Rapid Response Strategies built into Alternatives 2 and 3 would increase treatment effectiveness and this would have a cumulative effect in reducing spread of invasive plants.

In summary, Alternative 1, which treats the fewest acres of invasive plants, could have adverse cumulative effects to non-target plants. Alternatives 2 and 3, which treat the greatest number of acres of infestations, would not have cumulative effects from invasive plants on non-target plants.

Comparison of Alternatives for Treatment Effectiveness

Table 26. Summary comparison of alternatives for treatment effectiveness.

Measuring Factors	Alt. 1	Alt. 2	Alt. 3
Number of herbicide formulations available for use	3 on Ochoco NF, 4 on Deschutes NF in both upland and riparian areas	10 in the uplands 10 in riparian areas	10 in the uplands 7 in riparian areas
Acres of Invasive plants in 2014	13,640	7,767	8,519
Allows herbicide use within 10 feet of perennial waterbodies	Deschutes = No Ochoco = Yes Riparian acres infested in 2014 = 1,366 acres	Yes Riparian acres infested in 2014 = 238 acres	No Riparian acres infested in 2014 = 990 acres
Early Detection/Rapid Response (EDRR) Strategy for quickly treating new invasive plant populations	No, does not include an EDRR Strategy. New NEPA document would need to be developed for newly discovered infestations. This can take 5-10 years to complete.	Yes, incorporates an EDRR strategy	Yes, incorporates an EDRR strategy

Measuring Factors	Alt. 1	Alt. 2	Alt. 3
Summary of Treatment Effectiveness	Least effective in controlling invasive plants: Fewer acres treated and options most limited; No EDRR to limit spread of new sites. Invasive plants will continue to spread.	Most effective alternative in controlling invasive plants. 10 herbicides available for use; allows more broadcast; EDRR increases effectiveness	More effective than Alternative 1, but less than Alternative 2. 7 herbicides available near water; 10 everywhere else; restrictions on broadcast spraying within 300 ft. of water; EDRR increases effectiveness. No effective treatment of riparian rhizomatous species, will continue to have adverse impacts from species such as reed canarygrass

3.4 Non-Target Native Vegetation

The public is concerned that there is and will continue to be a loss of vegetation diversity within native plant communities from invasive plants. Threatened, Endangered, and Sensitive (TES) and other rare and uncommon plant species have been and will continue to be displaced by invasive plant species. There is also a concern that the application of herbicides has the potential to adversely affect non-target plants, including TES and other rare and uncommon species, found adjacent to or within treatment sites.

3.4.1 Affected Environment

The Deschutes and Ochoco National Forests and Crooked River National Grassland contain a wide variety of plant species and communities due to varying elevation and precipitation zones that occur within Central Oregon. The project area ranges from high elevation alpine habitats in the Cascade Mountains that receive 120 inches of annual precipitation to desert habitats that receive about 8-10 inches of annual precipitation.

Invasive plants pose threats to biological diversity of native plant communities, altering ecosystem processes. Invasive plants contribute to the decline in frequency of native plant species that depend on similar habitats, cause a decline in overall species numbers, are highly adept at capturing available moisture and nutrients, and are often able to quickly spread. Displacement of native vegetation, decreased species diversity, and changing habitat structure and composition result from invasions by invasive species (Olson 1999).

In general, grasslands, riparian areas, and relatively dry, open forests are more susceptible to invasion than are dense moist forests and high montane areas (USFS 2005a, 3-40; Interior Columbia Basin Ecosystem Management Project 2000). The former have frequent gaps in plant cover, which favor invasive plant establishment, whereas the latter have relatively closed plant cover or have extreme climate or soils, which are tolerated by fewer invasive plant species. Invasive plants tend to colonize disturbed ground along roads, highways, utility (power line and gasoline) corridors, recreational residences, and along trails and in campgrounds and quarries. Once established, invasive plants begin to spread, displacing native vegetation. Eastside forests are more susceptible to invasive plants for the above reasons.

Plant communities can be classified by a variety of factors such as vegetation structure, site moisture, overstory and understory. The Pacific Northwest Region Invasive Plant FEIS (USFS 2005a) used broad Potential Vegetation Groups (PVGs) to rate the susceptibility of vegetation. The susceptibility of plant communities to invasion can be influenced by many factors, including disturbance levels, community structure, and the biological traits of the invader species. Overall, the majority of plant community types found on the Deschutes and Ochoco National Forests and Crooked River National Grassland are highly susceptible to invasion (see Table 8 of the Botany Report for a summary of plant community types in the planning area).

Places where native plant communities are of high value are also affected; these include meadow systems (e.g. Big Marsh, Trout Creek Swamp, Alder Springs); Research Natural Areas (e.g. Ochoco Divide and the Island); lakes (e.g. Paulina, Hosmer, Lava); and wilderness areas (e.g. Black Canyon, Mill Creek). Plant community function has been disrupted and native vegetation has been replaced by invasive plants within these areas. Without control, these invasive plant sites will further displace native plant communities, and continue to spread.

Most of the highly valued plant communities listed are riparian communities. Riparian communities are extremely diverse in plant life and often provide great structural diversity within forested systems. Riparian habitat provides an important niche for insects, reptiles and wildlife. Hydrologically, these deciduous native plant communities provide excellent stability to stream banks and soil surfaces. Their deep and spreading root systems can resist flood pressures and slow water velocity. They provide shade to help maintain stream temperatures, and abundant leaf shedding in the fall increases soil fertility. Aesthetically, riparian communities provide diversification on the landscape enjoyed by humans.

Threatened, Endangered and Sensitive Plant Species

The Forest Service is directed to manage habitats for all existing native and desired non-native plants, fish, and wildlife species in order to maintain at least viable populations of such species. This direction comes from the Forest Service Manual section 2600 (USFS 1995, WO Amendment 2600-95-7) and stems from direction provided by the Endangered Species Act. Forest Service Manual (FSM) 2670.5 defines sensitive species as those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers, density, or habitat capability that would reduce a species existing distribution. In FSM 2670.22, management direction for sensitive species is, in part, to ensure that species do not become threatened or endangered because of Forest Service actions, and to maintain viable populations of all native species. A viable population consists of a population that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within the planning area.

There are no known occurrences of federally listed endangered or threatened plants within the Deschutes and Ochoco National Forests and Crooked River National Grassland. There is no habitat recognized as essential for listed or proposed plant species recovery under the Endangered Species Act. **Because there are no Threatened or Endangered plant species on the Deschutes and Ochoco National Forests and Crooked River National Grassland, this assessment will refer to "Sensitive" species.**

A biological evaluation is conducted to review Forest Service programs and activities for possible effects on endangered, threatened, proposed, or sensitive species, as required in Forest Service Manual 2672.4 (USFS 1995b). The biological evaluation process consists of a prefield review of available information to identify known or potentially occurring threatened, endangered, and sensitive (TES) plant species, a field reconnaissance of the proposed project, and an evaluation of potential effects to TES plant species from the proposed project. If there would be potential adverse effects or conflicts, then the project is evaluated to see if it can be revised so that adverse effects do not occur.

Pre-Field Review

A review of available information was completed in order to identify Sensitive plant species known or potentially occurring in the project area.

The following sources were consulted for the pre-field review:

- Regional Forester's Sensitive Species List (USFS 2004b).
- Oregon Natural Heritage Information Center's (formerly the Oregon Natural Heritage Program) Rare, Threatened and Endangered Species List (Oregon Natural Heritage Information Center 2004).
- U.S. Forest Service sensitive plant survey GIS layer and associated databases.
- USFS personnel (District Botanists and Ecologists).

- Literature.
- Known site GIS layer.

Sensitive Plant Species Considered in Analysis

USFS Region 6 Regional Forester has listed 50 sensitive plant species that are either documented or suspected to occur on the Deschutes and Ochoco National Forests and Crooked River National Grassland (Table 27). Of these 50 plant species on the Forests/Grassland Sensitive Plant List, 28 have been documented to occur on the Forests and Grassland.

Table 27. Sensitive plant species documented (D) or suspected (S) to occur on the Deschutes and Ochoco National Forests and Crooked River National Grassland.

Scientific Name and Code	Common Name	DES	OCH & CRNG	Habitat
Vascular Plants				
Achnatherum hendersonii	Henderson's needlegrass; Indian ricegrass		D	On dry, shallow, rocky soils of scabby ridges and openings in ponderosa pine forest or grassy steppe rangeland. Mostly on south to southwest aspect, gentle slopes at elevations of 3,400 to 5,400 feet. A regional endemic species. Often in association with *Poa sandbergii*, *Artemisia rigida*, and *Eriogonum* species.
Achnatherum wallowaensis	Wallowa needlegrass; Indian ricegrass		D	On dry, shallow, rocky soils of scabby ridges and openings in pondersosa pine forest or grassy steppe rangeland. Mostly on south to southwest aspect, gentle slopes at elevations of 3,400 to 5,400 feet. Often in association with *Poa sandbergii*, *Artemisia rigida*, and *Eriogonum* species.
Agoseris elata	tall agoseris	D		Forest openings and forest edges adjacent to wet/moist meadows, lakes, rivers, streams. Ponderosa pine/bitterbrush/Idaho fescue plant associations; also with lodgepole pine, mixed conifer forests, and Engelmann spruce.
Arabis suffrutescens var. horizontalis	horizontal woody rockcress	S		Meadows, woods; summits, ridges; steep, exposed rock outcrops. TNC records (as recent as 1993) only from Crater Lake NP, Lake of the Woods, and Mt. McLoughlin.
Arnica viscosa	Mt. Shasta arnica	D		Sparsely vegetated openings at high elevations. Scree, talus gullies and slopes w/ seasonal water runoff. Lava flows. May be w/in moraine lake basins or crater lake basins.

Scientific Name and Code	Common Name	DES	OCH & CRNG	Habitat
Artemisia ludoviciana ssp. *estesii*	Estes' artemisia; white sagebrush	D	S	Riparian zones along the Deschutes River. Upper riparian, away from aquatic plants. At edge of juniper/sage, or mixed conifer. Alder-birch or willow-spiraea communities, often with *Artemisia tridentata*, *A. biennis*, and *Solanum*.
Aster gormanii	Gorman's aster	S		Alpine or subalpine mixed conifer, open to partially closed canopy. Rocky ridges, outcrops, or rocky slopes.
Astragalus diaphanus var. diurnus	transparent milkvetch		S	Western juniper woodlands along John Day River on thin, gravelly, well-drained soils in woodland openings.
Astragalus peckii	Peck's milk-vetch	D	S	Sandy, pumice soils of Deschutes and Klamath Counties. Basins, benches, gentle slopes, pumice flats. Generally a non-forest species but can occur in lodgepole pine openings. Mostly in sagebrush/grassland habitats.
Astragalus tegetarioides	bastard milkvetch		D	Big sagebrush and ponderosa pine plant communities and basalt outcrops.
Botrychium ascendens	trianglelobe moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.
Botrychium crenulatum	scalloped moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.
Botrychium minganense	Mingan moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.
Botrychium montanum	mountain moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.
Botrychium paradoxum	peculiar moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.

Scientific Name and Code	Common Name	DES	OCH & CRNG	Habitat
Botrychium pinnatum	northern moonwort		D	Partially shaded or open settings, primarily in sedge/forb communities associated with seeps, drainages and edges of wet meadows. Engelmann spruce and stands of grand fir, Douglas fir and lodgepole pine.
Botrychium pumicola	pumice grape-fern	D		Alpine and subalpine ridges, slopes and meadows. Montane LP forest openings, open forest in basins containing frost pockets or pumice flats.
Calamagrostis breweri	Brewer's reedgrass	S		Alpine to subalpine habitats in meadows, open slopes, streambanks, and lake margins.
Calochortus longebarbatus var*. longebarbatus*	long-bearded mariposa-lily	S	S	Seasonally wet meadow and stream margins. Ponderosa, lodgepole pine and juniper forest openings and forest edges of vernally moist grassy meadows, occasionally along seasonal streams.
Calochortus longebarbatus var*. peckii*	longbeard mariposa lily		D	Vernally moist, low gradient draws and streambeds, and broad meadow basins where it is situated between the wettest parts of the meadow and the forested edge. Elevation = 4,300 – 5,200 feet.
Camissonia pygmaea	dwarf suncap		S	Sagebrush steppe at 1800' – 2000' elevation.
Carex backii			S	Wet meadows, streams, springs, seeps, moist conifer forest.
Carex hystericina	bottlebrush sedge	S	D	Wet to moist conditions in riparian zones; in or along ditches/canals in prairies and wetlands.
Carex interior	inland sedge		D	Riparian with other moist site sedge species.
Carex livida	livid sedge	S		Occurs in all forest types in peatlands including fens and bogs; wet meadows with still or channeled water.
Carex stenophylla (Carex eleocharis; Carex duriuscula)	needleleaf sedge		S	Open, dry to moderately moist, often grassy sites.
Castilleja chlorotica	green-tinged paintbrush	D		Ponderosa pine, lodgepole pine, and mixed conifer forest openings.
Cicuta bulbifera	bulblet-bearing waterhemlock	S		Shoreline marshes. Only records are for margins of Klamath Lake in 1902 and 1950. Persistence at these sites considered doubtful.
Collomia mazama	Mt. Mazama collomia	S		Meadows (dry to wet, level to sloping); stream banks and bars; lakeshores and vernal pool margins; forest edges and openings; alpine slopes.
Cypripedium parviflorum	lesser yellow lady's slipper		S	Very moist upland sites and riparian zones.

Scientific Name and Code	Common Name	DES	OCH & CRNG	Habitat
Gentiana newberryi var. *newberryi*	Newberry's gentian; alpine gentian	D		Alpine-subalpine mixed conifer openings. *Deschampsia caespitosa* meadows. Montane wet to dry meadows, sometimes adjacent to springs, streams, or lakes.
Lobelia dortmanna	Dortmann's cardinalflower	D		In water of lake, pond, slow river or stream, or wet meadow. Only one known location in Oregon on Deschutes National Forest.
Lomatium ochocense			D	Basaltic scablands on shallow basalt lithosoic soils. Restricted to terrain where there is exposed, fractured bedrock.
Lycopodiella inundata	inundated clubmoss	D		Deflation areas in coastal back-dunes; montane bogs, including Sphagnum bogs; less often, wet meadows.
Lycopodium complanatum	ground cedar	S		Edges of wet meadows; dry, forested midslope with 25% canopy cover.
Mimulus evanescens	Disappearing monkeyflower		S	Apparently associated with "drawdown" environments along lake; reservoir shores and banks/terraces of larger rivers.
Ophioglossum pusillum	northern adderstongue	S		Dune deflation plains; marsh edges; vernal ponds and stream terraces in moist meadows.
Penstemon peckii	Peck's penstemon	D	D	Ponderosa pine forest openings, pine/mixed conifer openings; recovering fluvial surfaces (streambanks, overflow channels, inactive floodplains); seeps, rills, springs, vernal pools; draws, ditches, skid roads; dry or intermittent stream channels; moist-wet meadows.
Pilularia americana	American pillwort	S		Alkali and other shallow vernal pools; not recently used stock ponds; reservoir shores.
Rorippa columbiae	Columbia yellowcress	D	S	Wet to vernally moist sites; meadows, fields, playas, lakeshores, intermittent stream beds, banks of perennial streams, along irrigation ditches, river bars and deltas. Two Deschutes sites along well-traveled highway on Crescent District are seasonally moist with melting roadside snow providing most of the moisture in the late spring/early summer. Runoff from the occasional summer storms can also provide moisture.
Scheuchzeria palustris ssp. *americana*	rannoch-rush	D		Open canopied bogs, fens, and other wetlands where often in shallow water.
Scirpus subterminalis	swaying bulrush	D		Generally submerged to emergent in quiet water 2-8 decimeters deep, in peatlands, sedge fens, creeks, ditches, ponds and lakes.

Scientific Name and Code	Common Name	DES	OCH & CRNG	Habitat
Thelypodium eucosmum	world thelypody		S	Moist, seepy areas on ashy-clay soils. in Grant and Wheeler Counties. Sites include steep drainages along the John Day River.
Thelypodium howellii	Howell's thelypody	S	S	Fir and Ponderosa pine forests; marshes.
Bryophytes				
Rhizomnium nudum	rhizomnium moss	D		On humus or mineral soil in seepages, vernally (at least) wet depressions or intermittently wet, low gradient channels. Exposure varies from full sun to full shade. Coniferous forests that include silver fir, western hemlock, mountain hemlock, western red cedar and Engelmann spruce, and on Deschutes NF include lodgepole pine, Engelmann spruce, mountain hemlock and western white pine.
Schistostega pennata	luminous moss	D		Usually on mineral soil in crevices on lower and more sheltered parts of root wads of fallen trees. A rare occurrence in a natural cave in upper bank of perennial creek. Often near steams or other wet areas. Canopy often full but as low as 20% at humid sites near water. Most commonly found within silver fir plant series but also common in western hemlock and mountain hemlock series. Also in lodgepole pine stands near water. Stand is typically late seral or old growth. There is a low probability of this species occurring in open disturbed habitats typically occupied by invasive plants (Dewey 2006, *personal communication*).
Scouleria marginata	marginate splashzone moss	S	S	Often forming dark mats on exposed to shaded rocks in streams; seasonally submerged or emergent.
Lichens				
Dermatocarpon luridum	silverskin lichen	S	S	Rocks or bedrock in streams or seeps usually submerged or inundated for most of the year.
Leptogium cyanescens	skin lichen	S		Occurs in riparian and wetlands habitats, such as seeps and springs. There is a low probability that it would occur on the Deschutes National Forest (Dewey 2006, *personal communication*).
Fungi				
Ramaria amyloidea		D		Humus or soil. Fruits in September and October. Found in Douglas fir, grand/white fir, and hemlock forests.

Field Surveys

Proposed projects that would involve any type of ground-disturbance on the Forests and Grassland are evaluated to determine if there are known sites and potential habitat for sensitive plant species through a prefield review process. Depending on the project and if potential habitat exists, areas are then surveyed using one or more survey techniques (i.e., Limited Focus, Intuitive Control, and/or Complete survey methods). The focus of the surveys is to identify where potential habitat exists and, in those areas, do a more intensive search. Records containing information on survey routes, surveyor, and results are on file at District offices. When a sensitive plant species is found, a plant inventory form is completed and sites are mapped using GPS technology. Sites are entered into a GIS layer (Geographical Information System) and database. Spatial layers in GIS and associated databases were used to evaluate the Project Area Units for known occurrences of Sensitive and Survey & Manage plants.

The majority of the Project Area Units had already been surveyed for sensitive plants or did not contain habitat for sensitive plant species (e.g., disturbed road shoulders). Only 9% of the Project Area Units needed additional surveys, which were conducted during field season of 2006.

Sensitive Plants that Occur in Project Area Units

Of the 50 plant species on the Forest/Grassland Sensitive Plant List, 16 occur within Invasive Plant Project Area Units (Table 28).

Table 28. Sensitive plant species that occur within Invasive Plant PAUs.

Unit	Scientific Name	Common Name	# Project Area Units Occurs in
Deschutes National Forest	*Agoseris elata*	tall agoseris	8
	Artemisia ludoviciana	Estes' Artemisia	1
	Botrychium pumicola	pumice grape fern	2
	Castilleja chlorotica	green-tinged paintbrush	5
	Gentiana newberryi	Newberry's gentian	2
	Penstemon peckii	Peck's penstemon	18
	Rorippa columbiae	Columbia yellowcress	1
	Scirpus subterminalis	swaying bulrush	1
Ochoco National Forest	*Achnatherum hendersonii*	Henderson's needlegrass	1
	Astragalus tegetarioides	bastard milkvetch	1
	Botrychium crenulatum	scalloped moonwort	1
	Botrychium minganense	Mingan moonwort	1
	Botrychium montanum	peculiar moonwort	1
	Botrychium pinnatum	northern moonwort	1
	Calochortus longebarbatus var. *peckii*	Peck's mariposa lily	25
	Carex hystericina	bottlebrush sedge	1
Crooked River National Grassland	*Penstemon peckii*	Peck's penstemon	1

Of the 289 PAUs, 61 have at least one documented sensitive plant site (30 PAUs on the Deschutes National Forest; 30 on the Ochoco NF, and one on the Crooked River NG). Table 29 summarizes which PAUs have known sensitive plant sites, the PAU Site Type (e.g., road or quarry), and which invasive plant species is closest to known sensitive plant populations.

Table 29. Invasive plant threats to Sensitive plant species within PAUs.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
11-02	Bend/Ft. Rock	Rd. 18	Road	Pumice grape fern (*Botrychium pumicola*) Green-tinged paintbrush (*Castilleja chlorotica*)	N	> 3,000	Spotted knapweed is the closest invasive plant.
11-04	Bend/Ft. Rock	Pine Mountain	Road	Green-tinged paintbrush (*Castilleja chlorotica*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near or within green-tinged paintbrush population.
11-05	Bend/Ft. Rock	Hwy 31	Road	Pumice grape fern (*Botrychium pumicola*)	Y	0	Spotted knapweed within pumice grape fern site. Overall, very few invasive plant sites in this Project Area Unit (Powers 2006, *personal communication*).
11-09	Bend/Ft. Rock	Rd. 40	Road	Green-tinged paintbrush (*Castilleja chlorotica*)	N	100	Spotted knapweed is the closest invasive.
11-12	Bend/Ft. Rock	Rd. 45	Road	Green-tinged paintbrush (*Castilleja chlorotica*)	N	26,000	Spotted knapweed is far from green-tinged paintbrush and not yet high risk.
11-17	Bend/Ft. Rock	Tumalo Creek	Meadow/ Wetland/ Floodplain	Newberry's gentian (*Gentiana newberryi*)	N	280	Spotted knapweed is closest invasive plant.
11-37	Bend/Ft. Rock	Rd. 25	Road	Green-tinged paintbrush (*Castilleja chlorotica*)	Y	0	Spotted knapweed within TES plant site.
11-62	Bend/Ft. Rock	Meadow Camp	Road	Estes' artemisia (*Artemisia ludoviciana* ssp. *estesii*)	Y	0	Canada thistle close to Estes' artemisia.
12-02	Crescent	Hwy 58, west	Road	Columbia yellowcress (*Rorippa columbiae*)	N	< 100	Tumble mustard (*Sisymbrium altissimum*) is across the Hwy from Rorippa.
12-05	Crescent	Big Marsh	Meadow/ Wetland/ Floodplain	Swaying bulrush (*Scirpus subterminalis*)	N	Within 100	Reed canarygrass occurs throughout the marsh and does threaten swaying bulrush.
15-01	Sisters	Little Montana, 800 Rd	Forest	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near TES plants.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
15-02	Sisters	Abbot Butte	Road	Tall agoseris (*Agoseris elata*)	N	130	Spotted knapweed is closest invasive.
15-03	Sisters	Rd. 16	Road	Newberry's gentian (*Gentiana newberryi*); Peck's penstemon (*Penstemon peckii*)	Y	> 3,000 and 0	Newberry's gentian is at the far south end of the Project Area in wet meadows and not close to any invasive plant populations. Peck's penstemon occurs with spotted & diffuse knapweeds.
15-04	Sisters	Indian Ford, N Sisters Gravel Pit	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds occur by Peck's penstemon.
15-05	Sisters	Hwy 20 road corridor	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort occur near Peck's penstemon.
15-06	Sisters	Hwy 242, Reed's Ranch	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds occur near Peck's penstemon.
15-07	Sisters	Cache Fire Area	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	St. Johnswort occurs near Peck's penstemon.
15-10	Sisters	Rd 1230	Road	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near TES plant sites.
15-11	Sisters	Black Butte	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near TES plant sites.
15-12	Sisters	Fly Creek	Road	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds occur near Peck's penstemon.
15-13	Sisters	1260 Rd	Forest	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near TES plants.
15-14	Sisters	Eyerly/Four Corners	Road	Peck's penstemon (*Penstemon peckii*)	Y	0/290	St. Johnswort occurs within Peck's penstemon population. Spotted knapweed is ~ 290 ft. away.
15-16	Sisters	Rd. 1220	Forest	Peck's penstemon (*Penstemon peckii*)	N	~100	St. Johnswort near Peck's penstemon.
15-18	Sisters	Rd. 1419/1420	Road	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near TES plants.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
15-19	Sisters	Rd. 14	Road	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near TES plants.
15-20	Sisters	Rd. 1216, 1217	Road	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near TES plant sites.
15-21	Sisters	Rd. 12	Road	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near TES plants.
15-27	Sisters	Glaze Meadow	Meadow/ Wetland/ Floodplain	Peck's penstemon (*Penstemon peckii*)	Y	0	Dalmatian toadflax near Peck's penstemon.
15-31	Sisters	NW 1290 and vicinity	Road	Tall agoseris (*Agoseris elata*)	Y	0	Spotted knapweed is closest invasive plant.
15-32	Sisters	Metolius River	Meadow/ Wetland/ Floodplain	Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near Peck's penstemon.
71-02	Lookout Mt.	Hwy 26	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	4,480	Spotted knapweed, the closest invasive plant; is still far away and not yet threatening Peck's mariposa lily.
71-08	Lookout Mt.	Rd. 42, s. portion of Rd. 30 + 42-320	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	3,260	Scotch thistle, the closest invasive plant, is still quite far away.
71-17	Lookout Mt.	2610 Rd. and Coyle Material Source	Quarry	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Russian knapweed near TES plants.
71-19	Lookout Mt.	22 Rd.	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	675	Houndstongue near Peck's mariposa lily.
71-25	Lookout Mt.	4240 Rd System	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	2,380	Houndstongue quite far down the road from Peck's mariposa lily.
71-31	Lookout Mt.	2600-450	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	2,000	Houndstongue down the road from Peck's mariposa lily.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
71-45	Lookout Mt.	2620-150, 020, Hamilton Pit	Quarry	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	17,000	No invasive plants close by Peck's mariposa lily.
71-50	Lookout Mt.	2730, 2735 Rd System	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	5,780	No invasive plants close by Peck's mariposa lily.
71-51	Lookout Mt.	FS 16, 17, 1680 Rd. System	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	800	Canada thistle near Peck's mariposa lily.
71-59	Lookout Mt.	27 and 3320 Rd. System	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	600	Canada thistle near Peck's mariposa lily.
72-01	Paulina	58, 5870, 58-800 roads	Road	Bastard milkvetch (*Astragalus tegetarioides*)	N	1,800	Whitetop is relatively far from Peck's mariposa lily.
72-03	Paulina	42 Road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Spotted knapweed, Canada thistle, and St. Johnswort near Peck's mariposa lily;
72-04	Paulina	4250 road to 4256 jct. and the 4250-100 road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Spotted knapweed and Dalmatian toadflax near Peck's mariposa lily.
72-05	Paulina	30 Road and 30-750	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	1,000	Closest infestation is Canada thistle.
72-06	Paulina	2630 Rd and 12 Rd to Forest Boundary	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	85	Canada thistle population is close to Peck's mariposa lily.
72-07	Paulina	38 Road, 3820 rd, 38-120 road	Road	Northern moonwort (*Botrychium pinnatum*) Scalloped moonwort (*Botrychium crenulatum*)	N	12	Canada thistle close to TES plants.
72-12	Paulina	`Parts of the 12, 4250 and 4274 roads	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Canada thistle near Peck's mariposa lily.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
72-13	Paulina	4270 road, part of 4274 road and 4254 road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Diffuse knapweed, Canada thistle and houndstongue near TES plants.
72-14	Paulina	4260 Road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-15	Paulina	4280 road, 4280-060 and 4280-061	Road/ Stream	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-16	Paulina	4260-570	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	35	Medusahead near Peck's mariposa lily.
72-17	Paulina	4260-560 system	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue and medusahead threaten Peck's mariposa lily.
72-18	Paulina	4260-650 road	Stream	Silverskin lichen (*Dermatocarpon luridum*)	N	0	Houndstongue occurs in area. Not within TES plant population because lichen occurs in water.
72-19	Paulina	4260-500 and 4260-501 Roads	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-20	Paulina	4260-400, 4260-300 and 4260-360 roads	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-25	Paulina	4280-067 road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-32	Paulina	3810-500 Rd. system	Road	Mingan moonwort *(Botrychium minganense)* Peculiar moonwort (*Botrychium montanum*)	N	135	Whitetop close to Botrychium species.
72-42	Paulina	Roba Ck., south of 42560-500	Stream	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
72-50	Paulina	Burnt Corral Creek south of 4260-300 to Burnt Corral Spring	Stream	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Houndstongue near Peck's mariposa lily.
72-52	Paulina	Black Canyon Wilderness	Trail	Bottlebrush sedge (*Carex hystericina*)	Y	0	Canada thistle near Carex plants.
72-59	Paulina	5820-011 road (closed) area	Forest	Henderson's needlegrass (*Achnatherum hendersonii*)	Y	0	Three medusahead plants were pulled in 2003 & not seen since.
75-43	Crooked River NG	Squaw Flat part 1	Other	Peck's penstemon (*Penstemon peckii*)	N	150	Medusahead abundant on CRNG and high risk to Peck's penstemon.

Other Rare and Uncommon Plant Species

In addition to sensitive plant species, there are other rare and uncommon vascular plants, fungi, lichens and bryophytes that are considered in project analysis within the area of the Northwest Forest Plan area (western portion of the Deschutes National Forest). Individual sites for these species would be managed for their long-term viability. Similar to sensitive plants, a prefield review is conducted to determine which species are known to occur in the project area.

Rare and Uncommon Plant Species Considered in Analysis

Seven rare and uncommon botanical taxa were evaluated in the prefield review (Table 30). Five of these taxa occur within Invasive Plant Project Area Units.

Table 30. Other rare and uncommon plant species considered in this analysis that are documented or suspected to occur on the Deschutes National Forest within the Northwest Forest Plan area.
See Table 33 for information about known sites within Invasive Plant Project Area Units.

Scientific Name	Common Name	Lifeform	Known Sites occur on DES?	Known sites in Project Area Units?	Habitat	Notes
Choiromyces alveolatus		Fungus	Y	Y	Forms sporocarps beneath the soil surface in association with noble fir, lodgepole pine, ponderosa pine, Douglas fir, western hemlock and mountain hemlock above 1,300 m elevation (Castellano et al. 1999).	Castellano et al. (1999) reported nine known sites within the range of the northern spotted owl in California, Oregon, and Washington. Aurora (1986) reports it particularly numerous in the Sierra Nevada mountains.
Cypripedium montanum	Mountain lady slipper	Vascular Plant	Y	Y	On Sisters District, suitable habitat is found either at low elevation, low gradient sites transitional between riparian & dry ponderosa or wet mixed conifer plant association groups, or at mid-elevation, distinctly upland, steep, north aspect sites, including road cut banks, in wet & dry mixed conifer & wet and dry ponderosa pine plant association groups.	This species occurs in western North America from Alaska south to California, east to Montana and Wyoming.
Hydnotrya inordinata		Fungus	Y	Y	Usually in association with the roots of Pacific silver fir, lodgepole pine, Douglas fir, and western hemlock from 1,100 m. to 2,000 m elevation (Castellano et al. 1999)	Endemic to Oregon. Castellano et al. (1999) reported four known sites within the range of the spotted owl , on the Mt. Hood, Deschutes and Willamette National Forests.
Hygrophorus caeruleus		Fungus	Y	Y	Occurs in soil in association with roots of tree species in the Pine Family (Pinaceae) near melting snowbanks (Castellano et al. 1999)	Endemic to Oregon and Washington. Castellano et al. (1999) reported three known sites within the range of the northern spotted owl.

Scientific Name	Common Name	Lifeform	Known Sites occur on DES?	Known sites in Project Area Units?	Habitat	Notes
Marsupella emarginata var. *aquatica*		Liverwort	N	N	Attached to submerged rocks in fast moving, perennial water.	Only Oregon site in a stream flowing out of Waldo Lake, Willamette NF. Possible habitat exists in higher elevation permanent streams on Deschutes NF. This species occurs in very wet habitats (the latter attached to submerged rocks in fast moving perennial water). Riparian invasive plant species, such as reed canarygrass and ribbongrass, could pose a threat to populations of these liverworts, but there are currently no known invasive plant threats to these sites (Dewey 2006, *personal communication*).
Tetraphis geniculata		Bryophyte	N	N	Large diameter rotten stumps and logs (especially the cut ends), rarely rocks, in shaded, humid sites including stream terraces and floodplains.	No known sites at this time.
Tritomaria exsectiformis		Liverwort	Y	Y	Strongly associated with rotten wood or other organics that are wetted by perennial water flow in creeks (Dewey 2006, *personal communication*). Associated with perennial seeps and springs with low volume water flow with minimal or non-scouring activity within the channel. Substrates include advanced decay class rotting logs and wood and peaty, organic soils in bog-like environments associated with springs.	Multiple known sites on Deschutes NF. Habitat where this species occurs is very low probability for most of our invasive plants except for possibly reed canarygrass or ribbongrass (riparian species).

Rare and Uncommon Plant Species that Occur in Project Area Units

Of the 289 Invasive Plant Project Area Units, 64 occur (or portions of them occur) within the Northwest Forest Plant Area.
The prefield review and surveys (conducted during field season 2006) determined that seven of the 64 Project Area Units have documented rare and uncommon plant species (Table 31).

Table 31. Rare and Uncommon plant species known sites within Invasive Plant Project Area Units, Deschutes National Forest.

Project Area	Location	Species	Life-form	Notes
11-07	Rd. 46 (Century Drive)	*Hydnotrya inordinata*	Fungus	Occurs near a high elevation lake along Century Drive. No invasive plant sites in vicinity of fungus.
11-17	Tumalo Creek	*Tritomaria exsectiformis*	Liver-wort	One *Tritomaria exsectiformis* site occurred downstream from a spotted knapweed site near the intake facility, but is believed to be extant; the other TREX3 site is at a seep near Skyliner Lodge. Spotted knapweed occurs along Tumalo Creek.
15-01	Little Montana	*Hygrophorus caeruleus*	Fungus	Within mapped spotted knapweed site.
15-05	Hwy 20	*Choiromyces alveolatus*	Fungus	Spotted knapweed occurs along Hwy 20; St. Johnswort has expanded in areas along Hwy 20 due to recent wildfires.
15-10	Rd. 1230; west B&B	*Hygrophorus caeruleus*	Fungus	Fungus site on edge of Project Area Unit, in vicinity of 1232/320 Rds junction.
15-14	Eyerly/Four Corners; Gunsight Pass	*Cypripedium montanum*	Vascular plant	Five sites. Diffuse knapweed occurs in the road very near Cypripedium montanum in the Gunsight Pass area. Cirsium vulgare and Bromus tectorum occur along the same road. Medusahead was found (and pulled) in the upper part of a timber sale unit immediately below the road.
15-17	Rd. 1499	*Cypripedium montanum*	Vascular plant	One site reported but follow-up field visits have not relocated this site

3.4.2 Environmental Consequences, Non-Target Native Vegetation

This section addresses effects of invasive plants and herbicides on non-target native plants, including Sensitive and other rare and uncommon plants.

The effects of non-herbicide methods are analyzed in Appendix J of the R6 2005 FEIS. Non-herbicidal methods include manual, mechanical, fire, cultural, restoration/revegetation, and biological control. While some native vegetation would be impacted by manual and mechanical methods, such as incidental damage to flowers, fruits or root systems, these effects are unlikely to be significant with properly trained crews (limited in occurrence and short term). Most of the concerns about adverse effects of treatment are related to herbicide use, either from direct spray and/or the potential for drift, leaching or runoff to affect non-target vegetation.

Effects of Invasive Plants on Non-Target Vegetation

The public has expressed concerns that there is and will continue to be a loss of vegetation diversity within local native plant communities from invasive plants. Invasive plants have the ability to deplete nutrients and water in the soil to levels lower than native plant species can tolerate, allowing invasive plants to out-compete native vegetation (Olson 1999). Many invasive plants are early successional species, meaning they colonize areas that have been recently disturbed. Since invasive plants have the ability to deplete available resources to lower levels than native vegetation can tolerate, they can quickly dominate disturbed sites and displace native vegetation. When invasive plants dominate native plant communities, native plant species diversity is decreased. The North American Pollinator Protection Campaign (2006) determined that invasive plants, left untreated, shift species composition and affect pollinated plants by disrupting the structure and function of ecosystems.

Invasive plants out-compete native species because they produce abundant seed, have fast growth rates, have no natural enemies, and are often avoided by large herbivores. For example, medusahead is able to compete effectively with desirable forage species partly because it is a winter annual that has rapid fall germination and root growth throughout the winter when other species are dormant (University of California 2006). Some invasive plants also produce secondary compounds, which can be toxic to native plant species or animals. Results from experiments on diffuse knapweed suggest that this invader produces chemicals that long-term and familiar Eurasian plants have adapted to, but that relatively new North American plants have not (Hierro and Callaway 2003). Weed infestation can therefore lead to a decrease in native plant species, which can alter the ability of wildlife to find suitable edible forage.

Many studies find that riparian habitats tend to be more highly invaded with non-native plants than other habitats. Factors are thought to include high resource availability (moisture and nutrients), low levels of environmental stress, and altered disturbance regimes. For example, reed canarygrass is a much-studied aggressive invasive plant that is found in many riparian areas on the Deschutes and Ochoco Forests. Based on current literature, it is expected that left uncontrolled, reed canarygrass would likely affect riparian native plant communities. Lavergne and Molofsky (2004) cite that invasion of reed canarygrass can occur relatively quickly, and has been shown to occupy up to 40% of islands and shorelines of a river in Wisconsin in less than 15 years. The presence of reed canarygrass impacts the structure of natural habitats; spread completely chokes water circulation in ponds and along shores and by growing vigorously on stream banks, it also increases sediment deposition, which further limits water circulation. In wet sedge meadows, the high sediment deposition due to the development of monotypic stands of reed canarygrass has been shown to decrease soil microstructure and organic content. Habitats that contain reed canarygrass generally have lower native plant species diversity as it has been shown to progressively displace native plant species on river islands and banks.

The Interior Columbia Basin Project's Science Integration Team did an extensive analysis of conditions in this region and note that exotic plants are a significant threat to rangelands (http://www.icbemp.gov/). As part of this analysis, Croft et al. (1997) did an analysis of vascular plants in the Interior Columbia River Basin and noted that exotic plant invasion is one of the major threats to native plant species. Of the 20 threats summarized in their report (ranging from agricultural conversion to fire to intensive livestock grazing to road maintenance and construction, etc.), there were more rare plants affected by exotic plant species than any of the other 19 listed threats.

Belnap et al. (2001) discuss how invasive plants affect biological soil crusts by reducing the diversity of native vascular plants. The vertical and horizontal vascular plant structure of many arid and semi-arid vegetation communities optimizes growth of biological soil crusts (Belnap et al. 2001). Vascular plants create windbreaks and shade, influencing how much moisture and light reach the soil surface. They also trap leaf litter, keeping the interspaces free of substantial or persistent litter cover. Invasive exotic plants generally decrease the structural diversity of native vascular plant communities by creating monocultures of densely spaced plants and by homogenizing litter distribution. They also lead to decreased biological crust cover and species richness in most ecosystems.

For these reasons, controlling invasive plant populations will help ensure the viability of native plant habitats and biological diversity.

Effects of Herbicides to Native Vegetation

Some members of the public have expressed concern that that the application of herbicides has the potential to adversely affect non-target plant species. All invasive plant treatments are designed to kill or slow the growth and spread of target plants, and some damage to non-target plant species is likely in all alternatives, despite careful planning and implementation.

<u>Type of Herbicide and Selectivity</u>

Herbicides have the potential to shift species composition of native plant communities, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. For example, the repeated broadcast spraying 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. Broadcast spraying of clopyralid, a selective herbicide that targets broadleaf plants in four plant families, might reduce native lupines that occur within invasive plant sites, though other plant species (e.g., bitterbrush and Idaho fescue) would not be affected. An 8-year field experiment at two grassland and two early seral forest sites in western Montana in which spotted knapweed was treated with picloram, clopyralid, or clopyralid + 2,4-D, observed a shift in the plant communities back to a grass-dominated structure (Rice et al. 1993, 1997). However, they found that depressions in plant community diversity were small and transitory; in the 3rd year after the initial applications, there were no significant differences among treatments and some herbicide-treated plots had begun to surpass the untreated plots in community biodiversity measures. Spot spraying has less potential for impacts to native vegetation, and therefore less potential for changes in community diversity, see the Application Method section below.

Native plants in the sunflower (*Asteraceae*), mustard (*Brassicaceae*) and legume (*Fabaceae*) families are generally more sensitive to herbicides because many broadleaved invasives are from these families and herbicides are designed to target the invasives (Mazzu 2004). Monocots, in general, tend to be more tolerant since many herbicides are designed for broadleaf dicot plants. This is especially true with grasses which tend to be more tolerant, except for herbicides specifically developed to control grasses.

The type of herbicide may also affect pollinators. A reduction or shift in pollinator species could also lead to changes in plant species composition or diversity (USFS 2005a, 4-27). However, invasive plants, left untreated, also shift species composition and affect pollinated plants by disrupting the structure and function of ecosystems (North American Pollinator Protection Campaign 2006). Native pollinators have co-evolved with the plants they visit, such that their physiology is matched to most efficiently exploit the nectar and pollen resources of the flowers upon which they specialize. Studies in natural area grasslands have found significant reductions in species diversity as dense roadside colonies of spotted knapweed invaded into adjacent native grasslands (Rice et al. 1997). It is highly likely that reduced species diversity from invasive plants has indirect effects on pollinators.

Herbicides can move off-site in water, soil, and wind, thereby affecting non-target vegetation. This can result from spray drift (from broadcast and spot treatments), 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 into groundwater in most soils. In contrast, glyphosate strongly binds to soil particles, which prevents it from excessive leaching or from being taken up from the soil by non-target plants, and has a low potential for leaching into groundwater systems, and degrades quickly (USFS 2005a, 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 and reduced productivity (e.g., physiological, structural, and abnormal growth). Effects, such as mortality, brown spots, and lack of chlorophyll may not be immediate, and may become apparent months later.

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 factors, as is duration of the treatment. The Herbicide Information Summary (Appendix D) provides information about the ten herbicides proposed for use, including their characteristics, mode of action, and potential hazards and risks. For example, glyphosate is generally non-selective (i.e., kills most plants that come into contact with it), yet does not persist for long in the environment, while picloram, which targets broadleaf and woody plants, is a persistent herbicide that can remain active for several growing seasons post application. Clopyralid mimics auxins, plant growth hormones, and stimulates abnormal growth. Metsulfuron methyl works by inhibiting the activity of an enzyme called acetolactate synthase, an enzyme necessary for plant growth.

The Herbicide Information Summary (EIS, Appendix D), also discusses selectivity of an herbicide. Some herbicides are selective for particular kinds of plants, whereas the ability to damage a broad spectrum of plant species makes an herbicide non-selective. The herbicides proposed for use in treating invasive plants vary in their selectivity ranging from non-selective glyphosate to clopyralid which is selective for plant species in four plant families. Some herbicides, such as sethoxydim, are selective for grasses and not other broadleaf plants. Picloram, one of the more persistent herbicides, could move to non-target native plants through root translocation (movement of an herbicide from one plant to another across root surfaces) or surface runoff.

Herbicide Application Method

The risk to non-target vegetation also varies with the herbicide application method. Spot and hand application methods may substantially reduce the potential for loss of non-target vegetation because there is little potential for drift as the herbicide is more directly applied to the target vegetation. Drift is mostly associated with broadcast treatments and can be mitigated to some extent by the applicator. Drift can be minimized by equipment (use nozzles designed for herbicide application that do not produce a find droplet spray), application methods (use low nozzle pressure), and applying during certain weather conditions (e.g., apply herbicide when wind velocity is between two and eight miles per hour, and do not spray if precipitation is predicted to occur within 24 hours).

Droplet size in herbicide application is a key factor in minimizing drift as larger droplets are heavier and, therefore, less affected by wind and evaporation. The largest particles, being the heaviest, will fall to the ground quickly upon exciting 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, for this reason if the droplet size forced out of the nozzle can be limited to larger particle sizes, the potential for herbicide to drift beyond the target vegetation can be controlled. Figure 6 demonstrates the relationship between droplet size and buffer distance. As droplet size increases (VMD microns), the distance herbicide may travel in concentrations sufficient to harm plants decreases. VMD is the "Volume Median Diameter" and is used to measure droplet size in microns. 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. 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 (USDA Forest Service 2006b). Vegetation on the ground, including the target invasive species themselves, acts as a substantial barrier to herbicide droplet drift as well.

Spray nozzle diameter, pressure, the amount of carrier-applied with the herbicide, and herbicide release height are important controllable determinants of drift potential by virtue of their effect on the spectrum of droplet sizes emitted from the nozzles. Meteorological conditions such as wind speed and direction, air mass stability, temperature and humidity and herbicide volatility also affect drift.

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 small particles as they fall through the air. They reduce the percentage of smaller, lighter particles that are the size most apt to drift.

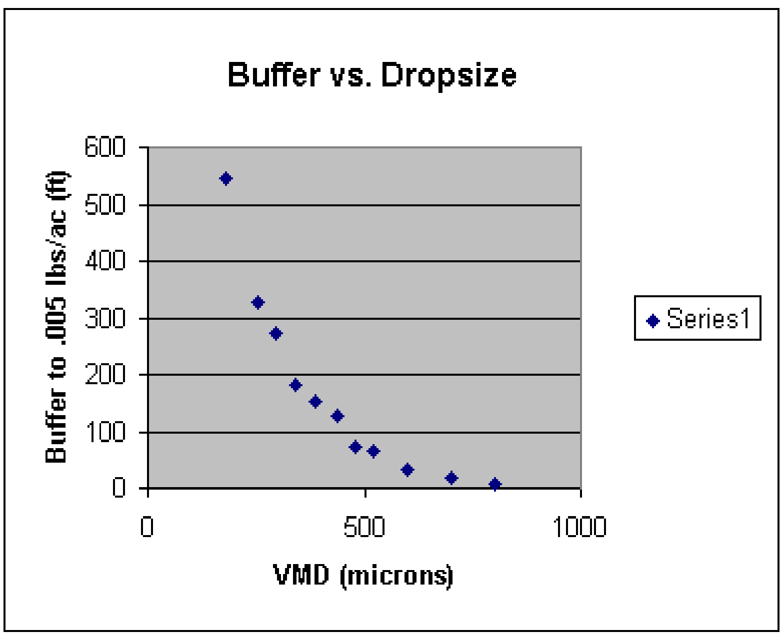

Figure 6. Illustration of how herbicide droplet size can reduce the distance that the herbicide can drift (USFS 2006c). VMD – Volume Median Diameter.

Marrs et al. (1989) in the study, "Assessment of the Effects of Herbicide Spray Drift on a Range of Plant Species of Conservation Interest," examined the distances in which drift affected non-target vascular plants using broadcast treatment methods. The five herbicides that they tested included sulfonylurea herbicides (chlorsulfuron plus metsulfuron methyl) and glyphosate. Their observations are consistent with drift-deposition models in which the fallout of herbicide droplets has been measured. Most of the severe impacts (death of the plants and severe growth suppression) were confined to a very short distance (about 2 meters, 6 meters maximum). Symptoms of plant damage and flower suppression were found at slightly greater distances, but most damage occurred near the sprayer. The maximum safe distance at which no lethal effects were found was 20 feet, but for most of the herbicides tested, the distance was 7 feet. In most cases, there was rapid recovery by the end of the growing season. They concluded: “In summary, the effects of severe damage by herbicide-droplet drift from simulation experiments set up to cover a range of high-risk herbicides under realistic application conditions, with standard hydraulic sprayers, suggest that buffer zones surrounding nature reserves and other sensitive vegetation could be quite narrow, in the order of *c*. 5-10 m” (~16-33 feet).

Herbicide Effects Specific to Non-Vascular Plants and Fungi

Fungi

The living body of a fungus is composed of thread-like filaments called hyphae. Masses of hyphae are called mycelium. The mycelium is generally underground and remains undetected until or unless it develops visible reproductive structures (fruiting bodes, such as mushrooms, truffles, corals, puffballs, cups), or the substrate is disturbed, exposing the usually white mycelial mats. Most fungi have a specialized niche in the environment, growing through the soil, and relying on spores to colonize new substrates. Occupied fungal sites are defined by the presence of one or more fruiting bodies, but the extent of a fungal individual cannot be determined by the size of the reproductive structure alone. In addition, fungi are often patchily distributed, so that there could be uncertainty about how much of the immediate surrounding habitat is occupied. Surveys for species presence are often difficult because fungi can be seen only when fruiting bodies are produced, and this does not happen every year.

The Region 6 Invasive Plant FEIS (R6 2005 FEIS, 4-130) concluded that some fungi could be damaged by at least two active ingredients (triclopyr and glyphosate). The FEIS also stated that fungi could be negatively impacted by herbicides known to affect soil mycorrhizae (sulfometuron methyl, picloram, glyphosate, triclopyr) but studies are laboratory based and results difficult to extrapolate to field situations (R6 2005 FEIS, 4-130). There is a lack of information regarding the effects of herbicides on fungi (Pilz 2006, personal communication); however, there has been some research done related to ectomycorrhizal fungi (see below). The effects of herbicides will vary depending on the type of herbicide, the amount applied, and the extent of the application.

Ectomycorrhizal fungi and their host plants

Mycorrhizae are mutualistic associations between specialized soil fungi and the roots of vascular plants. Most vascular plants form mycorrhizae and they have been shown to be essential for maintaining plant health. Benefits include improved nutrient and water uptake, improved root growth, improved plant growth and reduced drought stress. Estok et al. (1989) studied the effects of four herbicides (triclopyr, glyphosate, hexazinone, and 2,4-D) on the growth of three species of ectomycorrhizal fungi and found that each herbicide significantly reduced the radial growth of each species of ectomycorrhizal fungus at concentrations greater than or equal to 1,000 ppm. Growth was completely inhibited at concentrations greater than or equal to 5,000 ppm. Estok (1989) compared this to typical herbicide rates for silvicultural use and determined that it can be reasonably assumed that the expected initial bulk residues of the four herbicides would be less than about 100 ppm in the forest floor. This is below the concentrations where he observed significant effects. Whereas, Chakravarty and Sidhu (1987) conducted in vitro growth tests with glyphosate, hexazinone and triclopyr on five species of ectomycorrhizal fungi and found that fungal growth was significantly reduced particularly at concentrations above 10 ppm.

Chakravarty and Chatarpaul (1990) studied the influence of glyphosate on ectomycorrhizal development of pine seedlings under field conditions and concluded that at recommended application rates, glyphosate is not expected to pose long-term risks to seedling growth and ectomycorrhizal development of pine seedlings. Busse et al. (2003) studied ectomycorrhizal formation on ponderosa pine seedlings treated with a single application of sulfometuron methyl, triclopyr, or imazapyr under greenhouse and growth chamber conditions. They found that mycorrhizae formation was not inhibited by the three herbicides, and their results support "previous findings that commonly-used forest herbicides are not detrimental to soil organisms." Busse et al. (2004) tested the effects of triclopyr, imazapyr, and sulfometuron methyl on ectomycorrhizal formation on ponderosa pine, Douglas fir, and white fir seedlings grown in four forest soils of differing clay and organic matter content. Their results show that these herbicides do not alter the capability of mycorrhizal fungi to infect roots, even at concentrations detrimental to seedling growth. Ratcliff et al (2006) studied changes in microbial community structure (bacteria and fungi) following application of glyphosate and found that the addition of glyphosate at 100-times the field rate concentration (reflecting an undiluted chemical spill) produced a significant enrichment of bacteria and minimal change to the fungal community.

Trappe et al. (1984) reviewed literature on the effects of herbicides on ectomycorrhizal fungi and ectomycorrhizae, which variously reported toxic effects, no effect, and stimulation, depending on the species, the herbicide, and the dose (reviewed by Trappe et al. 1984).

Bryophytes and Lichens

As with fungi, little information is available on how herbicides may affect bryophytes and lichens. Newmaster et al. (1999) analyzed the relationship between herbicide application rates and changes in bryophyte and lichen abundance and species numbers after herbicide treatments. They divided bryophytes and lichens into three ecologically-defined response groups: herbicide-tolerant colonizers, semi-tolerant long-term stayers from dry open forest, and sensitive forest mesophytes. They tested two herbicides used in Canada in silviculture treatments to control competing vegetation: triclopyr and glyphosate. Their research showed that bryophyte and lichen abundance and species diversity decreased after herbicide treatments. The majority of our invasive plant sites are in highly disturbed areas (roads, quarries, etc.), with far fewer sites in upland undisturbed forests that would be typical of the type of situation studied by Newmaster et al. (1999).

Newmaster et al. (1999) cite references that state that physiological research has shown that some bryophyte and lichen species are extremely sensitive to herbicides, yet they also cite references showing that field trials and observations suggest that bryophyte and lichen diversity may be enhanced by silvicultural herbicide treatments.

Lichens and bryophytes lack roots and instead obtain moisture and nutrients directly from the atmosphere; therefore, they are particularly sensitive and vulnerable to aerosols and contaminants in the atmosphere such as herbicide mist. Lichens and bryophytes would be especially sensitive to herbicides because they lack a waxy cuticle and so would easily absorb them (Geiser 2006, *personal communication*).

Biological soil crusts are a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria. In rangelands, they function as living mulch by retaining soil moisture and discouraging annual weed growth (Belnap et al. 2001). Invasion of exotic annual plants into perennial plant communities can pose a long-term threat to biological soil crusts, as the crust-dominated interspace between perennial plants is often heavily invaded. Because biological crusts stabilize soils, germination of seeds of exotic species can be inhibited in sites with well-developed crusts and low plant litter, as was recently demonstrated for the annual exotic grass, cheatgrass (*Bromus tectorum*) (Belnap 2001). Kaltnecker et al. (1999) found that areas with intact biological soil crust cover maintain low cheatgrass densities despite abundant seed sources nearby. In contrast, native species that have evolved with biological soil crusts may have mechanisms, such as a geniculate awn that drills the seed into the soil. A study by Youtie et al. (1999) addressed herbicide effects on intact biological soil crusts. Direct application of two glyphosate herbicides (Roundup and Accord) on moss-dominated biological soil crusts had no short-term (within one year) negative impact on bryophyte cover. In fact, bryophyte cover decreased significantly in control plots due to litter buildup from exotic annual grasses that had invaded the site, while cover stayed the same or increased slightly in treated plots. There is little information on the effects of repeated herbicide application or long-term effects of glyphosate and other herbicides. Youtie et al. (1999) recommend selective spot spraying medusahead as early in the spring as possible, when the medusahead rye is most susceptible and native plants are dormant, to maximize the benefits from invasive plant control and minimize the impact from herbicide application.

Effects Common to All Alternatives

All herbicide laws and regulations will be followed. State and County herbicide applicators have specialized equipment that allows them to readily switch between hand application techniques (i.e., spot spraying individual plants) to a selective patch broadcast spray technique (Langland 2006, pers. comm). The objective in all alternatives when applying herbicides is always to minimize non-target plant species damage and to protect known populations of Sensitive, rare, and uncommon plants. In all alternatives, PDCs, implementation planning, and monitoring would be used to mitigate any effects to rare and uncommon plant species.

In all alternatives, the threat to native plant habitats from invasive plants is considered greater than effects from invasive plant treatments. Due to concerns about rare plant habitat loss from invasive plants, sensitive plant populations immediately threatened by invasive plants are a high priority for treatment. Short-term adverse effects from invasive plant treatments are expected to be offset by the long-term benefits of habitat protection.

All alternatives are required to meet the new Regional Invasive Plant Standards (R6 2005 ROD). Several of these standards specifically address minimizing or eliminating direct or indirect negative effects to non-target plants, including rare plant species (R6 2005 ROD, Standards 19 and 20).

Effects to non-target plants from herbicide would be reduced by using alternate methods. Non-herbicide methods will continue to be an important part of the Deschutes and Ochoco National Forests and Crooked River National Grassland Invasive Plant Program. These include biological control and manual treatments. All alternatives strive towards integrated treatments, such as using manual treatment as a follow-up to get plants missed by herbicide spraying, or using a mechanical method, such as weed whacking, on tall stems to reduce biomass and reduce the amount of herbicide used. Herbicide treatment is often followed up by manual treatment later in the season to get plants that were missed by the herbicide or several years later when invasive plant populations are reduced to the point at which they can be hand-pulled.

Comparison Measures to Evaluate Effects to Non-Target Plants

The indicators used to measure the effects of invasive plants on non-target plants will be:

- Number of inventoried invasive plant sites and acres that can be treated
- Number of herbicide formulations available
- Ability to respond quickly to new invasive plant populations with an Early Detection/Rapid Response (EDRR) Strategy
- Summary of the Treatment Effects Analysis

The indicators used to measure the effects of herbicides on non-target plants are:

- Number of inventoried acres of invasive plants treated
- Number of herbicide formulations available
- Project Design Features developed to protect non-target plants
- Summary of effects to non-target sensitive and other rare and uncommon plants from herbicides

ALTERNATIVE 1 – NO ACTION

Direct and Indirect Effects

Effects of Invasive Plants on Non-Target Native Vegetation

Alternative 1 is the least effective alternative in controlling invasive plants (*see Treatment Effectiveness*, Table 26). Only 238 of the inventoried 1,892 invasive plant sites would be treated. Invasive plant populations would continue to expand. The treatment effectiveness analysis estimates that the 14,547 acres of inventoried invasive plants would expand to 13,640 acres by 2014 (Table 26). This would further degrade native plant habitats, impacting other resources, such as wildlife forage and habitat, native pollinator diversity and soils. The majority of plant community types found on the Forests and Grassland are highly susceptible to invasion (Table 8 in Botany Report) and treatment of existing infestations is imperative in order to reduce this risk. Because Alternative 1 has limited treatment effectiveness, those plant community types that are highly susceptible to invasion will continue to be at high risk.

Herbicide use is limited in Alternative 1. As discussed above (*see Treatment Effectiveness*), there would be a heavy reliance on manual treatments at the majority of sites covered under this alternative. Manual treatment methods can be effective on small infestations if the entire root is removed (R6 2005 FEIS, p. 3-80). But, manual methods are usually not as effective for deep-rooted rhizomatous perennials where hand-pulling and hoeing often leave root fragments that can generate new plants (R6 2005 FEIS, p. 3-80). Also, manual methods are labor intensive and usually ineffective for the treatment of large, well-established infestations of perennial invasive plants with long-term viable seed such as knapweeds (Brown et al. 2001). Since manual treatments are expensive and labor-intensive, this has resulted in fewer sites being treated each year (Mafera 2006, *personal communication*). On Paulina District, this is leading to rapid expansion of houndstongue in several areas, which, in turn, because of the nature of spread, is also resulting in satellite populations further up drainages.

Brown et al (2001) tested the efficacy of various management techniques alone and in combination on spotted knapweed control. They found that herbicides alone provide the most effective spotted knapweed control for the lowest cost. Hand-pulling twice for two consecutive years was the most expensive treatment and provided less than 60% control of spotted knapweed after two seasons. Our local monitoring has shown that herbicides have been effective at reducing invasive plant populations. On the Deschutes National Forest, herbicide treatments in 1999-2001 reduced knapweed populations 83%, 94%, 95%, and 98% at four plots (Grenier 2002). However, Alternative 1 allows herbicides only on a limited number of sites. New invasive plant populations could not be treated with herbicides; therefore, the long-term effects to native plants and plant communities from invasive plants are expected to be greater than with Alternatives 2 and 3. Some of the newer herbicides that would be approved under Alternatives 2 and 3 are much more selective and would have fewer adverse effects on non-target species. Invasive plants are expected to continue to spread in Alternative 1 and eventually occupy susceptible native plant communities. The Treatment Effectiveness section (3.3.2) for Alternative 1 shows that after five years of invasive plant control, there are still 13,640 acres occupied; this figure is for spread only, and does not include new introductions.

Recognizing the importance of invasive plant species is necessary to preserve, protect, and manage for biodiversity in riparian habitats. Fierke and Kauffman (2006) found that abundance of reed canarygrass was strongly correlated with native plant composition and abundance. High abundance of reed canarygrass was correlated with lower values of understory species diversity and total species richness. Reed canarygrass and Himalayan blackberry were found to inhibit establishment of native understory tree, shrub, and herbaceous species. Without intervention to control the establishment and survival of these invasive species, it is conceivable that they will become more influential through time with adverse effects ensuing for overall biodiversity at the riverscape level.

Forests and Grassland would continue to implement prevention measures, and are required to comply with the standards for prevention practices included in the Invasive Plant ROD (R6 2005 FEIS). The Invasive Plant FEIS (R6 1005 FEIS) predicts that the rate of spread of invasive plants would slow from implementing the prevention practices; however, prevention alone is insufficient to reach desired future conditions because of the extent of existing infestation. As a result, the infestations on the Forests and Grassland would continue to expand. Manual treatments cannot keep pace with the growth of the larger invasive plant sites. Invasive plant populations increase in acreage at an estimated rate of 8-12 percent per year on Forest Service System land (R6 2005 FEIS, p. 3-2).

Effects of Herbicides on Non-Target Plants

Effects to non-target plants from herbicide drift and run-off is a lesser concern under Alternative 1 simply due to the limited number of sites and acres that could be treated with herbicides. However, moderate to large invasive plant infestations will likely continue to expand, posing high risk to the health and stability of native plant habitats.

A limited number of herbicides are available under Alternative 1. Only three herbicides are available for use on the Ochoco National Forest and Crooked River National Grassland (dicamba, glyphosate, and picloram). These 3 herbicides plus triclopyr are available for use on the Deschutes National Forest. The herbicides available under Alternative 1 do not provide the best options for the variety of invasive plant species and situations that are present within the Forests and Grassland. In many treatment situations, being limited to these herbicides could result in a higher degree of damage to non-target vegetation, than those available for use in Alternatives 2 and 3. For example, using clopyralid on knapweed species would not harm other vegetation that may be intermixed with the knapweed, unless the plant is in the Sunflower family. Currently dicamba and picloram are used, which are not as selective, they target all broadleaf plants. Highway 97 south of Bend, OR on the Bend/Ft. Rock Ranger District is a highly-traveled road, and knapweed is continually introduced. Bitterbrush and lupine, desirable native vegetation, are intermixed with the knapweed on the road shoulders; using dicamba to control knapweed can damage or kill this native vegetation, whereas clopyralid would not.

Limited herbicide use under Alternative 1 would reduce any potential for herbicide damage to biological soil crusts; however damage can also occur to soil crust from litter buildup from invasive plants, particularly annual grasses such as medusahead (Youtie et al. 1999). In addition, invasive plants reduce vascular plant diversity which, in turn, can decrease biological crust cover (Belnap et al. 2001). It is highly likely that invasive plants would continue to spread under Alternative 1, impacting native plant communities and indirectly affecting biological soil crusts.

Effects to Sensitive Plants

Under Alternative 1, sensitive plant populations in or adjacent to invasive plant populations have a greater risk of being degraded as invasive plants take over. Sixty-one of the 289 Project Area Units have documented populations of sensitive plants and, in many of these units, the invasive plant populations exist very close to sensitive plant populations (Table 30). Because Alternative 1 is limited in scope, treating the fewest invasive plant sites with the fewest tools available, there is increased difficulty to ensure protection to all sensitive plant populations as compared to Alternatives 2 and 3. Most of the newly discovered invasive plant sites (since the 1998 environmental assessments were completed) would not be treated. Therefore, it is likely that invasive plants will continue to increase and spread, jeopardizing sensitive plants.

Conservation planning documents on the Forests and Grassland have raised concerns that invasive plants are major threats to sensitive plants. Competition from non-native, invasive plant species may be the single greatest threat to persistence of Henderson's needlegrass (*Achnatherum hendersonii*) and Wallowa needlegrass (*Achnatherum wallowaensis*) (Dewey 2007). Invasive plants pose a significant threat to Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*) (Dewey 2008). Teasel (*Dipsacus sylvestris*) appears to have displaced at least one documented site of Peck's mariposa lily along Marks Creek on the Ochoco National Forest (Helliwell 1993). Pajutee (2008a) determined the spread of invasive plants has accelerated across the range of Peck's penstemon (*Penstemon peckii*) in the past decade. A management objective in the Conservation Strategy for Peck's Penstemon is to avoid the permanent habitat loss in protected sites in order to maintain species viability. Invasive plants alter native plant habitats and the failure to control invasive plants in Peck's Penstemon habitat in Alternative 1 could jeopardize viability of the species. Invasive plants have also been identified as a threat to rare moonworts (*Botrychium* spp.) in the Columbia Basin (Zika et al. 1995). By simplifying complex plant communities, invasive plants reduce biological diversity and threaten rare plant habitats. The Conservation Strategy for Pumice Grape-Fern (*Botrychium pumicola*) lists invasive plants as one of the threats to this species (Powers 2008). As invasive plants spread, this could become a larger problem predominantly in the montane sites.

Because the majority of invasive plant sites would not be treated under Alternative 1 and because of limited treatment effectiveness, the risks to sensitive plants are greater under Alternative 1 as invasive plant sites continue to expand and spread. The potential for the loss of population viability and a trend toward federal listing is higher in Alternative 1 than in Alternatives 2 and 3, and the loss of viability could occur for some species such as Peck's Penstemon and pumice grape-fern in Alternative 1.

To illustrate this level of risk, two Project Area Units (PAU) were selected for comparison purposes to represent how the alternatives differ in treating invasive plants that occur with sensitive plants (see Appendix I of the Botany Report). The representative PAUs are:

- PAU 15-01 – Known as "Little Montana," this PAU contains a large infestation of spotted knapweed, which is one of the most abundant invasive plants on the Deschutes National Forest. The sensitive plant, Peck's penstemon, occurs intermixed with spotted knapweed.

- PAU 72-50 – Known as "Burnt Corral Creek, this PAU contains a large infestation of houndstongue, one of the most abundant invasive plants on the Ochoco National Forest. The sensitive plant, Peck's mariposa lily, occurs intermixed with houndstongue.

In both PAUs, Alternative 1 results in longer time to control invasive plant infestations. Given certain assumptions, Alternative 1 results in more acres of invasive plant infestation remaining in Year 2014 than Alternatives 2 and 3 (see Appendix I of the Botany Report):

Project Area Unit	Alternative 1	Alternative 2	Alternative 3
15-01	132.1	0.1	1.0
72-50	6.5	0.03	2.7

Based on these estimates, it is reasonable to assume that sensitive plants will continue to be impacted by invasive plants under Alternative 1. For example, Peck's mariposa lily will be adversely affected by houndstongue as it continues to spread. St. Johnswort has expanded on Sisters District and continues to be the emerging weed threat within the Metolius Basin (Burtelow and Suna 2004), an important area for Peck's penstemon. Despite steady control efforts, largely by manual hand pulling, invasive plants are increasing across the range of Peck's penstemon, especially in wildfire areas (Pajutee 2008a). Canada thistle will likely continue to spread along the Deschutes River, further impacting Estes' artemisia. Spotted and diffuse knapweeds would continue to spread, increasing long-term degradation to habitats occupied by Peck's penstemon and green-tinged paintbrush. Houndstongue would continue to spread on the Ochoco National Forest, increasing negative effects to Peck's mariposa lily populations and habitat.

Alternative 1 does not provide as many herbicide options as Alternatives 2 and 3. These limited options reduce our ability to use a more selective herbicide when near sensitive plants. Alternative 1 does use the least amount of herbicide so there is less risk of herbicide to contact and damage individual sensitive plants and fungi, and is not expected to result in a loss of viability or a trend towards listing for any species. However, our ability to protect sensitive plant habitat in the long-term (5+ years) is reduced under Alternative 1.

Effects to Other Rare and Uncommon Plants

The effects to other rare and uncommon plant species would be similar to effects to sensitive plant species. The limited use of herbicides under Alternative 1 would result in a potential risk of herbicide damage to individual fungi, bryophytes, and lichens, but the use of herbicide would not be expected to decrease species distribution (loss of sites) or result in loss of habitat. However, the limited ability to effectively treat invasive plants will result in their continued spread, resulting in further loss of fungi, bryophyte and lichen habitat and greater threats to biological diversity. Invasive plants would continue to alter the composition and structure of native plant communities, reducing available substrates for nonvascular plants and reducing the availability of hosts that benefit mycorrhizal fungi. The failure to control invasive plants in Alternative 1 increases the potential for loss of species diversity and the loss of habitat for rare and uncommon fungi, bryophytes and lichens as compared to Alternatives 2 and 3.

Summary of Herbicide Effects to Native Vegetation, Alternative 1

Though limited herbicide use would pose the lowest risk of short-term (1-5 years) damage to individual non-target plants, Alternative 1 provides the least protection to native plant habitats because invasive plants will continue to spread.

- ***Greater risk to native vegetation from invasive plants than Alternatives 2 and 3.***

- The majority of invasive plant sites would not be treated, resulting in the continued displacement of native plant species.
- Limited herbicides are available; this will reduce treatment effectiveness, resulting in continued loss of native plant biodiversity and higher risks to native plants than Alternatives 2 and 3.
- Does not include an Early Detection/Rapid Response Strategy to be able to respond quickly to new infestations.
- Treatment effectiveness analysis determined Alternative 1 is the least effective in controlling invasive plants
- Alternative 1 is the least effective in treating invasive plants and, therefore, poses the highest risk to sensitive and other rare and uncommon plants from loss of habitat. Invasive plants will continue to impact rare plant habitat throughout much of the Forests and Grassland. Increased spread of invasive plants would alter native plant habitats and potentially risk long-term viability of rare plant species.

- ***Least risk of short-term (1-5 years) damage to individual non-target plants from herbicides yet less selective herbicides available***
    - Fewer acres (2,204 of 14,547 inventoried acres of infestation) would be treated; therefore, less risk of inadvertent damage to individual non-target native plants
    - Limited number and type of herbicides are not as selective as those allowed under Alternatives 2 and 3.
    - PDFs, which provide protection to non-target plants, are not available.

ACTION ALTERNATIVES 2 AND 3

Botany Project Design Features Common to Action Alternatives 2 and 3

Project Design Features (PDFs) were developed to reduce potential adverse impacts from invasive plant treatments to non-target plants. PDFs define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources. For PDFs involving herbicides, these are an added layer of caution to the already-regulated and approved use of these herbicides. Some PDFs were developed specifically to protect non-target plants (PDFs 63-71); other PDFs were developed for other resources (e.g., PDF 47 was developed to protect soils) but also provide protection to non-target plants. Table 34 lists the PDFs that would provide protection to non-target plants, including sensitive and other rare and uncommon plants.

The Herbicide Information Summary (Appendix D) identifies potential risks to non-target vegetation for each of the proposed ten herbicides. Information such as herbicide characteristics (e.g., selectivity of the herbicide), basic hazard identification, and risk characterization was used to design PDFs to minimize potential risks to non-target native plants.

PDFs are mandatory and apply to all alternatives, including the no action if pertinent (some are noted as being alternative specific). PDFs are taken into consideration when comparing the alternatives.

Table 32. Project Design Features that protect non-target native vegetation. Of the 95 Project Design Features (PDFs) in the Deschutes and Ochoco National Forests and Crooked River National Grassland Invasive Plant EIS, the following PDFs would protect non-target native plants from invasive plant treatments.

PDF #	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target plants
5	Prevent spread of invasive plants	When applying herbicides, protect non-target vegetation whenever practical in order to minimize the creation of exposed ground and the potential for re-infestation.	Careful use of herbicides to specifically target invasive plants will reduce damage to non-target plants, helping to maintain ground cover. This can be done through herbicide selection and application method and rate.
12	Application rates	Follow label advisory for effective rate. Lowest effective rates would be used. Additional limits on application rates are as follows: • Spot herbicide application of sulfometuron methyl would not exceed 0.2 lb a.i./ac. • Broadcast application of picloram would not exceed 0.5 lb a.i./ac. • Broadcast application of sulfometuron methyl would not exceed 0.12 lb a.i./ac. • Broadcast application of NPE surfactant would not exceed 0.5 lb a.i./ac.	This PDF was developed because limiting the application rate for these active ingredients will ensure their use stays below thresholds of concern for workers, the public, fish and other aquatic organisms; these rates are based on the results of Risk Assessment. This also adds another layer of caution for protecting non-target native plants.
13	Selective spray	Use selective spray techniques, or other targeted application techniques when practical and effective (cut stump, basal spray, etc.)	Selective spray techniques reduce the risk that drift will occur by directing the spray to target specific plants. Spot sprays are more discontinuous than broadcast and they increase operational control to that corrections may be made instantaneously. This reduces the potential for accidental impacts on non-target plants.
15	Wind	Herbicide applications would occur when wind velocity is between two and eight miles per hour. The less than 2 mph standard is to avoid spraying during inversions. During application, weather conditions would be monitored periodically by trained personnel.	Wind speed restrictions also substantially contribute to a reduction in drift (Desser 2008 citing the Spray Drift Task Force 2001).

PDF #	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target plants
16	Reduce herbicide drift	Use low nozzle pressure, apply a coarse spray, and use nozzles designed for herbicide application that do not produce a find droplet spray, e.g., use a nozzle diameter to produce a median droplet diameter of 200-800 microns, with an objective of > 500 microns.	This design feature reduces potential for drift and off-target impacts because drift is directly correlated with droplet size (Desser 2008). 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. By simply changing the type of nozzle (diameter of pore size) used during broadcast treatments, the drift potential of herbicide can be effectively and substantially decreased as the droplet size forced out of the nozzle is increased in size (Thistle 2006, *personal communication*).
17	Reduce herbicide runoff	No spraying would occur if measurable precipitation is occurring or is predicted to occur within 24 hours within the given treatment area, or as label directs. Local conditions to be monitored by the licensed applicators.	Precipitation during or right after application could be a source of runoff; therefore, this PDF reduces the potential for runoff and the potential for injury to non-target plants.
47	Avoid excessive herbicide runoff	Do not use chlorsulfuron on soils with high clay content (texture class 1).	Chlorsulfuron is highly mobile on clay and would have a high potential to move offsite in runoff (SERA 2004). Eliminating this herbicide/soil combination will minimize the potential for non-target plants down slope to be harmed by chlorsulfuron.
48	To avoid excessive herbicide runoff; reduce potential to accumulate in soil	Do not use picloram and/or sulfometuron methyl on soils with high clay content (texture class 1); shallow and unproductive soils; or acidic soils unless other methods are not available or feasible.	This design feature is based on the toxicological profile of picloram and sulfometuron methyl (Desser 2008). These herbicides are relatively persistent in soils, and, of the ten available herbicides, were identified in the R6 2005 FEIS as having potential to affect soil organisms. The intent is to minimize accumulation of these herbicides in the soil so that sufficient degradation occurs before more herbicide is potentially added to the soil. This also adds another layer of caution for protecting non-target native plants.
50	Native revegetation	Apply erosion control and native revegetation (e.g., mulching, native grass seeding, planting) where detrimental soil disturbance or devegetation may result in the delivery of measurable levels of sediment to federally listed fish species' critical habitat.	Though this PDF was developed to keep sediment out of streams and protect fish, however, it also benefits non-target plants by reducing the amount of bare ground where invasive plants can easily get established, and works to restore native plant habitats.

PDF #	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target plants
63	Survey for rare plants prior to the use of herbicides	Surveys will be conducted for Threatened, Endangered and Sensitive Plants (TES) and other rare and uncommon plants prior to invasive plant treatments if: 1) the area has not already been surveyed for these species; and 2) if the area contains likely habitat for any of these species, and 3) if the proposed treatments are likely to have a negative impact to individual plants. Surveys will be conducted in the area within 100 ft. from where herbicide broadcast applications are planned and within 35 ft. for all other treatment types (herbicide spot spray, manual). If species of concern are located, protection measures and treatment methods outlined in Project Design Feature 67, below, will be applied.	This PDF ensures that we have current survey information for sensitive and other rare and uncommon plants. Therefore, we can flag and avoid them during invasive plant treatments. Marrs et al. (1989) found the effects of severe (plant) damage by herbicide-droplet drift from simulation experiments set up to cover a range of high-risk herbicide under realistic application conditions, with standard hydraulic sprayers, suggest that buffer zones surrounding nature reserves and other sensitive vegetation could be quite narrow, in the order of about 5-10 meters (16-33 feet)." They found that "no effects were seen to vascular non-target vegetation further than 66 feet from the broadcast treatment zone." This reinforces 100 feet is more than adequate as a broadcast buffer for non-target native plants.
64	Professional botanists are involved in designing herbicide treatments around rare plants	Within TES and other rare and uncommon plant populations, prior to herbicide treatments where there are potential effects from the herbicide, a Forest Service Botanist will identify the steps that need to be taken to protect these plants. This may involve avoiding TES and other rare and uncommon plant populations or individuals (i.e., identify/map areas around the populations that must be avoided, or flagging individuals plants) and/or altering treatments (e.g., switching from herbicide to manual treatments within and adjacent to a TES or other rare and uncommon plant population). Forest Service Botanists will work closely with herbicide applicators to ensure Project Design Features are implemented, will monitor and document the results, and use adaptive management to refine treatments as needed to adequately protect TES and other rare and uncommon plants.	This PDF is to ensure appropriate steps are taken during herbicide treatments to protect TES and other rare and uncommon plant species. This is standard practice by Deschutes and Ochoco NF Botanists for managing rare plants per Forest Service Manual 2620 direction. Our monitoring has shown a high level of effectiveness when botanists are intimately involved in planning projects to protect rare plant species.

PDF #	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target plants
65	Professional botanists are involved in manual treatments around rare plants	For manual treatments within TES and other rare and uncommon plant populations, a Forest Service Botanist will instruct workers in the proper identification of plant species to be avoided and will monitor the manual treatments to ensure that individual TES and other rare and uncommon plants are protected.	This PDF is to ensure that TES and other rare and Uncommon plants are not pulled or otherwise damaged during manual treatments of invasive plants. This is standard practice by Deschutes and Ochoco NF Botanists for managing rare plants per Forest Service Manual 2670 direction. Our monitoring has shown a high level of effectiveness when botanists are intimately involved in planning projects to protect rare plant species.
66	Professional botanists are involved in determining herbicide buffers around rare plants	Forest Service Botanists will determine if buffers are needed to protect TES and other rare and Uncommon plant species from herbicide spraying. The need for buffers will depend on the species to be protected, the invasive plant species to be treated, and the type of treatment that would be used. If buffers are determined to be needed, the buffer widths in PDF 67 will be employed.	This PDF is to ensure appropriate steps are taken during herbicide treatments to protect TES and other rare and uncommon plant species. This is standard practice by Deschutes and Ochoco NF Botanists for managing rare plants per Forest Service Manual 2620 direction. Our monitoring has shown a high level of effectiveness when botanists are intimately involved in planning projects to protect rare plant species.
67	Buffers to protect rare plants from herbicides	If a Forest Service Botanist determines that herbicide buffers are needed (*see PDF 66*), then the following Protection Buffer Widths will apply for TES and other rare and uncommon Plant Species. *Greater than 100 feet:* All treatments permitted. All herbicides permitted. *Between 100 feet and 35 feet:* No herbicide broadcast spraying. Spot spray and other selective herbicide techniques can be used. *Between 35 and 0 feet:* No use of chlorsulfuron, imazapic, imazapyr, metsulfuron methyl, picloram, and sulfometuron methyl permitted. Clopyralid, glyphosate, sethoxydim, and triclopyr may be applied with selective methods, such as wicking, wiping, cut-stump, injection, etc. Spot spray of clopyralid, sethoxydim, and triclopyr may be conducted if plant is not susceptible to these selective herbicides. Spot spray of glyphosate may be used if conducted when rare plant is shielded or covered.	Herbicide use buffers provide a way to minimize the likelihood of herbicides inadvertently reaching a habitat of concern (Desser 2008) or, in this case, reaching TES and other rare and uncommon plants. The 100 foot broadcast buffer is based on modeling by Thistle (2006) that demonstrates the non-selective herbicide glyphosate is unlikely to harm non-target botanical species and on Marrs et al. (1989) who found that “no effects were seen to vascular non-target vegetation further than 66 feet from the broadcast treatment zone.” This reinforces 100 feet is more than adequate as a broadcast buffer for botanical species of concern (Desser 2008). The spot/selective herbicide spray buffer of 35 feet is based on Marrs et al. (1989) who recommend a buffer from sensitive vegetation of about 5-10 meters (16-33 feet) to protect from high-risk herbicides. Of the ten available herbicides, chlorsulfuron, imazapic, imazapyr, metsulfuron methyl, picloram, and sulfometuron methyl have the most risk for off-site movement and potential to non-target plants; a 35 foot buffer zone will reduce the potential for non-target plant effects.

PDF #	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target plants
68	Protect rare plants from herbicides	In order to protect TES and other rare and uncommon plants in saturated or wet soils at the time of application, do not use picloram or imazapyr due to their mobility.	This reduces the potential for runoff and inadvertent effects to non-target TES and other Rare and Uncommon plants.
69	Reduce impacts to non-target vegetation	Use selective herbicide applications (e.g., backpack, spot spray) of sulfonylurea herbicides (chlorsulfuron, sulfometuron methyl, and metsulfuron methyl) for one to two years after a wildfire. Dry powdery soils following wildfire are susceptible to wind erosion and transport of applied herbicide.	Sulfonylurea herbicides are very potent and even low amounts on wind-blown soil can affect plants downwind. The degree to which the applicator can direct the spray, limit drift and soil impacts, and ensure only target plants are affected is far greater under spot and selective methods than broadcast (Desser 2008). Selective application of these herbicides following wildfire will reduce the potential for wind transport, providing protection to non-target plants.
70	Protect non-target vegetation from herbicides	Do not apply imazapic to areas treated within the previous 18 months with chlorsulfuron, metsulfuron methyl, sulfometuron methyl, picloram, or imazapyr in areas where reseeding of susceptible species is to occur.	Treatment of areas that were previously treated with chlorsulfuron, metsulfuron methyl, sulfometuron or imazapyr may cause compound injury or death to desirable plants (Bautista and Bulkin 2007). This PDF will eliminate that possibility.
71	Reducing drift from sulfonylurea herbicides	When using sulfonylurea herbicides (chlorsulfuron, metsulfuron methyl, and sulfometuron methyl), use lowest application rates that will still be effective and do not use within 35 feet of known TES or other rare and uncommon plants identified by Forest Service botanists for protection.	Marrs et al. (1989) recommend a buffer from sensitive vegetation of about 5-10 meters (16-33 feet) to protect from high-risk herbicides. Of the ten herbicides, chlorsulfuron, imazapic, imazapyr, metsulfuron methyl, picloram, and sulfometuron methyl have the most risk for off-site movement and potential to non-target plants; a 35 foot buffer zone will reduce the potential for non-target plant effects

* "minimize" means reducing negative impacts to the lowest level practical.

The analysis is based on the assumption that all protection measures are followed: Project Design Features, Regional standards (R6 2005 FEIS and ROD), and herbicide label requirements.

Alternative 2

Alternative 2 proposes to treat inventoried invasive plant populations within 289 Project Area Units. Treatment prescriptions and long-term site objectives have been developed that strive to combine manual and mechanical methods with the use of herbicides for more effective treatment. Ten herbicides analyzed in the Region 6 Invasive Plant EIS (R6 2005 FEIS) would be available to more effectively control invasive plant infestations. The Proposed Action includes an Early Detection/Rapid Response strategy to treat new or expanding invasive plant infestations.

Direct and Indirect Effects

Effects on Non-Target Plants from Invasive Plants

Alternative 2 is the most effective alternative in controlling invasive plants (Table 28). It allows treatment of all inventoried 1,892 invasive plant sites that have been mapped across 14,547 acres. Ten herbicides would be available for use, including more selective herbicides than currently available. Alternative 2 allows more broadcast spraying of herbicides. An Early Detection/Rapid Response strategy allows us to quickly treat new invasive plant sites.

Increased treatment effectiveness under Alternative 2 would provide the highest protection of the three alternatives to native plant habitats.

Effects on Non-Target Plants from Herbicides

Alternative 2 allows the 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). However, the risk to non-target plants is reduced by careful implementation of Project Design Features (PDFs), and by following herbicide label restrictions and Regional Standards. The selection of herbicides available under Alternatives 2 and 3 (compared to Alternative 1) allow us to choose an herbicide that would pose lower risk to non-target plant species and be effective at controlling the target invasive species.

Table 32 describes PDFs that are developed to minimize (i.e, reduce negative impacts to the lowest level practical) or eliminate effects to non-target plants and explains why these would be effective. In addition to PDFs, several Regional Standards reduce the severity and extent of impacts associated with herbicide runoff and drift. For example, Regional Standard 16 restricts triclopyr to selective applications, which would reduce direct effects to non-target woody species, culturally important species, and ectomycorrhizal fungi. Regional Standard 19 requires that site-specific characteristics (soil characteristics, proximity to surface water and local water table depth to determine herbicide formulation, size of buffers needed, etc.) be used to design invasive plant treatments.

Sulfonylurea herbicides pose a higher risk to non-target plants because they are potent in small quantities. PDFs 12, 15, 16, 17, 47, 66, 67, 68, and 69 are specifically developed to protect non-target plants from the sulfonylurea herbicides (Table 32). These PDFs include using the lowest effective rate, soil texture restrictions, application method restrictions, and drift abatement. Drift can be controlled during application by using methods discussed earlier (see *Effects of Herbicides to Native Vegetation*), but there are inherent risks with these herbicides due to wind erosion. There is a possibility that wind can pick up herbicide molecules attached to soil and move them.

Wind erosion can be reduced by using spot or hand application techniques (instead of broadcast spray method) in areas with a lot of bare ground and very dry and light soils that are more likely to be carried by wind. Presence of vegetation and/or heavier soils would help reduce the potential for wind erosion and many of the invasive plant sites proposed for treatment with sulfonylurea herbicides have vegetation present to help reduce wind erosion. For example, wind erosion should be minimal if dense houndstongue patches on Paulina District were broadcast sprayed with metsulfuron methyl because there would be a lot of foliar interception and absorption by the plants, resulting in less soil contacted directly by the herbicide (Bautista 2006, *personal communication*). Sulfometuron methyl is proposed for use on medusahead, with the majority of sites on the Grassland. Historically (in the late 1930's), the Grassland experienced considerable wind erosion and deposition, yet there is currently little evidence of wind scour even on the most depauperate sites (Gibson 2006, *personal communication*). PDFs 15, 16, and 67 are intended to minimize movement of herbicide molecules by wind.

Repeated use of herbicides could potentially shift species composition, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. 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. (*Note: Regional FEIS Standard 16 limits the use of triclopyr to selective application techniques only (e.g., spot spraying, wiping, basal bark, cut stump injection).* However, invasive plants also shift species composition and alter habitats. Any shift due to herbicide spraying would be minimal for the following reasons: 1) Alternative 2, which has the most herbicide options, would treat a relatively small portion of the Forests and Grassland (~ 2% of 2,340,567 acres); and 2) the majority of invasive plant sites are along roads (72%) and within other disturbed sites in which native plant species composition is already altered. It is unlikely that there would be a significant shift in native plant species composition across the landscape.

One study, Rice et al. (1993), determined: "Concerns that recommended herbicide applications for spotted knapweed control will have negative effects on natural plant community diversity are not warranted." They found that plant community diversity is maintained and may increase in the years after spraying heavily infested sites.

Herbicide use at each site will decrease as the invasive plant population is controlled, reducing the risk of potential effects to non-target plants from herbicides. Table 35 reports the decrease in herbicide use at selected sites on the Deschutes National Forest (Oregon Department of Agriculture 2005). Monitoring has shown that herbicide use on the Deschutes National Forest at approved sites has declined since year 2000. Though annual fluctuations in invasive plant populations might require more herbicide use in some years, the overall amount of herbicide use has declined as invasive plant populations have been controlled On the Deschutes National Forest, there were 195.1 acres treated with herbicides in year 2000; in 2005, only 29.18 acres were treated.

Table 33. Acres treated with herbicides and total herbicide usage, 2000-2005, Deschutes National Forest. Data from Oregon Department of Agriculture (2005).

	2000	2001	2002	2003	2004	2005
Total Acres Treated	195.1	105.5	54.34	21.53	34.40	29.18
Total Picloram Usage (gal.)	.5	.25	.24	.09	.15	.10
Total Glyphosate Usage (gal.)	1.6.	1.0.	.95.	.25.	.15	.23
Total Dicamba Usage (gal.)	47.0	24.8	13.0	5.38	8.39	6.97

Table 34. Percent reduction in the amount of herbicide used at selected sites, 2000-2004, Deschutes National Forest. Data from Oregon Department of Agriculture (2005).

Invasive Plant Site	% Reduction in Herbicide Use in 2004 since treatment began in 2000
Highway 97	92
China Hat Road	90
Cascade Lakes Highway	86
Road 16, Sisters District	100

The presence or potential of biological soil crusts within proposed treatment areas is most likely in soils within a 9 to 14 inch precipitation zone that define juniper/sagebrush steppes (Ochoco soil map unit B4) and higher elevation scablands (Ochoco soil map unit P5) on the Ochoco National Forest, as well as juniper and/or sagebrush range sites on the Crooked River Grassland (Ochoco soil map units E and F) or Deschutes National Forest (Deschutes soil map units 48 and 91). Although there is a possibility of herbicide application on biological crusts in these areas, crusts are less likely to be present in areas of existing invasive plant populations due to their susceptibility to the physical disturbance that encouraged the invasive plant populations to prosper. However, if present, the effects of herbicide treatments on these crusts is not well documented but would likely be similar to those described for soil organisms (see Soils Resource Report; Sussmann, 2006, *personal communication*). As discussed earlier (*see Effects of Invasive Plants on Non-Target Plants*), Belnap et al. (2001) discuss how invasive plants affect biological soil crusts by reducing the diversity of native vascular plants. Invasive exotic plants generally decrease the structural diversity of native vascular plant communities by creating monocultures of densely spaced plants and by homogenizing litter distribution. Youtie et al. (1999) found they also lead to decreased biological crust cover and species richness in most ecosystems, as discussed earlier in this section ("Herbicide Effects Specific to Non-vascular Plants"). PDFs 46, 47, and 48 were developed to minimize effects of herbicides on the soil where herbicide and soil characteristics would combine to create a known hazard of toxicity to microbes or measurable losses to soil productivity. These PDFs would provide greater protection to biological soil crusts and the effects of herbicides.

The Early Detection/Rapid Response Strategy under Alternative 2 would reduce the risk of invasive plant spread and provide better protection to native vegetation than currently allowed under Alternative 1 because we would be able to respond more quickly to newly discovered invasive plant populations.

In summary, effects to non-target native vegetation from herbicide treatments under Alternative 2 are expected to be minimal because of the small portion of land that would be treated (~ 2% of the Forests and Grassland), utilization of selective spray techniques, application of PDFs, and the ability to use more selective herbicides than available in the past or under Alternative 1 (Table 36). This alternative would meet the desired future condition from Chapter 1 where "…healthy native plant communities remain diverse and resilient."

Sensitive Plants

Effects to Sensitive Plants from Invasive Plants under Alternative 2

Native plant habitats will benefit if invasive plants are controlled. Alternative 2 provides the highest protection to native plant habitats because it provides the most options and highest level of invasive plant treatment (Table 26). The more quickly invasive plants can be controlled in these sites, the better the chances for long-term survival and viability of sensitive plant populations. Alternative 2 would not result in the loss of viability or cause a significant trend toward listing for any sensitive plant species.

As discussed earlier under Alternative 1, two Project Area Units (PAU) were selected for comparison purposes to represent how the alternatives **differ in treating invasive plants that occur with sensitive plants (see Appendix I of the Botany Report**). The representative PAUs are:

- PAU 15-01 – Known as "Little Montana", this PAU contains a large infestation of spotted knapweed, which is one of the most abundant invasive plants on the Deschutes National Forest. The sensitive plant, Peck's penstemon, occurs intermixed with spotted knapweed.
- PAU 72-50 – Known as "Burnt Corral Creek, this PAU contains a large infestation of houndstongue, one of the most abundant invasive plants on the Ochoco National Forest. The sensitive plant, Peck's mariposa lily, occurs intermixed with houndstongue.

In both PAUs, Alternative 2 would control invasive plant infestations the quickest. Given certain assumptions, Alternative 2 results in the fewest acres of invasive plant infestation remaining in Year 2014 than Alternatives 1 and 3 (see Appendix I of the Botany Report):

Project Area Unit	Alternative 1	Alternative 2	Alternative 3
15-01	132.1	0.1	1.0
72-50	6.5	0.03	2.7

Based on these estimates, it is reasonable to assume that Alternative 2 provides greater protection to sensitive plants from invasive plants.

Effects to Sensitive Plants from Herbicides under Alternative 2

PDFs 63, 64, 65, 66, 67, 68, and 71 (Table 32) were specifically developed to minimize or eliminate herbicide treatment effects to sensitive plants and to comply with Regional Invasive Plant Standards (R6 2005 ROD). For example, PDF 71 requires the lowest effective application rate be used when applying sulfonylurea herbicides (chlorsulfuron, metsulfuron methyl, and sulfometuron methyl) and these herbicides cannot be used within 35 feet of a known sensitive (or other rare and uncommon) plant. In the long-term, sensitive plant habitats will benefit from invasive plant treatments. Regional standards that require restoration of disturbed ground (including passive restoration where there is a good supply of native plants to colonize sites), retention of native vegetation and development of a long term strategy for infested areas, will ensure that sensitive plants are given consideration during project planning and that healthy habitat will be promoted. Regional Standard 20 requires that we design treatments to reduce or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. Though there are no proposed or listed Threatened or Endangered plant species on the Forest and Grassland, we will be using site-specific project design (e.g., application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) in applying herbicide treatments near sensitive plants.

Even with PDFs and all the layers of caution integrated into herbicide treatments (*see* EIS, Figure 3), there is always the chance – though a minimal chance – that an individual sensitive plant(s) might be damaged in some way by herbicide contact. However, this would be a short-term (1-5 years) effect and it is expected that there would be no loss of viability and no significant trend toward listing for any sensitive plant or fungi in either the short term or long term (5+ years). Monitoring of *Botrychium gallicomontanum* in a native Minnesota prairie showed although damage occurred to plants when directly sprayed with glyphosate, plants underground, either as juvenile sporophytes or as dormant adult sporophytes at the time of herbicide application were not affected by the herbicide (Ahlenslager 2006, *personal communication*, referring to Johnson-Groh unpublished data). Thirteen days after the herbicide had been applied, newly discovered moonworts were yellowed and deformed, revealing obvious signs of damage. Two permanent plots were established in 1997 and have been monitored annually for the long-term effects of the herbicide. In 1998, there were 36 new plants that had not been present in 1997 when the plots were sprayed. Plants underground, either as juvenile sporophytes, which have not yet emerged, or, as dormant adult sporophytes at the time of herbicide application, probably were not affected by the herbicide. These new recruits are typical of moonwort populations and will likely sustain the populations despite one year of herbicide application. Invasive plant treatments would benefit sensitive plant species in the long-term by reducing impacts from invasive plants. Without the availability of herbicides as a treatment option, invasive plants have the potential to overrun and displace rare plants, jeopardizing their viability. As discussed previously, invasive plants are a serious threat to the long-term viability of sensitive plants. On the Forests and Grassland, Conservation Strategies for Peck's mariposa lily (Dewey 2008), Peck's penstemon (Pajutee 2008a), and pumice grape-fern (Powers 2008) all identify invasive plants as a threat.

The majority of invasive plant sites proposed for treatment are along roads and in other disturbed sites (e.g., quarries, utility sites, trails, etc.). The majority of sensitive plant populations are not centered along roads, quarries, or other highly disturbed sites that tend to be occupied by invasive plants, though the perimeter of sensitive plant populations may intersect with roads. PDF 63 requires surveys for TES and other rare and uncommon plants if needed (see PDF 63 for details); this gives us the knowledge and ability to employ other PDFs to protect sensitive plants if they are present.

There are sensitive plants that are adapted to open, disturbed habitats. Any species along roadsides or where activities occur that disturb native plant communities will be threatened by not only invasive plants, but by invasive plant treatments (R6 2005 FEIS, 4-130). Some sensitive plants actually do well in disturbed areas because they are adapted to early seral conditions. For example, tall agoseris (*Agoseris elata*) on Sisters District occurs in road ditches and along the edges of trails, which can be prime habitats for invasive plants such as spotted knapweed. Both tall agoseris and Peck's penstemon are fire-adapted and need bare mineral soil to germinate; spotted and diffuse knapweed competes for the same habitat. Those sensitive plant populations that occur in habitats occupied by invasive plants are at higher risk of being affected by invasive plant treatments. PDF 64 requires Forest Service Botanists to identify steps that need to be taken to protect sensitive plants, thus lowering the risk of inadvertently damaging sensitive plants by invasive plant treatments. This may involve avoiding and/or altering treatments so that sensitive plants are protected. Though tall agoseris and Peck's penstemon occur in early seral habitats, it is important to note that these habitats are dominated by native vegetation and might be considered low or moderately disturbed.

In some cases, the preferred herbicide for treating invasive plants that occur within sensitive plant populations could affect the sensitive plant if it were inadvertently contacted by the herbicide.

For example, metsulfuron methyl is the preferred herbicide for treating aggressive houndstongue, which can, and in some areas does, occur near Peck's mariposa lily. In this case, PDF 67 would be implemented and there would be no spraying of metsulfuron methyl within 35 feet of any Peck's mariposa lily plants. Houndstongue plants would either be sprayed with a different herbicide using selective methods, or hand-pulled. Table 34 explains why this PDF would be effective in protecting sensitive plants. Also, use of clopyralid on spotted knapweed or Canada thistle (both in the sunflower family) could harm individual plants of tall agoseris or Estes' artemisia (both also in the sunflower family). In this situation, PDF 67 would require that within 0 to 35 feet of these sensitive plants, clopyralid could be used but would be applied using selective methods such as wicking or wiping. If metsulfuron methyl is used to control St. Johnswort, it is possible for individual plants of Peck's penstemon to be harmed. Again, PDFs, such as PDF 67, would be implemented, lowering risk of damage to sensitive plants.

For example, in Project Area Unit 72-59, the use of sulfometuron methyl on medusahead could affect Henderson's needlegrass (*Achnatherum hendersonii*) plants if the herbicide inadvertently came into contact with the Henderson's needlegrass. At this site, in 2003, a Paulina District Botanist found and pulled three medusahead plants; in 2006, less than 12 plants were pulled. This early detection and rapid response was very effective in preventing rapid spread of the medusahead. Herbicides are proposed for this area if medusahead spreads beyond the point at which manual treatment is an effective option. If that were to happen, sulfometuron methyl could be selectively sprayed at distances of 35 feet or greater from Henderson's needlegrass plants using either a backpack spray or a dripless wick (PDF 67). PDF 64 requires a Forest Service Botanist to work with herbicide applicators to determine the best methods to protect this rare grass. In sensitive plant sites, the suite of available herbicides would be evaluated and the best one selected to protect the sensitive plant but still allow effective treatment. Sulfometuron methyl was identified as an herbicide that would be effective on medusahead (Appendix B, EIS); being a sulfonylurea herbicide, there is a potential for wind erosion. At this particular needlegrass site, there is not much risk of soil and/or wind erosion due to the amount of gravel and red clay soils (Mafera 2006 and Bautista 2006, *personal communication*). If a site evaluation suggested that wind erosion potential was high, other herbicides, such as glyphosate, would be considered. Both Alternatives 2 and 3 allow more herbicide options, allowing us more flexibility to select herbicides for particular situations to reduce/minimize non-target vegetation effects.

The ten proposed herbicides were evaluated for potential effects on each of the documented sensitive plant species (see Appendix C, Botany Report). Some herbicides are low risk to sensitive plant species because the herbicide does not target that plant family. For example, the herbicide sethoxydim is selective for annual and perennial grasses, whereas broadleaf plants and sedges tolerate this herbicide (*see* EIS, Appendix D). Clopyralid targets plants within the sunflower, legume, nightshade, and buckwheat families. Clopyralid treatment of spotted knapweed would not harm nearby plants of Peck's penstemon, which is in the figwort plant family. Conversely, tall agoseris is in the sunflower family, and could be affected by clopyralid. In some situations, some herbicides would not cause negative effects to a sensitive plant because the herbicide would not be proposed for use in the same habitat that a sensitive plant occurs in. For example, triclopyr is the preferred herbicide for use on Scotch broom and Himalayan blackberry and these two invasive plant species would not occur in habitats occupied by rare needlegrass species (*Achnatherum* spp.). Similarly, sensitive plant species that grow in aquatic environments would not likely be impacted by those herbicides that are not approved for aquatic use due to aquatic protection buffers.

The results of the evaluation are shown in Appendix C of the Botany Report and the information was used to make the determinations listed in Table 35. Forest Service Manual requires botanists to evaluate each proposed project to determine if it would affect sensitive plants, and to develop recommendations for removing, avoiding, or compensating for any adverse effects (USDA Forest Service 1995b). We are required to determine if a project will either have No Impact (NI), or May Impact Individuals or Habitat but will not likely contribute to a trend towards federal listing (MIIH), or Will Impact Individuals or Habitat (WIIH) with a consequence that the action may contribute to a trend towards Federal listing or cause a loss of viability to the population or species. There are no "WIIH" determinations in Alternative 2 because: 1) invasive plant treatments will benefit native plant habitats and therefore benefit sensitive plants; and 2) PDFs would provide protection to sensitive plants from invasive plant treatments (see Table 32, especially PDFs 63, 64, 65, 64, and 67). Due to the high level of threat to sensitive plants from invasive plants, any changes to native plant habitats that might occur from herbicide use or other invasive plant treatments would be relatively short-term (1-5 years). Invasive plant treatments may take several years to control or eradicate the population; however herbicide use would be reduced each year as the invasive plant population is reduced. Invasive plant treatments are critical for protecting sensitive plant habitats in the long-term.

If an herbicide has the potential to impact a sensitive plant, then PDFs listed in Appendix C must be applied in order to minimize or eliminate potential effects. An effects determination of May Impact Individuals or Habitat is due to remaining uncertainty because the herbicide could cause some damage if it were to unintentionally come into contact with an individual plant.

If additional populations of the sensitive plant species listed in Appendix C of the Botany Report are located in the future within Invasive Plant Project Area Units, this table provides guidance on which PDFs should be applied to protect the sensitive plant and this information would become part of the annual implementation planning process. If a new Sensitive plant species (i.e. not listed in Appendix C of the Botany Report) was located, the same analysis process used in this EIS would be applied: each herbicide would be evaluated for its potential to affect the sensitive plant and the appropriate PDFs identified to ensure that any risks are minimized or eliminated.

The Early Detection/Rapid Response Strategy under Alternative 2 would reduce the risk of invasive plant spread and provide better protection to sensitive plants than currently allowed (under Alternative 1) because it allows us to respond quickly to new invasive plant populations.

Alternative 2 is consistent with management direction in the Species Conservation Strategy for Peck's penstemon (Pajutee 2008a), the Conservation Strategy for pumice grape fern (Powers 2008), and the Conservation Strategy for Peck's mariposa lily (Dewey 2008). All three Conservation Strategies identify invasive plants as threats to these sensitive plant species; treating invasive plants is important for protecting these species. Control of invasive plants according to the methods proposed in Alternative 2 would avoid the loss of viability and a significant trend toward listing for these species.

Table 35. Evaluation of potential effects of proposed herbicides on currently known sensitive plant populations within Invasive Plant Project Area Units for Alternatives 2 and 3. Effects codes: NI = No Impact; MIIH = May Impact Individuals or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing or Loss of Viability to The Population or Species. See Appendix C of the Botany report for applicable PDFs for each species. Note: PDFs would minimize or eliminate effects to Sensitive plants; an effects determination of MIIH is due to remaining uncertainty because the herbicide could cause some damage if it were to unintentionally come into contact with an individual plant.

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
11-02	Pumice grape fern (*Botrychium pumicola*) Green-tinged paintbrush (*Castilleja chlorotica*)	N	> 3,000	No herbicides planned close to TES populations. Spotted knapweed is the closest invasive plant and clopyralid, which is proposed for use, would not affect either sensitive plant.	NI
11-04	Green-tinged paintbrush (*Castilleja chlorotica*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds and Canada thistle. Green-tinged paintbrush is in the figwort family and would not be affected by clopyralid.	NI
11-05	Pumice grape fern (*Botrychium pumicola*)	Y	0	Clopyralid is proposed for use on spotted knapweed. Pumice grape fern is in the Adder's tongue family and would not be affected by clopyralid. Very few invasive plant sites (Powers 2006, *personal communication*).	NI
11-09	Green-tinged paintbrush (*Castilleja chlorotica*)	N	100	Clopyralid is proposed for use on spotted knapweed. Green-tinged paintbrush is in the Scrophulariaceae family which would not be affected by clopyralid.	NI
11-12	Green-tinged paintbrush (*Castilleja chlorotica*)	N	26,000	No herbicides planned near TES populations. Spotted knapweed is the closest invasive plant and clopyralid, proposed for use, does not target Scrophulariaceae family.	NI
11-17	Newberry's gentian (*Gentiana newberryi*)	N	280	Spotted knapweed is closest invasive plant and clopyralid, proposed for use, would not affect Newberry's gentian.	NI
11-37	Green-tinged paintbrush (*Castilleja chlorotica*)	Y	0	Invasive plants would be treated manually so there would be no effects from herbicides.	NI
11-62	Estes' artemisia (*Artemisia ludoviciana* ssp. *estesii*)	Y	0	Clopyralid is proposed for use on Canada thistle, which is in the sunflower family. Being as Estes' artemisia is also in the sunflower family, there is a potential risk.	MIIH
12-02	Columbia yellowcress (*Rorippa columbiae*)	N	< 100	Sisymbrium altissimum is across the Hwy from Rorippa, but this species is not proposed for treatment. Rorippa occurs in a highly disturbed habitat and at high risk from invasive plants more than proposed treatments. Due to the variety of invasive plants that can occur along Highway 58, various herbicides might be used.	MIIH

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
12-05	Swaying bulrush (*Scirpus subterminalis*)	N	Within 100	Reed canarygrass occurs throughout the marsh, but swaying bulrush does not occur within areas proposed for treatment. Solarization techniques are the primary treatment with possibly some spot herbicide treatments. Swaying bulrush would be flagged prior to treatment and avoided.	NI
15-01	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds and Canada thistle. Peck's penstemon is in figwort family and would not be affected by clopyralid; however, tall agoseris is in the same plant family as the knapweeds and thistle (sunflower family); therefore potential effects. Peck's penstemon population is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a)	MIIH
15-02	Tall agoseris (*Agoseris elata*)	N	130	Spotted knapweed is closest invasive plant; clopyralid, proposed for use, could affect tall agoseris.	MIIH
15-03	Newberry's gentian (*Gentiana newberryi*) Peck's penstemon (*Penstemon peckii*)	N	> 3,000	Invasive plants would be treated manually so there would be no effects from herbicides. Newberry's gentian is at the far south end of the Project Area in wet meadows and not close to any invasive plant populations. Peck's penstemon does occur with spotted & diffuse knapweeds; clopyralid (proposed for use on knapweeds which are in the sunflower family) would not affect Peck's penstemon (which is in the figwort family). Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
15-04	Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds (sunflower family) and would not affect Peck's penstemon (figwort family). Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
15-05	Peck's penstemon (*Penstemon peckii*)	Y	0	Peck's penstemon would not be affected by the use of Clopyralid, on spotted & diffuse knapweeds, but could be affected by the use of metsulfuron methyl, proposed for use on St. Johnswort. This population is designated as a Managed population in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-06	Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds (sunflower family) and would not affect Peck's penstemon (figwort family). Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
15-07	Peck's penstemon (*Penstemon peckii*)	Y	0	Metsulfuron methyl is proposed for use on St. Johnswort and could affect Peck's penstemon. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-10	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Peck's penstemon would not be affected by the use of Clopyralid, on spotted & diffuse knapweeds, but could be affected by the use of metsulfuron methyl, proposed for use on St. Johnswort. Tall agoseris could be affected by both herbicides. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-11	Peck's penstemon (*Penstemon peckii*)	Y	0	Invasive plants would be treated manually so there would be no effects from herbicides. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
15-12	Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds (sunflower family) and would not affect Peck's penstemon (figwort family). Designated as Managed in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
15-13	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds and Canada thistle. Peck's penstemon is in figwort family and would not be affected by clopyralid; however, tall agoseris is in the same plant family as the knapweeds and thistle (sunflower family); therefore potential effects. This population is designated as a Managed population in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-14	Peck's penstemon (*Penstemon peckii*)	Y	0 and 291	St. Johnswort occurs within Peck's penstemon population; metsulfuron methyl, proposed for use on St. Johnswort, could affect Peck's penstemon. Spotted knapweed is ~ 290 ft. away; Peck's penstemon would not be affected by clopyralid. See Appendix C for applicable PDFs. This population is designated as a Managed population in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-16	Peck's penstemon (*Penstemon peckii*)	N	~100	Metsulfuron methyl, proposed for use on St. Johnswort, could affect Peck's penstemon. See Appendix C for applicable PDFs. This population is designated as a Managed population in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-18	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Invasive plants would be treated manually so there would be no effects from herbicides. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
15-19	Peck's penstemon (*Penstemon peckii*)	Y	0	Clopyralid is proposed for use on spotted & diffuse knapweeds and Canada thistle. Peck's penstemon is in figwort family and would not be affected by clopyralid. Picloram, proposed for use on Dalmatian toadflax, could affect Peck's penstemon. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-20	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Peck's penstemon would not be affected by the use of Clopyralid proposed for use on spotted & diffuse knapweeds, but could be affected by the use of metsulfuron methyl, proposed for use on St. Johnswort. Tall agoseris could be affected by both herbicides. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-21	Tall agoseris (*Agoseris elata*) Peck's penstemon (*Penstemon peckii*)	Y	0	Invasive plants would be treated manually except for Canada thistle. Peck's penstemon would not be affected by the use of clopyralid, which would be the preferred herbicide for Canada thistle. Tall agoseris could be affected by Clopyralid. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	MIIH
15-27	Peck's penstemon (*Penstemon peckii*)	Y	0	Bull thistle would be treated manually and there would be no effects to Peck's penstemon from herbicides. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
15-31	Tall agoseris (*Agoseris elata*)	Y	0	Spotted knapweed is closest invasive plant; clopyralid, proposed for use, could affect tall agoseris.	MIIH
15-32	Peck's penstemon (*Penstemon peckii*)	Y	0	Ribbongrass treatments would be extremely site- and species-specific and there would not be impacts to Peck's penstemon, which does not occur in the same habitat as the ribbongrass. Peck's penstemon is designated as Protected in the Draft Species Conservation Strategy (Pajutee 2006a).	NI
71-02	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	4,480	No herbicides planned close to Peck's mariposa lily populations. Spotted knapweed is the closest invasive plant; clopyralid, proposed for use, would not affect Peck's mariposa lily.	NI
71-08	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	3,260	No herbicides planned close to Peck's mariposa lily populations. Scotch thistle is the closest invasive plant; clopyralid, proposed for use, would not affect Peck's mariposa lily.	NI

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
71-17	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily (lily family) would not be affected by clopyralid, proposed for use on diffuse knapweed. Picloram, proposed for use on Russian knapweed, is not expected to affect CALOP because of monitoring results of using high application rates of picloram within a *Calochortus macrocarpus* population (Mark Lesko 2006, personal communication).	NI
71-19	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	675	Metsulfuron methyl, proposed for use on houndstongue, could be injurious to Peck's mariposa lily, so MIIH. However, currently houndstongue far enough from lily.	MIIH
71-25	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	2,380	No herbicides planned close to Peck's mariposa lily populations. Houndstongue quite far down the road from Peck's mariposa lily.	NI
71-31	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	2,000	Houndstongue quite far from Peck's mariposa lily.	NI
71-45	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	17,000	No herbicides planned close to Peck's mariposa lily populations. Spotted knapweed is currently quite far from Peck's mariposa lily.	NI
71-50	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	5,780	No herbicides planned close to Peck's mariposa lily populations.	NI
71-51	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	800	No herbicides planned close to Peck's mariposa lily populations. Clopyralid is proposed for treating the nearest Canada thistle (sunflower plant family) site (~ 800 ft. from Peck's mariposa lily) would not affect members of the lily family.	NI
71-59	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	600	Peck's mariposa lily (lily family) would not be affected – Canada thistle will only be treated with biocontrol. No herbicide effects expected.	NI
72-01	Bastard milkvetch (*Astragalus tegetarioides*)	N	1,800	No herbicides planned close to bastard milkvetch populations. Chlorsulfuron is proposed for use on whitetop, but whitetop is relatively far away. See Appendix C for applicable PDFs.	NI
72-03	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily would not be affected by clopyralid, proposed for use on spotted knapweed and Canada thistle, but could be affected by metsulfuron methyl, proposed for use on St. Johnswort.	MIIH

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
72-04	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily would not be affected by clopyralid, proposed for use on spotted knapweed, but could be affected by picloram, proposed for use on Dalmatian toadflax and sulphur cinquefoil.	MIIH
72-05	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	1,000	No herbicides planned close to bastard milkvetch populations. Closest infestation is Canada thistle; Peck's mariposa lily (lily family) would not be affected by clopyralid which is proposed for use on Canada thistle (sunflower family).	NI
72-06	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	85	Canada thistle population is relatively close to Peck's mariposa lily; however, clopyralid does not target the lily family.	NI
72-07	Northern moonwort (*Botrychium pinnatum*) Scalloped moonwort (*Botrychium crenulatum*)	N	12	Botrychium species (in the Adder's tongue family) are not in a plant family that is targeted by clopyralid (which is proposed for use on Canada thistle).	NI
72-12	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily (lily family) would not be affected by clopyralid, proposed for use on Canada thistle (sunflower family).	NI
72-13	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily would not be affected by clopyralid, proposed for use on diffuse knapweed and Canada thistle, but could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-14	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-15	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-16	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	35	Peck's mariposa lily could be affected by sulfometuron methyl, proposed for use on medusahead.	MIIH
72-17	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl (proposed for use on houndstongue) and sulfometuron methyl (proposed for use on medusahead).	MIIH

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
72-18	Silverskin lichen *Dermatocarpon luridum*	N	Not sure – may be plants in riparian area next to Roba Creek, near lichen	Silverskin lichen occurs in the water, usually submerged or inundated for most of the year. This analysis assumes that all herbicides would affect lichens, but PDFs would keep herbicides out of the water. Houndstongue is the closest invasive plant and metsulfuron methyl is proposed for use on it; this is not an aquatic herbicide and aquatic buffers and water-related PDFs would apply.	NI
72-19	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-20	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-25	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-32	Mingan moonwort *(Botrychium minganense)* Peculiar moonwort (*Botrychium montanum*)	N	135	Chlorsulfuron, proposed for use on whitetop, could affect the Botrychium species.	MIIH
72-42	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-50	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Peck's mariposa lily could be affected by metsulfuron methyl, proposed for use on houndstongue.	MIIH
72-52	Bottlebrush sedge (*Carex hystericina*)	Y	0	Invasive plants would be treated manually and there would be no effects from herbicides on the sedge.	NI

Project Area	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
72-59	Henderson's needlegrass (*Achnatherum hendersonii*)	Y	0	Currently, medusahead very limited due to rapid response (hand pulled 3 plants found in 2003 & < 12 plants in 2006). However, if medusahead does come back and rapidly expands beyond that which can be hand-pulled, or a large medusahead population is discovered nearby, herbicide would be considered. Sulfometuron methyl is proposed for use on medusahead, using a combination of techniques to avoid needlegrass. Glyphosate may be considered adjacent to needlegrass.	Currently = NI; if future rapid expansion of medusahead were to occur, then would be MIIH
75-43	Peck's penstemon (*Penstemon peckii*)	N	150	Sulfometuron methyl, proposed for use on medusahead, could affect Peck's penstemon.	MIIH

Effects to Other Rare and Uncommon Plants

The prefield review identified known sites for other rare and uncommon plant species within Project Area Units on the Deschutes National Forest within the Northwest Forest Plan area (a special area managed for old growth forest conditions). Seven Invasive Plant Project Area Units contain known sites of other rare and uncommon plant species (Table 31): one vascular plant (*Cypripedium montanum*, lady's slipper), one liverwort (Tritomaria exsectiformis), and 3 fungi (*Choiromyces alveolatus*, *Hydnotrya inordinata*, and *Hygrophorus caeruleus*)

As discussed earlier (*Effects of Invasive Plants on Non-Target Plants*), controlling invasive plants ultimately protects native plant habitats and biological diversity. This would benefit the long-term viability of other rare and uncommon plant species.

In the short-term (1-5 years), herbicide treatments could potentially damage individual rare and uncommon plants and possibly their host plants, but would not result in a decrease in distribution (loss of sites) or loss of habitat. Of these five rare and uncommon species, two would likely be most affected by both invasive plants (i.e., loss of habitat) and/or invasive plant treatments (ground disturbance from manual treatments or potential damage by herbicide):

- Mountain lady's slipper (*Cypripedium montanum*) would likely be the most affected because it occurs in the same habitat as invasive plants, along disturbed road shoulders. Table 38 describes the mountain lady slipper sites within the three Project Area Units, what invasive plants are proposed for treatments, and application of PDFs. Botany PDFs 63, 64, 65, 66, 67, and/or 69 would be applicable, depending on the treatment type (manual or herbicide). In addition, other layers of caution (e.g., the PDFs listed in Table 34) would reduce the risk of potential damage to no-target plants. In the long-term (5+ years), eliminating invasive plants within mountain lady slipper sites will protect these orchid species.
- A fungus, *Choiromyces alveolatus*, occurs in Project Area Unit 15-05 on Sisters District. This species forms fruiting bodies (i.e., sporocarps) beneath the soil surface, making it difficult to locate it and to determine the extent of the population (*see Herbicide Effects Specific to Non-Vascular Plants*). Due to recent wildfires, St. Johnswort sites have expanded, moving into the forest off of Highway 20. We cannot accurately locate and avoid this fungus when conducting invasive plant treatments. However, PDFs designed to use the lowest effective herbicide rate, minimize drift or runoff, minimize ground disturbance during manual treatments, and protect soils and non-target plants from herbicides (PDFs 12, 13, 15, 16, 17, 47, 48, 64, 65, 69, 70, and 71; see Table 32) would reduce the risk that fungal mycelium and non-target host plants of fungi would be impacted from herbicides. As with mountain lady's slipper, controlling invasive plants will protect the fungus habitat.

The other three rare and uncommon species sites are not currently threatened by invasive plants and would not be damaged from herbicide treatments (see Table 36) because:

- *Tritomaria exsectiformis* occurs in very wet habitats. Riparian invasive plant species, such as reed canarygrass and ribbongrass, could pose a threat to populations of this liverwort, but there are currently no known invasive plant threats to these sites (Dewey 2006, personal communication). Currently, the known Tritomaria exsectiformis site is more than 850 feet from mapped invasive plant sites -- far enough away so that no effects from the use of herbicides would occur (see discussion in PDF 67, Table 32).
- There are two known sites of *Hygrophorus caeruleus* within Project Area Units (Table 38). The fungus grows in moist, closed-canopied forest areas, whereas the invasive plants are found in sunny disturbed areas along road shoulders (Pajutee 2008b).

- The known *Hydnotrya inordinata* is not near any invasive plant sites.

The project is not likely to result in adverse impacts to these rare and uncommon species populations or their habitat because PDFs are tailored to protect non-target vegetation (Table 32). Changes in species distribution or loss of habitat are not expected. Other layers of caution, such as Regional Invasive Plant Standards and herbicide label restrictions, would be incorporated into planning and implementing treatments and provide added layers of protection. Potential impacts to other rare and uncommon plants are expected to be minimal (i.e., reduced the lowest extent possible) or eliminated, and there would be no decrease in distribution or loss of habitat.

The Early Detection/Rapid Response Strategy under Alternative 2 would increase our ability to more quickly treat invasive plant sites, providing more protection in the long-term to the native plant habitats occupied by other rare and uncommon plants.

Table 36. Evaluation of potential effects of proposed herbicides on known rare and uncommon plant populations within Invasive Plant Project Area Units for both Alternatives 2 and 3. Effects codes: NI = No Impact; MIIH = May Impact Individuals or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing or Loss of Viability to The Population or Species. An effects determination of MIIH is a conservative approach due to remaining uncertainty after PDFs have been applied. If a small amount of herbicide were to drift or run-off, there could be some damage to non-target plants or fungal mycelium.

Project Area	Species	Life-form	Invasive Plant within population	Distance from closest infestation (ft.)	Notes about proposed herbicide treatments for closest infestations and PDFs	Effects Conclusion after applying PDFs
11-07	*Hydnotrya inordinata*	Fungus	N	8,000	No invasive plant sites nearby.	NI
11-17	*Tritomaria exsectiformis*	Liver-wort	N	850+	One *Tritomaria exsectiformis* site occurred downstream from a spotted knapweed site near the intake facility, but is believed to be extirpated; the other TREX3 site is at a seep near Skyliner Lodge and at least 850 feet away from spotted knapweed & bull thistle sites along Tumalo Creek. Clopyralid, proposed for use on those 2 invasives, but TREX3 is far away and effects are not expected.	NI
15-01	*Hygrophorus caeruleus*	Fungus	Y	0	Within mapped spotted knapweed site. All applicable PDFs would be applied.	MIIH
15-05	*Choiromyces alveolatus*	Fungus	Y	0	Spotted knapweed occurs along Hwy 20; St. Johnswort has expanded in areas along Hwy 20 due to recent wildfires. The preferred herbicides to target these invasives would be Clopyralid for use on spotted knapweed and metsulfuron methyl on St. Johnswort. All applicable PDFs would be applied.	MII
15-10	*Hygrophorus caeruleus*	Fungus	Y	0	Fungus site on edge of Project Area Unit, in vicinity of 1232/320 Rds junction. Diffuse knapweed and St. Johnswort in area. All applicable PDFs would be applied.	MIIH
15-14	*Cypripedium montanum*	Vascular plant	Y	0	Five sites occur. Diffuse knapweed occurs in the road very near *Cypripedium montanum* in the Gunsight Pass area. Bull thistle and cheatgrass do occur along the same road. Medusahead was found (and pulled) in the upper part of a timber sale unit immediately below the road. All applicable PDFs would be applied.	MIIH
15-17	Cypripedium montanum	Vascular plant	Y	Unknown	One site reported but not relocated yet. Spotted and diffuse knapweeds, St. Johnswort, and Scotch broom are mapped along Rd. 1499. Cypripedium would not be affected by clopyralid (used on knapweeds), but could be affected by metsulfuron methyl for St. Johnswort, and possibly by triclopyr used on Scotch broom. PDF 61 (surveys) and 62 (botanist identify steps to protect) at a minimum would be needed to protect Cypripedium. All applicable PDFs would be applied.	MIIH

Summary of Effects to Non-Target Native Vegetation for Alternative 2

Table 26 compares the three alternatives for their effects to non-target plants from both invasive plants and invasive plant treatments. Specifically, Alternative 2 would result in the following:

- ***Provides greatest protection to non-target plants from invasive plants.***
  - All currently mapped invasive plant infestations can be treated.
  - Maximum number of available herbicides would increase treatment effectiveness.
  - An Early Detection/Rapid Response Strategy allows us to respond quickly to new infestations.
  - Treatment effectiveness analysis determined Alternative 2 is the most effective in controlling invasive plants
  - Alternative 2 provides is the most effective in treating invasive plants and, therefore, poses the highest protection to sensitive and other rare and uncommon plants from loss of habitat.
- ***Increased herbicide use is mitigated to minimize or eliminate effects to non-target plants from herbicides***
  - All currently mapped invasive plant infestations can be treated; therefore herbicide use is maximized in this alternative. However, effects to non-target plants are minimized or eliminated by incorporating PDFs and other layer of caution.
  - More selective herbicides provide options to reduce the risk to non-target native plants.

ALTERNATIVE 3

Direct and Indirect Effects

Alternative 3 was developed to respond to issues surrounding the effects to aquatic organisms. The areas proposed for invasive plant treatments are the same as Alternative 2, but differ in the prescriptions. Under Alternative 3, a 300-foot buffer will apply to all perennial streams, all fish bearing streams and all perennial lakes, ponds, and reservoirs. Within the buffers, treatment methods are restricted as follows:

- The following herbicides would not be allowed within 300 feet of water: Triclopyr, Picloram, or Sethoxydim.
- Broadcast spraying would not be allowed within these buffers or along road segments that are within 300 feet of perennial streams or lakes.
- Machinery or equipment that could cause substantial sedimentation would not be allowed within the buffers or along roads where they are within 300 feet of a perennial stream or lake.
- In addition, there would be no herbicide application allowed within the definable channel of intermittent streams when they are dry or within 10 ft of perennial or fish bearing streams, rivers, lakes, ponds or reservoirs and intermittent streams when flowing. (Under Alternative 2, invasive species that are below the high water mark could be treated with herbicides as water levels drop seasonally). This impacts treatment on approximately 230 acres of perennial streams, springs, or lakes and approximately 30 acres on intermittent streams.

Direct and Indirect Effects on Non-Target Plants for Alternative 3

As discussed earlier (*see Effects of Invasive Plants on Non-Target Plants*), controlling invasive plants ultimately protects native plant habitats and biological diversity. This would benefit the long-term viability of other rare and uncommon plant species. Both Alternatives 2 and 3 would be more effective in treating invasive plants (Table 28), providing more protection to native plant habitats from invasive plants.

Alternative 3 is similar to Alternative 2 in that the ten herbicides analyzed in the Regional Invasive Plant FEIS would be available for use, providing more options for more efficient and effective treatment of invasive plants than Alternative 1. The ability to use more selective herbicides in certain situations would reduce impacts to non-target plants, such as clopyralid which targets specific plant families. The same PDFs and other non-target plant protection measures (Table 32) described above for Alternative 2 also apply to Alternative 3. Combined with other layers of caution (e.g., Regional Standards, and herbicide laws and regulations), Alternative 3 would protect to non-target plant species from herbicides. Selective application methods, timing of treatments, and more selective herbicides that are less harmful to desired, non-target plants will result in minimal, if any, effects. The Early Detection/Rapid Response Strategy would increase treatment effectiveness through quick response to newly discovered invasive plant populations, controlling them before they spread further and providing increased protection to native plant habitats. Herbicide use would decrease as invasive plant populations are reduced.

The primary difference between the two alternatives is that Alternative 3 limits the herbicide methods (no broadcast spray within 300 feet of water), the selection of herbicides that can be applied within 300 ft. of water (cannot use triclopyr, sethoxydim, and picloram), and no herbicides can be used within 10 feet of water. The latter restriction currently affects only about 230 our mapped acres of invasive plants, but – for the reasons described below – does affect our current and future ability to protect riparian areas from invasive plants.

Restrictions on broadcast spraying under Alternative 3 would result in more selective herbicide application methods (i.e., spot spray, wicking) within 300 ft. of water. Selective herbicide application methods do result in the use of less herbicide with less potential drift or runoff (see *Effects of Herbicides to Non-Target Plants*).

Under Alternative 3, herbicides cannot be used within 10 feet of water. Controlling rhizomatous species, such as reed canarygrass, ribbongrass and Canada thistle, would be more difficult than under Alternative 2, which allows the use of some herbicides up to the water's edge. Large infestations of these rhizomatous species are difficult to control manually. Successful manual treatments of rhizomatous species would require persistent, frequent hand-pulling of all sprouting stems throughout the growing season. More than 250 clumps of ribbongrass occur along the edge and on islands within the Metolius River, scattered along 10 miles of river. The total size of this infestation is estimated to comprise only about one acre, yet due to the rhizomatous growth of ribbongrass and accessibility issues along the river, repeated and frequent manual treatments would be difficult. A demonstration project on private land being conducted by the Friends of the Metolius (with the Forest Service assisting in monitoring and data collection as a partner) is testing herbicide, manual, and solarization methods for treating ribbongrass. Initial treatments showed that hand-pulling ribbongrass clumps that occur on cobbles in the water were easier than on the streambank where it proved to be difficult and nearly impossible to avoid pulling the native grasses and sedges that are intermixed with ribbongrass. Pulling ribbongrass on the streambank leaves more bare soil that can add additional fine sediments to the river.

Additionally, manual treatment of ribbongrass is labor intensive and very costly. On August 27, 2008, volunteers from the Camp Sherman Weed Warriors and Sierra Club joined Forest Service specialists to conduct a test trail to provide preliminary information on what it would require to manually remove the ribbongrass (Pajutee 2008c). Using this demo as an indicator, a rough estimate of time and people required to pull the approximate one acre of ribbongrass infestation in the Metolius River would take 1,089 days (8 hours/day) for one person. For a 10 person inmate crew, it would take 109 days (8 hours/day) and cost approximately $109,000. This one acre of ribbongrass infestation would take the majority of focus, reducing our ability to treat the hundreds of other invasive plant sites.

Under Alternative 3, ribbongrass and other rhizomatous riparian plant species are likely to continue spreading. The same applies to reed canarygrass and Canada thistle. Riparian invasive plant species outcompete native riparian species that occupy the narrow wet margins of rivers and streams, such as clustered field sedge (*Carex praegracilis*). If ribbongrass continues to displace native vegetation, forming monocultures along the Metolius River, there would also be indirect effects to pollinators, aquatic insects, and wildlife that depend on the diversity of native plants. Within the 10-foot no herbicide buffer, soil solarization is another method that could be utilized; however, soil solarization can deter the growth of desirable native plant species (Tu et al. 2001).

Manual pulling of tap-rooted species, such as spotted knapweed, in riparian areas can also be very difficult (Powers 2006, *personal communication*). In some riparian sites, the soil is compacted from heavy riparian use; some sites are difficult to pull due to the multitude of intertwined roots from other species that can occur in riparian areas, which are often more densely-vegetated than the surrounding uplands. The ten foot no-herbicide buffer under Alternative 3 may result in less effective treatment of those riparian sites where these conditions occur.

In many riparian areas, manual treatment of invasive plants in the 10 ft. buffer would be feasible if populations are small and easily accessible, the soil is not compacted, and roots can easily be pulled. These sites will require more effort and time to eradicate the invasive plants because manual treatments are more labor intensive and time consuming. Depending on the size of the infestation and the number of people required to hand-pull plants, there can be trampling effects to native plants from the manual treatments. Given historical Forest Service budgets, it is likely that fewer acres of invasive plants would be treated annually and effects to native plant communities may be longer-term in these situations.

Alternative 3 does not allow the use of triclopyr within 300 ft. of riparian areas. Triclopyr is proposed for use on Himalayan blackberry, which occurs at one site (on ~ 0.8 acre) along Cottonwood Creek on Paulina District, growing approximately 50 feet or less from this perennial creek. Himalayan blackberry is an aggressive species that can grow up to lengths of 7 meters in a single season (Mazzu 2005). Once first year canes have arched over and hit the ground, daughter plants can develop where cane apices have rooted. Paulina District’s site is expanding and, if left unchecked, has the potential to become a very large infestation. This aggressive species is a high priority for treatment with the objective of eradicating it before it spreads further, impacting additional native plant habitat. The Paulina District’s Himalayan blackberry site went from one stem in year 2000, to 30 ft. diameter in 2002, and eight “daughter” plants formed in 2004 (Mafera 2006, *personal communication*). This site, which occurs along an anadromous fish stream, is not easily accessible -- it takes about 1.25 hours drive and a three mile hike to reach the site. For manual treatment to be effective it would require repeated treatments throughout several growing seasons; the distance involved in getting to this site reduces our ability to effectively treat it manually. Triclopyr is the preferred herbicide for treating Himalayan blackberry (Appendix B). Triclopyr is a selective systemic herbicide for woody and broadleaf species, especially root- or stem-sprouting species (Appendix C); Regional Standard 19 requires us to use selective application methods, such as cutting stems and applying the herbicide just to the cut stump (R6 2005 FEIS). Cut stump treatment is very selective, with no effects to native vegetation because there is no over-spray or drift. In Alternative 3, spot spraying using glyphosate would be used. Glyphosate is a non-selective herbicide that kills both grass and broadleaf plants; there will be some damage to non-target vegetation using spot spraying. In this situation, Alternative 2 would provide more effective treatment of Himalayan blackberry and fewer impacts to native vegetation than alternative 3.

Sensitive Plants

As discussed earlier in Alternatives 1 and 2, two Project Area Units (PAU) were selected for comparison purposes to represent how the alternatives differ in treating invasive plants that occur with sensitive plants (Botany Report, Appendix I). The representative PAUs are:

- PAU 15-01 – Known as "Little Montana", this PAU contains a large infestation of spotted knapweed, which is one of the most abundant invasive plants on the Deschutes National Forest. The Sensitive plant, Peck's penstemon, occurs intermixed with spotted knapweed.
- PAU 72-50 – Known as "Burnt Corral Creek, this PAU contains a large infestation of houndstongue, one of the most abundant invasive plants on the Ochoco National Forest. The Sensitive plant, Peck's mariposa lily, occurs intermixed with houndstongue.

In both PAUs, Alternative 3 would control invasive plants more quickly than Alternative 1 but not as quickly as Alternative 2 (Appendix I of the Botany Report):

Project Area Unit	Alternative 1	Alternative 2	Alternative 3
15-01	132.1	0.1	1.0
72-50	6.5	0.03	2.7

The primary difference between Alternatives 2 and 3 regarding sensitive plants is that Alternative 3 does not provide the ability to use the most effective treatment methods for riparian rhizomatous plants (Table 26) and it would take longer to control invasive plant infestation.

The same PDFs apply for both Alternatives 2 and 2 (Table 32). PDFs 63, 64, 65, 66, 67, 68, and 71 were specifically developed to minimize or eliminate herbicide treatment effects to sensitive plants and to comply with Regional Invasive Plant Standards (R6 2005 ROD). For example, PDF 71 requires the lowest effective application rate be used when applying sulfonylurea herbicides (chlorsulfuron, metsulfuron methyl, and sulfometuron methyl) and these herbicides cannot be used within 35 feet of a known sensitive (or other rare and uncommon) plant. In the long-term, sensitive plant habitats will benefit from invasive plant treatments. Regional standards that require restoration of disturbed ground (including passive restoration where there is a good supply of native plants to colonize sites), retention of native vegetation and development of a long term strategy for infested areas, will ensure that sensitive plants are given consideration during project planning and that healthy habitat will be promoted. Regional Standard 20 requires that we design treatments to reduce or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. Though there are no proposed or listed Threatened or Endangered plant species on the Forest and Grassland, we will be using site-specific project design (e.g., application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) in applying herbicide treatments near sensitive plants.

As with Alternative 2, even with the PDFs and all the layers of caution integrated into herbicide treatments, there is always the chance – though a minimal chance – that an individual sensitive plant might be damaged by inadvertent herbicide contact. However, this would be a short-term effect (1-5 years) and invasive plant treatments would benefit sensitive plant species in the long-term (5+ years). There is greater concern that uncontrolled invasive plants will negatively impact sensitive plants and their habitats.

The effects determination to sensitive plants from invasive plant treatments is the same for Alternatives 2 and 3 (Table 35), habitat and individuals may be impacted but would not result in a loss of viability of the species. Using control methods other than herbicides would be less effective, therefore would take longer to contain or control. This could result in sensitive plant habitat adjacent to water being occupied by invasive plants outpacing control efforts (see the Treatment Effectiveness Section). The primary differences between Alternatives 2 and 3 for sensitive plants are:

1. **A reduced ability to control rhizomatous riparian invasive species that occur within 10 feet of water** (*see discussion above in 2.2.8.1, Direct and Indirect Effects on Non-Target Plants for Alternative 3*). Examples of how this affects sensitive plants are:
    a. Estes' artemisia, a central Oregon endemic plant species (only occurs in this area), is found along the Deschutes River, usually within 10 ft. of the river. Canada thistle, a rhizomatous species, occurs in the same habitat, close to the River.
    b. At Meadow Camp Picnic Area (Project Area Unit 11-62) on the Deschutes River, Canada thistle grows about 10 feet from Estes' artemisia. Hand-pulling Canada thistle increases its spread; if herbicides cannot be used, the only feasible treatment is to clip seed heads which does not reduce the density of Canada thistle. Canada thistle is expected to expand at this site under Alternative 3.
    c. Likewise, Canada thistle occurs with the sensitive bottlebrush sedge (*Carex hystericina*) in Black Canyon Wilderness on Paulina District (Project Area Unit 72-52). Our ability to treat Canada thistle is limited under Alternative 3.
2. **In some situations, a reduced ability to control non-rhizomatous invasive species that occur within the 10 ft. zone.** For example, Peck's penstemon occurs in wet sways and along intermittent creeks on Sisters District and is primarily threatened by spotted and diffuse knapweeds. Depending on accessibility, small populations of spotted knapweed could be hand-pulled within the 10 foot no-herbicide buffer; this tap-rooted species is easier to hand-pull than rhizomatous species. However, it would be more time-consuming, difficult, and less effective to hand-pull large knapweed populations. Project Area Unit 15-01 is a large spotted knapweed site that occurs within a Peck's penstemon population (designated as protected, Pajutee 2008a). Protected populations are carefully selected to represent the existing array of geographic and morphological variation that occurs within this species. These protected populations are chosen to be geographically distributed to promote pollinator outcrossing and maintain natural modes of seed dispersal. Protected populations aim to achieve long-term species viability by maintaining existing genetic variance and promoting reproductive success. Within this site, intermittent channels dissect the area. At this site, Alternative 2 would allow quicker and more effective control of spotted knapweed than Alternative 3.
3. **Reduced ability to broadcast spray selective herbicides within 300 feet of water.** More selective application methods, such as spot spraying or wiping, would be effective yet would likely take longer to accomplish. In some situations, restrictions on broadcast spraying may result in fewer acres being treated and a longer time to gain control over invasive plants; this may affect some sensitive plant populations. For example, Peck's penstemon does occur within 300 ft. of many creeks; broadcast spraying clopyralid could be done with minimal, if any, effects to Peck's penstemon and many native plants, and allow more efficient treatment of more acres. In this scenario, Alternative 2 would provide more options to gain control over spotted knapweed than Alternative 3.

However, in some situations, more selective herbicide methods (than broadcast spraying) would need to be used to protect sensitive plants and this would be the same for both Alternatives 2 and 3. For example, if a Forest Service Botanist determines that buffers are needed to protect sensitive plants

(PDF 66), then the buffers in PDF 67 would apply (Table 32). For example, treating spotted knapweed plants with clopyralid within a tall agoseris site would require more selective herbicide application methods (e.g., spot spraying) to protect the tall agoseris because this member of the sunflower family would be affected by this herbicide. Likewise, Peck's mariposa lily could be affected by use of metsulfuron methyl on houndstongue, requiring more selective herbicide methods instead of broadcast spraying.

Alternative 3 is consistent with management direction in the Species Conservation Strategy for Peck's penstemon (Pajutee 2008a), the Conservation Strategy for pumice grape fern (Powers 2008), and the Conservation Strategy for Peck's mariposa lily (Dewey 2008). All three Conservation Strategies identify invasive plants as threats to these sensitive plant species; treating invasive plants is important for protecting these species. Control of invasive plants according to the methods proposed in Alternative 3 would avoid the loss of viability and a trend toward listing for these species.

Other Rare and Uncommon Plants

As with sensitive plants, controlling invasive plants ultimately protects native plant habitats and biological diversity, which benefits rare and uncommon plants (*see Alternative 2 and discussion in Effects of Invasive Plants on Non-Target Plants*). Alternative 2 and 3 are the same for potential effects on other rare and uncommon plants (Table 38 *and see discussion for other rare and uncommon plants under Alternative 2*).

Because fungi are difficult to survey for (*see Herbicide Effects Specific to Non-Vascular Plants*), there could be some populations we have not yet discovered. Alternative 3's broadcast spray restrictions within 300 ft. of water may reduce potential impacts to non-target rare and uncommon plant species and/or host plants that occur in this zone and have not yet been discovered. Selective herbicide spraying reduces the amount of herbicide used and the potential for drift and run-off resulting in a lower risk of damage to non-target rare plants.

Within the 10 foot no-herbicide zone, there are no currently known rare and uncommon plant sites threatened by rhizomatous riparian species (e.g., reed canarygrass or ribbongrass). Potential habitat exists in this zone for *Tritomaria exsectiformis* and *Marsupella emarginata* var. *aquatica* (Table 29). Because riparian rhizomatous plant species are difficult to control without the use of herbicides, Alternative 3 does not provide as much protection to this riparian habitat, though there still would not be any decrease in species distribution or loss of habitat for these species in Alternative 3.

Summary of Effects to Native Vegetation for Alternative 3

Table 37 compares the three alternatives for their effects to non-target plants from both invasive plants and invasive plant treatments. Alternative 3 would move toward the desired conditions, but at a slower rate in riparian areas. Specifically, Alternative 3 would result in the following:

- ***Provides high level of protection to non-target plants from invasive plants, but not as much protection at Alternative 2 in riparian areas.***
    - All currently mapped invasive plant infestations can be treated.
    - Maximum number of available herbicides would increase treatment effectiveness.
    - An Early Detection/Rapid Response Strategy allows us to respond quickly to new infestations.
    - Treatment effectiveness analysis determined Alternative 3 is more effective in controlling invasive plants than Alternative 1 and is not quite as effective as Alternative 2 in the number of infested acres controlled by Year 2014. The primary difference is that

Alternative 3 provides lower protection to riparian habitats from invasive plants than Alternative 2.

- o Riparian native plants may continue to be impacted by rhizomatous invasive plant species. Riparian rhizomatous plant species, such as reed canarygrass and ribbongrass, that are difficult to control without the use of herbicides, would continue to impact native riparian plant species that grow near the water's edge.
- o Restricted broadcast spraying will likely minimize short-term impacts to non-target plants but will inhibit our ability to treat as many acres and treat infestations effectively in some sensitive plant populations.

- ***Increased herbicide use is mitigated to minimize or eliminate effects to non-target plants from herbicides***
    - o All currently mapped invasive plant infestations can be treated. However, effects to non-target plants are minimized or eliminated by incorporating PDFs and other layer of caution.
    - o More selective herbicides provide options to reduce the risk to non-target native plants.

Early Detection Rapid Response and Botanical Analysis

An Early Detection/Rapid Response (EDRR) Strategy was developed for treating new or previously undiscovered invasive plant infestations. The intent of the EDRR approach is to treat new infestations when they are small so that the likelihood of adverse effects from treatment is minimized, and the invasive plants will do less ecological damage.

We are assuming that new infestations will be similar to current infestations. For example, the majority of weed sites occur along roads and that will probably be the case into the near future. We also expect that the impacts of similar treatments would be predictable.

To implement EDRR, an invasive plant assessment review team will be assembled annually to review information from surveys and monitoring from the previous field season. The team will identify site conditions and ensure that nothing outside the scope of this EIS exists. Then, the team will identify the preferred method of treatment and determine if these methods are within the scope of the analysis of this EIS. For each site, applicable PDFs will be identified so they can be adhered to during treatment implementation.

This EDRR strategy increases treatment effectiveness (Table 26). The ability to quickly respond to new infestations is extremely important. We will be able to use less herbicide by treating infestations when they are small and there will be less potential impact to non-target plants.

Cumulative Effects on Non-Target Plants for All Alternatives

Cumulative effects are those impacts on the environment which result from the incremental impact of each action when added to other past, present, and reasonably foreseeable future actions. For this analysis, the spatial boundary of the cumulative effects analysis is the project area (i.e., Forests and Grassland) and the time period is as long as it takes to control invasive plant populations; this analysis assumes 15 years.

Cumulative Effects of Invasive Plants on Non-Target Plants – See Cumulative Effects section for Treatment Effectiveness. Alternative 1, which treats the fewest acres of invasive plants, could have adverse cumulative effects to non-target plants because spread is expected to exceed control efforts due to less effective treatment methods such as hand-pulling (see Tables 24 and 25). Alternatives 2 and 3, which treat the greatest number of acres of infestations, would not have cumulative effects from invasive plants on non-target plants.

Cumulative Effects to Non-Target Plants from Herbicide Treatments

Alternatives 2 and 3 limit potential direct and indirect effects due to PDFs and other layers of caution, reducing the potential for cumulative effects, even when this project is considered with other past, present and future projects. While some commonly used herbicides are associated with hazards to non-target plants, harmful amounts of herbicides coming into contact with non-target plants as a result of Forest Service applications are not likely, because the PDF and buffers minimize the amount of herbicide exposure possible and eliminate scenarios where concentration of herbicide could exceed thresholds of concern.

Many sensitive and other rare and uncommon plant species range beyond the Forests and Grassland and there may be additional populations that are threatened by invasive plants. The Forest Service, working with the Bureau of Land Management in the Interagency Special Status/Sensitive Species Program, has prioritized those Sensitive plants most needing conservation planning and identified National Forests that will work together to develop Conservation Assessments and Strategies for managing these rare species. Invasive plant treatments on other populations of sensitive plants on other federal lands are occurring. This conservation work will continue into the future and would reduce cumulative range-wide threats from invasive plants on rare plant habitat.

Current grazing practices have been identified as a potential threat to the rare Peck's mariposa lily. However, grazing practices are being modified through range allotment planning efforts. This should improve conditions for Peck's mariposa lily in the long-term. Spread of invasive plants from grazing is expected to be reduced under Regional Invasive Plant Standard 6, which requires that we use available administrative mechanisms to incorporate invasive plant practices into rangeland management, such as revising permits and grazing allotment management plans, providing annual operating instructions, and using adaptive management. Over time, improved grazing practices combined with the proposed invasive plant treatments should benefit sensitive plants.

There would be no cumulative effects to Sensitive plants from herbicide spraying approved under other projects. There are no sensitive plants located within the 18 Fire Competing Vegetation Management project (U.S. Forest Service 2006c), which approved the use of spot herbicide treatments of grasses and shrubs using the herbicide hexazinone. There was potential habitat for green-tinged paintbrush, yet no plants were located by field surveys within the project area. The native vegetation that would be treated around planted trees in the 18 Fire area are species that abundantly occur on the Deschutes National Forest: greenleaf manzanita (*Arctostaphylos patula*), snowbrush (*Ceanothus velutinous*), Idaho fescue (*Festuca idahoensis*), and upland sedges (either *Carex rossii* or *Carex inops*). Cheatgrass would also be treated in the 18 Fire project, providing a beneficial cumulative effect by reducing this invasive species. There are no sensitive plants growing in a medusahead site within a rock pit that was approved for treating with herbicides (U.S. Forest Service 2005b).

In summary, there would be no cumulative effects to non-target plants (including sensitive and other rare and uncommon species) from invasive plant treatments, but there may be considerable cumulative effects if invasive plants continue to spread.

Comparison of Alternatives for Effects on Non-Target Plants

Table 37 on the next page compares the three alternatives for their effects to non-target plants from both invasive plants and invasive plant treatments. Alternative 2 provides the highest level of protection to non-target plants from invasive plants. Alternative 2 allows the highest level of herbicide use but effects to non-target plants are minimized or eliminated with PDFs.

Table 37. Summary comparison of alternatives for effects on non-target plants.

Issue Component	Issue Indicator	Alternative 1	Alternative 2	Alternative 3
Effects of Invasive Plants on Non-Target Plants	Number of inventoried invasive plant sites and acres treated	238 sites 2,204 acres	1,892 sites 14,547 acres	1,892 sites 14,547 acres
	Number of herbicide formulations available	3 Ochoco 4 Deschutes	10	10; 7 in riparian areas
	Ability to respond quickly to new invasive plant populations with an Early Detection/Rapid Response (EDRR) Strategy	No, does not include EDRR Strategy. Additional NEPA analysis required to treat newly discovered infestations; this can take 5-10 years to complete.	Yes, incorporates EDRR strategy	Yes, incorporates EDRR strategy
	Summary of Treatment Effectiveness Analysis	Least effective in controlling invasive plants: fewer acres treated and options most limited; No EDRR to limit spread of new sites. Treatment effectiveness analysis estimates invasive plant populations would increase from 14,547 acres to 16,027 acres by year 2014.	Most effective alternative in controlling invasive plants. 10 herbicides available for use; allows more broadcast; Early Detection/Rapid Response increases effectiveness. Treatment effectiveness analysis estimates invasive plant populations would decrease from 14,547 acres to 7.5 acres by year 2014.	More effective than Alternative 1, but less than Alternative 2. 7 herbicides available near water; 10 everywhere else; EDRR increases effectiveness. Treatment effectiveness analysis estimates invasive plant populations would decrease from 14, 547 acres to 19 acres by 2014. No effective treatment of riparian rhizomatous species, will continue to have adverse impacts from species such as reed canarygrass.

Issue Component	Issue Indicator	Alternative 1	Alternative 2	Alternative 3
	Summary of Effects to Non-Target Plants, including sensitive and other rare and uncommon plant species from invasive plants	Alternative 1 provides the least protection to non-target plants. Invasive plant sites would continue to expand causing further degradation of native plant habitats and potential loss of additional rare plants. Highest risk to sensitive plants from loss of habitat. Native vegetation will continue to be impacted by invasive plants. Long-term risk to native vegetation from spread of invasive plants.	Native plant habitats will benefit from invasive plant treatments. Alternative 2 provides the highest level of protection to non-target plants from invasive plants.	Riparian native plants will continue to be impacted by rhizomatous invasive plant species that are difficult to control without the use of herbicides. Alternative 3 provides greater protection to non-target plants from invasive plants than Alternative 1, but not as much protection as Alternative 2.
Effects of Herbicides on Non-Target Plants	Number of inventoried acres of invasive plant sites treated	2,204 acres	14,547 acres	14,547 acres
	Number of herbicide formulations available	3 Ochoco 4 Deschutes	10	10; 7 in riparian areas
	Project Design Features developed to protect non-target plants	No	Yes	Yes

Issue Component	Issue Indicator	Alternative 1	Alternative 2	Alternative 3
	Summary of Effects to Non-Target sensitive and other rare and uncommon plants from herbicides	Least risk of short-term (1-5 years) damage to individual non-target native plants from herbicides simply due to the limited acres that could be treated with herbicides.	PDFs will minimize or eliminate any short-term (1-5 years) effects to non-target native vegetation. There will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. More herbicide options help plan treatments that minimize non-target effects.	PDFs will minimize or eliminate any short-term (1-5 years) effects to non-target native vegetation. There will be beneficial effects to native plant habitats. Treatments will not lead to a trend toward federal listing. Restrictions on broadcast spraying (within riparian reserves) will further minimize potential short-term (1-5 years) impacts to non-target vegetation.
SUMMARY for Effects on Non-Target Plants		Though limited herbicide use would pose lowest risk of short-term (1-5 years) damage to individual non-target plants, Alternative 1 provides least overall protection to native plant habitats because invasive plants will to continue to spread.	Highest protection to native plant habitats. Low risk to non-target plants from herbicides due to PDFs.	High protection to most native plant habitats. Riparian plants may continue to be impacted by rhizomatous invasive plant. Low risk to non-target plants from herbicides due to PDFs.

3.5 Soils

3.5.1 Affected Environment

Landscape Geology

Controlling bedrock geology throughout the analysis area includes primarily basaltic, andesitic and rhyolitic features of various ages. Volcanics that comprise the Cascade Mountains on the Deschutes National Forest are relatively young in age and have been glaciated multiple times during past ice ages. The east slopes of the Cascade Mountains are underlain by glacial till and/or glacial outwash from this era. Other landforms on the Deschutes are primarily non-glaciated stratovolcanoes, cinder buttes and rhyolitic dome features located across the forest. Landforms on the Ochoco National Forest and the Crooked River Grasslands are predominantly associated with large basalt flows from the Miocene and early Pleistocene that cover older sedimentary and/or volcanic rocks. These landforms were not glaciated and are much older geologically than those on the Deschutes. Large landslide features are also present on the Ochoco National Forest associated with local faulting in the area.

Soils

Soil types within the analysis area vary widely in age and composition between the Deschutes and the Ochoco/Crooked River Grasslands. The majority of soil types located on the Deschutes are derived fully or partially from airfall ash volcanics emitted from the eruption of Mt. Mazama approximately 7,600 years ago. The depth and composition of material ejected from Mt. Mazama varies based on the distance and direction from the source of this eruption, as well as the amount of re-working from wind and water this material has experienced in the years following deposition. Representative taxonomy for soils formed in Mazama ash are Typic Vitricryands and Typic Vitrixerands (USDA 1999). Other parent materials found on the Deschutes include volcanic sources such as Sand Mountain ash or Blue Lake cinders deposited near the Suttle Lake and Metolius River areas, larger pumice from Newberry Crater on the Ft. Rock district, and older residuum weathered from underlying volcanic bedrock.

Soil types located on the Ochoco and Crooked River Grasslands are generally derived from ash sources or residuum weathered in place. Many soils have a surface veneer of finer ashfall from Mt. Mazama at depths ranging from 1 to 20”. Representative taxonomy describes soils with a veneer of ash between 7 and 14” as Vitrandic intergrades and those with ash depths greater than 14” as Vitrixerands (USDA, 1999). Lithic, loamy and loamy skeletal soils derived of residuum or older ash sources that are located in the shrub steppe, juniper woodlands and dry conifer vegetation types are generally classified as Lithic Argixerolls. Bottomland and riparian meadow locations on the Ochoco are classified as Typic Haplaxerolls and Typic Argixerolls (USDA 1999).

Geology & Groundwater

Groundwater resources in the Deschutes Basin have been documented by the US Geological Survey and reported in the publication *Groundwater Hydrology of the Upper Deschutes Basin, Oregon* (Gannett, et al. 2001). The primary aquifers within the planning area include the Quaternary basalts of the Deschutes Formation, the Tertiary Prineville basalts and the Quaternary sediments that comprise the LaPine Sub-basin.

The geology and groundwater of the Deschutes NF is primarily comprised of young Quaternary volcanics and alluvium of the Cascade Range. The Quaternary volcanics comprise the principal area of recharge for the Deschutes Basin due to the high permeability of the volcanics and the relatively thin soils that allow for rapid infiltration of rain and snowmelt. However, the lower strata of the Quaternary deposits have significantly reduced permeability due to hydrothermal mineralization and comprise the base of the regional ground water flow system beneath the Cascade and Newberry volcanoes. As a result, groundwater reaching this depth generally flows laterally in a northward direction before accumulating in the aquifers mentioned above or surfacing as springs along exposed outcrops, canyon walls, or stream channels.

The geology and groundwater of the CRNG and Ochoco NF includes variably permeable Quaternary and Tertiary deposits that provide recharge to local aquifers in the Prineville basalts, and late Eocene to early Miocene deposits of the John Day Formation that generally have very low permeability and are neither a significant source of groundwater nor a medium through which it can easily flow (Gannett, et al. 2001).

Project Area Units

Project Area Units (PAUs) are potential treatment areas under this EIS that were designated around known Invasive Plant sites across both Forests and the Grasslands. PAU boundaries encompass a buffer around the mapped populations of invasives that includes areas between non-contiguous populations that are susceptible to spread. The PAUs are stratified across a variety of site types that reflect the physical properties of the landscape and soil resource in general terms. Each site type is further stratified by the treatment methods proposed for this analysis (Chapter 2, Table 6).

The majority of PAU acres are located along roadsides (~35,700 ac) where soils generally have been heavily disturbed and are highly compacted. Spotted knapweed is the primary invasive located along roads identified for treatment on the Deschutes. Additional acres are located in forest settings (~8,800 ac) where varying levels of disturbance have occurred but the site is not dedicated as part of the permanent road system. Houndstongue is the most prevalent invasive on old landings underneath pile burns in forest sites identified for treatment on the Ochoco and medusahead is the primary invasive in the Grasslands. Other site types containing appreciable acres include riparian features (~3,100 ac); road/stream crossings (~1,300 ac); and quarries (~900 ac).

Soil Conditions within PAUs

Soils within the PAUs have generally been physically disturbed by activities that have created bare mineral soil and/or compacted conditions. These activities include road construction, machinery traffic from commercial harvest operations, recreational uses, quarry excavations, pile burning of harvest slash, and wildfire. Existing impacts within PAUs are unlikely to be reversed unless physical conditions at the site are rehabilitated or the invasive plants are removed and replaced with native individuals. Soil disturbance is especially pronounced on road prisms and road shoulders, but it is generally evident within PAUs located on all of the site types identified within the analysis area.

In general, soil disturbance within the PAUs has created conditions in which invasive species are able out-compete native species. Soils conditions that affect the growth and vigor of native vegetative, such as available moisture holding capacities and soil porosity, have been primarily altered by the following:

1) the loss or mixing of surface organics and mineral soil into subsurface mineral soil horizons from displacement, and/or;

2) the compaction of mineral soil to levels at which soil porosity and soil strength affect growth and spread of native vegetation.

Treatment sites in Big Marsh, Trout Creek Swamp, and along the Metolius River contain certain *Phalaris* species that have invaded riparian communities. These species have created monocultures in some areas by establishing dense rhizomatous mats. A history of hydrologic diversions and grazing impacts in Big Marsh and Trout Creek Swamp created conditions that allowed extensive colonization by reed canarygrass.

Introduced seed sources of Ribbongrass along the Metolius River have aggressively established monocultures along the riverbanks and on islands, apparently without extensive disturbance of the soil resource itself as a pre-requisite. The *Phalaris* populations within the river channel are primarily on woody substrates and the channel bedload that has accumulated around them.

Soil Types within PAUs

Soil types within PAUs are mapped and described in fourth order surveys in the respective Soil Resource Inventories (SRIs) for the Deschutes and Ochoco National Forests (Larsen 1976; Paulsen 1977). Although mapping at this scale is relatively coarse, the characteristics described for soil types within PAUs are applicable for effects analysis, primarily due to the homogeneous nature of volcanic air fall deposits, bedrock and other parent material influences across the landscape. The general range of profile depths and soil characteristics described for each SRI soil type allows for some variability of conditions across the landscape. A summary of SRI or survey soil types of concern mapped in each PAU can be found in Appendix B & C of this report.

***Deschutes NF*:** Soils located in PAUs on the Deschutes are predominantly volcanic in origin, the majority of which are comprised of a moderately deep to deep tephras comprised of airfall ash or pumice from Mt. Mazama or other Cascade sources. Primary features of the ash soils on the Deschutes that may affect herbicide pathways and degradation rates are a coarse textural class, low to moderate cation exchange capacity (CEC), relatively low organic matter content (1-10%) and rapid infiltration rates.

Soils on the Bend/Ft Rock and Sisters Ranger Districts have coarse surface textures (sandy loam and loamy sand) with low cation exchange capacities (CECs) reflective of low clay contents of the mineral component and relatively low organic matter contents concentrated in narrow surface horizons. Although moderately coarse in nature, the presence of microscopic vesicles in the sand sized pumiceous ash material contributes to a higher water holding capacity than soils of similar texture derived from granitic parent material. As a result, the rate and extent to which water and associated substances in solution migrate down through the profile is relatively slow. Chemical residues of herbicides in solution are more likely to be held within the biologically active portion of the soil profile where microbial degradation or hydrolysis can occur.

Soils on the Crescent District closer to the source of the Mazama eruption and those on the Ft. Rock District where the Newberry plume was deposited have very coarse popcorn size pumice present in their profiles. Although the surface horizons are very coarse textured, these soils do have medium textured subsurface horizons and some fines mixed in the surface horizons that provide moisture holding capacities capable of holding chemical substances in solution within the biologically active portions of the profile. The soils on the Deschutes have moderate to rapid infiltration rates that generally minimize overland flow volumes and energies during rainfall events except when compacted.

***Ochoco NF*:** Soils on the Ochoco include shallow to moderately deep airfall ash surface tephras comprised of Mazama ash, which share similar characteristics to the medium textured soils located on the Deschutes described above. Other soils include fine-textured and shallow clayey scablands and older, shallow to moderately deep soils comprised of colluvium, alluvium or directly weathered from underlying bedrock. Textural classes of soils on the Ochoco range from fine textured clay to fine sandy loams. Soils range from clay loams that contain significant cobble rock content within the profile to sandy loam surfaces overlying finer textured substrata, the latter of which surface horizons with lower CECs and subsurface horizons with slightly higher CECs.

Soils located on the Grasslands have a thinner veneer of airfall ash over similarly older soils comprised of colluvium, alluvium or directly weathered from underlying bedrock. Most soils located on the Grassland, and those located on the Ochoco that have lost the surface component of Mazama ash or never received it, are finer textured and generally have higher clay contents than those located on the Deschutes. Because of these characteristics, infiltration rates are moderate to slow and overland flows during storm events tend to be higher than soils on the Deschutes. The finer textured soils have higher CECs conducive to adsorbing chemical residues in the surface horizons where microbial degradation or hydrolysis can occur. These soils also have relatively low organic matter composition that is generally concentrated at the surface. Organic matter content generally ranges from 3 to 5.5% in the surface mineral soil horizon for a small subset of representative landtypes (USDA 1977).

Types of Invasive Species and Potential Effects Soil Characteristics

Discussion of the effects of invasive species on soil properties relates to the current population and species of invasive plants on site. Spotted and diffuse knapweed (Deschutes), houndstongue and knapweed (Ochoco), and medusahead (Grasslands) are the invasives of greatest extent in this analysis. Reed canarygrass and ribbongrass are also present on the Deschutes. All species proposed for treatment are listed in Table 9.

Invasive plants can have direct and indirect effects on soil properties. Invasive species can affect the soil quality on disturbed sites due to their physiologic and morphologic differences from native species. These differences allow them to out-compete native species for water and nutrient resources in the soil (Olson 1999a). The following soil properties that contribute to overall soil quality can be affected when invasive species become established on site.

- **Soil Organic Matter Content -** Organic matter may be reduced or redistributed in weed-infested soil. Invasive plants tend to have deeper roots and less foliage than native species and the decay of these plants is likely to contribute less litter and organic matter at or near the soil surface. Additionally, invasive plants tend to decay more slowly than native plant species (Olson 1999a; Olson and Kelsey 1997) and result in less annual input of organic matter to the soil.

- **Soil and Water Interactions** – The rate and volume of water infiltration can be reduced on invasive plant sites due to reduced cover (DiTomaso 1999; Olson 1999a). Significantly greater surface water runoff, indicating less infiltration, has been measured from spotted knapweed dominated sites compared to adjacent native grass dominated sites (Lacey et al. 1989). Compaction in many weed infested sites also tends to reduce infiltration rates. Reductions in soil organic matter can also reduce the amount of water held in the soil profile, especially near the surface (Brady and Weil 1999; Tisdall and Oades 1982).

- **Vegetative Cover -** Total vegetative cover may be reduced on invasive plant sites from that provided by native vegetation and can result in higher evaporation from exposed mineral soil on the surface (Lauenroth et al. 1994, Olson 1999a). Soil water stored deeper in the profile may also be depleted more rapidly on sites where vegetative cover provided by invasive plants is dense and associated transpiration rates are high (Olson 1999a).

- **Soil Erosion** – Soil infested with invasive plants has been shown to be more susceptible to erosion than soil supporting native grass species (Lacey et al. 1989). Invasive plants are less able to dissipate the kinetic energy of rainfall, overland flow, and wind that cause soil erosion, primarily due to the loss of cover provided by native plants on site (Torri and Borselli 2000; Fryrear 2000).

- **Soil Biota** - The abundance of soil microbial biomass is generally related to the organic matter content of soils (Brady and Weil 1999). Weed-infested soils may support smaller populations of microorganisms than non-infested soils because of changes in organic matter input and decay rates on site. It is possible that infestations of weeds could result in a change to the size and/or distribution of soil microbial population when considering the deeper root distribution and reduced litter production of invasive plants compared to native grasses.

- **Soil Nutrient Availability** – Invasive plants directly limit nutrient availability by out-competing native species for limited soil resources. Invasive plants have high nutrient uptake rates and can deplete soil nutrients to very low levels, especially in cases where weed species germinate prior to native species and exploit nutrient and water resources before native species are actively growing (Olson 1999). Potassium, nitrogen, and phosphorous levels were shown to be 44, 62, and 88 percent lower, respectively, in spotted knapweed infested soil than in adjacent grass covered soil (Olson 1999). Areas infested with invasive plants may also indirectly limit nutrient availability because of soil erosion from compacted conditions or reduced effective cover. Erosion selectively removes organic matter and the finer sized soil particles that store nutrients for plant use, leaving behind soil with a reduced capacity to supply nutrients (Brady and Weil 1999).

3.5.2 Environmental Consequences

Scope of the Analysis

The Deschutes, Ochoco and Crooked River Grasslands Invasive Plant Treatments EIS includes a variety of methods to treat invasive plants that have the potential to affect to the soil resource. These primarily include the application of herbicides and the manual treatment of invasive plant populations within the PAUs designated for analysis. Additional treatments could occur outside of these areas under the proposed Early Detection-Rapid Response Strategy (EDRR) outlined in Chapter 2 and Appendix F. Under EDRR, treatments would occur on newly identified invasive populations that were located in conditions similar to those analyzed within a PAU.

Potential Effects Tiered to other Decisions and Documents

Overall, site-specific effects to the soil resource from proposed herbicide applications are expected to be minimized due to the integration of multiple layers of caution into the planning and implementation process of this EIS. These layers include State and Federal laws, EPA label requirements, SERA Risk Assessments, and the Region 6 Toxicity Levels of Concern for Federally Listed Anadromous fish, which were implemented for all federal lands within the R6 Invasive Weeds FEIS analysis area and are tiered to by this project. The incorporation of all of these layers into the planning and implementation of the EIS are expected to reduce the risks and effects of herbicide applications on the soil resource and maintain them within those described under the Region 6 Invasive Weeds FEIS Record of Decision (R6 Invasive Weed FEIS, 2005).

Additional reduction of the risks and effects to the soil resource are provided by the Deschutes and Ochoco Forest Plan Standard and Guideline direction, FEIS Project Design Features, Proposed Treatment Methods and Applications, and Adaptive Management that includes compliance monitoring of implementation methods.

Analysis Assumptions

The effects of herbicide treatments and manual treatments described in the R6 FEIS are referenced in this report as a starting point for displaying the potential effects of herbicide applications on local soils specific to the analysis area of this project. The analysis of cumulative effects on the soil resource is based on the potential chemical and/or manual treatment of all inventoried acres of invasive plants over the life of the project, in addition to those discovered and treated under Early Detection Rapid Response (EDRR).

Effects displayed in this analysis specific to herbicide characteristics and pathways are primarily derived from herbicide risk assessments (SERA, 1999, 2001, 2003 and 2004). These assessments contain pertinent information, when available, on the potential effects of herbicide applications on the soil resource, including effects to soil organisms, studies considered for the risk assessments, models of individual herbicide movement, and specific information about herbicide properties such as persistence, adsorption rates to mineral soil or organic matter, and solubility in water. A summary table of the SERA Risk assessments referenced for the ten herbicides considered in this EIS can be found in the Fish Specialist Report (Dachtler 2009).

The extent and duration of effects to the soil resource from herbicide applications proposed under this EIS were assessed according to the individual characteristics of the volcanic soils within the analysis area. The existing site conditions in the PAUs and the proposed herbicide application rates under this Invasive Plants EIS are within the bounds described in the R6 FEIS and the pathways and transformations of herbicides proposed for application are not expected to be outside of those described in the R6 FEIS. However, differences in characteristics of soils located on the Deschutes with those on the Ochoco and Crooked River Grasslands are distinctive enough to affect subsequent degradation pathways for some herbicides and have been used to recommend modified application methods and rates. This is in accordance with R6 ROD Standard 19, which directs the use of site-specific soil characteristics present in the respective Forest project areas for determining application rates of herbicides that are appropriate for minimizing effects to the soil resource.

Analysis summary

The general effects and the chemical characteristics of the ten herbicides proposed for application under this analysis have been described within the R6 FEIS. Overall, effects of proposed herbicide applications on the soil resource are not expected to be measurable at the Forest scale. Some adverse effects from these actions have been shown to be unavoidable and are likely to include localized and short-term effects on soil microorganisms and soil productivity. Effects to soil microorganisms are primarily the result of the inherent toxicity and persistence of chemical residues, while temporal changes to vegetative cover or levels of soil disturbance resulting from manual and herbicide treatment methods can affect elements of soil productivity (R6 Invasive Weed FEIS, 2005, Appendix M).

The Deschutes and Ochoco Land Resource Management Plans include Standards and Guidelines that provide sideboards to minimize detrimental ground disturbance and long-term cover losses from proposed actions. Overall effects to the soil resource would be minimized and soil productivity would be maintained by this project as a result of Project Design Features included in the FEIS that limit the extent of physical disturbances and herbicide application rates. Manual treatments likely to temporarily reduce effective cover or contribute to detrimental soil conditions on a localized basis have been identified for active re-vegetation within nine PAUs to limit sediment contributions (PDF #50) or slow the aggressive return of invasives. These actions are in accordance with R6 ROD Standard 12, which directs the formulation of a long-term strategy for restoring infestations of invasive plants and necessarily includes the protection or improvement of soil productivity and conditions for soil microorganisms.

Additional PDFs included in the FEIS that would limit the effects of the herbicide applications to the soil resource include those that limit the application on certain soil types and locations based on label advisories (PDF #'s 45-48); and those that limit the amount of herbicide residue applied to the environment through appropriate application rates and methods (PDF #s 9-17, 54).

ALTERNATIVE 1 – NO ACTION

Current use of select herbicides (Dicamba, Picloram, Glyphosate, and triclopyr) approved under the guidelines of the Mediated Agreement (USFS 1992) would continue under the No Action alterative on specific treatment sites analyzed in the 1998 Noxious Weed Control Environmental Assessment for the Deschutes National Forest (USFS 1998a), and on specific sites analyzed in the Integrated Weed Management Environmental Assessment and Decision Notice (USFS 1995) and Integrated Noxious Weed Management Environmental Analysis and Decision Notice (USFS 1998b) for the Ochoco National Forest and Crooked River National Grasslands. Table 38 includes the extent of acres currently applied with herbicides annually under these decisions.

Table 38. Current Average Annual Net Acreage of Herbicide Application - NFS lands, Deschutes, Ochoco and Crooked River National Grassland.

	Deschutes NF	Ochoco NF	Crooked River NG	Total
Herbicide	82	85	108	275
Mechanical	0	0	0	0
Manual	555	663	47	1,265

Direct Effects

The effects of herbicide applications were analyzed for the soil resource in the previously mentioned NEPA documents (USDA, 1995; 1998a; and 1998b) and determined to meet a Finding of No Significant Impact (FONSI) for the soil and other environmental resources. Application rates and total acres treated with herbicides have decreased on these sites over the past five years (Oregon Department of Agriculture, 2005) and no visual effects on soil productivity have been observed (Langland; personal communication). It is expected that the amount of herbicide applied on these sites will continue to decrease into the future.

Manual treatments approved under existing NEPA document decisions would continue under the No Action alternative. Manual treatments include lopping, wrenching or pulling treatments that have averaged ~1,265 acres per year across the two Forests and the Grasslands. The majority of sites currently treated on the Deschutes are infested with spotted or diffuse knapweed, while sites on the Ochoco and Grasslands are primarily medusahead and houndstongue. The effects of manual treatments were analyzed in the R6 2005 FEIS (Appendix M) and are summarized in this section.

Manual treatments generally have only short term effects to the soil resource, primarily in the form of erosion risks associated with the short-term exposure of mineral soil and reduction of live vegetative cover. These effects are off-set somewhat by the short term cover and organic input to the soil provided by the pulled plants if treatments occur before flowering and the pulled plants are left on site. Regardless, sites treated with manual methods have a short term risk of erosion and possible sediment delivery to streams until loosened soil settles and live vegetative cover increases on site.

Weed pulling can also break mycorrhizal hyphae in the soil and possibly cause a transient reduction of mycorrhizal function in the soil environment from the species associated with the invasive weeds removed from that area. 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, 1988 and 1990). Although the return of natives in more heavily disturbed sites (i.e. roadsides, ditches, or thickly matted medusahead infestations) can be somewhat impaired, it appears that the return of native species to manually treated knapweed and houndstongue sites on forest site types has not been inhibited as a result of this disturbance (Pajutee and Mafera, personal communication).

Indirect Effects

Alternative 1 would indirectly affect the soil resource by not treating approximately 13, 421 acres identified for herbicide treatments under the Action alternatives. This would allow the majority of infested populations (~12,000 acres not manually treated under current treatment rates) to spread at an estimated 10% percent per year. Although the indirect effects of not treating invasive plants would vary slightly by site type and species, invasive plants are likely to continue to spread and cause adverse changes to the physical, chemical, and biological properties of the soil resource on all sites that were not treated. These changes can include increasing the proportion of bare ground, altering the type and amount of available soil nutrients and organic matter in the soil, and changing fire frequency on the site. The presence of invasive plants can also produce toxic chemicals that affect soil organisms.

Physical properties affected

The continued growth of invasive species is likely to maintain lower ground cover, and conversely, higher levels of exposed mineral soil, within these areas. This would indirectly affect the susceptibility of the soil to erosion during storm events and increase the risk of sediment production in sites hydrologically connected to streams and lakes. Soil erosion in a simulated rainfall test more than doubled in spotted knapweed-dominated rangeland areas when compared to natural bunchgrass/forb grasslands, primarily due to significantly lower infiltration rates and higher levels of bare ground than present on the uninfested areas (Lacey and Marlow 1989).

Additionally, lower canopy cover of native forbs and graminoids, as well as reduced populations of cryptogams, are likely to occur in untreated areas populated by spotted knapweed (Tyser, 1992). More rainfall is likely to directly impact and detach surface mineral soil and subsequently increase surface flows in areas with lower surface cover provided by vegetation. Soil erosion can have large impacts on soil functions even with modest losses of surface mineral soil, especially since most of the biologically active organic matter is concentrated in the top 1 to 4 inches of soil. Soil erosion can also have negative impacts on water quality in associated aquatic systems by contributing sediment to streams and lakes. Groundwater recharge may also be affected where surface and vegetative conditions reduce the infiltration of storm waters can.

The absence of treatment on nearly 12,000 acres of known invasive populations would expose more mineral soil to solar radiation and dry out the surface sooner in the growing season. A dry soil surface hinders seedling establishment and will negatively impact plants with surface root systems, including many native grasses and forbs. Exposure of the soil surface causes soil temperatures to be more extreme, due to solar heating during the day and greater radiative cooling at night. These extreme temperatures make seedling establishment more difficult and may affect soil organisms (Sheley and Petroff 1999).

Chemical and biological properties affected

Soils under exotic understory plants can have pronounced differences in soil properties when compared to soil under native shrubs, including significantly higher pH and extractable nitrate levels (Ehrenfeld, et al., 2001). Net nitrogen mineralization was also higher under the exotic plants, indicating changes in the composition or activity of soil microbes caused by the invasive plants. Invasive plants that increase the availability of nitrate in the soil may be promoting conditions that favor their own expansion at the expense of native plants that can tolerate lower nutrient levels.

Conversely, many non-native species deplete soil nutrients, which can make it difficult for native plants to compete with the invasive plants and may also affect the soil biotic community. Although the long-term effects of these changes are not known, spotted knapweed has been implicated in reducing available potassium and nitrogen (Harvey and Nowierski 1989). Some invasive plants are allelopathic to other plants, and produce secondary compounds that can directly increase the population of soil microbes capable of metabolizing this compound, while decreasing the populations of other microbes (Sheley and Petroff 1999). These changes will affect the soil food web and nutrient cycling, and may have impacts on the native plant community.

Changes in plant communities caused by non-native invasion can have large effects on the soil food web since the biota involved in nutrient cycling is powered by root exudates and decomposing vegetation from the plant community (Hobbie, 1992; van der Putten 1997). Nutrient cycling is a complex process that depends on a multi-level food web that is specific to the site, a system that includes bacteria, actinomycetes, fungi (pathogenic, saprobic, and mycorrhizal), amoebas, and a wide range of invertebrates. A study that compared soil organisms in native grasslands in a natural state and after invasion by cheat grass (Bromus tectorum) found that the cheat grass caused changes in most levels of the soil food web (Belnap and Phillips 2001). Although it is difficult to predict the specific effects of these changes, it is important to recognize that any change in the soil food web has the potential to interfere with critical nutrient cycling processes and to threaten the long-term integrity of the ecosystem.

Research on the impact of invasive plants on mycorrhizal fungi is lacking, but since plants and mycorrhizal fungi are strongly dependent on each other, it is likely that drastic changes in the plant community caused by the invasion of non-natives will be accompanied by changes in the mycorrhizal fungus community. Research comparing the mycorrhizal status of young slash pines (Pinus elliottii var. elliottii) in plots with weeds and plots that were kept weed free with herbicide treatment found the number of pine root tips colonized by mycorrhizal fungi to be 75 percent lower in the weedy plots than the weed free plots after 3 years. In addition, the species distribution of the mycorrhizal fungi associated with the trees had changed (Sylvia and Jarstfer 1997). Since the fungi associated with the invasive weeds are different than those associated with the pine, it is likely that competition from introduced fungi caused the decrease in the fungi associated with the trees.

If mycorrhizal fungi associated with invasive plants successfully compete with native fungi, a redistribution of soil resources in favor of the invasive plant appears to occur. Species of mycorrhizal fungi associated with native plants may be lost from the area of infestation. It may then be difficult to re-establish native vegetation on the site after the invasive plants are removed. Researchers have found that specific "helper" bacteria in the soil promote the establishment of mycorrhizae and mycelial growth of mycorrhizal fungi (Garbaye and Bowen 1989). Although little is known about the ecological requirements of these organisms, invasive plants may not support the helper bacteria employed by native plants and fungi.

Cumulative Effects

There would be no cumulative effects on the soil resource as a result of implementing Alternative 1. No additional manual or herbicide treatments would occur from those already approved under existing NEPA documents. The number of acres on which herbicides would be applied on approved sites would continue to be reduced each year based on observed herbicide effectiveness and reported herbicide use under the current working agreement (Langland, personal communication). This would minimize the overlap accumulation of residues on site below a degree measurable in terms of effects on the soil resource.

The acres of soil infested by invasive plants would increase each year at a continued rate of spread due to physical limitations to manual treatments, potentially reaching 16,000 acres in five years. Refer to the Treatment Effectiveness section for a discussion on expected spread of invasive plants under the No Action Alternative.

ALTERNATIVE 2 – PROPOSED ACTION

Proposed Herbicides and treatment locations

The application of herbicides and/or the manual treatment of invasive plant populations proposed under the action alternatives of this FEIS have the potential to directly, indirectly and cumulatively affect various components of the soil resource. Although parent materials of local soils are unique in some cases, soil characteristics such as organic matter content, surface texture and cation exchange capacity are within ranges used to describe the effects of herbicide residues in the R6 FEIS and research literature. Overall effects of herbicide treatments to the soil resource are not expected to be outside the scope of those described under the R6 FEIS (USDA 2005a). The toxicity, persistence and mobility in the soil environment of the various herbicides approved for use are the primary factors affecting the potential effects of herbicide application in this analysis.

Proposed Herbicides

Ten herbicides are proposed for application under the Invasive Weeds EIS, including chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl and triclopyr. The characteristics of the herbicides proposed for application under this project are summarized in the narrative beginning on page 39 of Appendix D. Much of the information on the chemical properties and degradation pathways of the herbicides, as well as their mobility, persistence and effects to the soil resource, is tiered from the Region 6 Invasive Plants FEIS (USDA 2005a). Some PAU boundaries contain multiple species of invasive plants and the type of herbicide(s) applied within each PAU may vary according to the primary invasive plants targeted for treatment.

Treatment locations

Manual and herbicide treatments are proposed for inventoried invasive plant populations located within 289 designated Project Area Units (PAUs). Each PAU boundary generally contains between one and ten mapped populations of invasive plants identified and additional acres to account for an annual rate of spread. The inventoried acres are identified as Invasive Plant Sites (Table 1) or Mapped Invasive Plant Site acres (Table 5) and cover varying amounts of the total area of each PAU. Proposed treatments could occur within the entire boundary of the PAUs depending on the accuracy of the inventory and the rate of spread since the inventory occurred. The effects described in this analysis are applicable for the entire PAU area within which invasive populations may spread and be treated in subsequent years following initial implementation of this project.

Each PAU is categorized as one of eight site types that broadly describe the landscape and environmental characteristics of the site (Table 4). They were further queried for any mapped soil types that may have a riparian soil, seasonal water table, erosion hazard, or surface textural class of concern (Soil Report, Appendix B & C; Tables 4 & 5).

Extent of herbicide application

Total annual applications of herbicides are bounded by physical and financial limitations of project implementation. Proposed treatment areas and actual infested acres are summarized by 5th field HUC to display the total existing acres that could be treated on an annual basis without budget limitations (see Wildlife Specialist report). New populations identified under Early Detection Rapid Response (EDRR), could add acres of treatment, although this would be limited 10% or less of the current extent of inventoried populations within any 6th field subwatershed. The extent of herbicide applied within PAUs is assumed to decrease annually due to an effectiveness rate on current vegetated populations averaging 80%. The response of the existing seed bank of the invasives on site may cause the extent of treatments to fluctuate slightly in any given year.

Extent of Effects

Herbicide applications: The direct effects of herbicide applications on the soil resource would be within the bounds of, and likely less than, those described in research and product literature. This is primarily a result of R6 direction to minimize herbicide concentrations in the environment below levels shown to be toxic to anadromous fish populations. These levels are lower than those allowed by the Environmental Protection Agency (EPA) or those produced by maximum application rates approved on the product label (USDA 2005a). PDFs are included in the document to use the lowest effective application rate for each herbicide and all proposed application rates under this FEIS are below the maximum rates allowable on the product labels.

Potential effects to the soil resource are generally minimized by implementing the most efficient application method and application rate for the amount of plant biomass treated on each site. Local herbicide applicators have indicated that they would not need to exceed typical application rates on the product labels for the majority of sites proposed for treatment, although some sites may need application rates closer to allowable limits to effectively treat the site (Langland, personnel communication).

Table 41 includes the adsorption properties, degradation rates, toxicity to microbes and activation mechanisms of the herbicides described in research literature and SERA risk assessments. Additional information about the characteristics of each herbicide that influence their potential effects on the soil resource is included in narrative summaries in the Soil Resource Report. Typical application rates used for the SERA risk assessments and the highest application rates reported by the Forest Service in 2001 are summarized in Table 12 (Chapter 2). All herbicide applications proposed under this FEIS are in accordance with label restrictions and are below the maximum application rates allowable by law. These conditions are expected to minimize the accumulation of residues in excess of those necessary for effective control of targeted invasive plants and reduce the potential effects of herbicide applications to the soil resource.

Table 39. General Research Findings of Pertinent Herbicide Characteristics Pertinent to the Soil Resource.

Herbicide	Toxicity to Soil Microbes	Adsorption	Degradation path and half life	Activation Mechanism
Chlorsulfuron	low	low	Hydrolysis 40 days	Acetolactate synthesis inhibitor (Selective: controls broadleaves and some grasses)
Clopyralid	low	strong	Soil microbes 14 to 29 days	Plant growth regulator (Very selective to broadleaves; post emergent)
Glyphosate	low	strong	Soil microbes 30 days	Inhibits 3 amino acids and protein synthesis (Non-selective; quickly absorbed by leaves with rapid movement through plant; no root absorption)
Imazapic	No info	moderate (Organic Matter)	Soil microbes 113 days	acetolactate synthesis inhibitor (Uptake by roots & leaves; active in soil as pre-emergent)
Imazapyr	Slight at high doses	low (Organic Matter and low pH raise	Soil microbes 25 to 180 days	acetolactate synthesis inhibitor (Uptake by roots & leaves; active in soil as pre-emergent)

		to moderate)		
Metsulfuron methyl	Short-term toxicity with little effects to populations over time	low	Slow microbial degradation at high pH, fast at low pH Up to 120 days	Acetolactate synthesis inhibitor (Potent herbicide; uptake by roots & leaves)
Picloram	Can inhibit microbial growth	low	Slow microbial 90 days	Plant growth regulator (Selective: rate and season dependant; pre-emergent and soil active)
Sethoxydim	low	low to moderate (Organic Matter)	Rapid microbial Up to 60 days	Inhibits acetyl co-enzyme (ACE) (Systemic that is absorbed rapidly by foliage and roots.
Sulfometuron methyl	Some growth inhibition of microbes in lab	low	Soil microbes 10 to 100 days	Acetolactate synthesis inhibitor (Non-selective pre and post emergent - uptake by roots & leaves. Potent herbicide;)
Triclopyr	Inhibits fungal and bacterial growth	low	Soil microbes 46 days	Plant growth regulator (Absorbed thru roots, foliage and green bark)

Manual and mechanical treatments: Proposed manual and mechanical treatments of invasive species included in this FEIS can also have direct effects on the soil resource. These are attributable to the physical disturbance of mineral soil from the prying, pulling and harrowing of the invasive vegetation proposed for treatment. The physical disturbance would be recognizable as exposed mineral soil that is unlikely to be detrimentally impacted as a result of these actions. The extent of soil disturbance within a manually treated PAU would coincide with the boundary of the mapped acres of invasive plants, although actual amount disturbed coincide with the basal area and rooting extent of the vegetation.

The extent of soil disturbance within a mechanically treated PAU would also coincide with the boundary of the mapped acres of invasive plants, although the harrow implement and tires of the machinery would travel over the entire area of treatment. The majority of the area is already in a compacted condition and this activity is unlikely to incur additional detrimental impacts on the site.

Direct Effects of Herbicide Treatments

The effects of proposed chemical treatments on the soil resource have been minimized to the extent possible as a result of adherence to label recommendations and R6 direction to maintain threshold residue levels below those toxic to anadromous fish. Herbicide treatments proposed under this FEIS were analyzed under the R6 FEIS for similar application rates of the same chemicals and found to have no significant effects on the soil resource. Project Design Features included in Chapter 2 of the FEIS have been developed to minimize the effects of herbicides on the soil where herbicide and soil characteristics could combine to create an elevated toxicity to microbes, measurable losses to productivity, or convey herbicide residues to surface or ground water resources at levels potentially toxic to aquatic species. These include PDF #s 9-17 and 45-48.

The primary direct effect of proposed chemical treatments on the soil resource is the potential toxicity of herbicide residues on soil microbes harbored in the organic and mineral soil. The direct effects of herbicides on soil microbes are generally tiered from information on the product labels and the SERA Risk Assessments referenced in the R6 Invasive Plants FEIS (USDA 2005a). The relative toxicity to soil microbes is drawn from SERA Risk Assessments and label warnings that display the effects of herbicides on soil microorganisms under typical and maximum application rates on the product label. Potential effects are based primarily on reviews of literature that have assessed the toxicity of each herbicide according to the increased persistence of residues as application rates increase (USDA 2005a). The potential effects on soil microbes are summarized in a comprehensive risk rating of toxicity for each herbicide displayed in Table 39.

Soil Microbes

The direct effects of herbicide applications proposed in this project on soil microbes are expected to be negligible due to limitations on proposed application rates directed by the R6 FEIS. These limitations were enacted in order to keep herbicide residue accumulations below threshold toxicity levels of concern identified for anadromous fish (USDA 2005b). As a result, potential residue levels produced under this project would be well below those allowed by the Environmental Protection Agency and analyzed in the SERA risk assessments as toxic to soil microorganisms. Evidence from research on the effects of residues produced by practicable application rates also supports a finding of minimal effects to soil microbes.

The direct effects on fungal and bacterial soil microorganisms vary according to the chemical type, the percentage of the applied residues that actually reach the soil surface and the degradation rate/half-life characteristics of the herbicide. Although the chemical type of a respective herbicide is the primary factor influencing the direct toxicity to microbes, a residue that is toxic because of the chemical type must also be present in large enough quantities and available for assimilation by microbes in the soil in order to have a toxic effect.

Herbicides with the highest risk of directly affecting soil microbes include picloram, sulfometuron methyl and triclopyr. Picloram (pyridcarboxylic acid chemical type) and sulfometuron methyl (sulfonylurea chemical type) are of particular concern due to their identified toxicity, even at low levels, and persistence in the soil (USDA 2005a). As a result, PDFs were included in the document to minimize the magnitude of effects from these and other herbicides on soil microbes by specifically restricting their use on soils conducive to their adsorption (FEIS, Chapter 2). PDF #s 46 & 48 restrict the application of specific herbicides that are readily adsorbed to fine textured or heavy clay soils identified as having the potential to extend the persistence of herbicide residues following application within a Project Area Unit (PAU).

The duration of the toxic effects is primarily determined by the half-life of the applied herbicide that is available for microbial assimilation listed in (Table 39). The half-life of each herbicide is influenced by the chemical characteristics of the herbicide (i.e. degradation rate and pathway), the physical characteristics of the soil profile, and the soil microbial environment. Local ash and residual soils have surface textures, Cation Exchange Capacities (CECs) and infiltration rates that are sufficient to adsorb residues and minimize the mobility of herbicide residues. Local soils also have a component of bacterial and fungal species that is sufficient to minimize residue persistence by degrading them at rates comparable to those identified in Table 36.

Although studies have been conducted on the direct effects of herbicides on soil microbes, information about the effects of specific herbicides to each of the myriad of soil organisms is not necessarily available. Effects that have been identified are generally not measurable by quantified losses of microorganisms in the soil environment (Busse, et al. 2001). As a result, direct effects to soil microbes are generally alluded to by changes to productivity of the site, of which microbial composition is one component.

None of the herbicides under consideration for use has been shown to have a notable effect on soil productivity. Anecdotal observations of a spotted knapweed treatment area applied with picloram for two years on the Paulina District of the Ochoco National Forest confirm continued production of native and more desirable species on site (Mafera, Personal Communication). The growth and expansion of desirable species in this treatment area indicates that productivity has not been compromised and microbial populations and functions have likely been maintained following successive herbicide applications. Additionally, studies of the effects of herbicides on mycorrhizal fungi and bacterial populations indicate relatively low impacts to microbial populations from herbicides (Busse, personal comm. 2006), even from multiple applications (Busse, et al. 2001).

PAUs in which spot or wicking applications occur are likely to have the lowest levels of residues accumulated in the soil that could directly affect soil microbes. Conversely, broadcast spray applications would have higher amounts of over spray likely to reach the mineral or organic soil surface and directly affect soil microbes. PDFs are included to minimize the duration and extent of effects that proposed herbicide applications and manual treatments could have on local soils. PDF #s 9 – 17 would minimize excess herbicide from being applied to each PAU site by restricting field application methods and minimizing application rates during treatments.

Specific herbicides identified as having a low toxicity to soil microbes generally have a mode of action on plant species that does not affect soil microbes as they assimilate the compounds that comprise the residues. These include chlorsulfuron, clopyralid, and sethoxydim. An exception is glyphosate, which has been shown in research to be very toxic to microbes grown directly on this herbicide in the laboratory, but has un-measurable effects on microbes compared to treatment controls when applied directly to soil in the laboratory or in the outside environment (Busse, et al. 2001). This group of herbicides is unlikely to directly affect soil microbes to a measurable degree.

Herbicide Degradation

PDFs are included in the FEIS that require the application of the minimum concentrations of herbicides effective for treatment. Although these PDFs are expected to minimize the amount of excess herbicide in the environment, there will be residues that are not absorbed into targeted invasive plant roots, moved offsite by overland flows or degraded by sunlight. These residues will be subject to degradation by microbes or hydrolysis after adsorption in the soil profile. The herbicides proposed for application are primarily degraded by microbes, although chlorsulfuron and metsulfuron methyl are primarily degraded by hydrolysis.

The persistence of herbicides within the soil is largely dependent on the degradation pathway and chemical characteristics of the herbicide residues. The half life listed in Table 36 reflects the type and rate of degradation for each herbicide determined by research and testing for SERA labeling under generalized soil conditions. The half life of an herbicide chemical reflects the time in which 50% of the amount present is degraded into more benign byproducts. In the case of chlorsulfuron and metsulfuron methyl degradation through hydrolysis produces sulfonamides and carbon dioxide over a two step process.

The rate at which the proposed herbicides degrade is driven by the adsorption characteristics of the herbicide listed in Table 41, the presence of microbes in the soil, and the Cation Exchange Capacity (CEC) of the soil profile. The CEC is a measure of the number of sites on mineral soil colloids and organic matter that are available to hold compounds with positive charges within the zone of microbial influence. Glyphosate and clopyralid have strong adsorption rates and the lowest half life of the proposed herbicides. Imazapic, imazapyr and sethoxydim have moderate adsorption rates if organic matter content is high, but have low adsorption rates similar to the rest of the herbicides in mineral soils with low organic matter.

Local soils provide CEC and microbial conditions within the A and A/C horizons that are sufficient to adsorb and degrade herbicide residues at rates listed in Table 41. The CEC for soil types on the Deschutes National Forest range from approximately 5 to 20 meq/100g of soil. These CEC figures reflect the minimal amount of clay colloids and relatively low organic matter content (generally <5%) in the mineral soil derived from Mazama ash. The CEC for soil types on the Ochoco National Forest and the Crooked River Grasslands are slightly higher, ranging from approximately 8 to 28 meq/100g of soil. These CEC figures reflect the slightly higher amounts of clay colloids present from weathered parent material and similarly low organic matter content (generally <5%) in the mineral soil.

Conditions provided by local soils are also sufficient to degrade herbicide residues at rates listed in Table 41. Local soil properties include the presence of microbes capable of degrading the residues over time. Microbial biomass of selected pumice and ash soils on the Deschutes National Forest has been measured to range from 324 to 345 mg C/kg of soil (Busse, personal communication). Although there is no microbial data for the Ochoco or Crooked River Grassland soils, the presence of a similar component of surface ash in some Ochoco soils, as well as a generally observed breakdown and incorporation of annually produced organic matter in these systems, suggests that there is microbial component in soils located on the Ochoco and Grassland areas capable of degrading organic compounds.

Microbial activity is directly related to soil temperatures in the A and A/C horizons. Soils within the PAUs have cryic or frigid temperature regime which generally warm above levels conducive to vegetative growth and microbial activity by April or May and remain at these levels well into October. This length of activity is not expected to be a limiting factor to the degradation of organic residues. Sites would see a seasonal delay in degradation activities when temperatures are below levels necessary for measurable microbial activity. This analysis assumes that soil temperatures are sufficient to support microbial activity for long enough during the year to degrade herbicide residues at rates shown to occur by research.

Herbicide treatments on upland soils

Herbicide treatments proposed within the analysis area would occur primarily on upland soils (~13,330 acres) across a variety of landforms and aspects. Direct effects to the soil resource are expected to be relatively minimal due to soil characteristics that provide sufficient cation exchange capacities (CECs), soil microbial populations and soil temperatures conducive to herbicide adsorption and degradation. The primary concern for herbicides applied to upland soils is their potential mobility within the watershed to ground or surface water sources via overland flows from rainfall soon after application, percolation through the soil profile, or erosion mechanisms following application. PDFs intended to reduce this risk are included in the FEIS that limit application rates of applied herbicides and require weather conditions be monitored prior to application (PDF #s 12 & 17).

The surface textures of upland and riparian soils within the PAUs were classified into three textural categories (fine = 1, medium = 2 and coarse =3) to help predict the potential mobility of the herbicides proposed for application. Project Design Features (PDFs) are included in the FEIS to limit the application of mobile herbicides on soil types with surface textures conducive to this movement in order to minimize herbicide runoff, percolation and/or accumulation in the soil. Herbicides identified as having higher mobility in the environment include: chlorsulfuron (clay soils), clopyralid (clay soils), metsulfuron methyl (clay soils), picloram (coarse textured soils) and sulfometuron methyl (clay and loam soils immediately after application; sandy textures for deep percolation).

Deschutes NF: Upland soils on the Deschutes are primarily comprised of ash and pumice from Mt. Mazama or other localized volcanic sources. These soils have CEC and microbial characteristics that would support pathways and rates of degradation for herbicides proposed for application similar to those described in research and the R6 FEIS. Although the organic matter content of these soils is relatively low, material, it is expected that the CEC sites contributed by the ash and pumiceous mineral soil are capable of adsorbing residues in excess of those absorbed by targeted invasive plants on each site. In addition, soil microbial populations are present in these soils to degrade residues held within the surface A and subsurface A/C horizons.

No surface texture class 1 soils are present on the Deschutes National Forest, minimizing the concern for the application of herbicides known to be mobile on clay soils. Soils with coarse surface textures (class 3) are prevalent on the Deschutes. The application of picloram and sulfometuron methyl is identified as having a potential risk on coarse textured soils with seasonal water tables or adjacent to surface waters. The identification of upland soils with seasonal water tables and riparian soils help identify areas where the risk of contamination of ground or surface waters could be elevated and these herbicides should not be applied. Forty-six PAUs on the Deschutes have upland soil types with seasonal water tables totaling 1,592 acres (Appendix B of Soils Report).

Following application, herbicide residues on the soil surface or plant vegetation are susceptible to dilution and transport by rainfall before they dry. This risk is highest in the first 24 hours and then lowers steadily after residues are assimilated into plant vegetation or the soil profile. The risk is lowered substantially for upland soils on the Deschutes due to the moderate to high infiltration rates provided by the coarse texture of these soils (sandy loam and loamy sands) that minimize overland flows during rainfall events. The risk of transporting herbicide residues via overland flows is further reduced with the inclusion of PDF #17, which advises applicators to monitor weather conditions and refrain from application if rainfall is expected within 24 hours.

Herbicide residues can become solubilized in soil water and transported down through the profile to groundwater. This risk is minimized on the Deschutes NF due to the moderate percolation rates and relatively high moisture holding capacity of upland ash and pumiceous soils. The moisture holding capacity provided by the many vesicles present in the mineral soil colloids reduces the amount and rate at which soil water moves downward through the profile. This allows for the adsorption of residues in solution in most cases before they reach bedrock or ground water. Sampling of hexazinone residues at 1, 6 and 12 month intervals following application on upland Mazama ash soils on the Bend/Ft Rock District showed no movement below 15 cm and very low residue levels in the profile one year after application (Craigg 2000).

Herbicide residues adsorbed to mineral soil colloids or organic matter on or near the surface can be moved off site by wind or water erosion. The risk of movement via wind mechanisms is relatively low on upland soils when surface cover is present. Soils that do not have coarse, popcorn sized pumice material on the surface are more susceptible to wind erosion when surface cover is reduced, especially immediately following fire. PDFs to minimize application of the sulfonylurea herbicides (chlorsulfuron, sulfometuron methyl, and metsulfuron methyl) within the first two years following fire have been included to minimize this risk (PDF #69). It is unlikely that measurable movement of residues via wind erosion would occur as a result of this project.

All soils are susceptible to erosion during rainfall events that exceed infiltration rates. On the Deschutes NF, overland flows have been observed to occur during intense thunderstorms that produce over 0.7 inches of rain within a thirty minute period. Although the overall risk of residue transport via this mechanism is reduced by PDF #17, unpredicted thunderstorm events can occur during the spring and summer months when herbicides are applied. Soils with moderate to high erosion hazard ratings were queried for the PAUs on the Deschutes and are summarized in Appendix C. Three PAUs have high erosion hazard ratings totaling 132.9 acres and ten PAUs have soils with moderate-high or high-moderate erosion hazard ratings totaling 110 acres (Table 40). PAUs that include soils with moderate erosion hazard ratings are summarized in Appendix C and total 809 acres.

Table 40. Deschutes PAUs with high and high/moderate (H_M) soil erosion hazards.

PAU #	SRI_code	Erosion hazard	acres	Surface Texture	texture class
15-12	89	H	62.60	LS	3
15-17	88	H	16.11	LS	3
15-17	89	H	50.70	LS	3

15-32	88	H	3.46	LS	3
			132.87		
11-04	91	H_M	3.12	SL	2
11-07	84	H_M	0.28	SL	2
11-38	18	H_M	1.66	LS	3
11-38	9C	H_M	1.04	LCOS	3
11-38	9R	H_M	2.81	LS	3
12-04	9R	H_M	4.41	LS	3
12-07	9Z	H_M	3.96	LCOS	3
15-11	86	H_M	1.44	LS	3
15-11	87	H_M	1.44	LS	3
			20.16		
11-33	8C	M_H	3.44	COS	3
11-38	8C	M_H	1.42	COS	3
11-38	8T	M_H	1.08	LS	3
15-05	95	M_H	31.66	LS	3
15-30	95	M_H	48.56	LS	3
15-30	95SB	M_H	3.34	LS	3
			89.49		

Ochoco NF and Grassland: Upland soils on the Ochoco NF are more variable than those on the Deschutes. Surface textural classes range from fine to coarse and many soils have clay loam subsoils. However, all soils do have CEC and microbial characteristics that would support pathways and rates of degradation for herbicides proposed for application similar to those described in research and the R6 FEIS.

Soils comprised of slightly weathered Mazama ash, alluvium or colluvium have medium to coarse surface textures that function similarly to those on the Deschutes in terms of CECs, infiltration rates and moisture holding capacities. Soils where Mazama ash has been held by vegetation or continues to accumulate, generally on north facing and lee slopes across the forest, includes SRI map units D1, E2, E3, F1, F2, and Y8. Assimilation of applied herbicides would be similar to those described for Deschutes NF for these soils including the level of risk for potential movement following application. Soils comprised of colluvium and alluvium with gravelly surface and subsurface horizons of medium and coarse textures include SRI map units N4, N8, N9, Q2-4, Q7, R1-6, U5, and V2-7. These also function similarly to the Deschutes soils described previously.

Upland soils with little or no ash on the surface generally have clay loam surface textures and low organic matter contents that may not be capable of adsorbing certain herbicides. These soil types are generally located on scablands, south facing slopes and outside the areas of Mazama ash deposition. Soil types with these conditions include SRI map units E8, G1-3, G7, J3, L3, L7, S1, T5 and X9. Soil types J0 and J2 are shallow scablands with varying surface textures and are included in this category despite generally having well drained surface characteristics. Soils with a high risk of producing overland flows during rainfall events are present in six PAUs currently proposed for treatment on the Ochoco NF, totaling 4.8 acres, and 4 on the Grasslands, totaling 150 acres (Table 41). Herbicides recognized to be mobile in clay soils should be substituted with picloram, glyphosate or imazapic in these locations (PDF #s 47 and 48).

Table 41. Ochoco PAUs with fine textured surface soils.

PAU #	SRI_code	Surface texture	texture class	Herbicide conflict	Infested acres

71-12	L3	SiL	1	substitute	0.10
71-51	L3	SiL	1	substitute	3.26
71-56	L3	SiL	1	substitute	0.03
71-65	L3	SiL	1	substitute	0.86
71-65	T5	SiL	1	"	0.42
71-75	L3	SiL	1	no	0.10
75-29	CTF	SiL	1	substitute*	38.98
75-50	CTF	SiL	1	substitute*	0.11
75-50	DAE	C	1	substitute*	110.68
72-01	X9	CL	1	substitute	0.02

* Large medusahead treatment sites on steep slopes and fine textured surfaces. Imazapic should be substituted for sulfometuron methyl if site is adjacent to surface water.

The majority of upland soil types on the Ochoco NF have older clay loam or finer subsurface soil horizons beneath thin layers of medium or coarse textured ash, alluvium or colluvium. The highly weathered subsurface horizons are near enough to the surface to reduce infiltration rates and influence adsorption properties. These soils have a risk of producing overland flows during rainfall events, depending on the depth to the finer textured subsurface horizon. Although the percolation rate of the subsoil horizons is generally moderate, the thickness of this horizon can lower this rate and produce lateral flows capable of reaching the surface on hill slopes or in drainages.

Soils on the Ochoco and Grasslands generally have higher erosion hazard ratings than those on the Deschutes due to lower infiltration rates and steeper slopes. Overland flows are generally observed to occur during intense thunderstorms that produce over 0.4 inches of rain within a thirty minute period. Soils with moderate to high erosion hazard ratings have been queried for the PAUs on the Ochoco and summarized in Appendix C.

Although the overall risk of residue transport via erosional movement of mineral soil is reduced by PDF #17, unpredicted thunderstorm events can occur during the months after herbicides are applied. This risk would be highest on the soils identified with high erosion hazard ratings in Appendix C of the Soils Report. Fifty PAUs have soils with high erosion hazard ratings, totaling 666 acres. Sixty-one PAUs have soils with moderate to high erosion hazard ratings, totaling 29 acres. Eighty-seven PAUs have soils with moderate erosion hazard ratings, totaling 3,914 acres.

Herbicide Treatment on Riparian Soils

Deschutes NF: Forty-four PAUs located on the Deschutes NF contain mapped invasive sites on riparian soils (SRI soil codes 05 and 08). Approximately 370 of the 484 total acres could receive herbicide applications as a part of proposed treatments. Riparian soils on the Deschutes generally have sandy loam surface textures and relatively high organic matter content in the A horizon. These characteristics provide sufficient CECs to adsorb excess herbicide residues that are not taken up by targeted species. As a result, excess residues not moved offsite by rainfall are expected to be adsorbed and degraded on site.

Phalaris sites: The majority of Deschutes NF sites on riparian soils are those in which Reed canarygrass or ribbongrass (Phalaris species) are targeted. Approximately 225 acres of Phalaris have been mapped at Trout Creek Swamp, Big Marsh, and islands and banks of the Metolius river. Other areas include Paulina, Davis, Hosmer, and Lava lakes, Crane Prairie and Wickiup reservoirs, and the Bull Bend and Ryan Ranch areas along the Deschutes River.

Treatment of Phalaris as emergent vegetation growing out of water is limited to the hand wick application of an aquatic form of glyphosate or imazapyr (Chapter 2, Table 2). Total amounts of herbicide applied on these sites would be minimized by the efficiency of the wick application method and restricted application rates (PDF #54). Although there is a short term risk of applied residues washing off into surface waters via heavy dew or rainfall, these residues dry quickly on the vegetative surface and begin to be absorbed within hours of application. Applied herbicide would be absorbed by plant leaves and translocated throughout the entire plant, including the roots, where the herbicide begins to inhibit amino acid and protein physiology (glyphosate) or acetolactate synthesis (imazapyr).

The possibility of herbicide residues entering the soil or soil water via root exudation appears to be minimal. Studies of the effects of glyphosate on root exudation appear to show changes in root exudates to types that induce an increase in mycelium propagules associated with bean roots in muck soils (Liu 1997) and suppress the lignification process in roots growing in hydroponic lab conditions (Descalzo 1997). Soils associated with emergent vegetation sites are comprised primarily of a thick organic root mass and thatch from the Phalaris species with a variable component of aggraded mineral soil and stream gravels. Any exuded residues are likely to become solubilized or adsorbed by organic matter on these sites. Although microbial degradation is limited in these conditions, the adsorption of residues would allow for hydrolysis degradation to occur.

Treatment of *Phalaris* species growing on mineral soil substrates located on streambanks, terraces or lakesides could occur with wicking or spot spray applications of aquatic glyphosate or imazapyr. The assimilation of these residues by targeted vegetation would the same as those described for the wet, emergent sites, although excess herbicide residues are highly likely to be adsorbed on organic or mineral soil cation exchange sites and readily degraded under unsaturated conditions during the summer and early fall with minimal effects on soil microbes (Busse, et al., 2001). The adsorption and subsequent degradation of any excess herbicide in the soil profile is expected to occur at, or above, rates reported for upland soils due to the CEC of the soil and the high adsorption rates of aquatic glyphosate and imazapyr. Effects to the soil resource in these areas are expected to be minimal, primarily due to the low toxicity of aquatic glyphosate or imazapyr to soil microbes.

A short term risk of herbicide mobility into water sources exists on all Phalaris sites in the event of rainfall or heavy dew within 24 hours of application. This risk is minimized somewhat by PDF #17, which advises applicators to monitor weather conditions for potential rainfall or winds to reduce the risk of overspray or transport to water. However, residues that had not been assimilated by targeted plants could be washed off of vegetation in subsequent days by lighter rains and dews and transported into soil or adjacent water if saturated conditions exist. Residues in soil solution may be mobilized into ground or surface waters before they were adsorbed on organic matter or cation exchange sites in the soil. Potential amounts contributed to adjacent water bodies were calculated using conservatively high assumptions for the GLEAMs model and found to be well below levels toxic to fish (Dachtler 2009).

Monitoring of aquatic glyphosate (2% solution) and aquatic imazapyr (1.5% solution) applications was informally conducted on private property near Camp Sherman with photos and field observations in 2007 and 2008. Jefferson County employees applied herbicide on 13 small plots located on the bank of the Metolius River and a spring fed tributary using backpack sprayers and wicks. Anecdotal and photographic observations support effective treatment of targeted ribbongrass with minimal overspray and effects to non-target species. Relatively low amounts of herbicide reduced targeted populations to less than 10% of the original extent after the next growing season. Re-application the following year to treat targeted individuals that survived required substantially less herbicide. Exposure of bare mineral soil on the treated plots was minimized by the accumulation of treated vegetation as a mat of thatch on the surface (Sussmann 2007). Further observations of the recovery of desirable species on these sites will be made in the summer of 2009.

Herbicide treatment of Phalaris sites proposed for treatment under this FEIS would be monitored for target species reduction and the return of native or more desirable species on site. Active re-vegetation of these sites with transplanted plugs of native sedges and other species to promote the return of live vegetation could occur on sites where natural regeneration was not occurring (Standard 12 from the R6 ROD).

Other Invasive Species: Nearly all of the other invasive species targeted under this FEIS could be treated on riparian soils within the Deschutes NF and could receive the following herbicides: clopyralid (yellow star, Canada and bull thistles; spotted and diffuse knapweed; and tansy ragwort); picloram (leafy spurge, field bindweed and Dalmation toadflax); metsulfuron methyl (St. Johnswort); chlorsulfuron (Kochia) and sulfometuron methyl (medusahead). The riparian sites are generally floodplains and terraces near streams or the edges of lakes where soils may be seasonally saturated but are likely dry by early summer.

Riparian soils on the Deschutes are generally alluvium or airfall ash with silt loam to sandy loam surface and subsurface textures. Organic matter content of the A horizon is generally moderate due to the relatively high annual production of biomass on these sites. The soils have moderate CECs that are capable of adsorbing herbicide residues within the soil profile where they would be degraded by microbes or hydrolysis pathways. The adsorption and subsequent degradation of excess herbicides in riparian soils is expected to occur at, or above, rates reported for upland soils in Table 39 because of the soil CECs and the adsorption rate of the herbicides.

The risk of erosion in riparian soils is relatively low due to relatively thick root masses and high vegetative cover. Although treated areas would see a short term reduction of live vegetative cover, biomass thatch and natural regeneration of non-target species is expected to offset this loss. Movement of residues adsorbed to soil colloids into water bodies as a result of erosion is expected to be minimal following herbicide treatments.

<u>Ochoco NF and Grasslands:</u> Twenty-two PAUs located on the Ochoco contain mapped invasive sites on riparian soils. A total of 7.5 acres were identified on SRI map units A12 and A2, which represent streamside floodplains and wet to dry terrace/meadow soils associated with drainages. A total of 15 acres were identified in SRI map units M13 & M2, which represent wet, moist and dry meadow sites overlying different bedrock types.

The primary target species located on riparian sites are houndstongue (Paulina district), spotted knapweed and houndstongue (Lookout Mtn. district) and spotted knapweed (Grasslands). The preferred herbicides for these species are clopyralid (knapweed) and metsulfuron methyl (houndstongue), both of which can be highly mobile in clay soils.

Riparian streamside soils on the Ochoco generally consist of younger alluvium with loam or sandy loam surface textures and relatively high organic matter content in the A horizon. These soils do not have a high clay content and provide sufficient CECs to adsorb excess residues from the application of clopyralid or metsulfuron methyl. As a result, the wicking or spot application of these herbicides on streamside floodplain sites is not expected to produce excess residues that cannot be adsorbed and degraded on site.

Riparian soils located on meadows or larger terraces associated with entrenched streams generally have older accumulations of alluvium with silt loam or loam surface textures and clay loam subsurface horizons. Although the subsurface clay content provides lower adsorption properties for clopyralid and metsulfuron methyl, the organic matter content in the surface A horizon does provide sites for adsorption. Although relatively low, the risk of downward mobility of these herbicides into groundwater and subsequently to streams is a possibility and may necessitate the need for choosing an alternative herbicide that is less mobile in clay soils, namely picloram. Specific site assessments of populations proposed for treatments on these soil types is recommended at the time of treatment.

Manual and Mechanical Treatments

Manual treatments approved under existing NEPA document decisions and described under the No Action alternative would continue under the Action alternatives. Additional sites would have all or portions of their area treated manually under this alternative with similar effects as those described under the No Action alternative. While the relative amounts of such treatments vary between the alternatives, the differences in terms of effects from such treatments are negligible.

The majority of manual treatments proposed would occur as the pulling or wrenching of invasive plants by hand or with shovels on upland sites. These methods would incur physical disturbance of the soil resource on individual sites like those described under the No Action alternative. While the relative amounts of manual treatments vary slightly between the alternatives, the differences in terms of effects from these treatments are negligible.

The manual pulling of invasive plants would incur an initial, short-term loss of live, vegetative cover, the length of which would depend on whether an active or passive restoration strategy is proposed on the site. There is a short term risk of surface erosion from sheet and rill overland flows during this period which would decrease over time as natural or active re-vegetation occurs on these sites. Potential erosion losses from treated areas in the short-term are not expected to compromise their productivity, as indicated by continued re-growth of both invasive and native plants on manually treated sites across the forest (Pajutee, personal communication).

Erosion that occurs on upland sites located within 100 ft of surface waters could contribute sediment to stream channels or lakes in the short term. These areas would be expected to produce a negligible amount due to their small total surface area within any given watershed. Sedimentation is expected to decrease as cover increases on these sites. Meadow sites are less likely to incur cover losses that would promote erosion. Approximately 44 acres of Glaze meadow on the Sisters Ranger District are proposed for manual treatments of bull thistle. Disturbance would be localized to the basal area of the plants and would not compromise existing cover levels of desirable species that exceed 80%.

***Phalaris* species:** Manual pulling is included as a treatment option for Reed canarygrass or ribbongrass (Phalaris species) on sites that are located on gravel, cobble and/or wood substrates. Sites include islands in the Metolius River, the edges of river channels below bankfull, and the edges of lakes below high water marks. These sites generally have organic soils that are seasonally saturated and comprised nearly entirely of Phalaris roots and thatch.

Manual treatment of these sites was experimentally during a pull of a Metolius river island in the fall of 2008. Although the treatment was variably effective in removing the vegetative and root masses of the targeted plants, the amount of labor involved to pull and transport the plant and root masses was relatively high (Pajutee 2008). The sites generally have some fine sediment incorporated into the thatch and root mass which was temporarily released into the water as the plants were loosened and pulled. Broken rhizomes were also released, although measures to capture these with nets could be incorporated into the operation. Root masses are voluminous and need to be transported from the site to be burned or solarized to prevent them from re-sprouting.

Phalaris sites located on floodplains or terraces above bankfull levels have a higher content of mineral soil and are generally include a mixture of other vegetative species. Manual treatment of this site type was demonstrated on private property in the Metolius basin and observed to be difficult due to the intermingled roots of other species that made digging very inefficient (Sussmann 2008). These sites would require far more excavation of the soil and riverbank to remove the targeted plants and repeated treatments would be necessary due to the difficulty in removing all of the *Phalaris* rhizomes. These treatments would expose mineral soil and raise the risk of erosion and sediment contribution to adjacent water bodies in the short term until vegetation was re-established. Although some natural regeneration of these sites by desirable species is likely to occur, active re-vegetation with transplanted native sedge plugs and other species to reduce the amount of soil medium exposed in the short-term is recommended (Standard 12 from the R6 ROD).

Phalaris sites may also be treated with a method called soil solarization. This process involves the installation of plastic mats over an area in order to trap infrared radiation and raise soil temperatures to levels capable of killing plants, seeds, plant pathogens and insects. Solarization is an option for killing invasive plants without the use of chemicals and has been used effectively in horticulture (Tu, et al. 2001). The process is non-discriminate towards biological flora and fauna and would kill native and non-native species alike on site. A small experimental patch on private property effectively reduced the presence of Phalaris but has not eliminated it from the site (Sussmann 2008).

Solarization would cause a direct loss of biological components of the soil resource from the heating process, although any losses of microbial diversity on the site appear to be short-term. Physical and chemical properties of the soil can also be altered as a result of the elevated soil temperatures, although a release of nutrients that are tied up in the organic component of the soil appear to be utilizable by plants introduced to the site after the plastic is removed (Tu, et al. 2001). The sites would be left with a layer of dead plant biomass following the removal of the plastic with minimal exposure of the soil substrate. The thick rhizomatous root layer would resist erosion but may be difficult to re-colonize with naturally regenerated species.

Houndstongue: Mechanical treatment of houndstongue is proposed in both action alternatives under this EIS on approximately 149 project area acres within three harvest plantations on the Paulina District of the Ochoco NF. These areas are currently impacted as a result of past harvest operations, with little or no organic matter cover on the soil surface and variably compacted mineral soil. Vegetative cover of houndstongue is currently estimated at between 40 and 80% and there are very low amounts of native grasses, shrubs or seedling/saplings providing organic input. Portions of these areas would be scarified following prescribed fire and/or herbicide treatments using a harrow implement pulled behind a four-wheeler in order to prepare the site for re-seeding of native or more desirable species.

Prescribed burning of houndstongue prior to harrowing would not be expected to have detrimental effects on the soil resource due low densities of combustible material on the soil surface that would produce very short residence times. The organic matter of the plants combusted by fire, killed by herbicide and/or cut or uprooted by the mechanical operations would be left on site and available to be incorporated into the mineral soil after the operations. Effects to soil productivity on these sites from the four-wheeler and harrow implement due to compaction or mixing are expected to be minimal. Harrowing would improve current conditions by breaking up and mixing the currently hardened mineral soil. The harrow tines would be pulled a four-wheeler through the surface mineral and organic horizons of the soil to depths of 1 to 4 inches. Active seeding of grass and forb cultivars following mechanical treatment would be expected to be supported by the organic, mineral and microbial components of the soil resource.

The erosion hazards of the soils present are moderate and capable of producing sediment when cover is reduced. There would be a short-term risk of erosion on these sites following the mechanical treatment until seeded and naturally regenerated vegetation recovers. Rainstorm events on the 20 to 30% slopes could produce overland flows capable of carrying the newly loosened mineral soil down slope toward the intermittent stream channel. However, a 50 ft buffer of non-treatment between the channel and an existing, parallel skid trail would be maintained to reduce the energies of potential overland flows and help filter out a portion of the sediment before reaching the channel. Total contribution of eroded sediment from mechanically treated areas is expected to be low during low and medium intensity rainfall events. Higher intensity rainfall events have the possibility of moving sediment to the channel until a vegetative component sprouted and grew from the planted seeds.

Indirect Effects

Indirect effects of proposed treatments include the transport of herbicide residues as a result of wind or water erosion from treated sites. Erosion risks at each site are determined by the length and amount of mineral soil exposure and the erosion hazard of the soil type on which treatments occur. PAUs containing soils with moderate or high erosion hazards are identified in Appendix C of the Soil Resource Report. Although the amount of excess herbicide residue on upland soils is expected to be minimized by application rates and methods, off-site movement of herbicides adsorbed to soil particles via wind or mass soil movement could occur during the initial half-life of an applied herbicide. Sites with moderate to high erosion hazard ratings could contribute herbicide residues adsorbed to soil particles to adjacent soil or water bodies. Although wind erosion does occur in local ash soils, transport of herbicide residues by this mechanism is not expected to occur at measurable rates.

The herbicides in the sulfonylurea chemical family have an elevated risk of off-site movement by rainfall and erosion mechanisms. Research on the mobility of sulfometuron methyl is limited, although one study measured movement to > 70 cm of depth in a silty clay loam soil when leached with an extreme amount of water (46 cm) over a 48 hour period (Lym and Swenson 1991). The greater risk appears to be lateral movement from clay and loam soils following a rainfall event within the first 48 hours of application (SERA 2003e; Herbicide Handbook 2002).

Broadcast applications of sulfometuron methyl are proposed on large medusahead sites on the Grasslands that contain clay loam subsurface textures with a shallow layer of medium textured ash on the surface. Although the risk of offsite movement of herbicide residues from these sites is moderate, the ash surface provides cation exchange sites that can adsorb the residues and minimize their lateral mobility from overland flows. The risk is reduced on these sites by PDFs that limit the application of this herbicide to the lowest rates possible for treatment effectiveness (PDF #12 - limit of 0.12 lb active ingredient/acre) and those that advise applicators to monitor weather conditions for the risk of rainfall in the short term (PDF # 17). These features would minimize the amount of excess residue on site available for transport by water and minimize the application on fine textured soils when conditions are likely for rainfall within 24 hours.

Off-site movement

The potential movement of herbicide residues to ground or surface water sources exists via overland flows generated by rainfall or the percolation of water through the soil. This mobility is largely determined by the individual characteristics of the herbicide and the soil on which it is applied, and can be minimized by the method, timing and rate of application.

Each herbicide proposed for use under this EIS has a different solubility in water and adsorption rate to soil and organic matter (Table 39). Herbicides that are highly water soluble or strongly adsorbed to soil particles capable of becoming sediment carried by overland flows have the potential to move off site during the first few days following application. Although applicators generally operate with an awareness of the current weather patterns and are less likely to apply within a day or two of measurable rainfall, rogue thunderstorms capable of capturing herbicide residues with these characteristics could occur. There is a slight risk of movement of residues to stream channels by overland flows on approximately 754 acres of invasive weed populations proposed for chemical treatment under this alternative. Approximately 724 acres are located across nine sub-basins within 100 ft of class I-III stream channels, lakes and springs (see Fisheries Report), and 30 acres are located within the 3 ft boundary designating class IV stream channels. These acres are located within the maximum distances from which 100% of applied herbicide is assumed to be capable of reaching surface waters during a rainfall that produces overland flows within the first few days following application.

Herbicide residues on treatment sites along some road segments are also at risk of delivery to surface waters if overland flows soon after application are focused through hydrologically connected road ditches or road surfaces. Approximately 320 acres of proposed treatment areas are adjacent to road segments within 300 ft of where they cross stream channels. These road segments are assumed to be hydrologically connected and all of these acres are assumed to be chemically treated under this analysis. Project design features that include spot or wicking applications of herbicides used for treatments within RHCAs and along hydrologically connected road segments would reduce the amount of herbicide applied in these areas and lower the amount of residues available to be soluble in overland flows or to adsorb to soil particles that could become sediment.

Individual herbicide characteristics and soil attributes influence the degree to which residues would be captured and moved by overland flows or percolated down through the soil profile to groundwater during rainfall events following application. Picloram, sulfometuron methyl, and chlorsulfuron have the highest risk of movement via overland flows if applied to soils with high clay content or that are shallow and unproductive. PDF #s 47 and 48 restricts the application of these herbicides on soils with these characteristics. Ochoco soil types with these conditions include SRI map units E8, G1-3, G7, J0, J2, J3, L3, L7, S1, T5 and X9.

Clopyralid and metsulfuron methyl have the highest risk of movement through the soil profile during their first half-life period. Application of these herbicides on coarse textured soil profiles with rapid infiltration rates could result in contamination of groundwater resources where soil moistures conducive to rapid percolation occur and seasonal water tables are present near the surface. PDF #45 restrict the application of these herbicides on sites with coarse textures in order to minimize the potential for groundwater or surface water contamination. Numerous soil types on the Deschutes have coarse textures that could enhance this movement, although most are located far from surface waters and do not have water tables within at least five feet of the surface. Soil types with seasonal water tables are summarized in Appendix B.

Soil productivity

The application of herbicides at rates necessary to control invasive plants could indirectly affect the productivity of the site in the short-term by altering the vegetative cover and associated organic input provided by plants site. The loss of cover or a transition of species composition on sites treated with herbicides is likely to affect the soil microbial community more certainly than any direct toxic action by herbicide residues on the microorganisms (SERA, 2003 - sulfometuron methyl). The loss of invasive plant species functioning as hosts to certain mycorrhizal fungi may cause a temporary shift in microbial populations and composition within the soil environment. However, the possible shift in microorganisms during this transition period is not expected to completely remove mycorrhizal populations associated with native plants or bacterial populations associated with decomposition and nutrient cycling. As a result, the indirect effects on site productivity from the short-term transition of species composition are expected to be minimal.

The treatment of sites with herbicides could also indirectly affect site productivity in the short term through changes in total organic production on site and annual input into the soil. These effects would be most pronounced on sites that are currently very heavily infested with invasive plants and are moving toward monocultures, including those with ribbongrass, medusahead or houndstongue. Chemically treated plants would die and become incorporated into the soil as organic matter during the first years following treatment. Annual input in subsequent years would be limited by the number of non-target species interspersed between invasive plants or the rate at which vegetation returned to the site. A short-term lag of organic input would temporarily reduce the amount of organic matter available for decomposition and nutrients, and thus indirectly affect the productivity of the site. Although nutrient input would be reduced in the short-term, the successful re-establishment of native vegetation is not expected to be limited by the productivity of the site. Other aspects of productivity, including the microbial component, are not expected to be affected enough by proposed treatments to change the productivity of the site. Direct effects to soil organisms from herbicides applied at approved rates have been researched to be relatively benign and are expected to be minimal.

Sites on which active restoration such as seeding or planting with inoculated individuals occurred would have minimal potential delays in the re-establishment of organic matter production and annual input to the soil resource. Sites with passive restoration strategies could have an indirect delay in the return of native species on heavily infested areas. Although any delays on these areas are expected to be relatively short lived, most sites are not monocultures of invasive plants and have enough native or more desirable species already on site to expand into open areas created with proposed treatments.

Early Detection Rapid Response (EDRR)

EDRR is included as a component of both action alternatives and is described in detail in Chapter. Sites detected outside of inventoried PAUs that have physical parameters similar to those described in this analysis are proposed for treatment with methods appropriate for the species and the site location. Restrictions on the amount of new sites treated under EDRR are included in. All EDRR treatments would follow PDFs included in this EIS and would include annual limitations on the amount of treatments within 6th field watersheds for uplands (<10% of inventoried populations), within the aquatic influence zone (<10 acres), and below bankfull or high water marks of surface waters (<1.0 acres) (Chapter 2 and Appendix F). These limitations are expected to keep the direct, indirect and cumulative effects to the soil resource within the bounds of this analysis.

Populations of invasives detected subsequent to existing inventories could have unique physical parameters that were not assessed during this analysis. These sites will be assessed on an individual basis for appropriate treatments and potential effects to the soil resource. These conditions would likely convene an interdisciplinary team and trigger additional NEPA requirements in order to minimize the environmental effects on the soil resource (Appendix F).

Cumulative Effects

Cumulative effects on the soil resource generally center on the possibility of multiple applications of herbicides over a period of up to five years on an individual project area unit. These effects could be compounded if excess residues are produced and the degradation of the herbicide does not occur at expected rates before the next round of herbicide was applied. Although the application of herbicide is likely in successive years on most sites, the time between applications and the half life of the various herbicides will minimize residue accumulations. PDFs included to apply herbicides at the lowest application rate for effective control will limit the amount of excess residue present on site each year, while the presence of soil microbes and soil temperatures conducive to degrading the herbicides will allow this to occur at rates cited by research. As a result, the extent of residues remaining in the soil when subsequent applications occur should be minimal.

Herbicide applications on each site could occur for up to five years or until populations are reduced sufficiently enough to allow manual treatments to be effective on site. The buildup of residues as a result of multiple applications should also be limited on proposed sites due to the treatment effectiveness of each application, which has been conservatively observed to be an estimated 80% or more each year (see discussion page 97). Total amounts of herbicide applied by Deschutes County employees on Deschutes NF sites currently approved for herbicides has decreased in successive years since 2000 (Oregon Dept. of Agriculture, Langland, 2005). As a result of this effectiveness, the total amount of herbicide applied to proposed sites is likely to decrease substantially each year and the accumulation of residues from these applications is not likely to be incrementally detectable.

Some sites proposed for treatment under this EIS have been sprayed with herbicides under previous NEPA decisions. These sites are not expected to be additive in herbicide accumulations for the same reasons presented above. In some cases the type of herbicide may change, most likely to a less mobile and less toxic chemical, as in the case of substituting clopyralid for dicamba on knapweed sites.

Herbicides treatments are also proposed to be implemented in place of manual treatments found to be ineffective on some of these sites. Additional upland acres treated under EDRR within any 6th field subwatershed would be limited to 10% or less of the existing extent of inventoried populations and would not cumulatively affect the soil resource on any individual sites.

Agricultural use of herbicides on private land ownership is not likely to cumulatively affect soils on Ochoco and Deschutes National Forest System lands due primarily to their lower watershed landscape positions. It is possible that residues could move from Deschutes and Ochoco Forest lands to other ownerships due to a generally higher location within the watershed. This mechanism is likely to be relatively minimal considering that Forest Service use of picloram nation-wide is less than one percent of agricultural use (SERA, 2003-picloram), and Forest Service use of sulfometuron methyl nationwide is less than one percent of all use in California (SERA, 2003-sulfometuron methyl). However, some sites on the Crooked River Grassland are immediately adjacent to private lands, a proximity that could contribute herbicide residues to treated sites from either direction. This effect should be minimized by limitations to treatment application rates on all land ownerships within the state of Oregon.

Reasonably foreseeable actions: Most forest or riparian sites proposed for treatment will have treatment and monitoring of invasive populations extended through the short term. Foreseeable management activities on these sites are likely to be minimal, except for the possibility of prescribed burns, wildfire suppression activities and subsequent salvage opportunities. Although these activities could result in direct detrimental disturbance to the sites, the effects to soils from herbicide applications proposed under this EIS are unlikely to incrementally change soil characteristics enough to alter the productivity of any treated sites. Activities proposed under this FEIS are not likely to be additive to the impacts of any other activities that could be cumulative to existing conditions on these sites.

Other management activities are not likely to occur on roadside treatment sites, which will be maintained as shoulder and drainage areas over the long term. Reduction of invasive populations on these sites may reduce the amount of mowing/clearing maintenance required to keep them functional for safety and drainage.

Under Alternative 2, the treatment of invasive plants on all sites would have cumulative effects within acceptable levels for maintaining soil productivity. Subsequent passive or active restoration of healthy native plant communities envisioned would generally benefit the soil resource in the short and long terms. The cumulative effects of Alternative 2 would be small in comparison to the potential effects of untreated invasive plants described under the No Action Alternative.

ALTERNATIVE 3

The effects to the soil resource under Alternative 3 would be similar to those described for Alternative 2 on acres treated with herbicide or manual treatments. The amount of area treated with chemical herbicides would be reduced by approximately 250 acres due to the changes in application methods adjacent to intermittent stream channels and restrictions of certain chemicals within 300 ft of lakes, ponds, and fish bearing streams. The following restrictions are included as Project Design Features (PDFs) in Chapter 2 for Alternative 3:

- No herbicide application would occur within the definable channel of dry intermittent stream channels, described as 3 ft width centered on the channel (30 acres removed from Alternative 2) or within 10 ft of rivers, lakes, ponds, reservoirs, perennial or fish bearing streams, or flowing periods of intermittent streams (approximately 230 acres removed from Alternative 2).
- Non-aquatic triclopyr, picloram, non-aquatic glyphosate, and sethoxydim would not be applied within the 300 ft buffers of perennial streams or lakes. (approximately 1,288 acres)

- Broadcast spraying would not be allowed within the 300 ft buffers or along roads that are within 300 feet of perennial streams or lakes. (Approximately 1,288 acres, including 320 acres along roads).

Direct and Indirect Effects

Alternative 3 would have similar effects to the soil resource as those described for Alternative 2, except for areas identified within RHCA buffers in which chemical herbicide may be substituted by manual treatments. Treatment areas within the 300 ft buffers proposed for the use of non-aquatic triclopyr, picloram or sethoxydim under Alternative 2 may be manually treated due to the ineffectiveness of other herbicides on the target species identified, including Russian knapweed, Scotch Broom and Himalayan Blackberry. However, clopyralid and aquatic glyphosate are options for herbicide treatment of Russian Knapweed in these locations under this alternative. Manual treatments would reduce the risk of toxic effects to soil microbes from herbicide residues in these areas, although as discussed under Alternative 2, these risks are low and soils within this buffer include both riparian and upland types that are capable of adsorbing excess residues and promoting their degradation.

Alternative 3 would impose a 3 ft strip centered on intermittent stream channels and a 10 ft buffer on either side of perennial stream channels that would be excluded from herbicide applications. These restrictions would remove approximately 250 acres proposed for herbicide application in Alternative 2. The targeted invasive populations in these Project area units (PAUs) would be manually treated under Alternative 3. These treatments would have direct effects to the soil resource as described for manual treatments under Alternative 2, primarily the disturbance of mineral soil from the prying and wrenching of individual plants. Soil disturbance from weed wrenching would be higher than that induced by treatment with herbicides and would slightly elevate the risk of erosion and contribution of mineral soil to adjacent stream channels immediately following implementation when compared to Alternative 2. Disturbance would be minimal on a spatial scale and would not be considered detrimental. Erosion risks would be relatively short lived, especially on sites with active restoration of native or more desirable non-native species. Native or more desirable non-native species are also likely to colonize these sites over time.

Alternative 3 would require spot spray application methods to replace broadcast spray methods within 300 ft of streams or other surface waters. The total amount of herbicide applied on each site may be reduced slightly under this alternative as a result of the change in application methods. The reduction of potential overspray and wind drift from this change would likely reduce the amount of herbicide that is initially applied to the soil surface and reduce the risk of off site movement of herbicides via overland flows or erosion mechanisms when compared to Alternative 2.

Cumulative Effects

The cumulative effects to the soil resource associated with Alternative 3 would be the same as those described for Alternative 2 for the treatment sites outside of application restrictions included in this alternative. Changes in treatment methods or reductions in the extent of herbicide applied under Alternative 3 would only slightly alter the cumulative effects described for the soil resource under Alternative 2.

The change from herbicide to manual treatments within intermittent stream channels and buffers along perennial streams would remove the possibility of residue accumulation within riparian soils from repeated herbicide applications. This change would, however, incur direct disturbance of mineral soil within these areas over a number of treatment years. Although not expected to detrimentally affect the productivity of these sites, this disturbance would be repeated as targeted species returning from existing seedbanks in the soil are treated each year. The risk of erosion of the mineral soil exposed by this treatment would be present each year until active or passive restoration provided cover with native or more desirable species on site.

3.6 Water Resources

3.6.1 Affected Environment

Watersheds

Watersheds are natural divisions of the landscape and the basic functioning unit of the hydrologic system. Watersheds are hierarchical – smaller ones nested within larger ones. Environmental changes commonly accumulate and appear on a watershed basis. For the purpose of analyzing and summarizing aquatic and vegetative data a hierarchy of watersheds and watershed boundaries was developed by the region using U.S. Geological Survey (USGS) protocols. The planning area for the Deschutes/Ochoco Invasive Plant Treatment EIS fits within four river basins (3rd field watersheds), the John Day Basin, Deschutes Basin, Klamath Basin, and Oregon Closed Basins. The watersheds and subwatersheds within these basins are all listed in Appendix I to this DsEIS. Refer to the Water Quality Report in the project file for information on which plans (i.e. Northwest Forest Plan, INFISH, etc.) apply to the watersheds, identification of key watersheds, and for a map of watersheds.

Climate & Precipitation

Most of the analysis area has a climate of relatively low precipitation and humidity, large daily temperature fluctuations throughout the year, and high evaporation rates, with increasing precipitation and cooler temperatures as elevation increases to over 9,000 feet in the Cascades. The planning area is in the rain shadow of the Cascade Mountains with the majority of the precipitation falling on the west side of the divide resulting in a dryer climate in the Deschutes and John Day Basins. Summers are typically hot and dry and winters cool and moist. Prevailing winds are generally southwesterly through westerly.

Mean annual precipitation in the analysis area varies from a minimum of less than 10 inches per year in parts of the Crooked River National Grassland, to a maximum of about 33 inches per year in the Ochoco Mountains, and 140 inches per year at higher elevations in the Cascade Mountains on the Deschutes National Forest. Precipitation generally increases with increased elevation and on the Ochoco National Forest also tends to be higher at the same elevation as you move north.

The majority of precipitation in the planning area occurs between November and March with most of it falling as snow at higher elevations. November, December, and January normally have the highest total monthly precipitation. Total precipitation usually declines through March and April then increases again in May and June as frontal movements bring late spring rains. July, August, and September have the lowest average monthly precipitation. August normally has slightly higher precipitation than July or September due to summer thunder storms which may be intense in limited areas. At lower elevations, the highest recorded total monthly precipitation for June, July and August may approach the highest recorded precipitation for the wet months of November and January due to the infrequent occurrence of intense summer thunderstorms. In dry years there may be no precipitation during some of the drier months. Refer to the Hydrologist Report for a precipitation map.

Analysis Guidance

Management of this project, as it relates to hydrologic and riparian function, is directed by the Northwest Forest Plan (1994), Ochoco Land and Resource Management Plan (LRMP 1989), Deschutes Land and Resource Management Plan (LRMP 1990), the Inland Native Fish Strategy (INFISH 1995), the Interim Strategies for Managing Anadromous Fish Producing Watersheds

(PACFISH 1995), several Wild and Scenic Management Plans, the Clean Water Act (1972) and Executive Orders 11988, 11990, and 12088. Additional scientific guidance and background information is available within various Watershed Assessments and the General Water Quality Best Management Practices (1988). The following paragraphs discuss the guidance within those documents for protecting water resources.

1. *Northwest Forest Plan (1994)*

   This plan outlines how Federal Lands within the range of the Northern Spotted Owl will be managed. The Aquatic Conservation Strategy (ACS) objectives more specifically outline how to manage for healthy watersheds. There are nine ACS objectives which will be addressed in this report under the effects of the action alternatives.

   Standards and Guidelines that are applicable to this project include the following.

   - RA-3 – Herbicides, insecticides, and other toxicants, and other chemicals shall be applied only in a manner that avoids impacts that retard or prevent attainment of ACS objectives.

2. *Ochoco Land and Resource Management Plan (1989)*

   Water goals, as established by the LRMP are to maintain or improve water quality, quantity, and timing of run-off, comply with the objectives of the Clean Water Act and Oregon State water quality standards, and to provide water of consistently high quality to users and dependent resources (page 4-35). A long-term Forest objective is to maintain or improve all riparian areas to "excellent condition," in order to maintain or improve water resources. The desired condition outlined in the LRMP (page 4-36, 4-74 and 4-75) states the following:

   - In ten years watersheds that are in good condition should remain so, while those presently not in good condition should be given first priority to improve watershed and riparian areas. Although the ten year time period has elapsed since the Forest Plan, efforts are still directed towards improving watershed condition.
   - In fifty years it is expected that 90 to 95 percent of the riparian areas on the Forest will be in "excellent condition."
   - In general, riparian areas should exhibit a low, but apparent level of management. Vegetation may or may not appear manipulated, depending on the condition of the stream. Within the limits of ecological potential, a shady, brushy condition with a canopy of alder, willow, aspen, or other deciduous vegetation will exist. Where coniferous evergreens are a natural component of the ecosystem, a variety of size classes will exist to perpetuate the supply of shade and woody debris over time. Sites unable to support a canopy of deciduous or evergreen species will be characterized by vigorous stands of forbs, grasses, and grass-like riparian species.

   Standards and guidelines (LRMP pages 4-199, 4-236 through 4-242) include the following;

   - Select, design, implement, monitor, evaluate, and adjust Best Management Practices based on site-specific conditions to protect water quality and beneficial uses.
   - Minimize the impacts to floodplains and wetlands.
   - For stream temperature, maintain compliance or improvement towards compliance with the State Temperature Standard and the Clean Water Act.
   - For turbidity, stream channel cutbanks should not exceed an average of 20% for any given stream drainage and allow for no more than a 10 percent cumulative increase in natural stream turbidity.

- Shade should be more than 80%, or 100% of potential if 80% is not attainable. Where site potential and topographic factors permit, manage riparian areas to provide the shade necessary to meet stream temperature goals.
- Retain at least 80% of the potential ground cover in grass forb riparian communities and at least 80% of the potential tree or shrub cover.
- Avoid management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment which seriously and adversely affect water conditions or fish habitat.

3. *Deschutes Land and Resource Management Plan (1990)*
   Aquatic goals, as established by the LRMP are to manage riparian areas to maintain or enhance riparian dependent resources such as water quality, water quantity, fish habitat, and wildlife and vegetation that owe their existence to riparian areas (page 4-61).

   Summarized Standards and Guidelines that are applicable to this project (LRMP pages 4-61, 4-62, 4-65, 4-69, and 4-70) include the following;

- Manage water temperatures to support benefiting resources. Evaluate the effect of proposed projects on water temperature and make adjustments where impacts to benefiting resources are predicted.
- Meet or exceed water quality standards for the State of Oregon in accordance with the Clean Water Act, through application of Best Management Practices (BMPs).
- Evaluate cumulative effects of proposed projects on water quality, runoff, and stream channel conditions and adopt measures to avoid adverse effects to these resources.
- Manage woody debris and riparian vegetation to maintain or enhance stream channel and bank structure.
- Native streamside vegetation and lakeside deciduous and conifer vegetation will be maintained or established which will enhance riparian resources. Where this vegetation has been altered, every effort will be made to reestablish riparian vegetation that will benefit riparian dependent resources.

4. *INFISH (1995)*

   Riparian Management Goals, as established by INFISH (pages A-1 and A-2 of the Decision Notice and Finding of No Significant Impact 1995), are to maintain or restore:

- water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;
- stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;
- instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges;
- natural timing and variability of the water table elevation in meadows and wetlands;
- diversity and productivity of native and desired non-native plant communities in riparian zones;
- riparian vegetation, to:
    a. provide an amount and distribution of large woody debris

characteristic of natural aquatic and riparian ecosystems;
b. provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and
c. help achieve rates of surface erosion, bank erosion, and channel migration characteristic of those under which the communities developed.

- riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved with the specific geo-climatic region; and
- habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

Riparian Management Objectives (RMOs) (page A-4 by INFISH), have been established to provide the criteria against which attainment or progress toward attainment of the riparian goals is measured. The interim RMOs provide the target toward which managers aim as they conduct resource management activities across the landscape. It is not expected that the objectives would be met instantaneously, but rather would be achieved over time. RMOs may be refined to better reflect conditions that are attainable in a specific watershed or stream reach based on local geology, topography, climate, and potential vegetation. RMO parameters that are applicable to hydrology and this project include water temperature and bank stability. RMOs are in Table 42.

Table 42. Riparian Management Objectives (INFISH, 1995).

Habitat Feature	Interim Objectives
Pool Frequency	Varies by channel width (See below)
Water Temperatures	No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period.) Maximum water temperatures below 59° F within adult holding habitat and below 48° F within spawning and rearing habitats.
Large Woody Debris (forested systems)	East of Cascade Crest in Oregon, Washington, Idaho, Nevada, and western Montana: >20 pieces/mile; >12” diameter; >35’ length.
Bank Stability (non-forested systems)	>80 percent stable.
Lower Bank Angle (non-forested systems)	>75 per cent of banks with <90° angle (i.e., undercut).
Width/Depth Ratio	<10, mean wetted width divided by mean depth

Wetted width (feet)	10	20	25	50	75	100	125	150	200
Pools per mile	96	56	47	26	23	18	14	12	9

Standards and guidelines that pertain to water and herbicides by INFISH are as follows;

- Apply herbicides, pesticides, and other toxicants, and other chemicals in a manner that does not retard or prevent attainment of Riparian Management Objectives and avoids adverse effects on inland native fish.

5. *PACFISH (1995)*

Guidance within this document is very similar to the INFISH strategy, yet applies to Sub Basins with anadromous fish. The RMOs and the above Standard and Guideline are the same as in INFISH with the exception of temperature. The interim objective for the PACFISH temperature RMO is: No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period). Maximum water temperatures below 64° F within migration and rearing habitats and below 60° F within spawning habitats.

6. *The Clean Water Act (1972) and Sections 319 and 303*

The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of all waters to protect the Beneficial Uses as documented according to criteria by the Oregon Department of Environmental Quality (ODEQ). A beneficial use is a resource or activity that would be directly affected by a change in water quality or quantity. Beneficial uses are defined on a basin scale in the Oregon Administrative Rules for water quality and cover large areas of land.

Under Section 319 of the 1987 CWA Amendments, states are required to determine those waters that will not meet the goals of the CWA, determine those non-point source activities that are contributing pollution, and develop a process on how to reduce such pollution to the "maximum extent practicable." Section 303 of the CWA requires that all water quality standards will be met. Section 303(d) requires a list be developed of all impaired or threatened waters within each state. The ODEQ is responsible for compiling the 303(d) list, assessing data, and submitting the 303(d) list to the Environmental Protection Agency (EPA) for federal approval. PDFs within this project serve as Best Management Practices (BMPs) and are the primary measures that ensure that State standards are being met (also discussed under Water Chemistry in Alternative 2).

7. *Executive Orders*

The following Executive Orders pertain to this project;

- Executive Order 12088 requires Federal compliance with pollution control standards (i.e. the Clean Water Act).
- Executive Order 11988 requires agencies to avoid adverse impacts associated with the occupancy and modification of floodplains.
- Executive Order 11990 requires agencies to avoid adverse impacts associated with the destruction or modification of wetlands.

Water Quality and the Clean Water Act

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. The Forest Plans also provide direction to protect and manage resources.

As specified in the Clean Water Act (CWA) of 1972 and subsequent amendments, water quality includes all attributes that affect existing and designated uses of a body of water which include fisheries and habitat needs as well as human uses. The CWA requires states to set water quality standards to support the beneficial uses of water. The Act also requires States to identify the status of all waters and prioritize water bodies whose water quality is limited or impaired. Where portions of streams do not meet the Federally-approved state water quality standards, they are listed as water quality limited under Section 303(d) of the CWA. A list of water bodies on the 2004/2006 Oregon State 303(d) List of impaired waters within the planning area is shown in Table 43. This latest list was approved by EPA on February 26, 2007. Inventoried invasive plant sites and PAUs within 100 feet of 303(d) listed streams and lakes/reservoirs are shown in Table 44.

There is no numeric State water quality standards for any of the herbicides or adjuvants that may be used in either of the action alternatives, so none of the streams are categorized as water quality limited based on the use of those herbicides.

The Forest Service responsibilities under the Clean Water Act are defined in a 2002 Memorandum of Understanding (MOU) between DEQ and the Forest Service. The MOU designates the Forest Service as management agency for the State on National Forest System Lands. Non-point pollution is the primary cause of impaired waters on National Forest System lands in the planning area. These cannot be tied to a point source such as a discharge pipe from a factory but are best controlled by good land management practices.

Table 43. 2004/2006 Oregon State 303(d) Listed Streams on the Deschutes and Ochoco National Forests, with Listing Parameter.

Watershed	Water Body	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
John Day Basin								
Lower John Day Sub Basin								
Bridge Cr.	Bear Cr.	Y						
	Bridge Cr.	Y						
	Gable Cr.	Y						
	Nelson Cr.	Y						
Upper John Day Sub Basin								
Lower South Fork John Day R.	South Fork John Day R.	Y						
Middle South Fork John Day R.	Murray Cr.	Y						
	Porcupine Cr.	Y						
	Sunflower Cr.	Y						
Mountain Cr.	Badger Cr.	Y						
Rock Cr.	Rock Cr.	Y						
Upr Mdl John Day R.	Cottonwood Cr.	Y						
Deschutes Basin								
Lower Deschutes Sub Basin								
Headwaters Deschutes	Lake Simtustus					Y		Y
Willow Cr.	Willow Cr.	Y						
Trout Creek Sub Basin								
Upper Trout Cr.	Auger Cr.	Y		Y				
	Big Log Cr.	Y		Y				
	Bull Cr.	Y		Y				
	Cartwright Cr.	Y		Y				
	Dick Cr.	Y		Y				
	Dutchman Cr.	Y		Y				
	Potlid Cr.	Y		Y				
	Trout Cr.	Y		Y				
Upper Deschutes Sub Basin								
Wickiup/Browns Cr.	Deschutes R.	Y						

Watershed	Water Body	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
	Odell Cr.	Y				Y		Y
	Odell Lake					Y		Y
Crain Prairie/Charleton Cr.	Deschutes R	Y						
	Lava Lake						Y	
Fall River	Deschutes R.	Y		Y	Y		Y	
Lake Billy Chinook	Lake Billy Chinook					Y		Y
Lower Metolius R	Lake Billy Chinook					Y		Y
Middle Deschutes/McKenzie Canyon	Deschutes R.	Y				Y	Y	
Pilot Butte	Deschutes R.	Y		Y	Y		Y	Y
Tumalo Cr.	Tumalo Cr.	Y						
Whychus Cr.	Indian Ford	Y						
	Whychus Cr.	Y						
Upper Metolius R.	First Cr.		Y*					
	Link Cr	Y						
	Metolius R.	Y						
	MFk S. Fork Lake Cr.	Y						
	Middle Fork Lake Cr.	Y						
Whychus Creek	Indian Ford	Y						
	Whychus Creek	Y						
Little Deschutes Sub Basin								
Crescent Creek	Crescent Cr.	Y						
	Big Marsh Cr.	Y						
Lower Little Deschutes	Paulina Cr.	Y						
Upper Little Deschutes	Little Deschutes R.	Y					Y	
	Hemlock Cr.	Y						
Lower Crooked River Sub Basin								
CR Nat. Grassland	Lake Billy Chinook					Y		Y
	Crooked R. RM 0-51	Y				Y		
McKay Cr.	Little McKay Cr.	Y						
	McKay Cr.	Y						
Mill Cr.	East Fork Mill Cr.	Y						
	Harvey Cr.	Y						
	Mill Cr.	Y						
	West Fork Mill Cr.	Y						
Upper Ochoco Cr.	Marks Cr.	Y						
	Canyon Cr.	Y						
	Hamilton Cr.	Y						
	Little Hay Cr.	Y						
	Ochoco Cr.	Y						
Upper Crooked River Sub Basin								
Bear Cr.	Bear Cr.	Y						
	Cow Cr.	Y						
	Klootchman Cr.	Y						
Camp Cr.	Double Cabin Cr.	Y						
Deep Cr.	Crazy Cr.	Y						
	Deep Cr.	Y						
	Double Corral Cr.	Y						

Watershed	Water Body	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
	Happy Camp Cr.	Y						
	Jackson Cr.	Y						
	Little Summit Cr.	Y						
	Toggle Cr.	Y						
Lower N. Fork Crooked	Fox Canyon Cr.	Y						
	North Fork Crooked R.	Y						
Upper N. Fork Crooked	Allen Cr.	Y						
	Fox Cr.	Y						
	Gray Cr.	Y						
	Howard Cr.	Y						
	Indian Cr.	Y						
	Lookout Cr.	Y						
	Lytle Cr.	Y						
	North Fk Crooked R.	Y						
	Peterson Cr.	Y						
	Porter Cr.	Y						
Upper Crooked Valley	Horse Heaven Cr.	Y						
	Little Horse Heaven Cr.	Y						
	Shortgun Cr.	Y						
	Wildcat Cr.	Y						
South Fork Crooked River Sub Basin								
Lower Beaver Cr.	North Fork Wolf Cr.	Y						
	Wolf Cr	Y						
Upper Beaver Cr.	Beaverdam Cr.	Y						
	Powell Cr.	Y						
	Rager Cr.	Y						
	Sugar Cr.	Y						
Paulina Cr.	Dipping Vat Cr.	Y						
	Dry Paulina Cr.	Y						
	Roba Cr.	Y						
South Fork Beaver Cr.	Begg Cr.	Y						

*Fish Use Map 130B shows that Oregon Water Quality Standard 340-041-0028(4)a) does not apply to First Creek; First Creek should have been delisted based on criteria change.

Water Quality Parameters for Listed Streams

Water Temperature – Water temperature is an important factor which influences aquatic productivity. Temperature changes may result from natural climatic conditions or human manipulation of the riparian environment. Water temperature is a function of flow, surface area, solar input, air temperature, and other variables. Aquatic biota are adapted to certain thermal conditions existing in the habitat for their survival and well being. It is known that physiological stress in fish increase as temperatures increase. State water temperature standards for the project area are found in Oregon Water Quality Standards 340-041-0028(4)(a), (c) and (f), based on Fish Use Maps 130A, 130B, 170A, and 170B. The Riparian Management Objectives (RMOs) for PACFISH and INFISH indicate that there should not be any measurable increase in water temperature.

The State standard for salmon or trout rearing and migration is a floating 7-day maximum average of 18.0˚ C (64.4˚F) and for bull trout spawning and juvenile rearing 12.0˚C (53.6˚F). The Confederated Tribes of the Warm Springs standard for bull trout in Johnson Creek and the Metolius River from the confluence of Johnson Creek to Lake Billy Chinook is 10.0˚C (50.0˚F).

Most invasive plants identified in this document are too small to provide effective shade (less than 4 feet tall). Only riparian invasive plants close to the water's edge have a potential for contributing any shade to surface water, and the shade effect decreases with the width of a stream. Riparian invasive species inventoried in the project area include reed canarygrass, ribbongrass, and yellow flag iris. Reed canarygrass and ribbongrass can out-compete beneficial native sedges, rushes, grasses, and forbs and can inhibit the establishments/reestablishment of riparian shrubs where their habitats overlap.

Sediment – Suspended sediment is a measure of suspended sand, silt, clay and organic matter which will settle in time to the stream bottom. It may adversely affect fish by filling in pools, reducing bottom fauna, and silting in spawning gravels. Sediment delivery to streams is dependent on the erosivity of the soil, slope, distance to a stream, amount of exposed soil (effective ground cover), and intensity and continuity of disturbance. Invasive plant sites have been found to be more susceptible to erosion than native vegetation (Lacey, Marlow, & Lane 1998), although this has not been observed in the project area.

Eliminating invasive plants can temporarily reduce effective ground cover, but the extent and continuity should be small. Burning can reduce effective ground cover and at higher intensities kill non target species, change soil chemical and physical properties, and retard the establishment of new vegetation. Manual and mechanical treatment can cause ground disturbance.

The streams listed for sediment in the Upper Trout Creek Watershed are within the planning area (Bull Creek, Cartwright Creek, Dick Creek, Dutchman Creek, Potlid Creek, Auger Creek, Big Log Creek, and Trout Creek).[14] Currently there is no numeric State standard for sediment, however ODEQ's statewide narrative criteria states, "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed." Total Maximum Daily Loads (TMDLs) for both the John Day and Deschutes Basins are currently being developed and will address such water quality impairments. The John Day Basin TMDL is expected to be completed in early 2010 while the Deschutes Basin TMDL is expected to be completed by 2012.

Turbidity – Turbidity is the disturbance of water due to the presence of suspended matter such as clay, silt, organic debris, plankton, various effluents, and others. It is an expression of the optical property of a sample of water which causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. Excessive turbidity reduces light penetration into water and therefore, reduces photosynthesis by photoplankton, algae, and submerged vegetation. Natural turbidities within watersheds may cause short term readings in excess of the recommended level due to spring runoff or seasonal freshets. Turbidity is often used as a surrogate to indicate changes in suspended sediment.

State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. There is normally a close correlation between turbidity and suspended sediment in a given stream, but this correlation can change as organic material increases over the summer or if the percent of sediment from different sources in the drainage changes. Turbidity does not measure the amount of sediment being transported as bedload. There is no state standard for suspended sediment, bedload, or total sediment.

The Deschutes River is listed for sedimentation and turbidity from Wickiup Reservoir downstream to River Mile 168.2. It appears this is the result of irrigation releases because turbidity levels increase by

[14] These streams were originally listed for embeddedness by the state based on the Trout Creek Watershed Analysis (USFS 1995e), which used data derived from surveys conducted either while the watershed was in a cattle allotment or shortly after it was changed to a sheep allotment in 1989. Only a short reach on the upper west fork of Auger Creek is still in a cattle allotment. The portion of the Upper Trout Creek Watershed that lies in the planning area has been in a sheep allotment for 16 years, which has reduced bank and channel disturbance. Recent pebble counts indicate that embeddedness is below the 20% threshold and recent monitoring shows that suspended sediment levels are low.

as much as 30 fold in the Deschutes when irrigation water is released in early spring and remains to twice background levels until late July.

pH - pH is a measure of the hydrogen ion activity in water. It is controlled naturally by the carbonate system consisting of carbon dioxide, carbonic acid, bicarbonate ions, and carbonate ions. pH is a very important factor in the chemical and biological systems of water because of its role in affecting the degree of dissociation of weak acids and bases and therefore, the toxicity of many compounds and nutrient availability. pH concentrations in streams vary seasonally and during the day due to biological activity. The Oregon State water quality standard for pH is 6.5 to 8.5. A pH range of 6.0 to 9.0 appears to provide protection for the life of freshwater fish and bottom dwelling invertebrates. pH concentrations outside this range can affect fish and other aquatic organisms by allowing acids or bases to penetrate external membranes causing physiological stresses. Listings in the planning area are due to pH values greater than 8.5. Trout can tolerate a pH to 9.5, and trout eggs and larvae can develop normally at pHs up to 9 (KY Water Watch, 2005).

Dissolved Oxygen (DO) – DO is a function of the temperature of the water, altitude and barometric pressure. The ability of water to hold oxygen decreases with increased water temperature, altitude, or dissolved solids (TDS). Inadequate dissolved oxygen is an indicator of decomposition, anaerobic conditions, or lack of photosynthetic activity. For cold water biota, it is desirable that DO concentrations be at or near saturation levels. This is especially important for fish spawning areas where DO levels should not be below 7 mg/l. For good growth and the general well being of trout, salmon, and associated biota, DO concentrations should not be below 6 mg/l. Warm water biota, including fish, should have DO concentrations above 5 mg/l.

The Regional Environmental Monitoring and Assessment Program (REMAP) is sponsored by the EPA. The Upper Deschutes River Basin R-EMAP (ODEQ 1999) attributed the large DO fluctuations to plant (or algal) respiration associated with photosynthesis from large algal and aquatic microphyte assemblages observed in the field. They also attributed the pH values that are above threshold to high oxygen production from photosynthesis on the South Fork of the Crooked River. Since the same three lakes and one stream are listed for being above threshold for both pH and chlorophyll a, it is reasonable to assume oxygen production is the cause here also.

Chlorophyll a – This parameter is used to identify streams, reservoirs, or lakes where photo plankton may impair the beneficial uses of that water and is usually indicative of high nutrient levels. High levels of photo plankton may result in swings in DO and pH between periods of photosynthesis and respiration and during die off.

Table 44. Mapped Invasive Plant Sites, Project Area Units, and Total Acres of Land within 100 feet 303(d) Listed Stream Segments on National Forest System Lands.

Watershed	Acres within 100 feet of Streams on the 303(d) list*		
	Mapped Invasive Plant Site Acres	Project Area Unit Acres	Total 303(d) Acres
John Day Basin			
Lower John Day Sub Basin			
Bridge Cr	0	3.5	137.9
Upper John Day Sub Basin			
Lwr SFk John Day River	9.8	15.5	18.2
Mdl SFk John Day River	0	18.7	134.6
Mountain Creek	0	0	91.6
Rock Creek	0	2.9	202.9

Watershed	Acres within 100 feet of Streams on the 303(d) list*		
	Mapped Invasive Plant Site Acres	Project Area Unit Acres	Total 303(d) Acres
Upr Mdl John Day River	0	2.9	229.4
Deschutes Basin			
Lower Deschutes Sub Basin			
Hdwtrs Deschutes	0	0	34.3
Willow Creek	0.6	0.9	210.6
Trout Creek Sub Basin			
Upper Trout Creek	0.7	129.9	1357.0
Upper Deschutes Sub Basin			
Wickiup	4.7	5.7	705.3
Crain Prairie	12.9	28.8	41.2
Fall River	17.2	20.7	1207.7
Lake Billy Chinook	0	0	17.2
Lwr Metolius R	0	0.2	40.3
Pilot Butte	5.8	46.8	2132.7
Whychus Creek	60.5	294.0	450.1
Middle Deschutes	0	0	23.6
Upper Metolius River	7.3	593.3	593.3
Little Deschutes Sub Basin			
Crescent Creek	2.8	3.4	164.8
Lwr Little Deschutes	2.0	10.1	202.5
Upr Little Deschutes	0	1.6	428.9
Lower Crooked River Sub Basin			
Crooked River Nat. Grassland	0	0	206.2
McKay Creek	8.3	145.6	601.1
Mill Creek	0.6	58.1	399.9
Upr Ochoco Creek	2.7	99.5	735.7
Upper Crooked River Sub Basin			
Bear Creek	0.4	32.3	347.4
Camp Creek	0	0	0
Deep Creek	1.9	114.5	1283.3
Lower North Fk Crooked River		22.7	425.0
Upper North Fk Crooked River	0.1	33.1	1290.0
Upper Crooked River Valley	6.5	15.2	337.6
South Fk Crooked R Sub Basin			
Lower Beaver Creek	6.7	99.1	550.6
Upper Beaver Creek	1.8	6.3	582.9
Paulina Creek	138.8	231.8	611.0

* Mapped inventoried plant sites contain the smallest area. They only include identified invasive plant sites. Inventoried invasive plant sites are areas where a boundary can be drawn around identified invasive plants and where invasive plants may dense to highly scattered. Project Area Units (PAUs) contain inventoried invasive plant sites plus projected expansion areas. Total 303(d) Acres are the total area within 100 feet of all 303(d) streams, lakes and reservoirs and includes areas without any identified invasive plants or PAUs.

Water Sources and Special Uses

Most of the stream flow and groundwater in the planning area originates on National Forest System lands. National Forests were originally established to "maintain favorable conditions of flow" which includes clean water. Clean water is necessary for maintaining viable populations of fish and water dependent species as well as for state defined beneficial uses. Domestic and special uses that may be directly affected by management activities on National Forest System lands can be broken down into the following categories:

1. Potable Water
    a. Municipal Watersheds
    b. Community Water Systems
    c. Potable water at campgrounds and picnic areas
    d. Domestic water at special use cabins (Deschutes NF only)
    e. Special use diversions for domestic use off forest
    f. Domestic uses (source off forest) on in-holdings and adjacent to Forest boundaries
2. Non-potable water
    a. Irrigation diversions and irrigation ditches
    b. Cattle/Sheep allotment water developments
    c. Other

The beneficial uses are discussed in relation to existence of project area units (PAUs) and mapped invasive plant sites.

Potable

Municipal Watersheds (Bend, Sisters, Mitchell)

A municipal supply watershed is one that serves a public water system as defined in Public Law 93-523 (Safe Drinking Water Act) or as defined in State safe drinking water regulations. The definition does not include state-defined community water systems served by a well or confined ground water unaffected by Forest Service activities. The only herbicide detected in a review of State-required water tests on the three municipal watersheds on the Ochoco and Deschutes National Forests plus 14 additional public systems in the planning area was 2, 4-D in the analysis for the backup water supply for the city of Sisters on 10/22/91. The Deschutes National Forest was not using 2, 4-D in 1991 and the contamination appears to have originated along the open ditch between the diversion on Forest Service administered lands and Sisters.

The Bend municipal watershed operates under a 1926 formal agreement between the city of Bend and the Secretary of Agriculture. Management within the watershed has been custodial with all actions being subservient to maintaining water quality. There are no inventoried invasive plant sites or PAUs above the diversion however there is a knapweed site just below the diversion and there is also a Canada thistle site further downstream.

The Sisters municipal watershed uses a tributary of Whychus Creek as an emergency backup to their primary water system. Sisters is currently using groundwater from wells closer to town for domestic use. Water from the municipal watershed has not been used for drinking water for several years. A review of the drainage area on the Forest found inventoried invasive plant sites for both Canada thistle and tansy ragwort. PAU 15-22 is in the municipal watershed.

The Mitchell municipal watershed diverts water from springs in the Bridge Creek Watershed. Project Area unit 71-23, along Forest Service Road 2630, is in the watershed above the Lillycrop ditch diversion. Invasive plant inventory maps show yellow star thistle and medusahead on the boundary of the Mitchell municipal watershed, but the actual sites are further to the east and outside the municipal watershed and yellow star thistle has not been observed here in several years (Lesko, pers. comm.). These species pose a risk for moving into the watershed.

Table 45. Municipal Watersheds with invasive plant Project Area Units (PAUs)

Forest	District	Watershed	Municipality	PAUs
Deschutes NF	Bend-Fort Rock	1707030105	Bend	
	Sisters	1707030108	Sisters	15-22
Ochoco NF	Lookout Mtn.	1707020403	Mitchell	71-23

Community Water Systems

A public water system, according to state regulations, is a system supplying water for human consumption that has four or more service connections or supplies water to a public commercial establishment which operates a total of at least 60 days a year, and which is used by ten or more individuals per day (340-040-0150(8)). A community water system is a larger public water system that has at least 15 service connections used by year-round residents and regularly serves at least 25 year-round residents. Most of the community water systems in the planning area are on wells and do not qualify as municipal watersheds. It is the policy of the State of Oregon and draft policy of the Forest Service (FSM 7420) to develop local Wellhead Protection Areas to protect the groundwater resource which a Public Water System relies on. Draft FSM 7421.15 states that Possible Contaminating Activities that use, transport, store, manufacture, produce or dispose of potential contaminants such as petroleum, pesticides, and wastewaters will be minimized within wellhead protection areas. It also states that each administrative unit shall work with their state primacy agency to ensure that source water assessments are conducted for each Forest Service public water system. A wellhead protection area was delineated in the areas surrounding wells supplying public water systems, because of a concern for contaminants moving toward and/or reaching that water well. Wellhead protection areas overlapping PAUs are shown in Table 46. In addition, overlap of project area units and community water source areas (where delineated by DEQ) are shown in Table 49.

Table 46. Wellhead Protection Areas (WPAs) Overlapping with Invasive Plant Project Area Units

	District	Watershed	Water System	Wells	Invasive Plant Site within WPA	PAU
CRNG	CRNG	Crooked River Grassland	Deschutes Valley	3	Yes	75-10
Deschutes	Bend-Ft Rock	Crane Prairie	Lava Lake Lodge	1	Yes	11-39
			Mt. Bachelor	2		11-07
		Wickiup	Twin Lakes Resort	1	Yes	11-54
		Fall River	Avion - Wild River	1		11-01/02, 11-11
		Pilot Butte	Avion – China Hat	2	Yes	11-08
			Avion - Conestoga	1	Yes	11-01, 11-02
			Avion - Gosney	1	Yes	11-01/02, 11-28
			Avion - Parrell	1		11-08
			Avion – River Bend	2		11-08
			Avion - Sundance	1		11-02
			Avion - Tekempe	3	Yes	11-08
			Widgi Cr. Village	1		11-07
	Crescent	Crescent Cr.	Manley's Tavern	1	Yes	12-02
	Sisters	Whychus Cr.	Black Butte Elem.	1		15-18
			Sisters High Sch.	1	Yes	15-06

	District	Watershed	Water System	Wells	Invasive Plant Site within WPA	PAU
			Tollgate	1	Yes	15-05

Table 47. Community Water Source/Recharge Areas (within Project Area Units)

	District	Watershed	Sub-Watershed	Invasive Plant Site within Recharge Area	PAUs*
CRNG	CRNG		170702040303	Yes	**71-10**
Deschutes	Bend-Ft Rock	Crane Prairie	170703010101		**11-07**
		Fall River	170703010301		11-12
			170703010303	Yes	11-08, 11-52
			170703010305	Yes	**11-11**
			170703010306	Yes	11-10, **11-50**
		Pilot Butte	170703010401	Yes	11-01, 11-19
			170703010402	Yes	11-08, 11-68, 11-69, 11-70, 11-71
			170703010403	Yes	11-01, 11-07, 11-08, 11-65, 11-66, 11-67, 11-68
			170703010405	Yes	**11-01**
			170703010406	Yes	**11-02, 11-27,** 11-28, 11-29
			170703010407	Yes	11-07, 11-58, 11-60, 11-61, 11-62
		Tumalo Cr.	170703010502	Yes	11-06, **11-15**
	Crescent	Wickiup	170703010201		12-02
	Sisters	Whychus Cr	170703010802	Yes	15-22
			170703010803	Yes	15-22
			170703010805		**15-07**
			170703010806	Yes	15-05, **15-06,** 15-22
			170703010807	Yes	15-05, 15-06
		Upper Metolius	170703010904	Yes	15-18
			170703010906		15-18
Ochoco	Lookout Mtn.	Upper Ochoco	170703050203		71-02, **71-30**
	Paulina	Upper Beaver Cr	170703030802	Yes	**72-01**

*PAUs in bold type are in the DEQ 0- year recharge zone.

Ranger Stations, Guard Stations & Government Housing

No inventoried invasive plant sites are located within the wellhead protection areas for potable water sources for Deschutes and Ochoco National Forest Guard Stations. Guard Station wellhead protection areas overlapping PAUs are shown in Table 48. There are no PAUs within the wellhead protection areas for the Cabin Lake, Fall River, Crescent Lake, or Cold Springs Guard Stations. Some of the wellhead locations are unknown for those facilities in Tables 48 and 49. PDF 29.1 states that if a wellhead location is unknown, then the wellhead protection area is one-quarter mile from the point of use. Once the wellhead is located, then the wellhead protection area is defined as described under the Potable Water section of Alternative 2.

The Ochoco Ranger Station has two wells. This water system serves the Ranger Station, government housing, the bunk house and Ochoco Campground. The storage tank is not in any inventoried invasive plant sites or PAUs. The wellhead protection areas for these wells have been delineated using procedures described under Potable Water in Alternative 2. The wellhead protection areas for both wells overlap PAU 71-19.

The Rager Ranger Station has only one well. This water system serves the Ranger Station, government housing, and the bunkhouse. PAU 72-01 overlaps the wellhead protection area. Whitetop, teasel, medusahead, spotted knapweed, and St. Johnswort are inventoried in the compound or are immediately adjacent to it and area within the well recharge area. The water tank appears to be outside the proposed project area.

Table 48. Potable Water at Ranger Stations, Guard Stations, & Government Housing

	District	Watershed	Facility	Well	None	Invasive Plant Sites Present	WPA in PAU
Deschutes	Bend-Ft Rock	Crane Prairie	Elk Lake GS	X			11-07*
		Pine	Cabin Lake GS	X			*
		Devils Garden	China Hat GS	X			11-02
		Fall River	Fall River GS		X		
	Crescent	Crescent Creek	Crescent Lake GS (on CG system)	X			
	Sisters	Upper Metolius	Allingham GS	X			15-32*
		Upper Metolius	Suttle Lake GS (on resort well)	X			15-05/09*
CRNG	CRNG	Willow Creek	CRNG Fld. Hq.		X		
Ochoco	Lookout Mtn.	Upper Ochoco Cr.	Ochoco RS/GH	X			71-19
		Upper N. Fork Crooked River	Cold Spr. GS	X			*
	Paulina	Upper Beaver Cr.	Rager RS/GH	X		Yes	72-01

* wellhead location not known

Potable water at campgrounds and picnic areas

Potable water systems for the campgrounds, organizational camps, horse camps, and day use areas were identified within the planning area. The state water rights data and water rights INFRA data base do not appear to be current. Some wellheads are more than a quarter mile from use points. Some of these systems qualify as public water systems. Water sources needing further verification have been identified. Table 49 lists current sites with potable water and the type of system at the diversion point. Recreation sites are also listed in the recreation section, 3.13.

Table 49. Potable Water at Campgrounds, Organization Camps, Horse Camps, and Day Use Areas.

	District	Watershed	Campground **	Well	Spr	Disc	WPA in PAUs
Deschutes	Bend-Ft. Rock	Crane Prairie	Beach DU (Elk Lake GS well)	X			11-07*
		Pine	Cabin Lake (GS well)	X			*
		Devils Garden	China Hat (GS well)	X			11-02
		Lwr. Little Deschutes Rvr.	Cinder Hill	X			

		Crane Prairie	Crane Prairie	X			
		Crane Prairie	Cultus Corral HC	X			
		Crane Prairie	Cultus Lake	X			
		Crane Prairie	Deschutes Bridge	X			11-07
		Lwr. Little Deschutes Rvr.	East Lake	X			11-03
		Crane Prairie	Elk Lake (GS well)	X			11-07*
		Wickiup	Gull Point (S Twin WS)	X			
		Lwr. Little Deschutes Rvr.	Hot Springs (E Lake CG well - geothermal well in CG)	X			
		Crane Prairie	Lava Lake	X			
		Pilot Butte	Lava Lands Visitor Cntr.	X			11-01
		Lwr. Little Deschutes Rvr.	Little Crater	X			
		Crane Prairie	Little Cultis Lake	X			
		Crane Prairie	Ltl. Fawn CG/GC	X			
		Crane Prairie	Ltl. Lava Lake (Lava Lk CG well)	X			
		Lwr. Little Deschutes Rvr.	Newberry GC	X			
		Wickiup	North Davis Cr.	X			
		Lwr. Little Deschutes Rvr.	Ogden GC (Prairie CG well)	X			
		Lwr. Little Deschutes Rvr.	Paulina Lake	X			11-03
		Crane Prairie	Point (Elk Lake GS well)	X			11-07*
		Lwr. Little Deschutes Rvr.	Prairie	X			
		Crane Prairie	Quinn Mdw. HC	X			
		Crane Prairie	Quinn River	X			
		Crane Prairie	Rock Creek (2 wells)	X			
		Wickiup	Sheep Bridge	X			
		Wickiup	South Twin	X			
		Wickiup	W. South Twin Lk. (S Twin Lk well)	X			
	Crescent	Crescent Creek	Crescent Creek	X			
		Crescent Creek	Crescent Lake	X			
		Wickiup	East Davis	X			*
		Wickiup	Odell Creek			X	
		Wickiup	Princess Creek (only hosts use spring - for cleaning)	X	X		12-02*
		Crescent Creek	Simax GC	X			
		Crescent Creek	Spring	X			
		Wickiup	Sunset Cove	X			
		Wickiup	Trapper Creek	X			
		Wickiup	W. Davis Lake			X	
		Crescent Creek	Whitefish HC	X			12-03
	Sisters	Upr. Metolius	Allen Spring	X			15-32*
		Upr. Metolius	Allingham	X			15-32*
		Upr. Metolius	Blue Bay (Suttle Lake WS)	X			15-05/09*
		Upr. Metolius	Camp Sherman (Allingham WS)	X			15-32*
		Upr. Metolius	Cinder Beach DU (Suttle Lk Resort WS)	X			15-05/09*
		Whychus Creek	Cold Spring	X			

		Whychus Creek	Gorge (Allingham WS)				15-32*
		Whychus Creek	Graham Corral HC			X	
		Whychus Creek	Indian Ford			X	
		Upr. Metolius	Link Creek (Suttle Lake WS)	X			15-15/09*
		Upr. Metolius	Lower Bridge		X		15-32*
		Lwr. Metolius	Perry South (4 wells)	X			15-12*
		Upr. Metolius	Pine Rest (Allingham WS)	X			15-32*
		Upr. Metolius	Pioneer Ford (Lwr Bridge Spr)		X		15-32*
		Upr. Metolius	Riverside	X			*
		Upr. Metolius	Scout Lk. GC/DU (Suttle Lk WS)	X			15-05/09*
		Upr. Metolius	Sheep Spring HC	X			*
		Upr. Metolius	Smiling River (Allingham WS)	X			15-32*
		Upr. Metolius	South Shore (Suttle Lake WS)	X			15-05/09*
		Upr. Metolius	Suttle Lake DU (Suttle Lake WS)	X			15-05/09*
CRNG	CRNG	Willow Creek	Haystack Reservoir	X			75-24*
Ochoco	Lookout Mtn	Bear Creek	Antelope Res.	X			71-51*
		Upr. Ochoco Cr	Crystal Spr. OC	X			*
		Upr. NFk. Crooked River	Deep Creek	X			72-03*
		Upr. Ochoco Cr	Ochoco Forest Camp (RS well)	X			71-19
		Upr. Ochoco Cr	Ochoco Divide (horizontal well)	X			*
		Upr. Ochoco Cr	Walton L. CG/DU (well S side/Spr N side)	X	X		71-07
		Mill Creek	Wildcat CG/DU	X			71-57*
	Paulina	Upr. Beaver Cr.	Sugar Creek (2 wells)	X			72-01*

*Wellhead location not known

Domestic water at special use cabins (Deschutes NF only)

Water systems for special use cabins or other facilities are not mapped in the Forest Geographic Information System (GIS). The water rights on the Forest's INFRA data base, dated to the early 1980s, give location to 40 acres (¼, ¼ section), do not designate who the permittee was, and many appear to be for surface water diversions probably no longer in use. Special use cabins are located in six general areas on the Deschutes National Forest as shown in Table 50.

A review of the maps showing inventoried invasive plant sites and project area units indicate that all special use cabins and other permitted facilities have a potential to be in proposed project area units.

Table 50. Potable Water at Special Use Cabins/Lodges (Deschutes NF)

District	Watershed	Special Use Name	Project Area Unit
Bend-Fort Rock	Crane Prairie	Elk Lake	11-07
	Lower Little Deschutes River	Paulina Lake	11-03 & 11-33
Crescent	Crescent Creek	Crescent Lake	12-03

	Wickiup	Odell Lake	12-02 & 12-16
Sisters	Upper Metolius River	Metolius River	15-18 & 15-32
	Upper Metolius River	Suttle Lake	15-05 & 15-09

Special use diversions for domestic use off forest

Reviews of the special use files at the Ochoco National Forest Supervisors Office and at the Ranger Districts on the Deschutes National Forest identified 11 domestic use diversions. There do not appear to be any special use diversions for domestic use off Forest on the Deschutes National Forest. Some diversion points are difficult to identify (for example, the Edmonds spring box is covered with sod and does not have an exclosure fence). Only three of the identified diversions fall within PAUs. There are two special use permits within PAUs on the Crooked River National Grassland. The Meisner special use diversion from a spring is in the Drake Creek subwatershed and has an exclosure fence. The point of diversion is in PAU 71-51 and has an inventoried bull thistle, Canada thistle, and teasel in the exclosure.

Table 51. Special Use Diversions for Domestic Use off Forest

	District	Watershed	Special Use Name	Source	Remarks
Deschutes	Bend-Fort Rock				none
	Crescent				none
	Sisters				none
CRNG	CRNG	Crooked Rvr. Grassland	Read	a spring	
		Hay Creek	Richardson	strg tank	well on pvt
		Willow Cr.	Williams	well/strg tank	
Ochoco	Lookout Mtn	McKay Cr.	Edmonds	unnamed spring Upr McKay Cr	
		Upr. Crooked River Valley	Meisner	a spring	
		Bear Creek	trespass	a spring	hunters camp
		Upr. Ochoco Creek	trespass	unnamed spring Marks Creek	residence
	Paulina	Upr Mdl John Day River	trespass	unnamed spring Cottonwood Cr	

Domestic uses (source off forest) on in-holdings and adjacent to Forest boundaries

Wells have been identified for some homes and summer cabins on in-holdings or adjacent to Forest boundaries. It is highly probable there are a number of wells, spring systems, and other water sources within 300 feet of the Forest boundary that are currently unknown. Wellhead protection areas would be delineated (as outlined in Alternative 2 under Potable Water) for these systems as they are identified prior to treatment. Also, PDF 6 states that the Forest Service would work with owners and managers of neighboring lands to respond to invasive plants that infest multiple ownerships and where treatments are within 100 feet of the forest boundary. PDFs 29, 29.1, and 30 are in place to protect springs.

Non-Potable

Irrigation diversions and irrigation ditches

Most irrigation diversions and ditches are not shown on Forest GIS databases. Many of the irrigation ditches not shown on Forest GIS layers are included on the interagency reconciled stream layer REO maps. A review of Forest special use permits identified 30 permitted ditches. The special use name and water source for identified ditches is shown in Table 52. Irrigation ditches would be treated the same as intermittent streams.

Table 52. Irrigation Diversions and Irrigation Ditches

	District	Watershed	Special Use Name	Source	Remarks
Deschutes	Bend-Fort Rock	Tumalo Creek	Columbia Southern Cnl	Tumalo Cr.	not in use
		Crane Prairie @ Tumalo Creek	Crater Creek Ditch	upr Soda Cr	trans WS div
		Pilot Butte	Arnold Irr.	Deschutes R	
	Crescent	N/A			none
	Sisters	Mdl. Deschutes	Snow Cr. Irr.	Three Creeks	
		Mdl. Deschutes	Thompson	Melvin Creek	
		Whychus Creek	Brogan	Whychus Cr.	
		Whychus Creek	Frisbee Revoc	Whychus Cr.	
		Whychus Creek	Pine Meadow	Whychus Cr.	
		Whychus Creek	Plainview Irr.	Whychus Cr.	
		Whychus Creek	Runco	Whychus Cr.	
		Whychus Creek	Stroemple	Whychus Cr.	
		Whychus Creek	3 Sisters Irr. D	Whychus Cr.	
		Whychus Creek	Reed	Trout Creek	
		Upr. Metolius R.	Corbett	Canyon Cr.	
		Upr. Metolius R.	5 Cr. Limited	Canyon Cr.	
		Upr. Metolius R.	Metolius LLC	Jack Creek	
CRNG	CRNG	Lwr. Crooked River Valley	Coats	Reservoir	pipeline
		Crooked River Grassland & Willow Creek	North Unit Irrigation Dist	North Unit Main Canal & laterals	source not on Forest
Ochoco	Lookout Mtn.	Mill Creek	Drap	Mill Creek	
		Mill Creek	Hereford	Mill Creek	
		Bridge Creek	Pape (Maxwell)	Bridge Creek	Source in wilderness
		Bear Creek	McCormick	Faught Cr./ Antelope Res.	
		Upr. Ochoco Cr.	Rhoden	Ochoco Cr.	
		Upr. Crooked River Valley	Thompson	Drake Creek	
		Upr. Ochoco Cr.	Woitt	Marks Cr.	
		Mill Creek	Wonser	EFk. Mill Cr.	
		Mill Creek	Wonser	WFk. Mill Cr.	
	Paulina	Rock Creek	Harris	Rock Creek	
		Lwr. Beaver Cr.	Miller	Wolf Creek	

Cattle/Sheep allotment water developments

There are three types of improvements used to provide water to livestock in the planning area: spring developments, ponds, and wells. In addition on the Crooked River National Grassland, storage tanks are used in conjunction with wells to provide water on extended water systems. At spring developments, the springs may be fenced but a substantial number are not. PDFs 15, 16, 17, 26, 75, and 76 and alternative-specific PDFs would mitigate potential contamination whether a spring is fenced or not. All surface water protection is important as campers and recreationists now use filtered water from springs for domestic uses.

Currently there are active livestock allotments on the Deschutes National Forest only on the Sisters Ranger District and on Fort Rock. Water is hauled to the allotments on Fort Rock and all springs and ponds that could be used by livestock are fenced for wildlife. There are no spring developments on any active allotments on the Deschutes. Inactive allotments may be reactivated in the future.

Most of the spring developments on the Crooked River National Grassland have state certified water rights and are on the INFRA data base. There was a Forest GIS layer with water right locations but it does not appear to be in the active files. Most of the active wells on the Grassland were not filed for. Most of these date from the homestead era with some improvements, are shallow, and do not have sealed well casings. Active wells are fairly recognizable. Exempt ponds (see Table 55) are plotted on hard copy maps but have not been entered into the computer system. A large number of these are not on the USGS Topographic Maps used in developing the data base for this analysis. Affects to water developments on cattle and sheep allotments are discussed under Range Resources and Grazing Management in Chapter 3 in the Invasive Plant EIS.

Table 53. State Certified Water Rights on Cattle/Sheep Allotments

	District	Allotment	Exempt Ponds*	Springs	Reservoirs	Pumping Stations
Deschutes		None				
CRNG	CRNG		17			
		Blanchard		4		1
		Cyrus		15	1	
		Camp Horse Past		2		
		Fox		2	1	
		Grizzly		4		
		Holmes/Whychus			2	
		Juniper Butte		4		
		Lone Pine		15		
		North		4		
		Rush		3		
		Kennedy		1		
Ochoco	Lookout Mtn		47			
		Badger		4		
		Bear		6		
		Big Summit		1		
		Burn		1		
		Canyon Creek		1	1	
		Crystal Springs		2		
		Double Cabin		15		
		East Maury		3	2	
		Elkhorn		4		
		Fox Canyon		1		
		Gray Prairie		2		
		Klootchman		10		
		Lost Horse		1		
		Marks Creek		3		
		Mill Creek		20		
		Pringle		1		
		Reservoir		3		
		Sherwood		5		
		Shotgun		12		
		Snowshoe		1		

		Trout Creek		9		
		West Maury		12		
		Wildcat		1	1	
	Paulina		68			
		Dry Corner		5		
		Heisler		1	10	
		Roba			11	
		Sun Flower		3	13	
		Wind Creek			19	
		Wolf Creek			1	

Other

Other non-potable water sources that occur in the planning area are wildlife ponds, horse troughs in horse camps and along trails, wildlife guzzlers, natural lakes, sag ponds (landslide feature), and ponds in rock pits. Many of these are not mapped, but may have substantial wildlife use.

Groundwater and Geology

Groundwater resources in the Deschutes Basin have been documented by the US Geological Survey and reported in the publication *Groundwater Hydrology of the Upper Deschutes Basin, Oregon* (Gannett, et al. 2001). The primary aquifers within the planning area include the Quaternary basalts of the Deschutes Formation, the Tertiary Prineville basalts and the Quaternary sediments that comprise the LaPine Sub-basin.

The geology and groundwater of the Deschutes NF is primarily comprised of young Quaternary volcanics and alluvium of the Cascade Range. The Quaternary volcanics comprise the principal area of recharge for the Deschutes Basin due to the high permeability of the volcanics and the relatively thin soils that allow for rapid infiltration of rain and snowmelt. However, the lower strata of the Quaternary deposits have significantly reduced permeability due to hydrothermal mineralization and comprise the base of the regional ground water flow system beneath the Cascade and Newberry volcanoes. As a result, groundwater reaching this depth generally flows laterally in a northward direction before accumulating in the aquifers mentioned above or surfacing as springs along exposed outcrops, canyon walls, or stream channels.

The geology and groundwater of the CRNG and Ochoco NF includes variably permeable Quaternary and Tertiary deposits that provide recharge to local aquifers in the Prineville basalts, and late Eocene to early Miocene deposits of the John Day Formation that generally have very low permeability and are neither a significant source of groundwater nor a medium through which it can easily flow (Gannett, et al. 2001).

Invasive Plant Species in Riparian Areas

Native riparian vegetation plays a key role in forming aquatic habitat for fish and other aquatic species. The roots of native vegetation help stabilize stream banks; the forest canopy provides large wood and protects streams from solar radiation in the summer. Invasive plants in riparian areas can cause a loss of functional riparian communities, loss of rooting strength and protection against erosion, and subsequent impacts on water quality (Donaldson 1997). Invasive plants can be especially difficult to control in riparian areas because they thrive in the moist environment and treatment measures are often limited. Ribbongrass is an example of an invasive plant that is affecting riparian areas. It is replacing native vegetation and does not provide the high quality habitat for aquatic plants and animals (including fish and amphibians), particularly in winter when the plants die back. Nor does it provide high quality habitat for insects and the birds and animals dependent on these insects for food.

Applicable to the area covered by the Northwest Forest Plan, the Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands (USDA USDI 1994a, B-9). The approach seeks to maintain and restore ecosystem health at watershed and landscape scales, prevent further degradation, and restore habitats over broad landscapes.

Existing Watershed Analyses were consulted for information on watershed and riparian condition. The documents address the existence of invasive plants and provide some general recommendations for prevention and control. Watershed analysis has not been completed for watersheds that do not contain key watersheds and that fall mostly outside the Northwest Forest Plan area. Invasive plant sites in these watersheds occur primarily along roadways, such as State Highway 58 and 97.

The following table displays 5th field watersheds that are at least partially within the range of the northern spotted owl, and managed under the Aquatic Conservation Strategy of the Northwest Forest Plan. The table also shows if a Watershed Analysis was completed, and acres of invasive plant sites within riparian reserves/RHCAs.

Table 54. Watersheds at least partially within the range of the Northwest Forest Plan, and amount of invasive plants present.

5th Field Watershed	Watershed Analysis Referenced	Size of Watershed (acres)	Acres of Invasive Plants in Riparian Reserves/ RHCAs
Wickiup	Browns/Wickiup WA 1997 Odell WA 1999 Snow Lakes 2006	131,858	129
Fall River	N/A	116,468	21.4
Pilot Butte	N/A	147,970	43.9
Crane Prairie	Cascade Lakes WA 1995 Snow Lakes WA 2006	167,889	65.2
Tumalo Creek	Forks/Bridge WA 1995	37,711	6.7
Deep Canyon	N/A	95,727	0
Whychus Creek	Why-Chus WA 1998	161,629	341.2
Upper Metolius River	Metolius WA Update 2004	140,809	490
Lower Metolius River	Metolius WA Update 2004	145,494	219.8
Upper Little Deschutes River	N/A	80,021	16
Crescent Creek	Big marsh WA 1997	118,932	162.3
Middle Little Deschutes River	N/A	48,608	0
Little Walker Mtn.	N/A	86,454	4.5

Aquatic Conservation Strategy Objectives number 5 and 7 of the Northwest Forest Plan state that National Forests within the range of the Northern Spotted Owl will be managed to maintain or restore the diversity and productivity of native and desired non-native plant communities in riparian zones and to maintain or restore habitat to support populations of well-distributed native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian dependent communities. In the

PACFISH EA (USDA, USDI 1994b) and INFISH EA (USDA, USDI 1995) these are referred to as Riparian Goals and are addressed in goals (5) and (8).

Table 55 was compiled to identify inventoried invasive plant sites and Project Area Units (PAUs) within Riparian Reserves (RRs) and Riparian Habitat Conservation Areas (RHCAs), and to show where these occur within 100 feet of streams. The first 100 feet adjacent to water normally has the highest risk of delivery of sediment and other contaminants, and is within the band where label restrictions for distance are applied (demonstrated in Figure 4, page 60). Table 58 identifies inventoried populations and PAUs adjacent to lakes, reservoirs, ponds, and springs, and in or adjacent to wetlands by sub-basin.

Table 55. Acres of Invasive Plant Sites (Inv.) and Project Area Units (PAU) in Riparian Reserves, Riparian Habitat Conservation Areas (RHCAs), and within 100 feet of streams on National Forest System lands.

	≤ 100 ft Class I-II (acres		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		Cat 1-4 RHCAs & RRs (acres)	
	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU
John Day River Basin								
Upr John Day Sub Basin								
Mdl SFk John Day River	0.1	37.5	0.3	6.0	0.9	33.0	2.5	113.1
Lwr SFk John Day River	9.8	34.1	0	9.3	0.7	23.6	13.0	210.1
Upr Middle John Day R	0.5	3.1	0	0	0	0.7	0.7	9.1
Mountain Creek	0.1	1.1	0	4.9	0	1.0	0.9	16.2
Rock Creek	0.1	8.4	0	5.1	0.4	6.0	0.5	56.7
Sub Basin Total	***10.6***	***84.2***	***0.3***	***25.3***	***2.0***	***64.3***	***17.6***	***405.2***
Lwr John Day Sub Basin								
Bridge Creek	6.5	68.7	11.6	41.0	8.3	61.9	50.9	425.9
Sub Basin Total	***6.5***	***68.7***	***11.6***	***41.0***	***8.3***	***61.9***	***50.9***	***425.9***
Deschutes River Basin								
Upr Deschutes Sub Basin								
Crane Prairie	4.0	61.2	0	0.7	<0.1	7.0	65.2	440.1
Wickiup	11.6	25.5	0.8	0.8	0.9	2.0	129.0	272.0
Fall River	4.9	6.1	0	0	0	67.6	21.4	123.7
Pilot Butte	0.5	5.9		1.3	11.6	59.3	43.9	147.2
Tumalo Creek	2.3	111.6	0	0	0	23.8	6.7	319.7
Deep Canyon	0	0	0	0	0	3.8	0	39.9
Middle Deschutes	0	0	0	0	0	0	0	0
Whychus Creek	70.9	198.4	4.7	8.5	88.5	135.2	341.2	739.2
Upper Metolius River	137.8	174.1	3.9	16.0	164.4	297.2	490.0	994.2
Lower Metolius River	33.5	52.4	3.8	7.1	80.9	197.9	219.8	456.8
Lake Billy Chinook	0	0	0	0	48.0	66.7	51.0	72.0

	≤ 100 ft Class I-II (acres		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		Cat 1-4 RHCAs & RRs (acres)	
	Invasive Plant Site	**PAU**	**Invasive Plant Site**	**PAU**	**Invasive Plant Site**	**PAU**	**Invasive Plant Site**	**PAU**
Sub Basin Total	***265.5***	***635.2***	***13.2***	***34.4***	***394.3***	***860.5***	***1368.4***	***3604.8***
Ltl Deschutes Sub Basin								
Upr Little Deschutes R	0	1.0	0	0	2.7	3.8	16.0	28.3
Crescent Creek	14.9	17.0	0	0	3.8	14.3	162.3	205.8
Mdl Little Deschutes R	0	0	0	0	0	0	0	0
Sellers Creek	0	0	0	0	0	0	0	0
Little Walker Mountain	0	0	0	0	0	0	4.5	6.2
Long Prairie Slough	0	0	0	0	0	2.9	0	2.8
Lower Little Deschutes R	1.3	9.0	0	0	0	1.2	11.1	45.9
Sub Basin Total	***16.2***	***27.0***	***0***	***0***	***6.5***	***22.2***	***193.9***	***289.0***
South Fk Crooked R Sub Basin								
South Fork Beaver Creek	0	0	0	0	0	0.8	0	0.8
Upper Beaver Creek	4.0	9.7	0.7	5.9	1.0	21.4	11.6	60.0
Paulina Creek	22.4	35.6	122.8	190.6	268.0	429.2	445.0	788.3
Lower Beaver Creek	4.7	104.2		1.6	1.3	37.6	9.3	243.8
Sub Basin Total	***31.1***	***149.5***	***123.5***	***198.1***	***270.3***	***488.9***	***465.9***	***1093.0***
Upr Crooked Sub Basin								
Crooked River abv NFk	0.2	5.2		0.7	0.1	11.7	0.6	28.8
Camp Creek	0.3	4.9		1.5	0.1	7.2	0.6	27.5
Upper NFk Crooked River	0.6	74.4		21.6	1.8	34.6	2.7	317.4
Deep Creek	1.5	99.2	0.4	36.3	15.9	51.5	28.5	478.2
Lower NFk Crooked River	0.1	17.9		9.7	0.8	29.3	1.7	91.3
Upper Crooked Valley	3.9	50.6	1.4	15.3	1.6	37.1	15.8	210.3
Bear Creek	0.5	42.9	0.2	10.2	<0.1	19.3	1.8	156.1
Prineville Reservoir	0	0	0	0	0.1	0.4	0.1	0.4
Sub Basin Total	***7.1***	***295.1***	***2.0***	***95.3***	***20.3***	***191.1***	***51.8***	***1310.1***
Lwr Crooked Sub Basin								
Upper Ochoco Creek	1.5	255.1	0.1	65.4	1.4	99.3	7.7	864.6
Mill Creek	0.8	78.2	0.1	10.9	0.1	32.7	1.9	212.7
Lower Ochoco Creek	0	0	0	0	0	2.1	0	2.0
McKay Creek	5.2	82.4	0.3	18.0	0.7	25.9	12.9	260.0
Badlands	0	0	0	0	0	0	0	1.6
Upr Dry River	0	0	0	0	0	0	0	0

	≤ 100 ft Class I-II (acres		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		Cat 1-4 RHCAs & RRs (acres)	
	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU
Lwr Dry River	0	0	0	0	0	0	0	0
Lwr Crooked R Valley	0	0	22.1	26.0	149.8	260.8	179.8	296.6
Crooked River Grassland	0	0	0	0	8.3	19.5	8.2	19.2
Sub Basin Total	***7.5***	***415.7***	***22.6***	***120.3***	***160.4***	***440.2***	***210.5***	***1656.8***
Lwr Deschutes Sub Basin								
Hrwtrs Deschutes River					0.9	7.4	0.9	7.2
Willow Creek	8.8	29.8	58.4	82.3	164.2	274.5	295.9	546.3
Sub Basin Total	***8.8***	***29.8***	***58.4***	***82.3***	***165.1***	***281.9***	***296.8***	***553.6***
Trout Creek Sub Basin								
Upper Trout Creek	0.4	59.2	0.1	20.6	0.2	36.1	2.0	235.8
Hay Creek								
Mud Springs Creek		2.0			52.6	122.5	55.9	159.4
Sub Basin Total	***0.4***	***61.2***	***0.1***	***20.6***	***52.8***	***158.6***	***57.9***	***395.2***

* On values within 100 feet of streams 1 acre = 218 feet & 24.24 acres = 1 mile approximately
Class I-II streams are fish bearing; Class III streams are perennial non-fish bearing; Class IV streams are intermittent non-fish bearing.
** Category 1-4 RHCAs and RRs – This field includes RHCAs and RRs for Class I-IV streams plus those identified or ponds, lakes, reservoirs, and wetlands. Categories are defined in the PACFISH and INFISH documents, whereas they are named in the Aquatic Fish Strategy (AFS). For example, Category I RHCAs (Class I & II streams) in PACFISH and INFISH are called fish-bearing streams in the ACF.

3.6.2 Environmental Consequences

The Invasive Plants Treatments EIS proposes biological (BIO), chemical (CH), cultural (CU), fire (FI), manual (MA), mechanical (ME), and no (NO) treatment or a combination of these. Table 58 shows the distribution of these treatments by Forest for Treatment 1 through 4 (the top 4 priority invasive plants listed per PAU – see Appendix A in the Invasive Plant EIS) in Alternative 2. The distribution in Alternative 3 is approximately the same but the percentage in chemical treatments will be reduced by a small amount due to not permitting chemical applications within 10 feet of water. Distance to water from a potential treatment is a primary factor in determining the risk of affecting water quality.

Table 56. Proposed Treatment Method Combinations

Treatment	Forest	
	Deschutes NF (%)	Ochoco/CRNG (%)
BIO	2.0	15.3
CH	0.2	24.2
CHMA	60.4	48.9
CHMACU	0	0.9

CU	0.1	0
CUCH	1.2	7.4
MA	32.1	0.9
MACH	<0.1	0
MAMECH	0.5	0
MECH	1.6	0
MECHMACU	2.8	0
MEFICHMA	0	0.5
NO	0.6	2.0

Biological Controls - As indicated in Table 58, biological treatments are proposed in about 2% of the treatments on the Deschutes NF and 15% of the treatments on the Ochoco NF and Crooked River National Grassland. Biological treatments are very species specific. The species targeted have very little potential of providing shade, and treatments would not result in ground disturbance or reduced effective ground cover. Therefore biological treatments would not have any effect on water quality and will not be evaluated further.

Chemical Control – The objective of herbicide treatments in this EIS is to effectively reduce invasive plant infestations to a level where they can be hand-pulled, to effectively treat expansive areas where invasive plants continually show up due to the nature of the site, to treat invasive plants where manual treatments pose a safety issue, and/or to effectively treat invasive plants that do not respond to other controls.

Cultural Controls – Cultural treatments in this EIS mainly focus on solarization techniques such as black plastic to cover reed canary grass and ribbongrass. Solarization covers kill everything under the plastic including non-target species. These treatments would not be directly on stream banks or result in ground disturbance and should not have any effect on water quality.

Manual Controls – Manual treatments proposed in this EIS are primarily on small, easily accessible populations of annual (e.g. yellow star thistle) and perennial (e.g. spotted and diffuse knapweed) tap-rooted species. This may result in ground disturbance which is discussed under sediment and turbidity.

Mechanical Treatments – Mechanical treatments proposed in this EIS are in combination with other treatments to increase overall treatment effectiveness. The majority of proposed mechanical treatments mow down vegetation using a weed-whaker. However, harrowing is proposed at two sites adjacent to old landings on the Paulina RD to prepare the sites for revegetation after being burned and treated with herbicide. Mechanical treatments are discussed under sediment and turbidity.

Prescribed Fire – Prescribed fire is proposed in this EIS to burn houndstung in two PAUs to reduce vegetative cover and stimulate germination before treating with herbicide and then harrowing/disking for regeneration of desirable species. Prescribed burning is discussed under sediment and turbidity.

A review of public comments on the proposed Non-Native Invasive Plants EIS indicated that the primary concern was related to herbicide application. Herbicides proposed for use on the two Forests and the Crooked River National Grassland are chlorsulfuron, clopyralid, glyphosate, aquatic glyphosate, imazapyr, aquatic imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, triclopyr-BEE, and aquatic triclopyr-TEA.

Project Area Units were not designed to be treated all at one time but are areas where a particular treatment could be applied should the non-native species expand outside where originally found and mapped. Project Area Units along roads on the Deschutes National Forest range from 150 to 250 feet wide (75-125 feet on either side of the road) while those on the Ochoco and Crooked River National Grassland are 150 feet (75 feet on either side of the road). Inventoried non-native invasive plant sites on Forest Service administered lands encompass about 28 percent of the Project Areas on both the Deschutes National Forest and on the Ochoco National Forest/CRNG. Invasive plants within an inventoried site may cover a very small percentage of the area. Based on the first four target species, chemicals are included in the proposed treatments for 65 percent of the Project Area Units on the Deschutes National Forest and 82 percent of those on the Ochoco National Forest/CRNG. Less than one percent of the area where herbicide application is currently permitted is being treated annually due to the non continuous nature of infestations and reductions in populations due to treatments. While the distribution may be somewhat different, the same concept would apply to proposed treatments in the action alternatives.

Accidental Spill

Accidental spills are not considered within the scope of the project. Project design features (PDFs 18, 19, 20, 21, 24, & 25) would reduce the potential for spills to occur, and if an accident were to occur, the PDFs minimize the magnitude and intensity of impacts. An herbicide transportation and handling plan is a project requirement. This plan would address spill prevention and containment.

The concentration of herbicide in the water as a result of an accidental spill depends on the rate of application and the streams' 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).

303(d) List

Table 43 shows the streams and lakes on the Crooked River National Grassland, Deschutes National Forest, and Ochoco National Forest that are on the Oregon Department of Environmental Qualities (DEQ) impaired waters list. There are 77 streams/stream reaches listed for exceeding the rearing water temperature threshold, 10 streams/stream reaches listed for exceeding the bull trout water temperature threshold, 1 stream listed for spawning temperature, 9 streams/stream reaches listed for sediment (there is no state standard for sediment), 1 stream reach listed for turbidity, 3 lakes and 1 stream listed for both pH and chlorophyll a, 2 stream reaches listed for pH, 1 stream reach listed for chlorophyll a, and 1 lake and 2 streams/stream reaches listed for Dissolved Oxygen (DO). Inventoried invasive plant sites and Project Area Units within 100 feet of 303(d) listed streams and lakes/reservoirs are shown in Table 44.

Temperature - Most invasive plants identified in this document are less than 4 feet tall and need to be within 5 feet of the stream channel to contribute measurable shade. Only riparian invasive plants close to the edge of the water have a potential to contribute measurable shade to surface water which in turn could produce measurable changes in water temperature. The only riparian invasive plants inventoried in the project area are reed canary grass and ribbongrass. Yellow flag (iris) is also known to occur in some riparian areas. There are 2 inventoried reed canarygrass sites and 1 ribbongrass site adjacent to 303(d) temperature impaired stream reaches in the project area. The Reed canarygrass site at Bull Bend on the 44 road on the east side of the Deschutes River (PAU 11-80) is about an acre. Reed canarygrass is also inventoried in Big Marsh on Big Marsh Creek (PAU 12-05) but most of the inventoried sites are on the old drainage ditches which have been decommissioned and no longer flow into the creek. PAU 11-10, approximately 3 miles downstream from Bull Bend, also has Reed canarygrass listed as a target species, however only spotted knapweed is inventoried at the 42 Road crossing on the 303(d) listed reach of the Deschutes River. The only ribbon grass site currently inventoried in the project area is in the Camp Sherman area on the Metolius River (PAU 15-32).

Sediment & Turbidity – There is no water quality standard for sediment in the current Oregon DEQ water quality rules. Supporting data to remove the streams in the Upper Trout Creek Watershed (Bull Creek, Cartwright Creek, Dick Creek, Dutchman Creek, Potlid Creek, Auger Creek, Big Log Creek and Trout Creek) from the sediment impaired list was provided to DEQ for the 2004/2006 update, however they were not removed and are still on the 2004/2006 303(d) list. The Deschutes River is listed for both sediment and turbidity between Wickiup Reservoir and Bend. This appears to be the result of irrigation releases since turbidity levels increase by as much as 30 fold in the Deschutes when irrigation water is released in early spring and remains up to twice background until late July.

Manual and mechanical treatments can cause ground disturbance, increasing the potential for erosion and sediment delivery. There is a potential for manual treatments (pulling) of knapweed, sulfur cinquefoil, Dalmatian toadflax, St. Johnswort, and Medusahead adjacent to 303(d) listed streams in the Upper Trout Creek Watershed (PAU 71-55). Manual treatments are proposed on the Deschutes River between Wickiup Reservoir and Bend at Bull Bend for reed canarygrass (PAU 11-80), at Tethrow Meadow for quack grass (PAU 11-57) and at the 42 Road crossing for spotted knap weed (PAU 11-10). However the mechanical treatments (mowing or weed whacking) associated with treating the reed canarygrass and quack grass in PAUs 11-80 & 11-57 would not result in any increase in sediment or turbidity.

pH/DO/Chlorophyll a - Treatments of non-emergent vegetation within 100 feet of 303(d) streams would not add measurable amounts of organic matter or nutrients to streams or lakes or further degrade pH, Chlorophyll a, or Dissolved Oxygen (DO). However, there is a potential for chemical treatment of emergent vegetation (reed canarygrass, ribbon grass, and yellow flag) to affect pH, DO, and chlorophyll a, in adjacent waters with high levels algae. Reed canarygrass has been inventoried on the Deschutes River at Bull Bend (PAU 11-80) and Lava Lake (PAU 11-39), both listed for DO on the 303(d) list, and on Odell Creek (PAU 12-02), listed for pH and chlorophyll a.

Alternative 1

The Deschutes National Forest, Ochoco National Forest, and Crooked River National Grassland GIS layers for the 1998 Weed EAs were compared to the current proposed action. The results are shown in Table 57. The 1998 Weed EA for the Deschutes National Forest included five treatments with herbicide prescribed for only 42 percent of the treatment area. The Ochoco National Forest and Crooked River National Grassland were a little more complicated with treatments varying by species within the Treatment Area (TA). Less than one percent of the TAs did not have any herbicide treatments. Approximately 67 percent of the TAs have a prescription of manual/herbicide. This prescription indicates that as a general rule, small populations of less than 10 plants would be hand pulled while larger infestations would be sprayed with herbicide. Herbicides currently being used on the two Forests and the Crooked River National Grassland and available under this alternative are picloram, glyphosate, and dicamba.

Table 57 provides a comparison between the 1998 Weed EAs for the Deschutes NF, Crooked River National Grassland, and the Ochoco NF and the current inventoried invasive plant sites and the proposed Project Area Units (PAUs) in Alternative 2 and 3. Column 2, Total 1998 TA, depicts the total acres in Treatment Areas in the 1998 EAs. The 1998 EAs authorized treatments along road right of ways outside National Forest System lands within the original congressionally designated reserve boundaries. Alternatives 2 and 3 only propose treatments on National Forest System lands. Column 3, Treatment Areas overlapping PAUs, indicates the number of acres in the 1998 Treatment Areas that still have invasive plants or that the weed coordinators on the Ranger Districts felt had a good chance of invasive expansion and still warranted treatment options under Alternatives 2 and 3. Column 4, Invasive Plant Site within TAs, shows the acres of currently inventoried invasive plant sites that are in 1998 designated Treatment Areas. Some of the species identified have been newly inventoried since the 1998 documents. Newly identified invasive plant sites tend to initially be small in size so the area outside the 1998 Treatment Areas can account for a large number of inventoried sites.

Table 57. 1998 Weed EA Treatment Areas compared to current Project Area Units.

Sub-Basin	Total acres 1998 TAs	Acres of TAs overlapping PAUs	Inventoried Invasive Plant Sites
Upper John Day R.	506.4	426.2	3.5
Lower John Day R.	1590.0	990.6	176.8
Upper Deschutes R.	4628.1	3360.2	2008.6
Little Deschutes R.	2355.0	927.5	866.4
South Fork Crooked R.	623.0	491.5	20.9
Upper Crooked River	2238.3	1967.4	141.2
Lower Crooked R.	2313.5	1697.1	231.3
Lower Deschutes R.	779.9	577.1	61.0
Trout Creek	1237.1	856.4	7.4
Summer Lake	258.1	234.0	233.9
Williamson	0	0	0

Table 57 shows there are substantial areas outside the 1998 Treatment Areas that are currently infested with invasive plants. Herbicide treatments within the Treatment Areas have substantially decreased, due to effectiveness (see Chapter 3.3).

Direct and Indirect Effects

The 1998 NEPA documents authorize pulling, clipping, burning, biological, and herbicide treatments. Based on the treatments authorized under the Environmental Assessments for treating weeds on the two Forests and the Grassland, it was determined that treatments greater than 100 feet from water were low risk. Treatment Areas within 100 feet of streams, lakes, springs, wetlands, and Riparian Habitat Conservation Areas (PACFISH & INFISH) or Riparian Reserves (NWFP) were evaluated. A table showing treatment areas where herbicide treatments are permitted within 100 feet of hydrologic areas of concern is shown in Table 58. As indicated previously, less than one percent of the area where herbicide application was authorized is currently being so treated annually.

Sediment and Turbidity

State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. However, limited duration activities necessary to accommodate essential legitimate activities that cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and a permit is granted under OAR 340-041-0036 (b). There is normally a close correlation between turbidity and suspended sediment in a given stream, but this correlation can change as organic material increases over the summer or if the percent of sediment from different sources in the drainage changes. Turbidity does not measure the amount of sediment being transported as bedload. There is no state standard for suspended sediment, bedload, or total sediment.

Sediment delivery to streams is dependent on the erosivity of the soil, slope, distance to a stream, amount of exposed soil (effective ground cover), and intensity and continuity of disturbance. Eliminating invasive plants can temporarily reduce effective ground cover, but the extent and continuity should be small. Burning can reduce effective ground cover and at higher intensities kill non target species, change soil chemical and physical properties, and retard the establishment of new vegetation. Manual and mechanical treatment can cause ground disturbance.

Two Treatment Areas were proposed for burning in 1998. Burning is no longer recommended for treatment of medusahead and recent experience with burning reed canarygrass without a follow-up treatment was unsuccessful. No additional burning is planned, and there will not be any sediment delivery from burning under this alternative. Manual treatment normally consists of pulling but may include cutting the root off or breaking them free with a shovel or Pulaski. This can result in some ground disturbance. The amount of disturbed soil is very small, tends to lack continuity, and should not result in measurable delivery to streams. Herbicide treatments leave the dead vegetation in place, thus maintaining effective ground cover, and will not result in any measurable increase in sediment or turbidity. Alternative 1 will not produce any measurable increase in sediment or turbidity within streams in the planning area and meets State water quality turbidity standards.

Water Temperature

State water temperature standards for the project area are found in Oregon Water Quality Standards 340-041-0028(4)(a), (b) and (f), based on Fish Use Maps 130A, 130B, 170A, and 170B. There are not treatments adjacent to Class I-III streams in the Klamath or Goose/Summer Lakes Basins in this alternative. The Riparian Management Objectives (RMOs) for PACFISH and INFISH indicate that there should not be any measurable increase in water temperature.

Pulling and killing invasive plants can reduce shade which can increase the amount of solar input into streams. However, most invasive plants provide little or no shade to streams and several factors play a part in determining whether loss of stream shading would result in water temperature increase. Dead vegetation, if not removed, would continue to provide shade where adjacent to a stream's edge. Clipping reed canarygrass on the Deschutes National Forest will not produce any measurable decrease in shade.

Ongoing treatments under Alternative 1 will not produce any measurable increase in water temperatures. Without a program for active eradication or control, riparian invasive plants are likely to spread. The spread of reed canarygrass and ribbongrass can increase overhanging banks and narrow channels, and also inhibits the establishment/reestablishment of riparian shrubs where their habitats overlap.

Water Chemistry

State water quality standards state that toxic substances may not be introduced above natural background levels in waters of the state in amounts that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bio-accumulate in aquatic life to levels that adversely affect public health, safety, or welfare, or aquatic life wildlife, or other designated beneficial uses. Tables 20, 33A, and 33B, in Division 41 – Water Quality Standards and Beneficial Uses of the Oregon Administrative Rules (OAR 340-41), contain the Water Quality Toxic Criteria for the state. Table 33C, which contains Water Quality Toxic Guidance Values, directs that chemicals with toxic effects that do not have guidance values designated, if detected in the waste stream, should determine guidance values through a review of scientific literature on effects to aquatic organisms.

Herbicides used under the existing NEPA documents could enter water through spray drift, surface water runoff, percolation into groundwater, and wind blown transport of herbicide attached to soil particles. Table 58 displays the acres of treatment areas from the 1998 EAs that occur near water. The 1998 EA for the Deschutes contained design elements (in addition to EPA regulations) to reduce the risk to water quality from herbicides.

Table 58. 1998 TAs within Hydrologic Areas of Concern with Herbicide Treatments*

Sub-Basin	≤ 100 ft Cls I-III (ac)	≤ 100 ft Cls IV (ac)	≤ 100 ft Lakes (ac)	≤ 100 ft Wetlands (ac)**	≤ 100 ft Springs (ac)	Cat 1-4 RHCA/RR (ac)**
Upr. John Day River	19.6	7.4	0	33.8	<0.1	73.1
Lwr. John Day River	128.9	61.5	0	26.8	1.8	371.6

Upr. Deschutes	84.6	61.6	8.6	106.7	2.4	323.5
Little Deschutes R.	2.2	0	0	3.0		14.4
SFk Crooked River	63.8	11.9	0	5.1	0.3	159.9
Upr. Crooked River	220.0	93.9	1.6	256.9	3.5	775.2
Lower Crooked River	359.4	108.0	30.1	259.5	1.7	1003.5
Lwr. Deschutes R.	59.7	54.9	25.3	109.8	0	200.9
Trout Creek	111.2	55.5	0	1.4	1.6	316.8
Summer Lake	0	0	0	0	0	0
Williamson	0	0	0	0	0	0

* Includes all Ochoco/CRNG TAs and about 42% of Deschutes TAs
** Wetlands may double count stream, lake, and spring buffers. RHCA/RRs include al the previously listed hydrologic systems but buffer widths may be different.

The Deschutes National Forest currently operates under the Noxious Weed Control EA (Deschutes NF, 1998). Design elements developed to reduce the risk to water quality from herbicide were:

1. Herbicides will only be applied following the Environmental Protection Agency (EPA) product labeling instructions and within the prescribed environmental conditions stated on the label. *This includes wind speed, relative humidity, distance from water, and other sensitive areas.*

2. No boom spraying within 100 feet of perennial stream, live intermittent streams, or standing water.

3. Within 100 feet of perennial streams, live intermittent streams, or standing water, chemical herbicides could be applied using backpack sprayers, wicking, or other methods that could treat individual small areas or plants.

4. No chemicals near water (100 ft) in designated treatment areas (Site Specific Mitigation Measures – *Chapter 2 Page 9-11 of EA*). *A review of the GIS layer found that all Treatment Areas that came within 100 feet of currently identified Class I-III streams, lakes, reservoirs and/or wetlands and that had a chemical prescription were designated*.

5. Only glyphosate, manual treatments, or biological treatments, would occur within ¼ mile of public wells and the company would be notified of the proposed treatment. *No wellhead protection area was specified for smaller systems*.

6. No mixing chemicals, transferring, or cleaning of spray equipment would occur within 100 feet of perennial streams, intermittent streams, or standing water.

7. Picloram would not be used in riparian areas, or within 100 feet of perennial streams or standing water. *Riparian area was not defined, but appears to be referring to wetlands*.

8. Dicamba could be used on dry sites in riparian areas (high water table but no standing water). These areas would be identified.

The Ochoco National Forest and Crooked River National Grassland currently operate under the 1998 Integrated Noxious Weed Management EA (Ochoco NF, 1998). Design elements developed to reduce the risk to water quality from herbicide were:

1. Herbicides will only be applied following the Environmental Protection Agency (EPA) product labeling instructions and within the prescribed environmental conditions stated on the label. *This includes wind speed, relative humidity, distance from water, and other sensitive areas.*

2. Herbicides will not be applied directly to water. Herbicide application within 50 feet of water will be by hand application with a backpack sprayer to minimize the potential for herbicide entering the stream system. A wick will be used within 10 feet of live water.

3. Application will be by spot spray. Spot spray means only the area that contains weeds will be sprayed. There will be no broadcast spraying. Aerial application is not proposed.

The 1998 Weed EA for the Deschutes National Forest directs that herbicides not be applied within 100 feet of water (including wetlands). On the Crooked River National Grassland and the Ochoco National Forest approximately 1045 acres in Treatment Areas (TAs) had herbicide prescriptions for at least some species within 100 feet of Class I-III streams and perennial lakes, reservoirs, and ponds or about 56 percent of the area in Project Area Units (PAUs) with herbicide treatments in Alternative 2 for these areas. Approximately 701 acres in TAs had herbicide prescriptions for at least some species within 100 feet of wetlands and springs. This is about 54 percent of area in PAUs with herbicide prescriptions in Alternative 2. The 1998 EAs did not authorize broadcast spraying on the CRNG or Ochoco NF and it could only be used on the Deschutes NF greater than 100 feet from perennial stream, live intermittent streams, or standing water. To minimize the risk of herbicide entering water, only wicking was authorized within 10 feet of live water on the CRNG and Ochoco NF. Currently a total of less than 300 acres on average (including uplands) are being treated with herbicides annually between the CRNG, Deschutes NF, and the Ochoco NF.

Potable Water

A review of identified potable water sources in the project area was accomplished. Treatment Areas where herbicide treatments are permitted within 200 feet of wells or springs and delineated recharge areas overlain by TAs are shown in Table 59. There were no herbicide treatments in any of the municipal watersheds in this alternative. Water sources not delineated in GIS were visually verified and 0.4 acres was added to the area within the wellhead protection area. Recharge areas were estimated by the Oregon Water Resources Department for larger public systems. Not all potable water sources have delineated source areas and smaller ones probably never will. It is not known how interconnected the surface is with the aquifers.

Design elements direct the Deschutes only use glyphosate, manual treatments, or biological treatments within ¼ mile of public water systems. There is no special project design criteria for wells on the Ochoco National Forest or the CRNG. There is currently no restriction in effect for the use of herbicides within a specified distance of public water wells.

Table 59. Potable Water areas with Potential Herbicide Treatments

Sub-Basin	Wellhead Protection Areas (WPAs)		Drinkable Water Source Area (DWSA)	
	Number of Treatment Areas**	Acres	Number of Treatment Areas	Acres*
Upr. John Day River	0	0	0	0
Lwr. John Day River	0	0	1	1.3
Upr. Deschutes	5	14.7	12	330.5
Little Deschutes R.	2	24.5	2	23.3
SFk Crooked River	1	2.8	1	13.7
Upr. Crooked River	3	1.2	0	0
Lower Crooked River	4	4.1	2	143.4
Lwr. Deschutes R.	0	0	0	0
Trout Creek	0	0	0	0
Summer Lake	0	0	0	0
Williamson	0	0	0	0

Sub-Basin	Wellhead Protection Areas (WPAs)		Drinkable Water Source Area (DWSA)	
	Number of Treatment Areas**	Acres	Number of Treatment Areas	Acres*
Total**	15	47.3	17	512.2

* The source area for each well or diversion is counted so the contributing area from a Treatment Area (TA) may be counted more than once.
** A Project Area may be in more than 1 Sub-basin

The 1998 EAs concluded that the herbicide treatments posed no significant impact to fish, aquatic invertebrates, workers or public health. Alternative 1 meets State Water Quality Standards for toxic substances.

Riparian Areas

Where treatment of invasive plants is authorized under existing NEPA documents, it will help in maintaining or improving native plant species diversity and productivity. However, many new sites have been inventoried since 1998 and cannot be treated under Alternative 1. Without effective control, riparian invasive plants, such as reed canarygrass, ribbongrass and yellow flag iris, which were not identified as target species in the 1998 EAs, will continue to spread and displace native vegetation. The Snow Lakes Watershed Analysis notes that reed canarygrass has a strong potential to spread from sites on the Upper Deschutes River downstream and out of the watershed. There is potential for water quality to degrade as ribbongrass continues to create a monoculture that replaces the diverse native riparian vegetation along the Metolius River. See also the Native Vegetation Section 3.4.

Cumulative Effects of Alternative 1

Project design in the 1998 EAs limited the potential for water contamination by herbicides or sediment. In addition to the discussion included in this EIS, indirect, direct and cumulative effects to the aquatic environment for current treatment programs are contained in each of the existing NEPA documents. In general, these documents do not anticipate any indirect, direct or cumulative adverse effects to the aquatic environment, due to the implementation of mitigation measures.

Alternative 2 – Proposed Action

This alternative proposes biological, herbicide, cultural, fire, and manual treatments, or a combination of these as described in Chapter 2. Distance to water from an area of invasive plant treatment is a primary factor in determining the risk of affecting water quality. Based on the treatments proposed in Alternative 2, it was determined that treatments within 100 feet of water had the highest risk of affecting water quality. Project Area Units (PAUs) within 100 feet of streams, lakes, springs, and wetlands were evaluated for potential adverse effects. PAUs were not designed to be treated all at one time but are areas where a particular treatment could be applied should the invasive plant sites present in the project area unit expand outside where originally found. PAUs where herbicide treatments are permitted within 100 feet of hydrologic areas of concern are shown in Table 61. Invasive plants within an inventoried site may cover a very small percentage of the area.

Sediment and Turbidity

State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. However, limited duration activities necessary to accommodate essential legitimate activities that cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and a permit is granted under OAR 340-041-0036 (b). There is normally a close correlation between turbidity and suspended sediment in a given stream, but this correlation can change as organic material increases over the summer or if the percent of sediment from different sources in the drainage changes. Turbidity does not measure the amount of sediment being transported as bedload. There is no state water quality standard for sediment.

Eliminating invasive plants can temporarily reduce effective ground cover which can increase erosion and sediment delivery, but the extent and continuity should be small. Proposed biological, cultural, and chemical treatments would not cause measurable increases in erosion or turbidity.

Manual treatment normally consists of pulling but may include weed wrenching, cutting the root off or breaking them free with a shovel or Polaski. This can result in some ground disturbance. The amount of disturbed soil is very small, tends to lack continuity, and would not result in measurable delivery to streams. Pulling knapweed, sulfur cinquefoil, Dalmatian toadflax, St. Johnswort, and Medusahead in the Upper Trout Creek Watershed (PAU 71-55) or knapweed at the 42 Road crossing on the Deschutes River (PAU 11-10), would not result in measurable increases of sediment in 303(d) listed streams (Auger Creek, Trout Creek, Potlid Creek, Cartwright Creek, Dutchman Creek, Big Log Creek, and the Deschutes River between Wickiup Reservoir and Bend). Mowing, weed whacking, tarping (solarization), and chemical treatments leave the dead vegetation in place, thus maintaining effective ground cover, and will not result in any measurable increase in sediment or turbidity. Tarping (solarization) is only proposed for Reed canarygrass in Big Mash (PAU 12-05) and as a test plot for ribbongrass on the Metolius (PAU 15-32). Tarping is non selective and kills all vegetation in the treated area including desired native species. Planting of treated sites on the flood prone area (2 times the bank full depth) would meet PDF 50 and reduce the risk of flood plain scour as the roots break down on treated vegetation.

Turbidity levels generated by manually pulling reed canarygrass and ribbon grass in channel will be reduced by dilution and mixing as it moves downstream. Turbidity generated by pulling plants off Large Woody Debris (LWD) in the channel would move downstream with the current rather rapidly but ribbon grass pulled in backwater areas and side channels would take longer to dissipate. Based on the discharge of the Metolius and Deschutes Rivers, two or three people pulling plants would be able to keep turbidity levels under threshold but a large group pulling in a concentrated area has the potential of producing higher turbidity readings, especially when pulling plants on the side of the channel adjacent to the bank. Due to the rhizomatous nature of reed canarygrass and ribbon grass, it would not be effective to pull it out of the bank. If turbidity could visually be seen 100 feet below where the activity is occurring, the workers would need to be dispersed further up and down stream. No less than 2 people should be pulling in the river at a given time fore safety and pulling plants in the channel will need to be within the dates permitted for in channel activities by the State. Hand pulling reed canarygrass at Bull Bend on the Deschutes River (PAU 11-80) would not result in measurable increases of sediment in the 303(d) listed reach of the Deschutes River below Wickiup Reservoir to Bend. Hand pulling quack grass at Tethrow Meadow (PAU 11-57) is also proposed adjacent to the 303(d) listed reach of the Deschutes River below Wickiup Reservoir, however since quackgrass is found further from the water and hand pulling would not be effective there is very little likelihood of measurable levels of sediment reaching the river.

Two additional proposed treatments have a potential to increase erosion and sediment delivery. Burning can reduce effective ground cover and at higher intensities kill non target species, change soil chemical and physical properties, and retard the establishment of new vegetation. Scarification, to prepare a seedbed for planting or to reduce compaction, causes ground disturbance and exposes soil.

Two Project Area Units in the Dry Paulina Creek Sub-watershed have burning and scarification included among the potential treatments. Fire is proposed to reduce large concentrations of standing dead houndstongue to allow access to new growth for either chemical or manual treatments (PAU 72-15 & 72-37). About 13 acres of the 390 acres in the two PAUs are proposed for burning and scarification. Scarification would be accomplished by pulling a harrow behind a small tractor to reduce the effects of previous logging practices and prepare the site for seeding of native or desirable non native grasses and forbs. Harrowing would break up the soil to a maximum depth of 1 to 4 inches. Organic matter uprooted by the harrowing would be left in place. There would be no tilling in the RHCA (50 feet) along the east and west fork of Dipping Vat Creek to filter potential sediment delivery.

Sediment delivery to streams is dependent on the erosivity of the soil, slope, distance to a stream, amount of exposed soil (effective ground cover), and intensity and continuity of disturbance. Based on the slope, the distance to Dry Paulina Creek and Dipping Vat Creek, and the ground disturbance resulting from the burning and harrowing, there is a risk of sediment delivery until seeded and natural vegetation recovers. No scarification within the 50 foot RHCAs would substantially reduce the amount of sediment delivered to streams and seeding would result in an additional 25 percent reduction (Packer and Christensen, 1964). Reshin et al. (2006) found a 10 meter (32.8 ft.) setback for felling and yarding activities prevented sediment delivery to streams from about 95 percent of harvest related erosion features and said a wider setback may be advisable on potions of units where steep inner gorges extended beyond 10 meters. Lynch et al. (1985) determined that a 30 meter (98.4 ft.) buffer from logging operations removed an average of about 75 to 80 percent of the suspended sediment in stormwater. Only 1.8 acres would potentially be harrowed between 50 and 100 feet on 5 treatment sites along the intermittent east & west forks of Dipping Vat Creek. Erosion should return to pre treatment levels within a year and fall below current levels within five based as grasses and forbs become established on the old landings. Based on the low intensity of the ground disturbance and the small number and dispersion of acres treated, sediment delivery should be negligible and there should not be a measurable increase in turbidity.

While fire may can cause nutrient flushes resulting from rapid mineralization and mobilization of nutrients (Baker, 1988) (Tiedeman and others, 1978), the effects of burning concentrations of houndstongue on 14 acres would be negligible. Most of the increased available nutrients would be taken up by plants or bound to soil, roots, or debris and if they did reach a stream would tend to get bound up in primary production and associated communities. Most of the increase in nutrient levels would occur in the first two storms after the burn and nutrient release resulting from the fire should not persist past the first winter (Van Wyk, 1982).

Alternative 2 would not produce a measurable increase in sediment or turbidity within streams in the planning area (or would be accomplished under permit per OAR 340-041-0036 (b) if problems are encountered pulling reed canarygrass or ribbongrass in channel) and will meet State water quality turbidity standards and PACFISH, INFISH, and the Aquatic Conservation Strategy objectives.

Water Temperature

State water temperature standards for the project area are found in Oregon Water Quality Standards 340-041-0028(4)(a), (b) and (f), based on Fish Use Maps 130A, 130B, 170A, and 170B. There are not treatments adjacent to Class I-III streams in the Klamath or Goose/Summer Lakes Basins in this alternative. The Confederated Tribes of Warm Springs water temperature standard for bull trout on Johnson Creek and the Metolius River below Johnson Creek is 10.0°C (50.0°F) and steelhead and salmon spawning and rearing temperature standards round down current DEQ standards to the nearest whole degree Fahrenheit on the Deschutes River below Round Butte Dam. The Riparian Management Objectives (RMOs) for PACFISH and INFISH indicate that there should not be any measurable increase in water temperature.

Pulling and killing invasive plants can reduce shade which can increase the amount of solar input into streams. Dead vegetation, if not removed, would continue to provide shade. Most invasive plants provide little or no shade to streams. Most non-native invasive plants identified in this document are less than 4 feet tall and would need to be within 5 feet of the stream channel to contribute measurable shade. Only emergent invasive vegetation close to the edge of the water has a potential at contributing measurable shade to surface water. The only emergent non-native invasive plants proposed for treatment in this analysis are reed canarygrass (PHAR3), ribbon grass (PHARP), and yellow flag (IRPS). There are 15 PAUs that include reed canarygrass and one PAU that includes ribbon grass as a target species. Riparian areas that are a dense monoculture of reed canarygrass or ribbongrass would be revegetated with native sedges, grasses, forbs, and shrubs. Any loss of stream shade is expected to be temporary. In PAUs where active restoration is proposed, re-establishment of native plants will take place within one to two seasons.

Treatment of reed canarygrass at Bull Bend (PAU 11-80) and ribbongrass on the Metolius River in the Camp Sherman area (PAU 15-32) could result in a small decrease in shade on 303(d) listed streams. Big Marsh Creek is also listed for water temperature. Only cultural treatment (black plastic tarping) is proposed for reed canarygrass in Big Marsh (PAU 12-05) with most of the inventoried sites on the old drainage ditches which have been disconnected and no longer flow into the creek. Due to limitations on how close tarping could be used to the active channel and the lack of connectivity of the old drainage ditches to the creek, treatments in Big Marsh would not affect water temperature in the creek. The other 13 reed canarygrass PAUs are on lakes, reservoirs and unlisted streams.

Approximately 80 percent of solar input into streams occurs between 0800 and 1600 hours during the period when maximum water temperatures occur on the Ochoco and Deschutes National Forests and the Crooked River National Grassland (July1 – August 15). The solar angle at 0800 and 1600 hours in Redmond, Oregon, is about 38 degrees and it is approximately 69 degrees at solar noon. The length of shade resulting from vegetation during this period is shown in Table 60.

Table 60. Shade Table

Vegetation Height (ft)	0.5	0.75	1.0	1.25	1.5	2.0
Shade Length @ Noon (ft)	0.3	0.5	0.6	0.8	0.9	1.2
Shade Length @ 0800 & 1600 (ft)	0.9	1.4	1.9	2.4	2.8	3.8

The direction shade comes from shifts over the day (vegetation on the east bank of a stream does not provide shade in the afternoon) and vegetation further from a stream can overlap shade from vegetation being treated. Dead vegetation, if not removed, would continue to provide shade. Therefore shade loss from vegetation being treated will normally be less than that depicted in Table 60. In addition, more than 70 percent more solar input occurs at noon than at 0800 or 1600 and a quarter of the solar input for the day comes between 1100 and 1300. Therefore, average effective shade loss should be closer to that at noon than to 0800 or 1600.

The Metolius ribbon grass survey found 7.58 percent of the riverbank occupied for the first 2/3 mile below Lake Creek. Assuming the Metolius was 50 feet wide and all vegetation was an average of 2 feet high, was completely removed, had no overlapping shade, and provided shade throughout the day, treatment of the ribbon grass on the Metolius would result in less than a half percent reduction in the shade on the river. Treatment of reed canarygrass on the Deschutes at Bull Bend should produce similar results. This would not result in any measurable increase in water temperature. Even if there was a risk that treatment of Reed canarygrass (ribbon grass) might result in a measurable increase in water temperature, short term increases in water temperature (up to 6 months) are allowed even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)). Water temperature monitoring results in the analysis area show that water temperatures drop below threshold within 6 months after potential treatments due to the weather. Non target and planted vegetation will be starting to provide shade by the time water temperatures start approaching thresholds the next season.

With the exception of Trout Creek in Trout Creek Swamp (PAU 15-22) the other Project Area Units (PAUs) proposing treatment of reed canarygrass are projected to only experience a very small decrease in shade as described for the Metolius which would not result in measurable increases in water temperature. Treatments within Trout Creek Swamp have the potential of reducing shade because the native plant communities in the PAU are shorter than the invasive Reed canarygrass. Trout Creek Swamp is a fen with most of the water movement occurring below the surface and between channels of the marsh which would buffer any surface water temperature increase. There is a low to moderate risk of a small water temperature increase of the channels in the fen but it would not be measurable when the surface and subsurface flows re-combined in Trout Creek below the swamp. In addition, when it is determined that the natural thermal potential of all or a portion of a water body exceeds the State threshold (64.4ºF for Trout Creek), the natural thermal potential temperature supersedes the biological based criteria as the applicable criteria for that water body (Oregon Water Quality Standards 340-041-0028(8)).

Alternative 2 meets State water quality standards, Confederated Tribes of Warm Springs Water Quality Standards, PACFISH and INFISH RMOs, and the Aquatic Conservation Strategy Objectives and Riparian Management Objectives for water temperature.

pH/DO/Chlorophyll a - The Regional Environmental Monitoring and Assessment Program (REMAP) is sponsored by the EPA. The Upper Deschutes River Basin R-EMAP (ODEQ, 1999) attributed the large Dissolved Oxygen (DO) fluctuations to plant (or algal) respiration associated with photosynthesis from large algal and aquatic microphyte assemblages observed in the field. They also attributed above threshold pH values to high oxygen production from photosynthesis on the South Fork of the Crooked River. Since five of the seven water bodies with 303(d) listings for pH also were listed for chlorophyll a, it is reasonable to assume this is also the case in the Upper Deschutes Sub-Basin. Treatments of non-emergent vegetation within 100 feet of 303(d) streams would not add measurable amounts of organic matter or nutrients to streams or lakes or further degrade pH, Chlorophyll a, or Dissolved Oxygen (DO). However, there is a potential for chemical treatment of emergent vegetation (reed canarygrass, ribbon grass, and yellow flag) to affect pH, DO, and chlorophyll a, in adjacent waters with high levels of algae.

Treatments of emergent vegetation which are adjacent to water bodies with algal bloom problems or 303(d) listed streams for pH, DO or chlorophyll a are proposed on 3 lakes/reservoirs and 2 streams. The Deschutes River at Bull Bend (PAU 11-80) and Lava Lake (PAU 11-39) are listed for DO on the 303(d) list and Odell Creek (PAU 12-02) is listed for pH and chlorophyll a. Crane Prairie Reservoir (PAU 11-53 & 11-56), Wickiup Reservoir (PAU 11-24), Paulina Lake (PAU 11-33), and Lava Lake (PAU 11-39) have been posted (Public Health Advisory) for toxic algae blooms according to the Oregon Department of Human Services at least once in the last 2 years. Emergent vegetation would be treated with the aquatic formulation (labeled for in water use) of glyphosate or imazapyr. Table 16 in the Invasive Plant EIS indicates that there is no buffer for spot spraying (includes area spraying) or hand application of these chemicals for reed canarygrass, ribbon grass, and yellow flag. While direct application to water is not proposed, accidental overspray and drift into water can occur during spot spraying. Since emergent vegetation has a shallow water table, there is a potential for herbicide to enter the stream or water body in ground water. While wicks can drip, this risk of this is low for hand application.

The SERA risk analysis for imazapyr in the R6 2005 EIS determined there was no risk to algae. However the SERA risk analysis for glyphosate concluded that low concentrations of glyphosate down to 0.002 mg/l (2µg/l) could stimulate algal growth. USGS Open-File Report 03-69 (Battaglin et al, 2003) attributed this to increased carbon input. Appendix D in the Invasive Plant EIS indicates that the average half life for glyphosate is 25-47 days. However, Goldsborough and Beck (1989) found that glyphosate dissipated rapidly from small forest ponds with first order half lives of 1.5 to 3.5 days, attributing this to sediment absorption and/or biodegradation. Feng and others (1989) found no quantifiable glyphosate residue in two streams after 96 hours following aerial application of glyphosate with an 8 hour rainstorm (20-28 hours following application).

Imazapyr should not result in any measurable affect to pH, DO or chlorophyll a. Due to sediment absorption, biodegradation, and dilution through mixing in streams, no measurable affect to pH, DO or chlorophyll a should occur in the Deschutes River or Odell Creek. However during algal blooms, there is a low to moderate risk of spot spray applications of glyphosate for emergent vegetation in ponds, lakes, and reservoirs, stimulating algal growth which would increase pH and chlorophyll a and decrease DO. These affects would be of short duration and small in area. Due to glyphosate's low mobility in soil, the primary delivery would be from spray drift and accidental overspray directly into the water.

Table 61. PAUs within Hydrologic Areas of Concern with Herbicide Treatments

Sub-Basin	≤ 100 ft Cls I-III (ac)	≤ 100 ft Cls IV (ac)	≤ 100 ft RHCAs (ac)	≤ 100 ft Lakes (ac)	≤ 100 ft Wetlands (ac)*	≤ 100 ft Springs (ac)	≤ 100 ft RHCA/RR (ac)*
Upr. John Day River	109.5	64.3	405.2	0.1	178.9	0.5	405.2
Lwr. John Day River	109.7	61.9	425.9	0	114.4	3.5	425.9
Upr. Deschutes	669.6	860.5	3604.8	200.2	1241.9	5.5	3604.8
Little Deschutes R.	27.0	22.2	289.0	59.8	142.7	0	289
SFk Crooked River	347.6	488.9	1093.0	15.0	9.2	6.3	1093
Upr. Crooked River	390.4	191.1	1310.1	0.5	438.1	4.2	1310.1
Lower Crooked River	536.0	440.2	1656.8	2.3	425.4	5.2	1656.8
Lwr. Deschutes R.	112.1	281.9	553.6	23.0	94.3	0	553.6
Trout Creek	81.8	158.6	395.2	0	13.6	1.4	395.2
Summer Lake	0	0	0	0	0	0	0
Williamson	0	0	0	0	0	0	0

* Wetlands may double count stream, lake, and spring buffers. RHCA/RRs include all the previously listed hydrologic systems but buffer widths may be different.

Water Chemistry

State water quality standards state that toxic substances may not be introduced above natural background levels in waters of the state in amounts that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bio-accumulate in aquatic life to levels that adversely affect public health, safety, or welfare, or aquatic life, wildlife, or other designated beneficial uses. Tables 20, 33A, and 33B, in Division 41 – Water Quality Standards and Beneficial Uses of the Oregon Administrative Rules (OAR 340-41), contain the Water Quality Toxic Criteria for the state. Table 33C, which contains Water Quality Toxic Guidance Values, directs that chemicals with toxic effects that do not have guidance values designated, if detected in the waste stream, should determine guidance values through a review of scientific literature on effects to aquatic organisms. None of the herbicides proposed for use in this alternative are found in State water quality Tables 33A-33C. However Hexachlorobenzene (HCB), a contaminant in picloram and clopyralid, is listed on Table 33A, EPA Number 88. HCB is a persistent carcinogen and bio-accumulates. The R6 2005 FEIS used herbicide risk assessments to evaluate the potential for harm to non-target plants, wildlife, human health, soils and aquatic organisms. They were accomplished by Syracuse Environmental Research Associates, Inc. (SERA) using peer-reviewed articles from open scientific literature and current EPA documents, including confidential business information. In addition other substances associated with the herbicides including impurities, metabolites, inert ingredients, and adjuvants were analyzed.

Herbicides can reach water bodies either directly through application or indirectly through surface runoff of subsurface flow. A primary goal of proposed activities is to keep herbicides out of streams, lakes and other water bodies.

Best Management Practices (BMPs) are employed to help assure that water quality is not degraded. Relevant Water Quality BMPs are incorporated into the Project Design Features listed in Chapter 2.4 of the Invasive Plant EIS. The objective of the PDFs is to keep herbicide residues in surface and ground water below levels that may be harmful, may chemically change to harmful forms, or that may accumulate in sediments or bio-accumulate in aquatic life to levels that adversely affect public health, aquatic life, wildlife, or other designated beneficial uses. Measures to reduce the risk of herbicide entering the hydrologic system include limiting drift (PDFs 15, 16), limiting runoff (PDF 17), reducing potential for and effects from accidental spills (PDFs 18, 19, 20, 21, 25), applying buffers around water bodies (PDFs 56), general surface and ground water protection (PDFs 43 through 56), and using only the lowest effect rate (PDF 12).

No direct application of herbicides into water is proposed in this alternative. However there is a moderate to high risk of drift or accidental overspray from spot praying targeted emergent vegetation (Reed canarygrass, ribbongrass, or yellow iris). Impacts from potential accidental direct application of herbicides to water are mitigated by only authorizing spot spraying up to the edge of water using aquatic formulations (herbicides licensed for direct application into water).

Buffers are one of the primary measures used to reduce potential herbicide to lakes and streams. Table 63 shows the acres of inventoried undesirable invasive plants and PAUs (projected expansion area) within 100 feet of fish bearing (Class I-II), perennial non-fish bearing (Class III), and intermittent (Class IV) lakes and GIS delineated wetlands. Studies by Clinnic (1985), Haupt & Kidd (1965), Heade (1990), and Reshin et al. (2006) found that 7-30 meter (23-98 foot) buffers were effective at removing sediment from timber harvest and Hook (2002) found a 94-99% sediment reduction in a 6 meter (20 foot) buffer regardless of vegetation type or slope in rangeland buffers. Sediment delivery to streams of herbicides bound to soil particles can be a major source of contamination and is indicative of overland flow which could directly delivery dissolved herbicide to the water body. De Snoo & De Wit (1998) found a 3 meter (10 foot) no spray cropped buffer decreased drift by 85-95% and a 6 meter (20 foot) buffer 100%. Desser (2008) observed that a 100 foot ground based buffer was conservative with Comerford et al. (1992) finding that a 15 meter (45 foot) buffer was an affective width for minimizing herbicide concentrations in streams from broadcast applications and that increased buffer widths produced diminishing returns. Therefore the values in Table 61 should depict the area of highest potential for delivery to streams and lakes. PDFs have been designed to minimize potential effects to water quality.

Herbicide-specific buffers were developed for this analysis based on risk assessment results regarding toxicity, persistence, and environmental fate (see Tables 15 and 16). Herbicides were grouped by characteristics such as mobility and potential affects to fish and other aquatic organisms based on R6 2005 FEIS SERA risk assessments and a review of those developed by other Forests and agencies. The less mobile, persistent, or potentially toxic to aquatic organisms, the closer to the stream that herbicide could be used and the more general the application method (broadcast spray to spot spray to hand application). Since Alternative 2 does not buffer seasonally intermittent streams when dry for clopyralid, imazapic, or metsulfuron methyl, there is a risk of elevated herbicide concentrations associated with runoff events soon after application of herbicides in intermittent and ephemeral streams that were dry at the time of herbicide application.

There is also a concern that road ditch lines that empty directly into a stream could function the same as an intermittent or ephemeral streams. Wood (2001) collected samples of several herbicides (including sulfometuron methyl and glyphosate) following roadside application. Rainfall of 0.3 inch/hr was simulated one, seven, and fourteen days after treatment. Wood detected concentrations of sulfometuron-methyl and glyphosate along road shoulders through the period. In the fall the road was again sprayed, and the ditch line of the road was checked during rainstorms for three months. Sulfometuron-methyl was detected along the shoulder in the ditch line, but was below detectable limits in the nearby stream. Glyphosate was not found at the shoulder, ditch line, or stream. Based on theoretical calculations, Wood concluded that application could conceivably generate 0.3 – 0.6 ppb of sulfometuron-methyl and 0.8 – 1.8 ppb of glyphosate in a study stream of a 0.3 inch/hr storm occurred within a day of application – a highly unlikely occurrence.

Application method can substantially reduce the risk and amount of herbicide available to enter water. Hand wicking eliminates the risk of drift and accidental overspray. Spot spray targets individual plants and reduces to risk of over spraying. Area spot spraying applies herbicide to a patch of invasive plants and then the spray is turned off. These more intensive application methods also reduce the risk of accidental direct application to live water or wetlands. In some cases where there is a high density of target species in a patch, area spot spraying can actually apply less herbicide to a given area than spot spraying because of the lower concentration of herbicide in the broadcast spray mix (less herbicide is needed because of more complete plant coverage). Broadcast spraying can treat large areas rapidly but presents a higher risk of herbicide entering water through vaporization and drift.

Wicks are designed to be dripless, however, it is possible that drip from some wicks or plants overhanging the water could occur during hand wicking applications to reed canarygrass or ribbongrass. The aquatic formulations of glyphosate and Imazapyr would be used for these applications (PDF 56). Sethoxydim is listed as the third choice for treating reed canarygrass and ribbongrass (Appendix B) but could not be used within 50 feet of water. The quantities entering a stream from drip would be undetectable and below any level that approaches a threshold.

Effects from drift, runoff and leaching considered in the herbicide risk assessments prepared for the R6 2005 FEIS assumed broadcast treatment occurred directly adjacent to streams. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to estimate the amount of herbicide that may potentially reach a reference stream via runoff, drift and leaching in a 96 hour period, assuming broadcast treatments on a 50-foot strip along about 1.6 miles of perennial stream. SERA risk assessments evaluated the hazards associated with each herbicide based on the concentrations of herbicide predicted by the GLEAMS model using these parameters.

Because broadcast spraying is not permitted under Alternative 2 any closer than 50 to 300 feet (depending on the herbicide) of perennial streams, GLEAMS likely overestimates the amount of herbicide concentrations that would plausibly enter streams from this project. Spot or hand treatments are inherently far less likely to deliver herbicide to water because the herbicide is applied to individual plants or small areas, so drift, runoff, and leaching are minimized.

The highest risk of getting herbicides in surface or ground water occurs within 100 feet of live streams, perennial lakes, reservoirs, and ponds, wetlands, and springs. The closer you get, the higher the risk. Table 16 in Chapter 2 of the Invasive Plant Treatments EIS shows what distance different application methods may be used for the herbicides proposed for use in this alternative. Some of these herbicides cannot be used up to the water or wetland. Within 10 feet of water, only wicking of authorized herbicides is proposed for non emergent vegetation with only the aquatic formulations of glyphosate, imazapyr, and triclopyr-TEA proposed for use between bankfull and the water surface. Table 15 indicates that the aquatic formulations of glyphosate and imazapyr may be spot sprayed in this buffer for emergent vegetation (reed canarygrass, ribbongrass, and yellow flag).

Herbicide prescriptions in Project Area Units (PAUs) are found in 6.0 percent of the total area within 100 feet of Class I-III streams and perennial lakes, reservoirs and ponds, and 3.7 percent of the total area within 100 feet of wetlands and springs. Currently inventoried invasive plant sites, which is greater than what would be treated in any year, are only found in 1.6 percent of the total area within 100 feet of Class I-III streams and perennial lakes, reservoirs and ponds, and 0.9 percent of the total area within 100 feet of wetlands and springs. Following Environmental Protection Agency (EPA) product labeling instructions and Project Design Features (PDFs) will minimize herbicide from getting into the water or limit delivery to a very small amount well within state standards. Only aquatic formulations of glyphosate and Imazapyr (labeled for in water use) would be used for spot spraying reed canarygrass and ribbon grass up to the waters edge, where there is a higher risk of accidental overspray and drift directly into the water.

To reduce the risk of multiple treatments in the same drainage cumulatively resulting in a herbicide concentration of concern for aquatic organisms or other beneficial uses a cap was placed on the amount of chemical treatment that could be accomplished adjacent to fish bearing (Class I-II) and perennial non-fish bearing (Class III) streams in any given year in a subwatershed. No more than 10 acres of actual treatment above bank full within the inner half of the Riparian Reserve or Riparian Habitat Conservation Area on Class I-III streams, lakes, and wetlands, would be accomplished in 6th field subwatershed and no more than 1 acre below bank full. Since GLEAMs analyzed 10 acres within 50 feet of water using broadcast spraying this should further reduce potential herbicide contamination, especially since there would not be any broadcast spraying within 50 feet of live water.

An 8 month post treatment study was accomplished of herbicide applications of picloram, triclopyr, imazapyr, and 2,4-D, in power line rights-of-way, in eastern New York (Environmental Consultants, Inc. 1991:III-43). Sites were selected with sandy or sandy loam soils to be the most likely to allow herbicide leaching. Buffer widths ranged from 10 to 100 feet. Samples were collected immediately downstream at 6 hour intervals until the streams froze and resumed with the spring thaw. Most of the samples collected did not have detectable levels of herbicide. Of those that did, samples containing detectable levels of imazapyr and picloram were collected shortly after application (indicating drift) or after the first significant rainfall event and one sample in the spring after autumn application. The highest concentrations of herbicide detected were 2 ppb for triclopyr, 1 ppb for picloram, and 6 ppb for imazapyr. Berg (2004) summarized the results of herbicide monitoring on the Eldorado National Forest in California. Herbicides, including glyphosate and triclopyr, were applied using 25 to 200 foot buffers. Samples were taken within the first 48 hours of application and after the first storm runoff event within 90 days of the application. Of 131 samples analyzed for glyphosate and 69 for triclopyr between 1992 and 2000, only 1 sample was above detection level. Triclopyr was detected following the first runoff event within 90 days of application. This was attributed to runoff picking up the chemical in an ephemeral stream reach which was dry, and was therefore not buffered, at the time of application. In other monitoring in Oregon, the Oregon Department of Forestry aerially applied glyphosate, clorothalonil, 2,4-D ester, triclopyr, clopyralid, hexazinone, and sulfometuron-methyl, adjacent to 26 streams in 1997 and 1999 using 60 foot no-herbicide buffers. The detection limit was 1 ppb (for all herbicides) on 21 sites and ranged from 0.04 to 0.5 ppb on the 5 remaining sites. No herbicide concentration was detected above 1 ppb.

Studies by Evens and Dusej (1973) and Johnsen and Warskow (1980) showed rapid dilution after herbicide entered the water. Evens and Dusej sprayed picloram at 1 to 2 lbs/ac (2.9 to 5.7 times the typical application rate). They took samples 5, 10, 100, and 1000 meters (16, 33, 328, & 3281 feet) below the treatment areas in a drainage ditch. A 1.5 inch rainstorm occurred within a week of the treatment. Picloram concentrations were diluted by 85 to 98 percent within 100 meters (328 feet) and were diluted to below detection levels at all but one site within 1000 meters (3281 feet). Within 12 weeks all concentration were at or below 0.001 ppm and within a year it was not detectable. Johnsen and Warskow injected 1.5 pounds of picloram directly into a 1.3 cfs stream in Arizona. The original 6.258 ppm solution was diluted to 96 percent by the time it reached 1600 meters (about a mile) downstream. Two days after the treatment, concentrations were near the point of detection at the 400 and 1600 meter (1312 and 5249 feet) below the treatment area. The original concentration was about 560 times the highest concentration predicted by the herbicide risk assessment completed by SERA for the R6 2005 FEIS.

On watershed scale monitoring for 13 herbicides (including glyphosate and triclopyr) in California, samples were taken on the Klamath, Trinity, and Scott Rivers, and Elk, Pine, and Supply Creeks partially in conjunction with runoff events (Jones et al. 2000a). 40,631 pounds of active ingredients of the above 13 herbicides plus 19 insecticides were applied upstream of the monitoring sites. Samples collected in dry weather in September 1998 served as background. Samples in October of 1998 and 1999 sampled storm runoff and Samples collected in June 1999 corresponded to the end of the heaviest pesticide application season. No detectable concentrations of any herbicides were identified (reliable detection limits ranged from 0.04 to 2.0 ppb). The lack of positive detections is probably attributable to chemical degradation, absorption to soil, dilution in streamflow between the application and monitoring sites.

A far more extensive compilation of monitoring results of primary broadcast application of herbicides along streams may be found in “Assessment of Herbicide Best Management Practices: Status of Our Knowledge of BMP Effectiveness” by Berg (2004). A detailed discussion about herbicide delivery and fate are contained in the herbicide risk assessments completed by SERA for the R6 2005 FEIS. This information is also summarized in the Invasive Plant EIS Appendix D – Herbicide Information and PDF Crosswalk.

Despite the presence of aquifers and recharge mechanisms within the planning area, the overall risk of groundwater contamination from herbicide applications proposed in this EIS is relatively low. Although the transport of rainfall and snowmelt to groundwater is documented in the higher elevation recharge areas of the upper Deschutes Basin, the risk of herbicide contamination of groundwater resources would be minimized due to PDFs and physical treatment limitations that would minimize the extent, timing, and rates of herbicide applications. The extent of herbicide applied annually within any 5th Field subwatershed would be limited by riparian PDFs, physical and funding limitations to the amount of treatment of existing infested acres that could occur each year, and restrictions of acres identified by EDRR that could be treated annually in addition to the existing acres of infested populations identified in the EIS. The combination of these PDFs have been shown to reduce potential concentrations of herbicide residues in surface waters to be below the LD_{50} for human health and aquatic fish (see Human Health and Aquatics effects sections), and are likely to do the same for groundwater.

The timing of herbicide applications proposed under this EIS would also minimize the potential for residue transport into groundwater resources. The highest groundwater recharge sites in the planning area are located along the Cascades at higher elevations where significant snow packs accumulate. Application would occur during the summer months after the snow pack has melted, effectively minimizing the solubilization and transport of applied residues by this mechanism. This time period would also allow enough time for residues to be absorbed by targeted invasive species or mineral and organic soil before the following season of snow pack begins to accumulate.

There is a risk of rainfall following application of herbicides on all sites proposed under this EIS. However, precipitation is the lowest during the summer season and generally very localized as thunderstorms. PDFs to restrict application when rain events are forecast would minimize the immediate solubilization and transport risk of applied residues in overland or infiltrated flows before they dried on plant and soil surfaces, or were absorbed by leaves and plant roots. As a result, the transport of residues to groundwater beneath these areas in concentrations high enough to exceed the LD_{50} for human health is very low.

Application PDFs included in the EIS also include limiting applications of mobile herbicides on soils with seasonally high water tables or coarse textured soils that can transport infiltrated water directly to groundwater. Water tables in the LaPine basin and along the Upper Deschutes are relatively shallow and at greater risk for accumulating excess residues translocated through the soil profile. However, PDFs minimizing overall application rates to below label requirements and reduced application rates in subwatersheds containing T&E fish species minimize the risk of residues in excess of plant uptake and soil adsorption rates from being solubilized and transported to groundwater. Adsorption of herbicide residues on mineral and organic sites in the soil, as well as absorption of residues by targeted invasive species is likely to reduce the amount of residues capable of annually being transported to groundwater well below these amounts calculated for surface waters in the EIS.

Based on:

- using herbicides in accordance with label instructions and R6 standards (PDF 9 & 10) to limit adverse affects to aquatic organisms, fish, wildlife and human health
- selecting spray techniques, using lowest effective application rates, and calibrating equipment (PDF 12, 13 & 22) to assure herbicide use stays below thresholds of concern,
- broadcast and spot spraying of herbicides at between 2 and 8 mph using low nozzle pressure, and using a nozzle designed to not produce a fine droplet spray (PDF 15 & 16) to reduce drift,
- not applying herbicide when raining or when rain is expected within 24 hours (PDF 17) to reduce the risk of runoff and percolation,
- the use of site specific soils characteristics for determining appropriate herbicide (PDF 43, 45, 47, & 48) to minimize leaching and percolation into the ground water and interflow,
- not using POEA and NPE surfactants within 100 feet of surface water, wetlands or road ditch lines feeding directly into streams (PDF 44) to reduce the risk of runoff or percolation,
- limiting applications of picloram and sulfometuron methyl to once a year (PDF 46) to reduce potential accumulation in the soil and reduce the risk of runoff or percolation,
- placing a cap on herbicide applications adjacent to streams, lakes and wetlands (treatment caps under implementation planning, section 2.3.4) to assure herbicide use stays below thresholds of concern,
- herbicide storage, mixing, and post-application equipment cleaning more than 300 feet from live water and domestic wells and spring boxes (PDF 52) to reduce the risk of spills and higher chemical concentrations from contaminating water,
- using selected buffers widths and application methods in Table 15 (PDF 56) to reduce potential herbicide delivery into surface water and wetlands in concentrations of concern,

potential herbicide delivery to surface and groundwater should be substantially reduced to near or below detection levels for non emergent vegetation. This is supported by monitoring studies (shown above), which indicate delivery to streams should be very small to below detection limits, herbicides that do reach streams would rapidly dilute and delivery from multiple treatments in multiple subwatersheds in the same watershed would not result in an ever-increasing concentrations. There is a higher risk of measurable levels of the aquatic formulations of imazapyr and glyphosate when spot sprayed for treating reed canarygrass, ribbon grass, and yellow iris from drift and accidental overspray because they can be spot sprayed up to the edge of the water for emergent vegetation (see Table 16). In addition imazapyr and glyphosate are very highly soluble (Appendix D Water Solubility Chart). Since emergent vegetation has a shallow water table, there is a potential for herbicide to enter the stream or water body in ground water. Even though the aquatic formulation of imazapyr and glyphosate are licensed for direct application to water, this project proposes **no** direct application to water. Where the target invasive plants are near water, PDFs, such as using the lowest effective rates (PDF 12), not applying herbicides when raining or when rain is expected in 24 hours (PDF 17), buffering when spot spraying (PDF 54), would reduce delivery to lower than that projected by the GLEAMs risk analysis in the R6 Invasive Plant EIS.

It is reasonable to assume, based on BMP effectiveness and the analysis in the Fisheries/Aquatics, Terrestrial Wildlife Species of local Interest and the Human Health – Worker and Public Exposure to Herbicides in Chapter 3 of the Invasive Plants EIS, that herbicide levels in surface and groundwater would be below the level of concern and meet state water quality standards.

Potable Water

There are two surface water sources, 14 springs, and 78 wells used for domestic purposes identified on or immediately adjacent to the Crooked River National Grassland, Deschutes National Forest, and the Ochoco National Forest.

There is currently no State restriction in effect for the use of herbicides within a specified distance of public water wells. To address concerns with wells and springs, a calculated Wellhead Protection Area (WPA) was developed for a hypothetical well with an annual use of approximately half a million gallons using the Calculated Fixed Radius model in the Washington State "Wellhead Protection Program Guidance Document" (Washington DOH, 1995) using the equation:

$r = (Qt/\pi nH)^{**}0.5$

in which r is the radius in feet;
Q is the pumping rate of the well (ft^3/yr);
n is the aquifer porosity (0.22 default if unknown);
H is the open interval or length of well screen (10 ft. default if unknown or open interval at base);
t is the travel to the well in years.

A half million gallons annual use results in a 98 foot one year travel time (zone 1), 220 foot 5 year travel time (zone 2), and a 310 foot 10 year travel time (zone 3). The Washington guidance document indicates that proper management of zone 1 can protect the drinking water supply from viral, microbial, and direct chemical contamination. The zone 1 buffer would also function as a sanitary control to prevent surface flows from reaching the wellhead and traveling down the casing. In Zone 2, potential contamination sources should be identified and controlled with an emphasis on prevention and risk reduction. Zone 3 determines the boundary of the wellhead protection area. Within this zone, high risk operations and facilities should be identified and steps taken to reduce contaminant loading. Mixing, cleaning and chemical storage were determined to be high risk operations and would be restricted in Zones 1 through 3 (see PDF 52). Larger, moderate, and many smaller wells in the project area are properly constructed and sealed and have one or more impermeable layers overlying a confined aquifer and are less susceptible to contamination with little interaction with the upper unconfined aquifer. Drinking Water Source Areas (DWSAs) for moderate to large wells, delineated by the Water Quality Division of the Oregon Department of Environmental Quality, were also evaluated. Inventoried invasive plant sites and project area units within calculated fixed radius zone 1 and 2 wellhead protection and those within DEQ delineated 1-2 year drinking water source areas are shown in Table 62. WPAs shown in Table 62 include those calculated for wells that also have state delineated SWSAs.

A review of identified potable water sources in the project area was accomplished. The acres of Project Area Units (PAUs) within 200 feet of wells or springs and delineated 1-2 year DWSAs overlain by PAUs are shown in Table 62. Water sources not delineated were visually verified and 0.4 acres was added to the area within the wellhead protection area. The Drinking Water Source Areas in the table were estimated by the Oregon Water Resources Department for medium and larger public systems. Well logs indicate that the medium to larger wells went through confining layers, however it is not known how interconnected they are with the surface aquifers. Not all potable water sources have delineated source areas and smaller ones probably never will be delineated by the State.

Herbicides proposed for use in this alternative on the two Forests and the Crooked River National Grassland are chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, triclopyr, and nonylphenol polyethoxylate surfactant (NPE).

Table 62. Acres of PAUs within 200 feet of wells or springs and delineated 1-2 year DWSAs overlain by PAUs.

Sub-Basin	Wellhead Protection Areas		Drinkable Water Source Area	
	# of PAUs	Acres	# of PAUs	Acres
Upr. John Day River	0	0	0	0
Lwr. John Day River	0	0	1	1.3
Upr. Deschutes	15	45.6	28	1794.2
Little Deschutes R.	4	2.4	0	0
SFk Crooked River	1	3.7	1	17.4
Upr. Crooked River	2	0.8	0	0
Lower Crooked River	3	10.3	3	737.0
Lwr. Deschutes R.	2	0.8	0	0
Trout Creek	1	0.4	0	0
Summer Lake	1	0.8	0	0
Williamson	0	0	0	0
Total**	27	64.7	33	2549.9

* The source area for each well or diversion is counted so the contributing area from a PAU may be counted more than once.
** A Project Area Unit may be in more than 1 Sub-basin

In addition to PDFs to protect general in stream water quality, Alternative 2 includes PDFs to protect water in Municipal Watersheds by requiring coordination with the managing agency or association on all treatments in the watershed other than biological or manual. Herbicide applications may include spot spraying individual plants, stem injection, or dabbing (wicking). Broadcast spraying could not be used without the agreement of the entity managing the watershed. There are no emergent species of concern (Reed canarygrass, ribbon grass, or yellow iris) inventoried in any of the municipal watersheds, so the closest spot spraying to live water would be at least 10 feet. Herbicides would not be applied within 100 feet of the water intake or within 100 feet of the stream for the first 600 feet above the intake. The 600 foot long 100 foot no chemical treatment buffer was derived from Evens and Duseja (1973) finding that picloram concentrations were diluted 85 to 98 percent 100 meters (328 feet) below treatment areas. Drinking water from wells and spring boxes would be protected using the Wellhead Protection Area (WPA) concept. Project Design Features (PDFs) were included in this alternative to preclude the use of all herbicides within WPA Zone 1 (100 feet) of domestic wells, broadcast spraying and the use of picloram and clopyralid within Zone 2 (100-200 feet) of wells and all herbicides within WPA Zone 1 & 2 (200 feet) of domestic spring boxes. High risk operations (mixing, cleaning and chemical storage) would be restricted in Zones 1 through 3 (0-300 feet). Herbicides could not be used within 1/4 mile of campgrounds, guard stations, and special use cabins with unknown well or spring box locations until the diversion point is located and a WPA delineated. To further protect ground water, PDFs were developed restricting the use of clopyralid, metsulfuron, chlorsulfuron, picloram, and sulfometuron methyl, within areas based on soils (PDFs 45, 47 & 48), to avoid excessive runoff or leaching (percolation).

Both picloram and chlorsulfuron have a very high solubility rate and mobility in the soil, however the herbicide crosswalk in Appendix D of the Invasive Plant EIS indicates chlorsulfuron has very low application rates so has little potential to enter ground water. While clopyralid is only highly soluble, it is has a very high soil mobility rate. Hexachlorobenzene (HCB) is found as a contaminant of picloram and clopyralid, as byproducts of manufacture. HCB is a persistent carcinogen and it bio-accumulates. Use of these chemicals in areas with highly permeable soils or with shallow water tables can result in groundwater contamination. In addition to solubility, picloram is more than twice as persistent as clopyralid and is therefore more of a concern. Wood and Anthony (1997) found picloram in 7% of natural springs draining small surficial aquifers in southern Saskatchewan. However the levels detected were in the parts per trillion (ppt) range. Pang and others (2000) found increases in picloram following irrigation and rainfall events 71-174 feet down gradient from 15 meter square plots (approx. 50 feet square) still 2 years following the application of the herbicide at 22 kg/ha (19.6 lb/ac) active ingredient. This application rate is about 62.9 times the typical application rate of 0.35 lb ai/ac shown in Table 12. Neary and others (1985) found picloram residues in two springs approximately 460 feet below two 5 acre test plots 82 days after initially being treated with picloram at 4.4 pounds to the acre. Picloram residues were found only at trace amounts for 18 days during the 40 weeks the springs were monitored. The application rate of 4.46 lb/ac acid equivalent in pellet formulation is about 12.7 times the typical application rate of 0.35 lb ai/ac shown in Table 12 of the Invasive Plants EIS. The study concluded, "In terms of water quality impacts, there was no adverse effect on water quality of the springs."

There are chemical treatments proposed in the Sisters municipal watershed (PAU 15-22) in both Alternative 2 and 3. Picloram is listed as the second choice on the Common Control Measures (Appendix B) for Canada thistle in the Project Area Units within the Drinking Water Source Area (DWSA). The town of Sisters currently uses groundwater from wells for domestic use. The municipal watershed is an emergency backup and has not been used for drinking water for several years. There are no chemical treatments proposed in either the Bend or Sisters Municipal Watersheds. However, there is a proposed treatment on Bridge Creek along the 2630 Road for knapweed and houndstongue (PAU 71-23). During irrigation season water from Bridge Creek is diverted through the Mitchell Municipal Watershed. The 2630 Road crossing on Bridge Creek is over 2 miles from the Mitchell Municipal Watershed and any herbicide that did get into Bridge Creek would be below detection levels by the time the irrigation ditch crossed the state delineated DWSA (Evens & Dusej (1973), Johnsen & Warskow (1980)). As indicated earlier, no herbicides would be applied within 100 feet of the diversion or within 100 feet of the stream for 600 feet upstream from the diversion. Upstream from this, minimum buffer widths shown in Table 16 would be used, and as directed in PDF 27, chemical treatments would be coordinated with the municipal department in charge of the water system.

Only five of the 27 Project Area Units (PAUs) that intersected Wellhead Protection Areas (WPAs) and two of the 33 PAUs that crossed Drinking Water Source Areas (DWSAs) delineated by the state did not have picloram as the first or second choice chemical for at least one of the target species. Of special concern are surface water sources, springs, special use cabin areas, and shallow wells with unsealed casings. To address this concern with groundwater contamination and HCB, picloram and clopyralid would not be used within 200 feet of wellheads/spring boxes (zone 1 & 2 of the calculated wellhead protection area). Further, Project Design Feature #29, which directs that no herbicide will be applied within 100 feet of a domestic well, picloram or clopyralid will not be used within 200 feet of a domestic well, no herbicide will be applied within 200 feet of a domestic spring box, and no broadcast application will occur within 200 feet of a domestic well or spring box, would reduce the potential delivery of picloram, clopyralid, and other herbicides into potable groundwater sources. Based on minimal interaction with confined aquifers, pre-project planning, delineation of wellhead protection areas, the use of the lowest effective label rates, PDFs to protect soils, water quality, fisheries and aquatic organisms, and the intensity of treatment, it was determined that specific PDFs were not needed to protect state (DEQ) delineated groundwater Drinking Water Source Areas (DWSAs). DEQ delineated sensitive areas within surface DWSAs will be evaluated during coordination with the municipal department in charge of the water system under PDF 27.

None of the herbicides proposed for use in Alternative 2 are on the State Water Quality Criteria Summary Tables 33A-C (criterion not to be exceeded in waters of the State in order to protect aquatic life and human health). Hexachlorobenzene (HCB) is found as a contaminant in picloram and clopyralid and is listed on Table 33A, EPA Number 88. HCB is a persistent carcinogen and it bio-accumulates. A review of well tests on public water systems in the watersheds being treated did not find any HCB. The footnote below Table 33C states, that while not having designated values, a review of scientific literature may be appropriate to derive guidance values for other chemicals with toxic effects. Since none of the herbicides proposed for use in Alternative 2 are in Summary Tables 33A-C, the protocol in the footnote was followed, using the Risk Assessments and Appendix Q of the Region 6 2005 EIS, to verify proposed treatments were meeting state water quality standards.

The R6 2005 FEIS Appendix Q considers plausible direct, acute, and chronic exposures to any herbicides proposed for this project. Risks from two hypothetical acute contamination scenarios to drinking water sources were evaluated: runoff or leaching from an adjacent application into a stream and a 200 gallon spill into a ¼ acre pond. Both of these scenarios evaluated much higher levels of contamination than proposed treatments in wellhead protection areas would produce. The scenario with a person drinking water directly from the pond shortly after the 200 gallon spill into the pond produced results that were of concern. A spill is a random event and is not a direct or indirect affect of proposed treatments. Contamination from spills into drinking water would be mitigated by Project Design Features (PDF 19 & 20) that require a Transportation and Handling Plan which would have spill prevention and remediation measures. For an adult drinking from a pond contaminated by leaching from and adjacent treated area over a lifetime, non of the estimated exposures, for any of the application rates (see Table 12), for any of the herbicides, NPE, or the impurity HCB was above the level of concern. In addition, the cancer risk from HCB in picloram or clopyralid would be at least 5 orders of magnitude less than the risk standard of 1 chance in 1 million for all chronic contamination drinking water scenarios. A more detailed discussion of human health and public exposure to herbicides can be found in Chapter 3.8.

There is also a risk of residue from previous Forest Service treatments. Based on the project assumption that a single chemical treatment will remove about 80 percent of the target species, that different species within the same Project Area Unit may be treated at different times during the year, and that it may take up to 5 years to reduce the target species down to a level where it can be controlled manually, there is a risk there will still be residue from previous applications. However based on the half life of the proposed chemicals being used, PDFs restricting those with longer half lives to only one application in a calendar year, the time between treatments, intensity of treatments, and typical herbicide application rates, concentrations will be extremely small to not detectable.

Based on:

- Not applying any herbicides within 100 feet (WPA Zone 1) and limiting chemicals and application within 200 feet (WPA Zone 2) of domestic wells and not applying any herbicides within 200 feet (WPA Zone 2) of spring boxes (PDF 29) to minimize potential contamination of potable water sources,
- Not applying herbicides within ¼ mile of known use areas with unknown well or spring box locations until WPAs are delineated (PDF 29.1) to prevent overspray,
- using herbicides in accordance with label instructions and R6 standards (PDF 9 & 10) to limit adverse affects to people,
- selecting spray techniques and application rates minimizing application rates (PDF 12 & 13) to assure herbicide use stays below thresholds of concern,
- not applying herbicide when raining or when rain is expected within 24 hours (PDF 17) to reduce the risk of runoff and percolation,
- the use of site specific soils characteristics for determining appropriate herbicide (PDF 45, 47, & 48) to minimize leaching and percolation into the ground water and interflow,
- the notification of special use permit holders to mark spring box and wellheads (PDF 30) to reduce the risk of over spaying a diversion point,
- coordination with the municipal department in charge of the water system in municipal watersheds (PDF 27) to identify sensitive areas and maintain a sense of cooperation,

- not apply herbicides within 100 feet of a municipal surface water diversion or within 100 feet of the stream for 600 feet upstream from the diversion (PDF 28) to reduce potential chemical delivery from drift, runoff, and sediment delivery, and foster downstream mixing and dilution,
- herbicide storage, mixing, and post-application equipment cleaning more than 300 feet from live water and domestic wells and spring boxes (PDF 52) to reduce the risk of spills and higher chemical concentrations from contaminating drinking water,

potential herbicide delivery to surface and groundwater potable water sources should be substantially reduced below those analyzed in Appendix Q of the Region 6 2005 EIS and would be sufficient to protect groundwater recharge areas.

Alternative 2 would meet State Water Quality Standards for toxic substances.

Cumulative Effects

Water Temperature

Overall, no measurable increases in water temperature are expected to occur as a result of the invasive plant treatments proposed; however in the Upper Trout Creek Subwatershed (Wychus Creek Watershed), there is a low to moderate risk of a small increase in water temperature in surface waters in Trout Creek Swamp due to the restoration of shorter native vegetation (including a sensitive species) after removing Reed canarygrass. The water temperature increase would not be measurable when the surface and subsurface flows re-combined in Trout Creek below the swamp. Trout Creek is not listed as being over threshold on the 2004/2006 303(d) list.

Past logging and roading have reduced shading in the planning area. This has been offset in some drainages by increased shading from dense overstocked stands of conifers. Pre Northwest Forest Plan timber sales that are still limiting shade would continue to recover. The objective in Trout Creek Swamp is to restore native vegetation and maintain it over time. Any cumulative increase in water temperature would be small, within DEQ water quality standards, and would meet Aquatic Conservation Strategy objectives.

Connected and reasonably foreseeable activities will occur in the subwatershed: Black Crater Roadside Salvage (sold) and Black Crater Salvage (no harvest proposed in Riparian Reserves). Black Crater Roadside Salvage would remove fire killed trees that posed a threat to public safety. Where these are within approximately 100 feet of a perennial stream, there may be a reduction in shading, since the trees are dead, shading would be less that that from live vegetation and there is a high probability of the trees falling down over the life of this document and only providing shade if they fell into the creek. Since Black Crater Salvage would not harvest trees in the Riparian Reserve, there would not be any affect to shade or water temperature.

Project Design Features are in place to protect water quality, revegetation and restoration of treated sites will take place where necessary, and the areas to be treated are small in relation to stream or waterbody size. Improvement in growth of native vegetation may occur in areas where riparian invasive plants are treated on non-National Forest System lands, thereby providing additional improvements to streamside vegetation.

Sediment and Turbidity

Overall, no measurable increases in sediment or turbidity is expected to occur as a result of the invasive plant treatments proposed; however in the Dry Paulina Creek Subwatershed, there is a risk of a small localized increase in sediment due to mechanical treatments associated with the reestablishment of desired vegetation after chemically treating houndstongue. Sediment delivery from harrowing in PAUs 72-15 and 72-37 would not contribute substantially to the existing sediment levels because a 50 foot buffer will be maintained alongside the stream channels, only a small area will be scarified, and active revegetation will take place to return grasses and forbs to the site. Sediment delivery from harrowing in PAUs 72-15 and 72-37 should return to pre treatment levels within a year of disturbance and fall below current levels within five based as grasses and forbs become established on the old landings.

Roads and livestock are the two primary management activities currently resulting in surface sediment levels above background in the subwatershed, even though the open road density in the watershed is 1.76 mi/sq mi. (far below the 3 mi/sq mi guideline in the Forest Plan). The roads are over 10 years old and based on the soils in the subwatershed should have erosion rates around a tenth of that from a new road. The Dry Paulina Subwatershed is in the West Pasture of the Roba Allotment. Livestock are probably the second largest non-background contributor of sediment in the planning area. Surface erosion can result from trampling and trailing but the primary affect is to channel condition. Channel condition can be affected by hoof action (i.e. trampling, hoof shear, post holing) and the reduction and vigor of palatable woody streamside vegetation. It is not possible to quantify livestock generated sediment because of the dispersed character of the impacts, problems with distinguishing between cattle and wildlife impacts, inability to attribute or portion channel affects specifically to livestock, and inability to separate long term affects from past management or events from current management. A new Allotment Management Plan was implemented in 2007, reducing use to 236 cow/calf pairs from 6/1 to 6/30. Management standards are more stringent than in the Forest Plan. The permittee is required to provide at least one rider throughout the grazing season to maintain proper distribution and keep cattle moving away from riparian areas. It is reasonable to assume that there will be an improvement in riparian condition and a decrease in sediment load do to the new management direction.

No connected and reasonably foreseeable activities were identified in the Dry Paulina Subwatershed.

pH/DO/Chlorophyll a

Overall, no measurable increases in pH or chlorophyll a or decrease in Dissolved Oxygen (DO) are expected to occur as a result of the invasive plant treatments proposed; however during algae blooms, there is a low to moderate risk of spot spray applications of glyphosate for emergent vegetation on pond, lakes and reservoirs, stimulating algal growth which would affect pH, DO, and chlorophyll a. Proposed treatments of emergent vegetation (reed canarygrass) on water bodies with identified algal bloom problems are: Lava Lake (PAU 11-39), Crane Prairie Reservoir (PAU 11-53 & 11-56), Wickiup Reservoir (PAU 11-24), and Paulina Lake (PAU 11-39). All of these water bodies have had Oregon Department of Human Services (ODHS) public health advisories for algal blooms. Lava Lake is also on the state 303(d) list for DO.

The high algae concentrations are primarily the result of nutrient input from the breakdown of local geology but has been supplemented by inputs from special use cabins on Paulina Lake and heavy designated and dispersed recreation. Designated campgrounds include Lava Lake, Quinn River, Rock Creek, Crane Prairie, Cow Meadow, Seep Bridge, Gull Point, North Wickiup, Wickiup Butte, Round Swamp, Reservoir, Paulina Lake, Newberry, and Little Crater.

Because there is a low to moderate risk of spot spray applications of glyphosate for emergent vegetation on pond, lakes and reservoirs, stimulating algal growth, there could be a cumulative increase in nutrients and carbon which could increase the size of an algal bloom or increase the length of time a water body was on a ODHS Public Health Advisory for toxic algal blooms. Algal growth stimulation from low concentrations of glyphosate would last less than four days and would be confined to small areas close to treatments. But because there will be no direct application of glyphosate to water, and PDFs to control drift and runoff are in place, the risk is very low.

Herbicides

Most of the National Forest System lands being analyzed for this EIS are in headwater areas (upstream of other sources of herbicides). There is some herbicide use in inholdings, but most use is downstream of the National Forests on private lands. The exception to this is within Rimrock Springs and Lower Whychus Creek subwatersheds on the Crooked River National Grassland, where there is a large area of agricultural land *upstream* of the Grassland boundary. There are approximately 180 acres of invasive plant control proposed within the aquatic influence zone (AIZ) in the Rimrock Springs 6th watershed; and 120 acres in the AIZ within the Lower Wychus Creek 6th field watershed.

Because there is agricultural use, and therefore probably herbicide use upstream of National Forest System lands within these two watersheds, the potential for accumulation downstream would be based on the potential for herbicide from agricultural use to reach the water in a measurable amount to where the Forest Service proposes treatment and then for there to be a measurable amount from Forest Service treatments, so the two sources could combine. Several conditions make this highly unlikely. First, herbicide use on agricultural lands would have to reach the stream in sufficient quantity to not be diluted downstream. Research by Evens and Duseja (1973) however, found picloram concentrations diluted 85 to 98 percent 100 meters (328 feet) below treatments areas, and below detection levels at 1000 meters (3281 feet) following a 1.5 inch rainstorm within the first week of spraying at a rate of 1 and 2 lb/ac (3 to 6 times typical application rate) on test plots ranging from 1 to 2 acres. GIS remote sensing data indicates that most of the agricultural land is more than one mile above the Grassland boundary.

Second, this project's protective measures make it very unlikely that herbicide would reach streams in concentrations of concern. These protective measures are the PDFs that limit application rate, limit application method near water, and the restrictions on the type of herbicide that can be used near water. Any herbicide reaching the stream would be quickly diluted. As the herbicide moved downstream it would become less and less likely to cause impacts. In the case of aquatic glyphosate, the herbicide most prescribed for streamside treatments, would become biologically inactive upon contact with organic matter in the stream or stream bank. Even though there are relatively large amounts of invasive plant treatment proposed in these two watersheds, the treatment caps limit the amount of area treated with herbicide within the aquatic influence zone to 10 acres per year per 1.5 mile of stream. Additionally, the water ends up shortly downstream in Lake Billy Chinook. The large size of Lake Billy Chinook would dilute any herbicides should it reach there. At the watershed scale, the amount of herbicide potentially reaching a common downstream point would not be detectable.

The other way for accumulation to occur with private land uses, is for herbicide from this project to move downstream to mix with residues from applications on Non-Forest System lands. To demonstrate the likelihood of herbicide moving downstream and mixing with herbicide residue originating from lands outside the Forest, we consider the Headwaters Metolius River 6th field watershed in the Upper Deschutes Subbasin (the subbasin with the most invasive plant treatment and herbicide use within the aquatic influence zone, Table 57). Because of the relatively large number of acres within the AIZ, the presence of the Metolius River, and Non-FS lands just downstream that shares the Metolius River, this could be considered a worse-case scenario for considering cumulative effects of herbicides in water. Approximately 139 acres of herbicide treatment are proposed within the AIZ. This amounts to about 0.8% of the subwatershed acres.

The Metolius leaves the Headwater's 6th field subwatershed and flows downstream where there is tribal land of the Warm Springs Reservation. The Confederated Tribes of the Warm Springs released a Vegetation Management Noxious Weed Control Plan and Assessment (2005) that proposes manual, mechanical, biological, prescribed burning, and herbicide treatments. Estimated amount of herbicide use and acres of invasive plant treatments on the tribal lands are not available, but the potential for accumulating with herbicide originating on National Forest System lands is very low. The Metolius is a large-flowing waterbody with makes mixing and dilution even more effective. At the watershed scale, the amount of herbicide potentially reaching a common downstream point would not be detectable. Thus, no contribution to cumulative effects from herbicide delivery to streams is possible.

As described in the Water Chemistry direct and indirect effects section above, expected mixing and dilution of any trace amount of herbicide that may result from invasive plant treatment would occur quickly, making it highly unlikely that herbicide concentrations would be additive or synergistic with similar treatments at the watershed scale.

As described in Section 4.1.1 of the R6 Invasive Plant FEIS (USFS 2005a), and at the beginning of Chapter 3, the effects of herbicide mixtures could be additive or synergistic in nature. Exposure to mixtures of pesticides is more likely to be additive than synergistic. However, they may also be antagonistic and have less effect. The Regional EIS concluded that based on the limited available data and chemicals considered in this EIS, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis and any synergistic or additive effects are expected to be insignificant. Based on the water concentration analysis in the Fisheries section, and taking into account dilution and mixing as it moves downstream, the concentration of herbicide should be so small that it would be highly unlikely to create an additive or synergistic effect.

Additive doses are possible if herbicide was used on neighboring lands during the same day as planned on National Forests. A PDF addresses the coordination so that treatments are coordinated with other landowners. The timing of applications to not overlap (applications not occurring at the same time) reduces the risk even further, since any herbicide that does get into the water will have more time to dilute and degrade before mixing with another contaminant. The State of California conducted monitoring on surface water where 40,631 pounds of active ingredient of 13 herbicides and 19 insecticides were applied within the privately-owned watersheds upstream of sampled locations. No detectable concentrations of any herbicides were identified (reliable detection limits ranged from 0.04 to 2.0 ppb). The analysis included glyphosate and triclopyr. The results could have been affected by several months passing between dry weather application and the first rain, potentially allowing chemical degradation or adsorption to soil; or dilution of streamflow between application and monitoring sites may have contributed to the lack of positive detections (Jones et. al., 2000).

Accumulation of residue from repeated treatments is not a concern. Given the half life of the herbicides being used, PDFs restricting those with longer half lives to only one application in a calendar year, buffers and application methods limiting the risk of herbicides reaching water, and the time between treatments, measurable concentrations would be very unlikely.

Placement of instream wood for improving fish habitat in the Metolius River is planned for the near future. Without effective treatment of ribbongrass along the Metolius, the wood could become colonized with ribbongrass. If private landowners also treat invasive species such as ribbongrass and yellow flag iris along the Metolius, the treatments proposed on National Forest System lands will have a better chance of being effective and not becoming re-infested from other property. Private landowners may use a variety of techniques to control ribbongrass, such as solarization, herbicide application, seed head clipping, and hand pulling/digging. Coordination with the Forest Service on timing of treatments could limit the possibility of impacts from National Forest System lands to accumulate with the effects of treatment on private property.

Monitoring

Ten percent of small domestic wells and springs (campgrounds and special use cabins) within 500 feet of chemical applications should be monitored after treatments for the first one to three years, to verify delineated Wellhead Protection Areas are affective with an emphases on springs and picloram.

Alternative 3

Alternative 3 was developed to address issues and concerns related to fisheries and other aquatic organisms but would also reduce potential herbicide entering streams in municipal watersheds and address potable groundwater concerns. The Project Area Units are the same as those in Alternative 2. The buffers on all fish bearing streams, all perennial non-fish bearing streams, and all perennial lakes, ponds, and reservoirs were expanded to 300 feet. Within this buffer, the following changes were made:

1) Triclopyr-BEE, non-aquatic glyphosate, picloram, and sethoxydim would not be used.

2) Broadcast spraying would not be permitted.

3) No mechanical treatments (ripping, scarifying, disking, etc.) would be allowed within 300 feet of all water sources or on road segments that are within 300 feet of perennial waterbodies.

4) There would be no chemical applications within 10 feet of fish bearing streams, non-fish bearing perennial streams, or perennial lakes, ponds, and reservoirs.

5) In addition, intermittent streams would have no chemical application within 10 feet of the channel when flowing. When dry, there would be no chemical application within the defined channel of intermittent streams.

6) Table 16 “Minimum Buffers (ft) for Herbicide Application used in Alternative 3” in Chapter 2.4 shows how close to water an application method may be used for each proposed herbicide for this alternative.

Direct and Indirect Effects

The effects of invasive plant treatments to water quality would be similar to those for non emergent vegetation in Alternative 2 except potential delivery of herbicides to streams, lakes, wetlands and groundwater would be substantially reduced due to limiting the use of certain herbicides, not allowing broadcast spraying, not allowing herbicide application within 10 feet of streams, and applying buffers to intermittent streams. Where triclopyr, picloram, or sethoxydim are the first choice herbicide within 300 feet of water, the treatment would move to the second choice or to non-herbicide methods. Scotch broom in this buffer would need to be treated manually.

Due to restrictions on the use of herbicides within 10 feet of fish bearing streams, non-fish bearing perennial streams, or perennial lakes, ponds, and reservoirs, invasive non-native vegetation (e.g. reed canarygrass and ribbongrass) could not be treated by hand application or spot spraying of herbicide so would be treated with non-herbicide methods such as hand pulling and digging or solarization. This could increase the risk of causing sedimentation when the invasive plants are removed by hand pulling and/or digging. Due to the rhizomatous nature of reed canarygrass and ribbon grass, it would not be effective to dig or pull it out of the bank so most manual treatments would involve pulling plants off Large Woody Debris (LWD) and loose depositional areas in the channel. It could also mean that some sites would not be treated because manual treatment would not be affective and would be infeasible.

Effects to potable water from wells and springs would be similar to those in Alternative 2. PDFs for municipal watersheds and other drinking water sources would still apply if more stringent. The more stringent application design features in Alternative 3 would reduce potential herbicide delivery to the waters in Municipal Watersheds and it is reasonable to assume additional BMPs will be developed during coordination with the managing agency or association for the two surface water municipal systems. This would especially be true in the Sisters backup water system due to potential delivery from the extensive road and ATV trail systems.

The total amount of herbicide applied would be reduced due to changes in application method and restricting herbicide applications to outside the defined channel of dry intermittent streams or within 10 feet of fish bearing streams, non-fish bearing perennial streams, flowing intermittent streams or perennial lakes, ponds, and reservoirs.

This alternative reduces the area within 100 feet of Class I-III streams and perennial lakes, reservoirs, ponds, wetlands and springs that can be treated with herbicide by about 10 percent from Alternative 2. Herbicide application to currently inventoried invasive plant sites within 100 feet of perennial streams, springs and lakes would be reduced by 32 percent. These restrictions, in addition to following Environmental Protection Agency (EPA) product labeling instructions and Project Design Features (PDFs) will prevent herbicide from getting into the water or limiting it to a very small amount within state standards.

Specific differences in direct and indirect affects from Alternative 2 include:

- Sediment and Turbidity – the restriction on mechanical treatments within 300 feet of perennial streams would preclude the scarification of the old, houndstongue infested, landings adjacent to Dry Paulina and Dipping Vat Creeks (PAU 72-15 & PAU 72-37) reducing ground disturbance by up to 13 acres and reducing potential sediment delivery in the Dry Paulina Subwatershed.
- Water Temperature – the restriction on herbicide application within 10 feet of perennial streams and water bodies would preclude the chemical treatment of emergent vegetation (reed canarygrass and ribbon grass) close to the edge of water, thereby reducing potential shade reduction on the 303(d) listed Deschutes River (PAU 11-80) and Metolius River (PAU 15-32), other streams and water bodies, and alleviating potential water temperature increases in surface channels in Trout Creek Swamp (PAU 15-22). In the long term (decades) invasive riparian species such as ribbongrass and reed canarygrass may reduce shade because their encroachment may inhibit the reestablishment of riparian deciduous shrubs as they die of old age.
- pH/DO/Chlorophyll a - the restriction on chemical applications within 10 feet of perennial streams and water bodies would preclude the spot spraying of herbicides on emergent vegetation (reed canarygrass and ribbon grass) within 7 feet of water, thereby preventing drift and accidental overspray of aquatic formulations of glyphosate and imazapyr directly into the water and substantially reducing the potential movement into the water body through shallow groundwater. Keeping glyphosate concentrations below 2µ/l would prevent the stimulation of algal growth in water bodies with identified algal bloom problems (Lava Lake, Crane Prairie Reservoir, Wickiup Reservoir, and Paulina Lake).
- Chemical – the restriction on chemical applications within 10 feet of perennial streams and water bodies, and intermittent streams when flowing, and not within the defined channel of intermittent streams would reduce the risk of elevated herbicide concentrations associated with runoff events soon after application of herbicides adjacent to live streams and in intermittent streams that were dry at the time of herbicide application (Berg, 2004). This would also prevent drift and accidental overspray of aquatic formulations of glyphosate and imazapyr directly into live water and substantially reducing the potential movement into the water body through shallow groundwater from spot spraying for emergent vegetation up to the edge of water.
- Potable Water – precluding the use of picloram in Alternative 3 would assure that this chemical would not contaminate wells, irrigation ditches, or any body of water used for irrigation or domestic purposes (see Appendix D).

Where effective treatment can be implemented, it will help maintain or improve native plant species diversity and productivity within riparian areas. By treating new infestations while they are small, the early detection-rapid response strategy will help prevent newly discovered invasive plant sites from becoming large and expanding into uninfested areas. But where riparian invasive plant species cannot be effectively controlled by non-herbicide methods, they will continue to displace native vegetation.

Alternative 3 meets State Water Quality Standards for water temperature, turbidity, and toxic substances. Alternative 3 is consistent with the ACS, PACFISH, and INFISH.

Cumulative Effects

Herbicides cannot be applied within 10 feet of any waterbody; therefore, the potential for direct or indirect effects from herbicides are even less than those for Alternative 2, and there would be no effects to accumulate at any measurable level. At the 5th field watershed scale, invasive plant treatment would not add significantly to effects from other land management activities or invasive plant treatment activities occurring on other ownerships. Because the amount of herbicide use is less than Alternative 2, the concern over cumulative effects associated with herbicide application is less than Alternative 2, which is very low.

Rhizomatous species such as ribbongrass and reed canarygrass will continue to spread if not effectively controlled manually and monocultures would continue to develop and expand. If the ribbongrass on the Metolius River causes the number and size of islands in the river to increase, there is a moderate risk of the river shifting toward an anastimozing channel type over the next 20 to 50 years. Placement of instream wood for improving fish habitat in the Metolius River is planned for the near future. Without effective treatment of ribbongrass along the Metolius, the wood could become colonized with ribbongrass.

Monitoring

Ten percent of small domestic wells and springs (campgrounds and special use cabins) within 500 feet of chemical applications should be monitored for treatments the first one to three years, to verify delineated Wellhead Protection Areas are effective with an emphasis on springs.

Aquatic Conservation Strategy Objectives

The Northwest Forest Plan directs the Forest Service to manage riparian-dependent resources to maintain the existing condition or implement actions to restore conditions (USDA USDI 1994a). Invasive plant treatments and subsequent re-establishment of native vegetation will lead to improved riparian conditions and therefore meet the intent of the Aquatic Conservation Strategy (ACS). The amount of inventoried invasive plants within the Riparian Reserve/RHCA portions of watersheds is minute when compared to the size of the watersheds; most cover less than one-tenth of one percent (see Table 54).

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 half of one percent of National Forest Service system lands within any 5th field watershed is currently infested.
- The proposed invasive plant treatments are expected to aid in restoration of riparian reserve conditions by allowing native vegetation to return to sites currently invested by invasive plants.
- The proposed project has a risk of adding some minor amounts of sediment and herbicide to surface water, but the amount is insignificant and not expected to affect watershed function. Most of the treatments areas are previously disturbed landings, roadways and trails so ground

disturbance is not a significant concern. Modification of surface ground cover can also change the timing of run-off. Treatment areas comprise a small portion of any watershed so no effects to stream flows are plausible from the result of manual/mechanical treatment and/or site preparation for planting.

- Removal of some invasives would reduce cover and shade for a short period of time along the stream's edge. However, a significant amount of vegetation would need to be removed to change water temperature in a stream, and shade would have to be provided only by the invasive plant removed. Treatment of invasive plants would restore vegetation structure and, in time, could facilitate the establishment/reestablishment of native riparian deciduous shrubs and trees. The PDFs prohibit broadcast applications to invasive plants closest to the water. This will protect overhanging non-target vegetation and smaller trees that are currently providing shade closest to the stream and other waterbodies.

Proposed invasive plant treatments that will take place in Riparian Reserves are consistent with the recommendations found in Watershed Analyses (see Table 54). Also, the proposed invasive plant treatments that will take place in Riparian Reserves are consistent with applicable standards and guidelines from the Northwest Forest Plan (identified in Appendix C). The standards and guidelines help to ensure that a project will meet or not prevent attainment of ACS Objectives.

The following is a summary of how this project compares to each of the Aquatic Conservation Strategy Objectives (ROD B-11); effects analysis of specific sites is contained in the water quality and fisheries sections.

ACS Objective #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 1 would maintain current direction under the 1998 EAs, which would limit the area of invasive plant treatment (in comparison to Alternatives 2 and 3). Under Alternative 1, invasive plant populations are expected to increase at a rate of 10% per year. In 1998, the Deschutes and Ochoco had 2,330 acres of invasive plants. The figure grew to 14,547 acres in 2008. Continued growth in invasive plant populations will jeopardize the distribution, diversity, and complexity of watershed scale features (such as riparian areas) as invasive plants displace native riparian vegetation.

Alternatives 2 and 3 would at least maintain, if not enhance the distribution, diversity and complexity of watershed and landscape-scale features because of restoration of the Riparian Reserves through invasive plant eradication. Alternative 2 would more aggressively treat riparian areas than Alternative 3. As stated under the effects section, Alternative 2 has more of a short term (1-year) risk of herbicide input to streams and increase in stream temperature, but more of a long term (>1-year) benefit to riparian vegetation and overall watershed/aquatic condition.

This project does not involve activities such as roading or logging that could fragment aquatic habitat. Channel components that contribute to channel complexity (pool quantity and quality, substrate, flows) would be maintained because invasive plant treatments will have no impact on those features. Proposed invasive plant treatments are expected to aid in restoration of riparian reserve conditions by allowing native vegetation to return to sites currently infested by invasive plants.

ACS Objective #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.

Riparian areas and associated streams and floodplains are essential to providing connectivity within and between watersheds. Alternative 1 currently maintains connectivity within and between watersheds. However, as invasive plant populations continue to spread at a rate of 10% per year there is potential to lose connectivity as watershed scale features (such as riparian areas) lose native plant composition and are displaced by less desirable, non-native invasives.

Of all alternatives, Alternative 2 treats the most riparian acres for eradication of invasives. Alternative 2 has the highest potential to maintain and restore spatial and temporal connectivity within and between watersheds by providing opportunity for native riparian plants to persist.

Alternative 3 would treat fewer riparian acres than Alternative 2. Some invasive plant populations within riparian areas would not get treated. These populations are predicted to continue spreading at a rate of 10% annually. Riparian areas under Alternative 3 could potentially lose connectivity within and between watersheds as riparian vegetation gets displaced by invasive plants. However, alternative 3 does more to protect connectivity than Alternative 1.

ACS Objective #3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Alternative 1 would provide very little protection to maintaining and restoring the physical integrity of aquatic systems. By not aggressively treating invasive plant populations within riparian areas there is potential for loss of aquatic system integrity. The potential for alteration of banks, shorelines, and bottoms is low in the short term (1-year), but as invasive plant populations expand the potential for alteration is much greater. The amount of alteration depends primarily on the species of invasive plant and it's rooting structure. Some invasive plants have good rooting structure (reed canarygrass) while others do not. Reed canarygrass is a good bank stabilizer even though it is an invasive plant. However, left unchecked, reed canarygrass and other water-tolerant invasive species can choke out streams and lead to channel deposition, hence alteration in channel morphology. Changes in channel morphology would happen over time (>10 years).

Alternative 2 would do the most to protect and restore the physical integrity of aquatic systems. Treatment of invasive plants near streams would allow for re-establishment of native riparian plants that typically have better root structure (and bank holding capacity) than non-native invasive plants. Project design features including applying erosion control measures (PDF 50), application methods close to channels (PDF 56 or 57), using the lowest effective rates (PDF 12), and protecting non-target vegetation (PDF 15, 16, and 63 through 71) will protect the aquatic systems during treatment.

Alternative 3 would protect the integrity of the aquatic systems more than Alternative 1. However, Alternative 3 would have no application of any herbicides within 10 feet of the water's edge on perennial waterbodies and within the high water mark of intermittent streams. So the invasive plants within these areas will most likely continue to spread if not treated otherwise, which could alter the channel morphology (over a long period of time, >10 years) as stated in the Alternative 1 discussion.

ACS Objective #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.

Alternative 1 would do very little to maintain and restore water quality to support healthy ecosystems. With the predicted invasive plant rate of spread of 10%, those riparian areas that are untreated will continue to lose native vegetation. As stated earlier, native riparian vegetation would typically be taller than invasive plants and provide more shade. Alternative 1 would, however, have the lowest risk (of all alternatives) for herbicides getting into live water and altering the biological, physical, and chemical integrity of the aquatic system.

Alternative 2 would treat more invasive plants within riparian areas than Alternative 3. Because of this, alternative 2 provides more opportunity for eradication of invasive plants and re-establishment of native riparian vegetation. However, because alternative 2 treats more areas, close to live water, the potential for herbicides to enter a live water system are inherently greater than that of alternatives 1 or 3. However, PDFs have been designed to mitigate potential degradation of water quality.

Treatment of reed canarygrass at Bull Bend (PAU 11-80) and ribbongrass on the Metolius River in the Camp Sherman area (PAU 15-32) could result in a very small decrease in shade on 303(d) listed streams. The potential increase in stream temperature would be non-measurable for the following reason. The Metolius ribbon grass survey found 7.58 percent of the riverbank occupied for the first 2/3 mile below Lake Creek. Assuming the Metolius was 50 feet wide and all vegetation was an average of 2 feet high, was completely removed, had no overlapping shade, and provided shade throughout the day, treatment of the ribbon grass on the Metolius would result in less than a half percent reduction in the shade on the river. Treatment of reed canarygrass on the Deschutes at Bull Bend should produce similar results. This would not result in any measurable increase in water temperature. Even if there was a risk that treatment of reed canarygrass (ribbon grass) might result in a measurable increase in water temperature, short term increases in water temperature (up to 6 months) are allowed even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)). Water temperature monitoring results in the analysis area show that water temperatures drop below threshold within 6 months after potential treatments due to the weather. Non target and planted vegetation will be starting to provide shade by the time water temperatures start approaching thresholds the next season.

In addition, the amount of work to be done that could contribute sediment is very small and PDFs aimed at reducing erosion would maintain the overall sediment levels in the long term (>1 year). There is a low risk of a short term (<1 year), very limited increase at sites where invasive plants are removed, that would last until native vegetation and/or effective ground cover was restored.

Alternative 3 would treat fewer riparian acres than Alternative 2. Some invasive plant populations within riparian areas would not get treated. These populations are predicted to continue spreading at a rate of 10% annually. Because of this, alternative 3 provides less opportunity for eradication of invasive plants and re-establishment of native riparian vegetation (than Alternative 2). However, because alternative 2 treats more areas, close to live water, the potential for herbicides to enter a live water system are inherently greater than that of alternatives 1 or 3. PDFs have been designed to mitigate potential degradation of water quality.

ACS Objective #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.

Alternative 1 would maintain current direction under the 1998 EAs, which would limit the area of invasive plant treatment (in comparison to Alternatives 2 and 3). Under Alternative 1, invasive plant populations are expected to increase at a rate of 10% per year. The current population of invasive plants has a non-measurable effect to the current sediment regime of waterbodies. However, with the projected expansion of invasive plants this could be more of a problem over the next 10 years and beyond under this alternative. Invasive plants in riparian areas can cause a loss of functional riparian communities, loss of rooting strength and less protection against erosion, and subsequent impacts on water quality (Donaldson 1997).

Alternative 2 would treat more invasive plants within riparian areas than Alternatives 1 and 3. Because of this, alternative 2 provides more opportunity for eradication of invasive plants and re-establishment of native riparian vegetation. However, because alternative 2 treats more areas, close to live water, the potential for short-term (<1 year) sediment delivery to streams is inherently greater than that of alternatives 1 or 3. However, as discussed previously, PDFs have been designed to mitigate potential erosion. PDF 50 requires application of erosion control measures and native re-vegetation where there is potential for sediment delivery following invasive plant control. Longer term (>1 year) erosion is expected to be less as native vegetation re-establishes. Based on the low intensity of the ground disturbance and the small number and dispersion of acres treated, sediment delivery should be negligible and there should not be a measurable increase in turbidity.

Alternative 3 has less invasive plant treatments in riparian areas (than Alternative 2). There would be less potential for short term (<1 year) sediment delivery to waterbodies, but more potential for longer term (>1 yr) sediment delivery as invasive plant populations expand and displace native vegetation.

ACS Objective #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.

Alternatives 1, 2, and 3 would maintain in-stream flows. There is no potential for increased peak flows or alteration of the timing, magnitude, duration and spatial distribution of flows as a result of treating/not treating invasive plants.

ACS Objective #7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

As mentioned in ACS Objective #6, alternatives 1, 2, and 3 have no potential for altering flows. Because of this, all alternatives would maintain the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

ACS Objective #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.

Alternative 1 would maintain current direction under the 1998 EAs, which would limit the area of invasive plant treatment (in comparison to Alternatives 2 and 3). Under Alternative 1, invasive plant populations are expected to increase at a rate of 10% per year. In 1998, the Deschutes and Ochoco had 2,330 acres of invasive plants. The figure grew to 14,547 acres in 2008. Continued growth in invasive plant populations under Alternative 1, will not maintain or restore the species composition and structural diversity of plant communities in riparian areas.

Alternative 2 would treat more invasive plants within riparian areas than Alternatives 1 and 3. Because of this, Alternative 2 provides more opportunity for eradication of invasive plants and re-establishment of native riparian vegetation (see Figure 1). The improvements in conditions will be particularly noticeable in areas where invasive plants have created a monoculture, excluding the establishment of native riparian plant species such as alder. Alternative 2 would maintain and restore species composition and structural diversity of plant communities in riparian areas.

Alternative 3 would maintain and restore species composition and structural diversity of plant communities more than Alternative 1, but less than Alternative 2. In Alternative 3 there would be no application of herbicides within 10 feet of the water's edge on perennial waterbodies and within the high water mark of intermittent streams. So the invasive plants within these areas will most likely continue to spread if not treated otherwise, which would continue to displace and out-compete native riparian vegetation.

Figure 7. Photo on left is diverse native vegetation on the Metolius River. Photo on right shows an area where ribbongrass has created a monoculture, displacing the native vegetation.

ACS Objective #9: Maintain and restore habitat to support well-distributed populations of native plant invertebrate and vertebrate riparian-dependent species.

Continued growth of invasive plant populations under Alternative 1, will not maintain or restore the habitat of riparian dependent species.

Alternative 2 would treat more invasive plants within riparian areas than Alternatives 1 and 3. Because of this, alternative 2 provides more opportunity for eradication of invasive plants and re-establishment of native riparian vegetation and habitat. Due to not treating some of the invasive plant areas in Alternative 3, there would be more potential for displacement of native riparian vegetation by invasive plants, and potential for loss of habitat.

3.7 Fisheries and Aquatic Organisms

Introduction

Fish species within the aquatic environment being analyzed under this EIS include the native bull trout, redband trout, steelhead trout, spring Chinook salmon, mountain whitefish, various sculpins, speckled dace, longnose dace, Chinook salmon Essential Fish Habitat and coho salmon Essential Fish Habitat. Introduced game fish species within the project area include, but are not limited to, brown trout, kokanee salmon (native only to Suttle lake), brook trout, lake trout, rainbow trout (non-native strains) and cutthroat trout.

The effects on aquatic organisms, including special status fish were assessed in the Pacific Northwest Region Invasive Plant Program FEIS Biological Assessment (USFS 2005d). The main aquatic issue in the regional EIS was that herbicides could leach, drift, spill or run off into aquatic habitats and harm aquatic organisms. One aquatic approved herbicide, glyphosate, has been shown to affect fish. Others may affect aquatic plants. Fish kills are not likely with the concentrations of active ingredients that are being proposed to be applied near the water. In rare circumstances, high concentrations of herbicides could wash into streams from unforeseen rainfalls shortly after herbicide application along road ditches or other surfaces that rapidly generate overland flows, or as a result of an accidental spill.

Standard 19 (see Chapter 1, page 15) requires use of 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. It also requires Forests to only consider those herbicides and herbicide mixtures registered for aquatic use when evaluating herbicide use near streams or surface water.

Analysis of effects uses the functional definition of a riparian area rather than Riparian Reserve definition. Riparian area is defined as a three-dimensional zone of direct interaction between terrestrial and aquatic ecosystems. Boundaries of riparian areas extend outward to the limits of flooding and upward into the canopy of streamside vegetation. Riparian areas can be viewed in terms of the spatial and temporal patterns of hydrologic and geomorphic processes, terrestrial plant succession and aquatic ecosystems (Gregory et al. 1991). For analysis of alternatives, an aquatic influence zone of 100 ft on either side of stream was used to determine where effects to fish in streams, rivers and lakes may occur from herbicide application. Within the analysis area there are riparian areas wider than 100 feet, but Level 2 Stream Survey data (USFS 1989-2005 unpublished data, Deschutes Headquarters files) indicates that the majority of true riparian vegetation around major class 1 and 2 streams within the analysis area is less than 100 ft.

3.7.1 Affected Environment

Federally Listed Fish and Critical Habitat

On the Ochoco, Deschutes and CRN Grassland, Middle Columbia River summer steelhead and bull trout are listed as threatened and Essential Fish Habitat (EFH) for spring Chinook and coho is present (Tables 63 and 64). Although coho EFH is listed in the Upper Trout Creek Watershed it is uncertain if this species was ever present there. Critical habitat has been designated for Steelhead and bull trout.

Critical habitat for steelhead on federal lands is located where documented steelhead use occurs. Maps of steelhead distribution (critical habitat) are located in the Fisheries Report. Critical habitat for steelhead has not yet been designated for Whychus Creek or Crooked River tributaries where steelhead were recently reintroduced in the Upper Deschutes Basin above Pelton Round Butte Dams. Critical habitat for bull trout has only been designated on private lands.

The Critical Habitat Analytical Review Teams (CHART) prepared reports for critical habitat designated by NMFS in 2005. Tables in the report display critical habitat by watershed for all ESU/DPSs, and a rating of watershed importance to species conservation which can be found at: http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/2005-Biological-Teams-Report.cfm.

Interior Columbia River Redband Trout are on the 2008 Region 6, Regional Foresters sensitive species list. Redband trout are one of the most wide spread fish species in the project area and are present in most perennial and some intermittent streams, except for the Upper Little Deschutes River and some closed watersheds that were historically fishless.

Table 63. Species Federally Listed and their Critical Habitat on the Ochoco & Deschutes NF and Crooked River National Grassland.

Species	DPS or Critical Habitat	Status	Federal Register Reference	5th Field Watersheds on NF (Critical Habitat)
Steelhead	Middle Columbia River	Threatened	64 FR 14308 3/24/99	Upper Trout Creek, Bridge Creek, Mountain Creek, Bridge Creek, Rock Creek, Upper Middle John Day, Lower South Fork John Day
	Middle Columbia River Critical Habitat	Designated	70 FR 52629 09/02/05	Upper Trout Creek, Bridge Creek, Mountain Creek, Bridge Creek, Rock Creek, Upper Middle John Day, Lower South Fork John Day
	Middle Columbia River	Threatened	Populations to be Reintroduced in next 5 years*	Whychus Creek, Mckay Creek, Middle Deschutes River, Lower Crooked, Upper Crooked,
Bull Trout	Columbia River	Threatened	64 FR 14508 03/25/99	Upper Metolius, Lower Metolius, Lake Billy Chinook, Willow Creek, Lower Crooked and Wickiup, Middle Deschutes River
	Columbia River Critical Habitat	Designated	70 FR 52629 09/02/05	Same as above but only on certain private lands

*None of these reintroduced populations have had critical habitat designated.

Table 64. Designated EFH on ONF, DNF and CRNG lands.

EFH Species	5th Field Watersheds
Chinook salmon	Upper Metolius, Lower Metolius, Lake Billy Chinook, Willow Creek, Lower Crooked to Opal Springs Dam and Whychus Creek, Middle Deschutes River to Steelhead Falls, Upper Trout Creek, Bridge Creek, Mountain Creek, Rock Creek, Upper Middle John Day, Lower South Fork John Day
Coho salmon	Upper Trout Creek

For purposes of addressing federally listed fish species under the jurisdiction of NOAA Fisheries and USFWS within the context of their status and life history, only brief summaries from various sources are presented in this document. Additional information related to life history information and status of populations at the ESU or DPS scale can be found at the following sources:

- Regional Invasive Plant EIS Fisheries Biological Assessment, Environmental Baseline (USDA 2005b).
- NMFS Federal Register documents (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm)
- Critical habitat designations and recovery plan documents for bull trout can be found at the USFWS Pacific Region. (http://www.fws.gov/pacific/bulltrout/)

Management Indicator Species and Strategic Species

Management indicator aquatic species were designated only on the Ochoco NF and these species include brook trout, redband trout and summer steelhead. Existing conditions and effects to redband trout and steelhead are discussed in detail in the following pages of the EIS and in Appendix H.

Brook trout are listed as a management indicator species even though they are an introduced species native to the Eastern United States and Canada. In the past, brook trout were stocked by the Oregon Department of Fish and Wildlife (ODFW). They are no longer stocked in the streams of the Ochoco NF but naturally reproduce in many streams (Class II). Redband trout serve as a surrogate for brook trout and rainbow trout in this analysis as they have similar habitat requirements. For purposes of this analysis, effects to redband trout and steelhead are described in the Threatened, Endangered, and Sensitive Species section and will act as a surrogate for MIS fish species effects analysis. No further evaluation for MIS will be discussed.

A new list of aquatic strategic species was put forth by the Regional Forester in 2007 and these include species that have information gaps (i.e. distribution, habitat, threats) resulting in status or taxonomic uncertainties. Many of these species are suspected to occur on the ONF, DNF and CRNG but have not been confirmed (Table 65). Some of these strategic aquatic species may be added to the Region 6 sensitive species list if they are confirmed on federal lands.

Table 65. Strategic aquatic species that are suspected to occur within the project area. Source: USFS 2008 Region 6 strategic species list.

Scientific Name	Common Name
FLUMINICOLA SP. NOV.	METOLIUS PEBBLESNAIL
JUGA BULBOSA (1)	BULB JUGA
JUGA HEMPHILLIA SP. NOV. (1)	INDIAN FORD JUGA
JUGA SP. NOV.	BLUE MOUNTAINS JUGA

JUGA SP. NOV.	OPAL SPRINGS (CROOKED RIVER) JUGA
OREOHELIX VARIABILIS	DALLES MOUNTAINSNAIL
GOMPHUS LYNNAE	COLUMBIA CLUBTAIL
MOSELYANA COMOSA	A CADDISFLY
NAMAMYIA PLUTONIS (1)	A CADDISFLY

Fish Species and Their Status

The following table and discussions of fish species in the planning area are taken from the Fisheries Report. More detailed information and maps of watersheds and fish distribution are contained in the Fisheries specialist report on file at the Ochoco National Forest headquarters.

Table 66. Summary of Fish Species and their Status in the Planning Area.

Species	Status
COLUMBIA RIVER BULL TROUT - *Threatened*	
Metolius River Population	Subpopulation of Deschutes Recovery Unit, considered healthy. Habitat generally in good condition.
Metolius Bull Trout Critical Habitat	Designated near the mouth of Lake Cr., Abbot Cr., Heising Spring and along ½ mile of Metolius River.
Upper Deschutes River Populations	Upper Deschutes River/Little Deschutes River and Crescent Lake/Crescent Creek populations probably extinct.
Odell Lake Population	Reproductively isolated from the rest of Upper Deschutes Basin, and only remaining population in Upper Deschutes River drainage. At high risk of extinction with less than 100 adult spawners.
Crooked River Populations	Extinct above Ochoco Reservoir since dam built in 1920.
Lower Deschutes River Population	Warm Springs River and Shitike Cr. population at moderate risk due to low redd counts and abundance of brook trout; Metolius River population at low risk; population in Lake Billy Chinook sustaining a quality trophy fishery.
MIDDLE COLUMBIA RIVER STEELHEAD - *Threatened*	
Deschutes River Basin	Summer steelhead populations declining in the lower Deschutes River. Pelton-Round Butte dam prevents upstream passage. Trout Creek watershed is the only network of drainages on both Forests where Deschutes River summer steelhead spawning and rearing occurs.
John Day River Basin	Longest free-flowing river with wild steelhead in Columbia River Basin. Production is limited by existing rearing conditions.
SPRING CHINOOK SALMON - *Proposed, but not Warranted*	
Upper Deschutes Basin	Chinook salmon and sockeye salmon released on an experimental basis into Metolius River and selected tributaries.
Chinook Salmon Essential Fish Habitat	Upper Deschutes and Crooked River basins identified as EFH under the Magnuson-Stevens Act.
INTERIOR COLUMBIA BASIN REDBAND TROUT – *Forest Service Region 6 Sensitive*	
Crooked River Basin	Populations are considered very depressed; thought to be declining in the basin.
Metolius River Basin	Population increasing in recent years.
Whychus Creek Drainage	Some populations at risk from rainbow trout from irrigation ponds; unscreened irrigation diversions are a problem.
Upper Deschutes Basin	Population status is considered excellent with several strongholds (Odell Creek, Tumalo Creek, and Upper Deschutes River near Benham Falls). Redband in Little Deschutes River are scarce.
Lower Deschutes and Tributaries	Robust population in Lower Deschutes; less abundant in tributaries. Redband trout dominate the Trout Creek drainage.

John Day River Basin	Found in tributaries to the John Day River and South Fork John Day River, overlapping with steelhead populations.
OTHER FISH SPECIES	
Crooked River Basin	Other fish include mountain whitefish, speckled dace, bridgelip suckers, introduced brook trout, northern pikeminnow, chisel mouth, large scale suckers; small mouth bass and brown bullhead.
Deschutes River Basin	Other fish include brown and brook trout, mountain whitefish, sculpins, dace, and bridgelip, large scale suckers, kokanee salmon.

Columbia River Bull Trout - *Threatened*

Bull trout characteristically occupy high quality habitat, often in less disturbed portions of a drainage. Necessary key habitat features include high channel stability, spawning substrate with a very low percentage of fine sediment, abundant and complex habitat, deep pools, cold water temperatures, and no barriers inhibiting connectivity (Reiman and McIntyre 1993).

Metolius Bull Trout Status and Distribution

The Metolius bull trout population continues to recover since listing in 1988, with redd counts peaking in 2004 at over 1,000 redds. Only 26 redds were found when counts were initiated in 1986. Continued protection of the spawning population made through restrictive angling regulations in the entire watershed has resulted in this recovery. Bull trout spawn in most perennial tributaries of the Metolius River. Recent surveys have found bull trout are expanding spawning habitat to include Spring Creek, and the Metolius River upstream of Lake Creek. Additional rearing only habitat includes Brush Creek, Abbot Creek, Lower Lake Creek, and some unnamed tributaries to Canyon and Roaring creeks. Annual redd numbers have recently declined to 382 redds in 2008. This may potentially be the result of lower kokanee numbers in Lake Billy Chinook that adult bull trout forage on.

The Metolius River bull trout population contains a mixture of both river dwelling and lake dwelling fish. Some resident fish may exist in the upper Jefferson Creek tributaries. All life strategies use tributaries to the Metolius River for spawning. Spawning occurs in spring-fed reaches of Jack Creek, Heising Spring, Canyon Creek, Roaring Creek, Candle Creek, Jefferson Creek and Whitewater River. Main stem river spawning has been documented in only a 0.5 mile reach of the upper Metolius River near the mouth of Jack Creek. Rearing habitat is known in all spawning streams plus Brush Creek, Spring Creek near Lake Creek, and the Metolius River. Abbot Creek is dominated by redband trout but an occasional bull trout is reported during annual surveys. Lake Billy Chinook (Round Butte Dam) provides additional rearing habitat. Street and Spring Creeks, tributaries to the Metolius Arm of Lake Billy Chinook, are suspected to provide additional secondary rearing habitat for the Metolius bull trout population. Fish surveys of these two streams found only one juvenile in Street Creek but not in Spring Creek.

Most juveniles move out of the spawning and rearing streams at age 2 and move into the Metolius River and eventually into Lake Billy Chinook. Primarily, age 3 and older bull trout reside in the lake. At age 5, most bull trout mature and move up the Metolius River and into tributaries to spawn.

In the Metolius basin, young bull trout less then 100 mm were found most consistently in the coldest, spring-influenced tributaries (Ratliff 1992). In the Metolius River system, bull trout Age 0+ range between 20-40 mm, 1+ range between 60-99 mm, 2+ range between 100-159 mm and 3+ are greater than 160 mm (Ratliff et al. 1996). In other systems, bull trout less than 110 mm feed on aquatic insects, macro-zooplankton, and mysids while those larger are primarily piscivorous (Horner 1978; Shepard et al. 1984). Growth differs little between resident and migratory forms during stream residence but diverges as migratory fish move into larger and more productive waters. Resident adults range from 150 to 300 mm in length (Geotz 1989; Mullan et al. 1992) while migratory bull trout commonly exceed 600 mm (Pratt 1984; Shepard et al. 1984; and Goetz 1989).

The Metolius River/Lake Billy Chinook bull trout is a sub-population of the Deschutes Recovery Unit and is healthy as stated by Ratliff and Howell (1992) and Buchanan et al. (1997). Trends in spawning population size have increased since 1986 from 27 redds to over 1000 redds by 2004. The increase is attributed to protection from harvest by more restrictive angling regulations (Riehle et al. 1997). The Metolius bull trout population is the only population with an allowable angler harvest in the state of Oregon. Oregon Department of Fish and Wildlife regulations allow one bull trout over 24 inches to be harvested daily on Lake Billy Chinook.

The known spawning areas in the Metolius River are confined to a ½ mile reach near the mouth of Jack Creek, where there is significant groundwater upwelling in the channel and from various spring along the riverbank. Spawning habitat has expanded with the increased numbers of adults in the system. Newly documented spawning areas have been found in Spring Creek and the Metolius upstream of Lake Creek. Juvenile bull trout have been found in Lower Lake Creek, near the springs. The Blue Lake/Link Creek/Suttle Lake bull trout group in the Metolius Basin has not been observed since 1961.

Juvenile bull trout densities in the tributaries and in the upper Metolius River monitoring sites have remained relatively unchanged. The most change in juvenile densities was noted from a high in 1995 and a decrease after the 1996 flood (USFS 2004f); most significantly in rearing only streams. Juvenile densities recovered within a short period after the flood. Densities of bull trout in the streams in which rearing but no spawning occurs have been more variable. The year 1995 was a significantly high year for Brush Creek and Upper Canyon Creek (USFS 2004f).

Growth of bull trout within this drainage is slow for juveniles due to cold temperatures, yet fast for ages three and older that move to Lake Billy Chinook (Pratt 1991). There is some evidence from the trap at the mouth of the Metolius River that fry growth rates may be decreasing, possibly a result of increased densities (Scott Lewis, Portland General Electric, personnel communication). Growth rates in Lake Billy Chinook are some of the highest reported in the literature (Riehle et al. 1997). Survival estimates have not been calculated but the population has increased with more restrictive angling regulations since 1983 (Riehle et al. 1997).

Bull trout habitat in the Metolius River drainage and Upper Deschutes below Steelhead Falls are generally in good condition. Water temperature in most spawning and rearing streams are below 10° C during spawning and rarely exceed 12° C during the peak of the summer. Juvenile habitat in the form of undercut banks, overhanging vegetation, aquatic vegetation and wood is abundant in many of the rearing streams tributary to the Metolius River. Wood density is high compared to other basins. Due to the stability of the streams, little wood is transported out during normal spring flows. Fine sediment in spawning areas is a concern and may have increased from past road construction and riparian logging. The low gradient, spring-fed reaches are particularly sensitive to fine sediment loading due to their low sediment transport rates. The percentage of fine sediment in spawning gravel monitored is moderate to low and has declined as a result of the 1996 flood (Houslet and Riehle 1998). If fine sediment had historically increased from past management activities, we may still be witnessing the effects to the springs today, due to their stable nature.

Metolius Bull Trout Critical Habitat

Responding to a court order, the U.S. Fish and Wildlife Service announced in September of 2005 that it had revised its designation of critical habitat for the bull trout under the Endangered Species Act in the Columbia and Klamath River basins of Oregon, Washington, and Idaho. Critical habitat was only designated on private lands. The Service also recognized conservation and management efforts by states, tribes and agencies.

Critical habitat refers to specific geographic areas that are essential for the conservation of a threatened or endangered species and which may require special management considerations. A designation does not set up a preserve or refuge and only applies to situations where Federal funding, permits, or projects are involved. It does not affect citizens engaged in activities on private land that do not involve a federal agency.

In the Metolius Basin, critical habitat was designated near the mouth of Lake Creek, Abbot Creek, Heising Spring and along the Metolius River on a ½ mile reach between Wizard Falls and Bridge 99. The Heising Spring area, including Jack Creek and the Metolius River is an important spawning habitat for bull trout. The Metolius River reach downstream of Wizard Falls has good island and side channel habitat for rearing bull trout but no spawning has been documented in that segment.

Upper Deschutes River Bull Trout Status and Distribution

Upper Deschutes River bull trout populations have probably been reproductively isolated upstream from Big Falls for approximately 18,000 years and 5,500 years ago a lava flow further divided the upper Deschutes population into the Odell lake population and the Upper Deschutes population above Big Falls (Larry Chitwood, DNF Geologist 1998, personal communication). The Upper Deschutes Basin bull trout populations were further reproductively isolated upon completion of Crane Prairie Dam (1922), Crescent Lake Dam (1928), and Wickiup Dam (1949), which are used for storing irrigation water. These dams do not have fish passage facilities and have blocked access for adult bull trout migrating to the upper Deschutes River spawning areas.

Increased water temperatures, loss of quality juvenile rearing habitat, altered stream flow regimes, barriers to spawning areas, competition with non-native fish species, and over-harvest eliminated remnant bull trout populations in the Deschutes River above Big Falls during the 1950s (Stuart et al. 1997). Bull trout were last observed in Crane Prairie, Wickiup, and Crescent Lake in 1955, 1957, and 1959, respectively. The last known bull trout observation in the Deschutes River above Bend occurred in 1954 (Ratliff et al. 1996). The upper Deschutes River/Little Deschutes River and Crescent Lake/Crescent Creek bull trout populations are probably extinct (Ratliff and Howell 1992). There may have been separate populations in Fall River and Tumalo Creek, but bull trout spawning remains undocumented (Ratliff et al. 1996).

Odell Lake Bull Trout Status and Distribution

The Odell Lake bull trout population is the only remaining population in the Upper Deschutes River drainage and is the only natural adfluvial population remaining in Oregon. This population was cut off from the rest of the Upper Deschutes when a lava flow cut off access and created Davis Lake about 5,500 years ago (Larry Chitwood, DNF Geologist 1998, pers. comm.). Historically, they were found in Davis Lake and the stream systems associated with these water bodies; they are now primarily found in Odell Lake and Trapper Creek.

Redd counts have been conducted on Trapper Creek since 1995. In the last few years redd counts have been conducted on parts of Odell Creek and some of its tributaries, no redds have been confirmed in these areas. Redd numbers in Trapper Creek have been very low and ranged from 0 to 24 redds. This population is estimated to be less than 100 adult spawners and is at high risk of extinction.

Juvenile snorkel surveys have been performed on Trapper Creek since 1996 and numbers ranged from 26 in 1996 to a high of 208 in 2001 (Dachtler 2004). Recently snorkel and electrofishing surveys have found juveniles in Maklaks Creek, Fire Creek, Crystal Creek, Odell Creek and a spring fed tributaries that feeds into Odell Creek (Dachtler 2003). A complete channel restoration project was performed on the lower half mile of Trapper Creek in 2002 and 2003 in order to restore hydrologic function and improve fish habitat. Fishing regulations were put in place during 1992 and 1993 in Odell Creek, Odell Lake, and Trapper Creek to protect bull trout (ODFW 1996). Reasons for this populations decline can most likely be attributed to over harvest, interaction with exotic species (brook and lake trout), Tui Chub eradication efforts in Davis Lake and Odell Creek during 1961 and impacts to habitat from the railroad, Highway 58, roads and timber harvest.

Crooked River Bull Trout Status and Distribution

Crooked River bull trout populations are assumed to have gone extinct above Ochoco Reservoir soon after the reservoir was competed in 1920. The assumption is based on the historic condition of the riparian areas at the time the Blue Mountain Forest Reserve was formed and because migration of bull trout was eliminated by the dam.

Lower Deschutes River Bull Trout Status and Distribution

The Warm Springs River bull trout population is considered at moderate risk and bull trout populations at the Metolius River and Shitike Creek are considered at low risk (Ratliff and Howell 1992). A more recent status review by Buchanan et al. (1997) downgraded the status of bull trout in Shitike Creek to moderate risk due to the abundance of brook trout and recent low redd counts. Round Butte Dam was built in 1964 on the Deschutes River creating Lake Billy Chinook. Due to its position, which is lower in the system, there have been fewer impacts, since critical spawning areas are above it. Presently, the bull trout populations in Lake Billy Chinook are sustaining a quality trophy fishery.

Middle Columbia River Steelhead - Threatened

Deschutes River Basin Status and Distribution

All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run steelhead (Schreck et al. 1986, Reisenbichler et al. 1992, and Chapman et al. 1994). These steelhead populations were listed as threatened in 1999 and critical habitat was designated in 2005. Life history information for steelhead of this ESU indicates that most Middle Columbia River steelhead smolts at 2 years and spend 1 to 2 years in salt water prior to re-entering fresh water, where they remain up to 1 year prior to spawning (Howell et al. 1985).

Wild summer steelhead juveniles rear in the lower Deschutes River for 1 to 4 years before migrating to the ocean. Lower Deschutes River origin wild summer steelhead typically return after 1 or 2 years in the Pacific Ocean. A total of eight life history patterns were identified on scales collected from a sample of lower Deschutes River origin wild adult summer steelhead (Olsen et al. 1991). Typical of other summer steelhead stocks, very few steelhead return to spawn multiple times.

Passage conditions for both juvenile and adult anadromous fish at Columbia River main stem dams contribute to declines in wild summer steelhead. The Dalles Dam, which all Deschutes River migrants must pass, has one of the lower rates of juvenile salmonid passage efficiency for main stem Columbia River dams due to a lack of turbine screening and effective juvenile bypass facilities. Bonneville Dam, particularly Powerhouse 2, does not have an effective juvenile turbine screening. Increased spill of water at both The Dalles and Bonneville dams, to increase survival of ESA-listed Snake River salmon, should result in better survival of wild lower Deschutes River summer steelhead at these dams. Longer travel time for juveniles through dam-created reservoirs in the Columbia River, increased water temperature in the reservoir environment, and increased predation near main stem dams all contribute to increased losses of juvenile and adult wild summer steelhead.

Summer steelhead occur throughout the main stem lower Deschutes River below Pelton Reregulating Dam (RM 100) and in most tributaries below the dam. Before construction of the Pelton Round Butte hydroelectric complex, summer steelhead were also found in the Deschutes River upstream to Big

Falls (RM 128), in Squaw Creek, and in the Crooked River (Nehlsen 1995). Historic summer steelhead presence in the Metolius River is uncertain (Nehlsen 1995).

Construction of Pelton and Round Butte dams, completed in 1958 and 1964, respectively, included upstream passage facilities for adult Chinook salmon and steelhead and downstream facilities for migrating juveniles. By the late 1960s, it became apparent that the upriver runs could not be sustained naturally with these facilities, due primarily to inadequate downstream passage of juveniles through the complex, and summer steelhead production upstream of the dam complex was lost.

The Lower Deschutes River summer steelhead is currently classified as a wild population on Oregon's Wild Fish Management Policy Provisional Wild Fish Population List (OAR 635-07-529[3]). A population meets ODFW's definition of a wild population if it is an indigenous species, naturally reproducing within its native range, and descended from a population that is believed to have been present in the same geological area prior to the year 1800. Human-caused genetic changes, either from interbreeding with hatchery origin fish or habitat modification, do not disqualify a population from the wild classification under this definition. It is likely the current wild steelhead population in the lower Deschutes River has undergone some of these genetic changes particularly from recent interbreeding with hatchery origin summer steelhead. Irrespective of this, naturally produced summer steelhead in the lower Deschutes River meet ODFW's definition of a wild population.

Wild summer steelhead spawn in the lower Deschutes River, Warm Springs River system, White River, Shitike Creek, Wapinitia Creek, Eagle Creek, Nena Creek, the Trout Creek system, the Bakeoven system, the Buck Hollow Creek system and other small tributaries with adequate flow and a lack of barriers to fish migration. Spawning in White River is limited to the 2 miles below White River Falls, an impassable barrier. A natural barrier also limits spawning opportunities in Nena Creek.

The Warm Springs River system is believed to contribute a large portion of the tributary-spawned wild summer steelhead in the lower Deschutes River. Tributary spawning ground counts are incomplete most years because many tributaries are inaccessible during spawning. The Warm Springs system is particularly valuable as a refuge for wild summer steelhead since all hatchery marked or suspected hatchery origin summer steelhead are not allowed to pass the barrier dam at Warm Springs National Fish Hatchery (WSNFH Operational Plan 1992-1996). This effectively excludes all non-Deschutes River origin summer steelhead except stray wild summer steelhead. The number of stray wild summer steelhead being passed above the barrier dam is unknown.

Spawning in the lower Deschutes River and westside tributaries usually begins in March and continues through June. Spawning in eastside tributaries occurs from January through mid-April, and may have evolved to an earlier time than westside tributaries or the main stem because stream flow tends to decrease earlier in the more arid eastside streams (Olsen et al. 1993).

Fry emerge in spring or early summer depending on time of spawning and water temperature during incubation. Zimmerman and Reeves (1996) documented summer steelhead emergence in late May through June. Juvenile summer steelhead emigrate from the tributaries in spring at age 0 to age 3. Many of the juveniles that migrate from the tributaries continue to rear in the main stem lower Deschutes River before smolting.

The Pelton Round Butte hydroelectric complex at RM 100 is currently a complete upstream passage barrier to anadromous and resident fish and does not have functional downstream juvenile passage. Although much historic summer steelhead habitat and production in the Crooked River has been lost due to dams on that river, historic and current production potential in the main stem Deschutes River below Steelhead Falls, Squaw Creek, and the Metolius River has been lost because of the Pelton Round Butte hydroelectric complex (Nehlsen 1995).

Most tributaries used by wild summer steelhead for spawning and rearing experience low flows and high temperatures, both of which are related to streambank degradation, poor riparian habitat conditions, and water withdrawals. Streambank degradation is a problem throughout the subbasin both in tributaries and portions of the main stem.

The Trout Creek watershed covers approximately 675 square miles with about 140 miles of main stem and tributaries. Trout Creek is the upper-most, eastside tributary of the Deschutes River below the Pelton Round Butte complex. The headwaters originate in the Ochoco Mountains with a main stem distance of 52 river miles. The Trout Creek watershed is currently the only network of drainages on both the Ochoco and Deschutes NFs where Deschutes River summer steelhead spawning and rearing occurs. Trout Creek enters the Deschutes River downstream from the Pelton Round Butte complex at RM 88.5.

Ongoing summer steelhead redd surveys are being conducted on various drainages within the Trout Creek watershed. The average number of miles that were surveyed within the Trout Creek watershed was 22 for the years of 1988 – 2000. The average number of fish per mile was 0.7, while the average number of redds per mile was 1.9 (ODFW 2000b).

A summer steelhead out migration study on Trout Creek is currently ongoing at RM 3.7, approximately 13.7 miles north of Madras, Oregon. Preliminary results indicate that Trout Creek is, in all likelihood, a substantial spawning and rearing tributary for wild Deschutes River summer steelhead (Nelson 2000). Further investigations as to what percentages of these spawning fish are hatchery or wild summer steelhead is expected to be answered in subsequent years of the study. Until such time, concerns for whirling disease from hatchery steelhead still exist.

Prolonged drought conditions from 1984 or 1985 to approximately 1994, exacerbated main stem and tributary habitat deficiencies and may have contributed greatly to declining summer steelhead populations in the lower Deschutes River.

A variety of man's activities outside the subbasin constrained natural production in the subbasin. Streambank degradation, primarily caused by livestock and recreational use, may also limit production by providing a chronic source of sedimentation and decreasing available juvenile rearing habitat by inhibiting growth of riparian plant communities.

John Day River Basin Status and Distribution

The John Day River is the longest free flowing river with wild steelhead in the Columbia River Basin. These steelhead populations were listed as threatened in 1999 and critical habitat was designated in 2005. The John Day Basin has the distinction of being one of the few large basins in Oregon with no steelhead hatchery program. In the early 1960s, managers released approximately 500,000 hatchery winter steelhead fry and limited numbers of pre-smolts used for experimental purposes. Few likely survived due to the use of improper stocks and hauling mortality (90% of the fish were dead on arrival to the release site). No production releases of hatchery steelhead pre-smolts were ever made in the John Day Basin. Hatchery releases for any purpose ceased in 1966 in favor of wild stocks. There are five populations of John Day steelhead: Lower Main stem (below Picture Gorge), Upper Main stem (above Picture Gorge), North Fork, Middle Fork, and South Fork.

Wild summer steelhead juveniles rear in the lower John Day River for 1-4 years before migrating to the ocean. John Day River-origin wild summer steelhead typically returns after 1 or 2 years in the Pacific Ocean. Typical of other summer steelhead stocks, very few steelhead return to spawn multiple times.

Although stray hatchery steelhead are caught in the Lower Main stem John Day River, especially below Cottonwood Bridge, they have been rare in the upper John Day basin. Stray rates have been estimated at 4-8% or less. A rate accepted by experts to be normal and necessary to maintain genetic diversity of the wild stock.

Summer steelhead enter the John Day River Basin in late August and or September when stream temperatures drop and stream flows increase. Steelhead reach spawning areas from March through mid-May while stream flows are suitable. They spawn from March through mid-June. Fry emergence is usually from May through mid-July depending on time of spawning and water temperature during incubation. Fry emergence has been noted as late as August. Rearing is from 1-4 years and juvenile summer steelhead emigrate from April to July. Survival of egg to smolts typically ranges from 0.5-1.5%. Survival of smolts to adults range from 2-5%.

The Ochoco NF manages partial stream reaches in Bridge Creek, Mountain Creek, Rock Creek, Lower South Fork, and Upper Middle John Day watersheds. Summer steelhead access stream reaches in all of these watersheds. Redd surveys are conducted annually in coordination with ODFW on various stream reaches within the basin. The average number of miles that were surveyed within the John Day River Basin was 26.6 for the years of 1959-2000. The average number of steelhead observed was 41.3 per mile, while the average number of redds was 5.9 per mile. Surveys have shown that preferred steelhead spawning streams on the Ochoco NF include, but are not limited to: Badger Creek, Rock Creek, Black Canyon Creek, Cottonwood Creek, and Wind Creek. Barriers on private land are the most limiting factor to upstream migration onto Forest Service administered lands.

In the John Day River Basin, summer steelhead production is limited primarily by existing rearing conditions. Livestock overgrazing, water withdrawals for irrigation, clearing of land, road building, logging, and channelization degrade fish habitat by disturbing or destroying riparian vegetation and destabilizing stream banks and watersheds. The results are wide, shallow channels, low, warm summer flows; high turbid spring flows; high sediment loads; and decreased fish production.

Low flow and high water temperatures in the Columbia River during drought years magnify main stem dam passage difficulties for both adult and juvenile summer steelhead. Streambank degradation, primarily caused by livestock and recreational use, may also limit production by providing a chronic source of sedimentation and decreasing available juvenile rearing habitat by inhibiting growth of riparian plant communities.

Chinook Salmon Essential Fish Habitat

Spring Chinook, ESA Status – Proposed but not Warranted

Spring Chinook salmon (*Oncorhynchus tshawytscha*) historically spawned in the Warm Springs River system, Shitike Creek, the main stem Deschutes River upstream from the location of the Pelton Round Butte hydroelectric complex, Squaw Creek, and the Metolius River. Historic use of the Crooked River by spring Chinook salmon is documented but conflicting reports exist on when this population was lost (Nehlsen 1995).

Construction of Pelton and Round Butte dams, completed in 1958 and 1964, respectively, included upstream passage facilities for adult Chinook salmon and steelhead and downstream facilities for migrating juveniles. By the late 1960's, it became apparent that the upriver runs could not be sustained naturally with these facilities due primarily to inadequate downstream passage of juveniles through the project. As a result, in 1968, PGE agreed to build and finance the operation of an anadromous fish hatchery at the base of Round Butte Dam to mitigate for losses above the dams.

Oregon's Provisional Wild Fish Population List currently recognizes natural production of spring Chinook from two separate populations: one in the Warm Springs River and one in Shitike Creek, both located on the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS). It is uncertain at this time, however, if the two groups have enough genetic differences to qualify as separate populations. Spawning occurs in the Warm Springs River and tributaries Mill Creek and Beaver Creek, and in Shitike Creek.

Life History and Population Characteristics

Wild spring Chinook adults enter the Deschutes River in April and May. The run arrives at Sherars Falls in mid-April and peaks in early to mid-May with most spring Chinook salmon passing the falls by mid-June.

Wild spring Chinook salmon spawning in the Warm Springs River occurs primarily above WSNFH. Wild spring Chinook salmon begin arriving at WSNFH in late April or early May, once water temperatures exceed 50^{o} F, and continue until late September. All fish passing WSNFH must enter a trap at the hatchery and be passed above that facility to gain access to the spawning areas. Since 1986, only wild spring Chinook have been allowed upstream into the spawning areas (WSNFH Operational Plan 1992-1996). The wild population currently meets the strictest guidelines of OAR 635-07-527, Oregon's Wild Fish Management Policy.

The run peaks at the hatchery by the first of June, with a second smaller peak in late August or early September. In most years, approximately 70% of the run arrives at Warm Springs Hatchery by June 1 and 90% by July 1 (Lindsay et al. 1989). Most of the fish that pass WSNFH are believed to hold in the Warm Springs River canyon within about 7 miles of the hatchery until August when they continue upstream to the spawning areas.

The run size of wild spring Chinook salmon in the Deschutes River has been estimated annually since 1977 by summing harvest and escapement. Estimated total harvest has been obtained each year since 1977 (except 1985 and 1986) by conducting statistical harvest surveys of the tribal subsistence and sport fisheries at Sherars Falls. With the exception of a small number of wild spring Chinook that spawn downstream from WSNFH or in Shitike Creek, all others are captured and counted at WSNFH. The average run size of wild spring Chinook into the Deschutes River from 1977 through 1995 was 1,913, with a range of 241 to 3,895.

Redd counts in Shitike Creek indicate an estimated average spawning escapement of 49 adult spring Chinook annually from 1982 to 1995. Of 17 spring Chinook carcasses sampled during redd counts in Shitike Creek from 1986 through 1995, no hatchery origin spring Chinook were found, indicating that this escapement is composed of wild spring Chinook (CTWS unpublished data).

The Shitike Creek spring Chinook population is recognized as a separate population on Oregon's Provisional Wild Fish Population List and qualifies as a small population under Oregon's Wild Fish Policy. Managers are unsure if spring Chinook spawning in Shitike Creek are a separate population or if they are the same population that spawns in the Warm Springs River. No escapement goal for spring Chinook into Shitike Creek has been established and insufficient information on production potential and adult escapement is available. The CTWS have used an upstream migrant adult trap in Shitike Creek in year 2000 to better quantify the number of spring Chinook entering the system.

State and Tribal managers assume that, absent a specific escapement goal for spring Chinook in Shitike Creek, an adequate number of spawning adults will reach Shitike Creek and the population's genetic resources will be protected if wild spring Chinook in the lower Deschutes River are managed to meet the optimum spawning escapement goal into the Warm Springs River. The escapement goal is 1,300 adults over the WSNFH barrier dam. An additional assumption is that Shitike Creek spring Chinook are subject to similar harvest and mortality rates prior to spawning as Warm Springs River origin wild spring Chinook.

Emergence of spring Chinook salmon in the Warm Springs River probably begins in February or March. Information on completion of emergence in the Warm Springs River is not available but may be similar to the John Day River, where emergence is completed by May (Lindsay et al. 1989).

Juvenile spring Chinook migrate from the Warm Springs River in two peaks, a fall migration from September through December, and a spring migration from February through May (Lindsay et al.

1989). The fish migrating in the fall are age 0, range in size from 3.1 inches to 4.3 inches fork length, and do not have the appearance of smolts. Most spring migrants are age-1 fish, range in size from 3.5 inches to 5.1 inches fork length, and have the bright silver coloration characteristics of smolts. The total number of fall and spring migrants from the Warm Springs River ranged from 28,038 fish to 131,943 fish for the 1975 through 1993 broods, the last brood to complete migration (CTWS unpublished data).

Wild spring Chinook salmon that migrate from the Warm Springs River in the fall at age 0 appear to rear over winter in the Deschutes or Columbia Rivers before entering the ocean the following spring at age 1. During research activities in the late 1970's, spring Chinook salmon that were marked in the fall as age-0 migrants from the Warm Springs River were recaptured in the Deschutes River the following spring. Wild spring Chinook salmon smolts generally migrate through the Columbia River in April and May at age 1 based on recoveries of marked smolts (Lindsay et al. 1989).

Natural Production Constraints

Habitat constraints in the Warm Springs River and Shitike Creek system are related to degraded stream banks and riparian areas, and water quality and quantity conditions, especially during years of below-normal precipitation and low stream flow. High water temperature, low flow, sedimentation, and gravel quality affect production in the lower Warm Springs River and its tributaries.

The Pelton Round Butte hydroelectric complex at RM 100 is currently a complete upstream passage barrier to anadromous and resident fish. The Pelton fish ladder was built to facilitate anadromous fish passage at the complex. This ladder was abandoned after facilities at Round Butte Dam failed to effectively pass juvenile salmonids downstream. The Pelton ladder extends from below Pelton Reregulating Dam to Pelton Dam, which impounds Lake Simtustus. The ladder is 10 feet wide, 6 feet deep, and 2.8 miles long, and was originally designed and constructed to allow passage of adult Chinook salmon and summer steelhead around the Reregulating Dam to Lake Simtustus. From Lake Simtustus, fish were passed over Round Butte Dam by means of a trap and tramway. Some limited downstream migration is possible, as evidenced by successful passage of kokanee, hatchery rainbow, and brown trout from the reservoir complex into the Deschutes River, below the Pelton Reregulating Dam. However, efforts to perpetuate natural spawning runs above the hydroelectric complex were abandoned because of the lack of effective downstream passage of juvenile salmonids. Hatchery compensation was initiated by PGE in 1968 (Nehlsen 1995).

The number of adult spring Chinook that spawned above the hydroelectric complex is unknown. The Metolius River was thought to be the major spring Chinook spawning and rearing area of the upper Deschutes subbasin. Up to 580 adult spring Chinook were captured at a hatchery rack in the Metolius River during the years 1948 to 1958 and this number of fish was thought to be considerably less than what was historically present (Nehlsen 1995). Regardless of the true production potential upstream of the hydroelectric complex, loss of these areas currently constrains natural production in the subbasin. As part of the FERC relicensing requirements for the Pelton Round Butte Dams adequate fish passage will be designed and placed at the dams. Reintroduction of Chinook to the Metolius Watersheds will begin in the winter of 2008..

Hatchery Produced Spring Chinook

Available information indicates that very few hatchery-origin spring Chinook adults spawn in the main stem Deschutes River, Shitike Creek, or the Warm Springs River below WSNFH. Rather, they return to their respective hatchery and do not spawn in the wild. Lindsay et al. (1989) makes reference to RBH adults being observed in Shitike Creek, but the absence of spawned-out hatchery fish during carcass surveys suggests that these fish left the system rather than spawning there. One of 14 spring Chinook carcasses examined during spawning surveys in the Warm Springs River downstream of WSNFH from 1986 to 1995 was a hatchery-origin spring Chinook as determined by fin mark.

Hatchery-origin spring Chinook have not been allowed access into the Warm Springs River spawning grounds above WSNFH with the exception of 1982 to 1986; these fish are retained at the hatchery for brood stock. Since 1986, only wild fish have been allowed upstream to spawn.

Round Butte Hatchery is funded by PGE, the current operator of the Pelton Round Butte hydroelectric complex, and was constructed and funded to mitigate for lost production of wild spring Chinook salmon and summer steelhead above the Pelton Round Butte hydroelectric project. RBH is operated by the ODFW. Operation of the hatchery began in 1972 after it was agreed that natural production above the hydroelectric facility was not adequate to sustain the runs.

The spring Chinook salmon production program at RBH currently consists of two different rearing techniques. Both techniques result in the release of full-term smolts that migrate through the lower Deschutes River rapidly. This is believed to minimize interaction with wild fish. One technique involves rearing approximately 25,000 to 30,000 juvenile Chinook salmon at the hatchery until spring of their second year (age 1+), and then trucking them 10 miles downstream for release immediately below Pelton Reregulating Dam. The second scenario involves rearing approximately 200,000 juvenile Chinook salmon at the hatchery until fall of the year following egg-take (Age 0+) and trucking them to Pelton ladder in November where they rear over winter until they are allowed to migrate volitionally the following April at age 1+.

Warm Springs National Fish Hatchery (WSNFH) was constructed on the Warm Springs River after the CTWS Tribal Council requested that the Bureau of Sport Fisheries and Wildlife (now the FWS) determine the feasibility of a permanent fish hatchery on the reservation. WSNFH was authorized by Federal Statute 184, on May 31, 1966, to stock the waters of the CTWS reservation with salmon and trout. The FWS operates WSNFH on lands leased from the CTWS. The current production goal is the release of 750,000 juveniles (WSNFH Operational Plan 1992-1996). Actual current spring Chinook production varies according to brood stock availability.

Upper Deschutes Basin Spring Chinook Salmon Status and Distribution

Chinook salmon and sockeye salmon have been released on an experimental basis into the Metolius River and selected tributaries. The upper Deschutes and Crooked River basins have been identified as Essential Fish Habitat under the Magnuson-Stevens Act. This act protects habitat important to commercial ocean fisheries. The Listing included the Upper Deschutes Subbasin with the likelihood future passage of anadromous fish will be passed through Deschutes River dams. Under the proposed new hydropower operating license for Pelton Round Butte Dams, fish passage will be a part of the new operation at the dam complex on the Deschutes River. This proposed reintroduction marks a return to anadromy to the watershed. Chinook salmon may be released for reintroduction as early as 2008 under the fish passage plan for Pelton Round Butte Dams. Returns of adult salmon to the Metolius River are not expected until at least 2012.

Habitat for Chinook salmon was documented in historic reports in a review by Nehlsen (1995). She described Chinook salmon spawning in the Metolius River and collections were made in the Camp Sherman area to supply the hatchery with eggs. Historic reports of salmon being caught in traps in Lake Creek were given as evidence of use in that stream. The upper reach of the Metolius River is thought to be the primary spawning habitat for historic Chinook salmon populations. Recent growth rates examined of age 1 Chinook were fastest in the experimental fry released in the springs at the Head of the Metolius River and condition factors were good in lower Lake Creek. (Jens Lovtang, OSU, pers. comm.). Although rearing could occur in other tributaries and lower in the Metolius River, the springs may be important for early rearing and spawning habitat.

Rearing habitat is thought to be within the optimum temperature range for Chinook salmon in limited reaches of the Metolius River and in most of the year in Lake Creek. Juvenile Chinook salmon caught in juvenile trap in the mouth of the Metolius River were found to be small on average. It is unknown if additional rearing and growth would occur after the juvenile Chinook migrate out of the Metolius River system. Larger smolts would have better survival to the ocean.

Coho Salmon EFH (Essential Fish Habitat)

Coho salmon Essential Fish Habitat is listed for the Trout Creek subbasin. There currently are no coho salmon in this system and their previous existence here is uncertain. No historical documentation could be found that supports their past occurrence in this system. If coho once did exist here it would have been at the edge of their historical range.

Interior Columbia Basin Redband Trout - Forest Service Region 6 Sensitive Species

Redband trout are the native form of rainbow trout in the interior Columbia River basin. This subspecies is adapted to arid conditions east of the Cascade Mountains and generally have a high tolerance for high stream temperatures. Redband trout are spring spawners, depositing eggs in a redd in the gravel in cool, clean water. Emergence from the gravel occurs in June and July and the fish grow and often reside in the same stream were they were spawned (Stuart et al. 1996). Generally growth rates are slow and fish rarely reach lengths greater then 10 inches. Redband trout in the Crooked River downstream of Bowman Dam have faster growth rates and attain larger sizes. Maturity is reached at age 3, or approximately 5-6 inches. Spawning Occurs in April or May (Stuart et al 1996).

Redband Trout of the Crooked River Basin

Redband trout populations throughout much of the Crooked River Basin and the Ochoco National Forest can be characterized as "very depressed" (ODFW 2003). Redband trout are present throughout the basin, except in Haystack Reservoir, Reynolds Pond, Walton Lake and possibly Antelope Flat Reservoir. Historically, there were two groups in the basin separated by a geologic barrier in the North Fork Crooked River. Today, there are several separate smaller populations isolated by artificial barriers such as impoundments, irrigation diversions and culverts. Redband trout populations are thought to be declining in the basin and have been listed as a Sensitive species by the State of Oregon and the Forest Service (Stuart et al. 1996).

Redband trout in the Crooked River Basin were found to occupy 75% of their historic range and their abundance was a fraction of historic levels (Stuart et al 2002, draft report). Many streams in the southwest portion of the drainage may have lost populations due to habitat degradation, reduced flows and high water temperatures. Strong populations exist in 7% of the basin, including the Crooked River just downstream of Bowman Dam and just upstream of Lake Billy Chinook. Other strong holds for redband trout in the Crooked River Basin included headwaters streams on the Ochoco National Forest (Stuart et al 2002, draft report).

A joint USFS and ODFW study undertaken from 1997-2003 on Deep Creek redband trout populations has documented a marked population decline (ODFW 2003). No particular age-class declined markedly compared to one another, suggesting a reduction due to non-selective influences. The study concluded that drought largely caused the population crash and that fish numbers will not likely recover until normal climatic conditions return. It also states that low-quality habitat conditions have left these populations susceptible to climatic and anthropogenic disturbances. Additionally, a water-born pathogen (*Ichthyoptherius multifilis*) in Little Summit Creek in the summer of 1998 resulted in approximately 60% mortality among the redband trout and speckled dace (*Rhinichthys osculus*) populations within a two mile reach (ODFW 2003).

Redband Trout of the Metolius River Basin

Redband trout (*Oncorhynchus mykiss gairdneri*) are found in Lake Creek, Link Creek, Canyon Creek, First Creek, Abbot Creek, Suttle Lake and the Metolius River. The Metolius River population has been increasing in recent years and the adult spawning population has more than tripled in the last five years. The cause of the increase is unknown, but may be the result of recovery after drought, lack of hatchery fish and/or increased large wood in the upper river (Mike Riehle, Sisters R.D. Fisheries Biologist, personal communication). Lake Creek is a spawning stream for redband trout although the spawning timing is slightly later than for the Metolius River. Hatchery rainbow trout from Wizard Falls Trout Hatchery were stocked in the Metolius River until 1995 when the program was discontinued to protect wild fish. Numbers of adult spawning fish have increased since 1995 by three fold in the upper river and has stabilized in recent years (USFS/ODFW data on file).

Redband Trout of the Whychus Creek Drainage

Indian Ford and Trout Creek are located within the Whychus Creek drainage. Within the Whychus Creek drainage, redband trout (*Oncorhynchus mykiss gairdneri*) are found in Squaw Creek, Indian Ford Creek, Snow Creek and Trout Creek. Migration barriers such as dry channel reaches and irrigation diversion dams impede movement of redband trout in Squaw Creek and tributaries during the summer months of dry years. Redband trout populations in Indian Ford Creek and Whychus Creek are at risk from hatchery strains of rainbow trout from irrigation ponds and recreation ponds in the watershed (USFS 1998d). Unscreened irrigation diversions remain a problem within the watershed. In October 1997, the Three Sisters Irrigation District reported that approximately 5,000 fish were recovered from District ditches and released into the District and private ponds. One diversion is screened on Indian Ford Creek (USFS 1998d).

Trout Creek, a tributary to Indian Ford Creek, is intermittent in its lower reaches and flows into Indian Ford Creek only during high precipitation events. An extant population of redband trout survives in this stream and in the vicinity of Trout Creek Swamp (USFS 1998d). The connection, although infrequent, between Trout Creek and Indian Ford Creek is important for redband trout genetic exchange and repopulation if a catastrophic event were to occur. Without this connection the current isolated population of redband trout in Trout Creek remains highly susceptible to loss due to habitat manipulations, catastrophic events, over fishing, exotic species introduction or disease.

Redband Trout of the Upper Deschutes Basin

Upper Deschutes River has a strong hold for redband trout in the reach near Benham Falls to Bend (ODFW 1996). Electrofishing surveys showed redband population status to be excellent and this is likely due to water inputs in this reach that are less influenced by storage and release of irrigation water. Redband trout are managed for in and above Crane Prairie Reservoir and native stock has been introduced to the hatchery program for the reservoir and other waterbodies. This high use recreational fishery on both the reservoir and river upstream attracts many anglers to the area. Other strongholds for redband trout in the upper Deschutes River Basin include Odell Creek, and Tumalo Creek.

Populations of redband trout in Big Marsh and Crescent Creek are present but there status is unknown. Recent fish surveys above Big Marsh have not found any redband and surveys in Crescent Creek above Big Marsh Creek have only found a few fish (Dachtler 2004 and USFS data on file). Redband were documented in 1998 only below the 6020 road in Big Marsh Creek during an electrofishing survey (Dachtler 1998). In Big Marsh Creek competition from brook and brown trout are the most likely the reason for the decline. In Crescent Creek extreme low flow conditions during the winter are most likely why they are scarce above Big Marsh Creek

Little Deschutes River has a native population of redband trout historically but in recent years few if any redband trout have been reported (rated as scarce). The majority of the river is dominated by brown trout today, with brook trout in the upper reaches and tributaries (ODFW 1996). Surveys of the

Little Deschutes and its tributaries above Crescent by the USFS in recent years have not found any redband trout.

Redband Trout of the Lower Deschutes River and Tributaries

Redband trout in the Lower Deschutes River is an abundant and robust population which dominates the salmonid community in the lower river and is less abundant in the tributaries, where juvenile steelhead trout dominate. The upper Trout Creek drainage is dominated by resident redband trout where they coexist with steelhead trout.

Redband Trout of the John Day River Basin

Redband trout are also found in tributaries to the John Day River and the South Fork John Day River. These populations overlap with steelhead populations and in some cases their range extends farther upstream in the headwaters than steelhead trout. Steelhead migration to reach several headwater tributaries is limited by natural migration barriers and in some cases by man made barriers such as culverts and irrigation diversions. Little is know about the status or health of redband trout populations in tributaries to the South Fork John Day. Tributaries to the South fork of the John Day River may not have strong populations.

Other Fish Species

In the Crooked River Basin, redband trout dominated most fish bearing streams (Stuart et al 2002, draft report). Other species found included mountain whitefish, speckled dace, bridgelip suckers, introduced brook trout, northern pikeminnow, chisel mouth, large scale suckers. Near reservoirs, small mouth bass and brown bullhead are present (Stuart et al 2002, draft report). Below Bowman Dam mountain whitefish are found in abundance.

In the Deschutes River Basin, redband trout dominate most drainages, with brown trout and brook trout, mountain whitefish, sculpins, dace and bridgelip and large scale suckers common in some streams. In the Metolius River Basin, bull trout are more common in the tributaries, but brown trout, brook trout, mountain whitefish, sculpins, longnose dace and bridgelip suckers are common in the Metolius River. Kokanee salmon spawn in many rivers and streams that flow into lakes and reservoirs, including the Metolius River, the Deschutes River, and tributaries to Odell Lake, Suttle Lake, Crane Prairie Reservoir, and Wickiup Reservoir.

Invasive Plants in Riparian Habitats

The areas of invasive plant infestations and proposed treatment areas are widespread throughout the Riparian Reserve and RHCA network. Within most of the subwatersheds on the two forests, invasive plant infestations occur in the RR/RHCA where fish habitat also occurs. Large acreage of invasive plant infestation is associated with wetland or reservoir shoreline treatments most commonly associated with reed canarygrass or ribbongrass infestations. Fish habitat around and downstream of reed canarygrass infestations on National Forest System lands are important because of the value of the habitat for bull trout and Chinook salmon in the Metolius River, and redband trout in the Deschutes River, Fall River and Metolius River. These infestations are located on the streambank or lake shoreline and are in close proximity to fish habitat or serve as fish habitat depending on life stage and time of year.

Areas where fish species and fish habitat overlap with invasive plant sites is summarized below:

- Overlap of redband trout and invasive plant sites are found throughout the analysis area with the exception of the east side of the Bend/Fort Rock Ranger District, the upper Little Deschutes River and some isolated closed systems adjacent to Wilderness.

- The wide distribution of redband trout in the Deschutes, and John Day basins makes them the most likely species to be exposed to treatments in riparian areas.
- Bull trout are in proximity to weed infestations in the Davis Lake, Odell Lake, and Metolius River watersheds.
- The Metolius River ribbongrass infestation overlaps with a portion of the Chinook salmon EFH (Essential Fish Habitat).
- A limited amount of invasive plant treatment sites are along streams that are known to support steelhead populations. This indicates steelhead are at low risk from invasive plant treatments.
- Steelhead reintroduced to Whychus Creek and Mckay Creek in 2007 and 2008 have invasive plant sites in close proximity to them but risk from invasive plant treatments is still considered to be low.

Analysis of effects for alternatives two and three use the functional definition of a riparian area and not RR or RHCA. Riparian area is defined as a three-dimensional zone of direct interaction between terrestrial and aquatic ecosystems. Boundaries of riparian areas extend outward to the limits of flooding and upward into the canopy of streamside vegetation. Riparian areas can be viewed in terms of the spatial and temporal patterns of hydrologic and geomorphic processes, terrestrial plant succession and aquatic ecosystems (Gregory et al. 1991). For analysis of alternatives an aquatic influence zone of 100 ft on either side of stream was used to determine where effects to fish in streams, rivers and lakes may occur from chemical application. Within the analysis area there are riparian areas wider than 100 feet, but Level 2 Stream Survey data (USFS 1989-2005 unpublished data, S.O. files) indicates that the majority of true riparian vegetation around major class 1 and 2 streams within the analysis area is generally less than 100 ft.

USFWS and NMFS Conservation Measures

The biological and conference opinion for the Pacific Northwest Region Invasive Plant Program offered the following list of conservation recommendations relating to herbicide application that may be necessary for ESA compliance at the project level, depending on site specific considerations. They are designed to provide guidance in selecting appropriate conservation measures and practices in future ESA consultations on actions implementing the proposed direction. The Conservation Recommendations are included in the following table, with reference to this project's corresponding Project Design Features from Chapter 2.4.

Table 67. Conservation Recommendations from Biological Opinion and Corresponding Project Design Features.

Conservation Recommendation from R6 BO	Project Design Feature of this EIS
Where applicable, ground application adjacent to waters should only be done by hand wicking, wiping, dripping, painting or injecting.	#56 and #57 aquatic buffers (shown in Tables 16 and 17)
Riparian buffer zones should be flagged before beginning herbicide applications.	#56 and #57 aquatic buffers in consultation with fisheries biologist
Broadcast application should only occur when winds are not expected to cause drift into streams.	#15 wind velocity; #16 droplet size; and aquatic buffers
During broadcast application, consider monitoring weather conditions periodically by trained personnel at spray sites.	#15 monitor weather conditions
Consider not applying if precipitation has been forecasted to occur	#17 precipitation

within 24 hours of spraying.	
When applicable, use water to mix (dilute) herbicide products for application.	#9 herbicide carriers limited to water or vegetable oil
The applicator should only use surfactants or adjuvants in riparian areas that do not contain any ingredients on EPA's List 1 and 2, where listing indicates a chemical is of toxicological concern, or is potentially toxic with high priority for testing (U.S. EPA 2000a). If surfactant or adjuvant that contains any List 1 or 2 ingredients is considered, the risk to ESA-listed species and their habitat with that chemical should be evaluated before a use decision is made.	#56 and #57 aquatic buffers; consistency with R6 standard 18.
Maintenance and calibration of spray equipment should occur at least annually to ensure proper application rates.	#22 calibration of equipment
If consistent with project site objectives, use herbicide formulations containing clopyralid, glyphosate, imazapyr, metsulfuron methyl, or sulfometuron methyl, in riparian areas beside habitat used by ESA-listed salmonids.	#43 low risk to aquatic herbicides
Aerial applications should be designed to deliver a median droplet diameter size appropriate to reduce drift.	No aerial application proposed
Aerial spray should be released at the lowest height consistent with invasive plant control and flight safety.	No aerial application proposed

Consistency with these design features and conservation measures will ensure that the effects to fish are within those estimated in the Regional Invasive Plant EIS (USFS 2005a), the NMFS Biological and Conference Opinion (USDC 2005) and the USFWS Biological Opinion Concurrence and Conference Report (USDI 2005). Following these guidelines will ensure that the aquatic effects are minimized and the effects to listed fish are within those estimated in the Regional EIS ESA/MSA consultation.

3.7.2 Environmental Consequences

Introduction

The environmental consequences discussion focuses on the potential impacts of removing invasive plant populations by herbicides application, manual methods, prescribed fire, or mechanical methods. These methods could affect fish and aquatic biota from herbicide entering the water, sedimentation to spawning areas or reduction of overhead cover within riparian areas. Some discussion on impacts to aquatic invertebrates, aquatic macrophytes and algae are included where pertinent information is available. The effects analysis is tiered to The Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program (USFS 2005a), where most of the quantitative information related to potential concentrations of herbicides in water and their effects on fish and their habitat are covered. The PDFs listed in Chapter 2.4 and in the above table have been designed to add site-specific protection in addition to that provided by standards in the BO/BA from USFWS and NOAA for the R6 2005 FEIS (USDI 2005, USDC 2005).

The effects analysis focuses on watersheds that have Threatened or Sensitive fish species or where salmon or steelhead are proposed for reintroduction or have recently been reintroduced. Effects for each method proposed are included with more emphasis on herbicide effects and pulling of invasive plants. These two methods are the most common treatment methods and will be used across the analysis area. Site specific analysis is included for all watersheds that have the potential for effects to Threatened or Sensitive fish species. Also, effects are analyzed for watersheds where salmon or steelhead are proposed for reintroduction or have recently been reintroduced. Redband trout is the only sensitive fish or aquatic species on the Regional Forester's list that occurs in the project area. Redband trout are found throughout the analysis area; effects were analyzed alongside bull trout and steelhead where they overlap. Some of the watersheds with only redband trout were analyzed separately or where larger project area units existed or where treatment methods were different than those analyzed for federally listed fish species.

Six different treatment methods (manual, mechanical, biological, cultural, fire, and herbicides) were analyzed in the R6 2005 FEIS. Refer to Table 10 Chapter 2 for descriptions of the treatment methods. More details on methods specific to target species are included in Appendix B. Non-herbicide methods are discussed briefly and herbicides are discussed in more depth, because issues related to invasive plant management are about herbicide use.

General Non-herbicide Effects on Fish

Manual --- Pulling of invasive plants by hand or with tools will disturb small patches of soil which depending on proximity or location could add very small amounts of fine sediments to fish bearing streams. All the native species of fish found within this project area are stream or river spawners. Fine sediments that enter a stream could enter a redd and cause increased egg mortality by filling in the spaces between the cleaned gravels in the redd cutting off flow and oxygen to the redd. This can suffocate fertilized eggs or alevin and lead to decreased survival of offspring from the redd. Weed pulling most often occurs on small populations or scattered individual plants. Amounts of fine sediments produced from this action would be undetectable against natural sources and other man made sources of fine sediment.

Mechanical --- Scarifying or "harrowing" can have the same effects as hand pulling described above except it has a greater potential of adding fine sediments to a stream since it is generally done on a larger area that leads to more exposed and disturbed soils until vegetation reestablishes itself. Depending on size of area and location and proximity to a stream, this method could add measurable amounts of fine sediments to a stream and negatively impact spawning success.

Mowing and weed whacking are not ground disturbing activities but they would remove vegetative cover that could be import for juvenile fish rearing in the margins of streams, rivers and lakes. The reduction in cover and shade could potentially increase the amount of solar radiation reaching the water surface. Invasive plant species associated with riparian areas such as ribbongrass would have the greatest potential for reducing shade. However this is unlikely to have much effect on water temperatures as most shade comes from topography, aspect and larger streamside trees and shrubs. Some reduction in overhead cover could occur from removal of ribbongrass along stream margins.

Biological --- The Animal and Health Inspection Service (APHIS) must approve the entry of all biological control agents into the United States (see Appendix J in the 2005 R6 FEIS, USDA 2005b). Biological control agents under this project will be primarily used on Canada thistle and St. Johnswort. Effects from biological agents are analyzed by APHIS before being approved for use. Only biological agents approved by APHIS and the state of Oregon, and that comply with standards in the Forest Plans, would be approved for use under this document. Biological agents such as insects that target noxious weeds have very little to no chance of having direct, indirect or cumulative effects on listed fish species or their habitats. This method will be compliant with Standard #14, will have no effect and will not be discussed any further in this document.

Cultural --- Soil enhancement such as amendments and mulching should help to stabilize soils and provide increased growth to native plants that already existed or have been planted as part of active restoration efforts. This should be a beneficial effect to areas where invasive plants have been eliminated through different treatment methods.

Tarping may be tried experimentally in areas where moderate to small patches of reed canarygrass or ribbongrass are present to kill rhizomes and prevent regrowth. This method will require a tarp to cover an infested area for 3 months to 2 years and allow shade and heat to kill the plants and essentially sterilize the soil. Bare soil would be present after the tarp was removed which could contribute fine sediments to streams. Active restoration of bare soil patches with native plantings and possible use of mulching and soil amendments would most likely be required to prevent any sediment to enter runoff following a treatment with this method.

Fire --- Areas burned could produce varying amounts of fine sediments depending on the size and intensity of the burn along with soil characteristics, slope, rainfall and proximity to stream channels. The intent of fire is to reduce the biomass of the target invasive plant in areas that have dense populations. Usually these areas treated with fire will be followed up with herbicide treatments.

General Effects of Herbicide Use

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). Herbicides used for aquatic invasive plant control have been shown to affect aquatic ecosystem components, however concentration of herbicides coming in contact with water following land-base treatments are unlikely to be great enough to cause such changes. 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. Or, sublethal effects could result from substantial effects to habitat or food supply.

Herbicide risk assessments considered worst-case scenarios including accidental exposures and application at maximum label rates. The R6 2005 FEIS (USDA 2005a) added a margin of safety to the SERA Risk Assessments by making the thresholds of concern substantially lower than is normally used for such assessments. Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available. Table 19, Chapter 3.2 displays the risk assessments and date for herbicides considered for use. The risk assessments 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.

Herbicides considered for use in this project may harm aquatic plants or algae. However this is not anticipated because following herbicide label requirements and PDFs will protect against this. The amount or number of these organisms that could be affected is unknown but is expected to be very few and to not have a detectable impact on fish behavior or survival. This would not adversely impact aquatic habitats and the food chain because the amount of herbicide that could be delivered is relatively low in comparison with levels of concern from SERA Assessments and the duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived. Any impacts would be very localized and most likely occur only at or very near the point the herbicide entered a waterbody.

The location, application rate and method, along with the behavior of the herbicide in the environment, influence the amount and length of time an herbicide is detectable 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 herbicide must be present in an active form at a concentration high enough to cause a biological effect (USDA 2005b).

Effects of Active Ingredients in Herbicides to Aquatic Organisms

The most sensitive effect from the most sensitive species tested was used to determine the toxicity indices for each herbicide. Quantitative estimates of dose from each exposure scenario were compared to the corresponding toxicity index to determine the potential for adverse effect. Doses below the toxicity indices resulted in discountable effects. Table 68 lists the toxicity indices for fish used for this project and the R6 2005 FEIS BA (USFS 2005d).

Table 68. Toxicity indices for fish (USFS 2005d)

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

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
Chlorsulfuron	Acute	NOEC	**2 mg/L** (1/20th of LC50)	Brown trout	LC50 at 40 mg/L
	Chronic	NOEC[1]	3.2 mg/L	Brown trout	rainbow trout length affected at 66mg/L
Clopyralid	Acute	NOEC	**5 mg/L** (1/20th of LC50)	Rainbow trout	LC50 at 103 mg/L
	Chronic				none available
Glyphosate (no surfactant)	Acute	NOEC	**0.1 mg/L** (1/20th/LC50)	Coho salmon	Impaired olfaction at 1.0 mg/L from Tierny et al. 2006
	Chronic	NOEC	2.57 mg/L[2]	Rainbow trout	Life-cycle study in minnows; LOAEL not given
Glyphosate with POEA surfactant	Acute	NOEC	**0.065 mg/L** (1/20th of LC50)	Rainbow trout	LC50 at 1.3 mg/L for fingerlings (surfactant formulation)
	Chronic	NOEC	0.36 mg/L	salmonids	estimated from full life-cycle study of minnows (surfactant formulation)
Imazapic	Acute	NOEC	100 mg/L	all fish	at 100 mg/L, no statistically sig. mortality
	Chronic	NOEC	**100 mg/L**	fathead minnow	No treatment related effects to hatch or growth
Imazapyr	Acute	NOEC	**5 mg/L** (1/20th LC50)	trout, catfish, bluegill	LC50 at 110-180 mg/L for North American species
	Chronic	NOEC	43.1 mg/L	Rainbow	“nearly significant” effects on early life stages at 92.4 mg/L
Metsulfuron methyl	Acute	NOEC	10 mg/L	Rainbow	lethargy, erratic swimming at 100 mg/L
	Chronic	NOEC	**4.5 mg/L**	Rainbow	standard length effects at 8 mg/L
Picloram	Acute	NOEC	**0.04 mg/L** (1/20th LC50)	Cutthroat trout	LC50 at 0.80 mg/L
	Chronic	NOEC	0.55 mg/L	Rainbow trout	body weigh and length of fry reduced at 0.88 mg/L
Sethoxydim	Acute	NOEC	**0.06 mg/L** (1/20th LC50)	Rainbow trout	LC50 of Poast at 1.2 mg/L
	Chronic	NOEC			none available
Sulfometuron methyl	Acute	NOEC	7.3 mg/L	Fathead minnow	No signs of toxicity at highest doses tested
	Chronic	NOEC	**1.17 mg/L**	Fathead minnow	No effects on hatch, survival or growth at highest doses tested
Triclopyr acid	Acute	NOEC	**0.26 mg/L**	Chum	LC50 at 5.3 mg/L[3]

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in **bold** indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.					
			(1/20th LC50)	salmon	
	Chronic	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
Triclopyr BEE	Acute		**0.012 mg/L**	Bluegill sunfish	LC50 at 0.25 mg/L
	Chronic[4]	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
NPE Surfactants	Acute[5]	NOEC	**0.2 mg/L** (1/20th LC50)	fathead minnow, rainbow trout	LC50 at 4.0 mg/L
	Chronic[6]	NOEC	1.0 mg/L	trout	no LOEL given

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

Chronic and Acute Exposures

The toxicity metric values (estimated or measured NOEC values) used in the R6 2005 FEIS (USFS 2005a) analysis was selected as the most likely to protect against acute sub-lethal effects. For assessing potential risk to listed fish, while accounting for uncertainty regarding sub-lethal effects, the 1/20th of the acute LC50 (US EPA 2004) or a lower acute or chronic NOEC value was used for the acute toxicity index. For the proposed action, effects analysis tiers to the results of the R6 2005 FEIS (USFS 2005a) for chronic and acute exposures, and analyzes the potential for more than a discountable risk of acute sub-lethal effects as well as indirect effects from impacts to the food web.

Results of the R6 2005 FEIS (USFS 2005a) analysis using SERA (2001, 2003, 2004) risk assessments indicates that chronic exposures to fish are not plausible, in other words not mathematically possible . Therefore, chronic exposures to fish for the proposed action are highly unlikely to occur. It is safe to assume that it is highly unlikely to reach a LOC for chronic exposures herbicide treatments on the ONF, DNF or CRNG.

The R6 FEIS (USFS 2005a) identified four herbicides that mathematically exceeded the LOC for aquatic plants: imazapyr, metsulfuron, sulfometuron and chlorsulfuron. Low rainfall rates over most of the project area would also make chronic effects very unlikely because transport of these herbicides to waterbodies in amounts high enough to reach chronic levels is unlikely. The R6 2005 FEIS (USFS 2005a) concluded that exposure of aquatic plants to chronic toxicity concentrations of these herbicides to be mathematically possible. The SERA risk assessments indicate that low levels of chronic effects could occur from these herbicides but they did not take into account buffers zones and the use of herbicides only at the typical application rate within 100 feet of perennial water (PDF 54). This proposed action prohibits broadcasting of these herbicides within 100 feet (50 feet for aquatic imazapyr) of perennial waterbodies further reducing the chance for drift and runoff contamination after rain events. After reviewing past field data and reports Michael (2004) concluded that maximum concentrations of herbicides found in streams is related to application method with broadcast applications generating the highest concentrations.

Herbicide Risk Categories

The sections that follow below focus on the probability and magnitude of acute exposures from herbicide treatments based on results from the SERA (2001, 2003, 2004) risk assessments. It must be made clear that the risk categories for herbicides identified in the R6 2005 FEIS Fish BA (USFS 2005d) is risk to aquatic organisms (fish, invertebrates, algae, aquatic macrophytes) among the herbicides analyzed for the R6 2005 ROD. The herbicides analyzed in the R6 2005 FEIS (USFS 2005a) were compared to each other and placed in a risk level category according to results from worst-case acute exposure scenario used in the SERA (2001, 2003, 2004) risk assessments. Herbicides analyzed in the R6 2005 FEIS (USFS 2005a) were displayed in the following category of risk:

- Lowest risk: *results from SERA risk assessments indicated no risk or a plausible risk to aquatic macrophytes only*,
- Moderate risk: *results from SERA risk assessments indicated a plausible risk to algae or invertebrates, in addition to plants*,
- Highest risk: *results from SERA risk assessments indicated a plausible risk to fish (may or may not be a risk to algae, invertebrates, or macrophytes)*

The herbicides were rated into the three categories based on their potential for affecting fish and other aquatic life. Herbicides that are specifically formulated and approved for use in waterbodies are also listed. These aquatic approved herbicides are not necessarily less toxic to aquatic organisms. These ratings are based on the effects reviewed by the R6 FEIS (USFS 2005a) and are primarily based on the finding in the SERA (2001, 2003, 2004) Risk Assessments. With these findings, the following herbicides considered for use with this project were rated into categories for level of concern regarding effects to fish and aquatic species such as algae, macroinvertebrates and aquatic macrophytes:

- **Lower level of concern** for aquatic species: clopyralid, imazapic, metsulfuron methyl
- **Moderate level of concern** for aquatic species: chlorsulfuron, imazapyr, sulfometuron methyl
- **Higher level of concern** for fish species**:** glyphosate, triclopyr, picloram, sethoxydim
- **Aquatic approved herbicides include specific formulations of:** glyphosate w/o surfactant, triclopyr TEA, and imazapyr

The lowest risk group contains those herbicides for which LOCs were either not exceeded, or only exceeded the LOC for aquatic macrophytes. The moderate risk group contains those herbicides for which LOCs were exceeded for two aquatic species groups other than fish. The higher risk group contains those herbicides for which LOCs for fish were exceeded.

The ability and amount of herbicides that may come in contact with perennial waterbodies once in the soil depends on herbicide movement in soils, in water and other site specific environmental parameters such as on the ground organic matter and vegetation. Detailed information about each herbicide is in the Fisheries Report, BA, and R6 2005 FEIS and associated consultation documents.

Herbicide Mixtures

Under specified conditions, dose addition analysis is believed to provide a reasonable estimate of the cumulative toxicity of herbicide mixtures. The hazard index (HI) method of assessing dose addition is relatively simple and straightforward. The approach is used or recommended by a number of agencies, including EPA, National Academy of Sciences, National Research Council, and Occupational Health and Safety Administration (ATSDR, 2004).

The individual herbicides in each mixture are analyzed to determine estimated dose, which is then divided by the respective “toxicity index” to produce a hazard quotient (HQ). When the HQ is less than 1.0, then the dose is less than the toxicity index. The HI is calculated by adding all the HQ’s for the herbicides in the mixture. This is known as dose addition. If the HI is < 1.0, then an acceptable level of mixture toxicity risk is assumed to be present. A HI would be calculated at the project level to assess potential effects to listed species in a project area.

Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al., 2000). The precise toxic mechanism(s) in birds and mammals are not known for all of the 10 herbicides contained in the proposed action. But in terrestrial wildlife, effects to the kidney and liver are typical endpoints. Effects to the fish and fry are typical endpoints.

Dose addition analysis is also a reasonable assumption when analyzing mixtures of herbicides with different or unknown toxicity mechanisms, when expected doses will be below known toxic levels (ATSDR, 2004). This is also supported by data from Feron et al. (1995), as cited in EPA (Choudhury et al., 2000), which showed interaction when mixture herbicide components were present in concentrations at or near their respective LOAELs. No interaction was observed between herbicide components when present at concentrations 1/10 or 1/3 or their respective LOAELs.

The dose addition analysis described in this document is believed to produce conservative estimates of mixture toxicity for several reasons. First, the assumption of dose addition in itself is conservative; the dose addition protocol assumes an additive response for all herbicides in the mixture, when in fact some herbicides may produce independent, non-additive responses. For example, the EPA description of dose addition analysis in Choudhury et al. (2000) states that separate dose addition analyses should be performed for each affected organ. This protocol utilizes one HI that includes all herbicides, regardless of toxicity site, potentially resulting in a higher HI value than if mixture components were analyzed in smaller groups by affected organ.

Also, by requiring the HI for the mixture to be less than 1.0, the Hazard Quotients of each component in the mixture must be below known toxic levels and will meet the criteria cited in ATSDR (2004) and Choudhury et al. (2000).

The primary sources of uncertainty in utilizing dose addition analysis in the proposed manner are the lack of mixture analysis studies utilizing more than two herbicides. The risk of adverse effects, with respect to the lack of information on mixtures involving more than two herbicides, increases with the number of mixture components. In an effort to minimize these risks mixtures will contain no more than three active herbicide ingredients (PDF #51).

Uncertainty and Data Gaps

Generally, active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects that must be considered, laboratory experiments do not account for organisms in their natural environments. Environmental stressors can increase the adverse effects of contaminants, but the degree to which these effects may occur for various herbicides is largely unknown. This leads to uncertainty in the risk assessment analysis. Additional discussion of incomplete and unavailable information can be found in the R6 FEIS (USFS 2005a).

Inerts, Adjuvants and Impurities

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. They 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.

Inerts and adjuvants, including surfactants, are not under the same registration guidelines as are pesticides. The EPA classifies these compounds into four lists based on the available toxicity information. If the compounds are not classified as toxic, then all information on them is considered proprietary and the manufacturer need not disclose their identity. Therefore, inerts and adjuvants generally do not have the same amount of research conducted on their effects, compared to active ingredients.

Impurities and Metabolites

All herbicides likely contain impurities as a result of the synthesis or production process. The toxic effects of impurities are addressed in toxicity tests using the technical grade product, which would contain the impurities. Impurities found in herbicides proposed for use are either non-toxic or will occur in such concentrations that adverse effects are no expected.

Hexachlorobenzene is an impurity in the technical grade products of clopyralid and picloram. Hexachlorobenzene is a ubiquitous and persistent herbicide in the environment, as it is used or present in a wide variety of manufacturing processes. It has been shown to cause tumors in animals, and EPA has classified it as a probable human carcinogen (SERA, 2003 Picloram). The amount of hexachlorobenzene released into the environment from Forest Service use of picloram and clopyralid is inconsequential in comparison to existing background levels and the annual release from manufacturing processes (SERA, 2003 Picloram). The use of picloram and clopyralid in remote forest locations could constitute the primary source of localized contamination. The projected amounts of hexachlorobenzene released during invasive plant treatments are calculated to be well below the level that poses a risk to cancer in fish or mammals.

Technical grade glyphosate contains an impurity, N-nitrosoglyphosate, but the amount of this impurity in glyphosate has been classified as toxicologically insignificant by the EPA.

POEA surfactant used in Roundup and Roundup Pro contain 1,4-dioxane as an impurity, which has been classified by EPA as a probable human carcinogen. Based on current toxicity data and an analysis by Borrecco and Neisess (1991), the potential effects of 1, 4-dioxane are encompassed by the available toxicity data on the Roundup formulation (SERA, 2003 Glyphosate). Borrecco and Neisess (1991) also demonstrated that the upper limit of risk of cancer from this impurity was less than one in a million.

Triclopyr contains an impurity, 2- butoxyethanol (aka EGBE), that is a major industrial herbicide used in a wide variety of industrial and commercial applications. It is known to cause fragile red blood cells in rodents (Borrecco and Neisess, 1991). EPA has classified EGBE as moderately toxic. Borrecco and Neisess (1991) found that potential doses of EGBE to mammals were less than 0.001 of the lowest LD_{50} and did not substantially increase risk over the risk identified for triclopyr, even under worst-case scenarios.

Similar to impurities, the potential health effects of herbicide metabolites are often accounted for in the available toxicity studies, assuming that the toxicological effects of metabolism within the test animal species would be similar to those in other animals. The potential toxic effects of environmental metabolites (those formed as a result of processes outside of the body) may not be accounted for by laboratory toxicity studies.

TCP (3,5,6-trichloro-2-pyridinol) is an environmental metabolite of triclopyr. It is substantially more toxic to fish than either triclopyr acid or triclopyr TEA, and is similar to the toxicity of triclopyr BEE (SERA, 2003 Triclopyr). For fish, the risk characterization for TCP was considered quantitatively, using available toxicity data. SERA (2003, Triclopyr) found that worst-case exposures of fish to TCP did not exceed levels of concern when triclopyr is applied at the typical application rate. However, at higher application rates, the level of concern is substantially exceeded and adverse effects to fish are plausible (using worst-case exposure assumptions) from this metabolite.

Site-specific analysis is necessary to further evaluate the risk of toxic effects from TCP. The Proposed Action restricts use of triclopyr to specific application methods, such as spot spray or cut stump applications. Since the worst-case exposure estimates were done using either an accidental spill of 200 gallons of triclopyr, or a broadcast spray of triclopyr to a 10-acre area, it does not appear plausible for the resulting estimates of TCP concentration to occur given the restrictions contained in the Proposed Action. Exposure of fish to TCP would also be minimal.

Inert Ingredients

An inert ingredient in an herbicide is any ingredient that does not kill plants. Surfactants are a special type of inert ingredient discussed in a following section.

The EPA has categorized approximately 1,200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of known or suspected toxicological concern. List 4 contains non-toxic substances such as corn oil, honey and water. List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 or 2) or non-toxic (List 4).

None of the inert ingredients included on EPA's List 2, 3, or 4 need to be disclosed on the herbicide label, despite evidence that some compounds on these lists may cause adverse effects to laboratory animals and humans (Anonymous 1999; Cox 1999; Knight 1997; Knight and Cox 1998; Marquardt et al., 1998). EPA's own website (http://www.epa.gov/opprd001/inerts/) states, "Since neither federal law nor the regulations define the term "inert" on the basis of toxicity, hazard or risk to humans, non-target species, or the environment, it should not be assumed that all inert ingredients are non-toxic." Northwest Coalition for Alternatives to Pesticides (NCAP) obtained the identity of many inert ingredients through a Freedom of Information Act request; the list of inerts they obtained can be found at http://www.pesticide.org/FOIA/

Use of formulations containing inert ingredients on List 3 and 4 is preferred for invasive plant treatment under current Forest Service policy. Standard #18 in the Proposed Action requires review of inert ingredients in a risk assessment prior to formulations being approved for use on FS projects.

Most information about inert ingredients that is submitted to EPA for pesticide registration is classified as "Confidential Business Information" (CBI). CBI is not generally released or available for public review. SERA risk assessors obtained clearance to review the identity and data on inerts in the CBI files, as well as used publicly available data, when preparing herbicide risk assessments. However, even when the inert ingredients can be identified, toxicity data on the ingredient may be lacking. This leads to substantial uncertainty in the assessment of hazard or risk posed by the inert ingredients. There is very little data regarding the effects to most wildlife or fish species from inert ingredients contained in the 10 herbicides considered in the Proposed Action.

FS/SERA Risk Assessments analyze the effects of inert ingredients and full formulations by the process described below:

- Compare acute toxicity data between the formulated products (includes inert ingredients) and their active ingredients alone;
- Disclose whether or not the formulated products have undergone chronic toxicity testing; and
- Identify, with the help of EPA and the herbicide registrants, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers who have studied the relationships between acute and chronic toxicity have found that relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al., 1984). The court in *NCAP v. Lyng*, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decision maker to make a reasoned decision. *In SRCC v. Robertson*, Civ.No. S-91-217 (E.D. Cal., June 12, 1992) and again in *CATs v. Dombeck*, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001) the district court upheld the adequacy of the methodology described above for disclosure of inert ingredients and additives.

Available information for the 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 metsulfuron 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 formulations, 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 pure 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 increase the potential risk.

Triclopyr - Formulations contain ethanol (The salt (aquatic) form of triclopyr) or kerosene (The ester form of triclopyr), 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. Use of formulations containing toxic inert ingredients may increase the risk of toxic effects to wildlife above that, or in addition to, the risk discussed for the active ingredient.

Surfactants

Surfactants, or surface-acting agents, facilitate and enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of herbicides. There is a fair amount of research on the effects of surfactants to terrestrial and aquatic organisms because they are widely used in detergents, cosmetics, shampoos and other products designed for human exposure.

The following information is taken from “Analysis of Issues Surrounding the Use of Spray Adjuvants with Herbicides” (USDA 2003) and “Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications” (USDA 2003). Refer to these documents for more complete discussions.

Some glyphosate formulations contain polyethoxylated tallow amine (POEA) surfactant, which is substantially more toxic to aquatic species than glyphosate or other surfactants that may be used with glyphosate (SERA, 2003 Glyphosate). In the SERA risk assessment, the toxicity of glyphosate is characterized based on the use of a surfactant, either in the formulation or added as an adjuvant in a tank mixture (SERA, 2003 Glyphosate).

Polyglycol 26-2, used in picloram, will impact mitochondrial function in vitro, but information is insufficient to evaluate risks *in vivo* from field applications at plausible levels of exposure (SERA, 2003 Picloram).

The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as NonylPhenol polyEthoxylate (NPE). NPE is found in these commercial surfactants at rates varying from 20 to 80 percent. NPE is formed through the combination of ethylene oxide with nonylphenol (NP), and may contain small amounts of un-reacted NP. Nonylphenol is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA’s inerts List 1). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen, estradiol.

NP and NPE are weakly estrogenic in aquatic and terrestrial organisms (1000 to 100,000 times weaker than natural estrogen). NP and NPE are not toxic to soil microbes. NP is highly toxic to many aquatic organisms at low concentrations (currently on U.S. EPA’s Inert List 1).

NP and NPE have been studied for effects to aquatic organisms. NP is more toxic than NP9E, by one to three orders of magnitude (USDA 2003). The toxicities of the intermediate breakdown products, NPEC and others, are intermediate between NP and NPE. In the aquatic environment, the breakdown products NP1EC and NP2EC are likely to be present also. These two metabolites are known to affect vitellogenin (a precursor for egg yolk) production in male fish, but NP, which is a more potent estrogenic compound, did not cause vitellogenin increases in male Xenopus laevis, or leopard frogs (Selcer et al., 2001; cited in USDA 2003).

Mann and Bidwell (2000, 2001) tested several Australian frogs and Xenopus for effects to NP8E. They found that Xenopus was the most sensitive to toxic effects, with an LC50 of 3.9 ppm (3.9 mg/L). Similar to studies with herbicides, the LC50 values for the frogs are comparable to those for fish (USDA FS, 2003). NP8E inhibited growth at concentrations as low as 1 ppm (Mann and Bidwell, 2000, 2001). Mild narcosis of tadpoles can occur at EC50 values as low as 2.3 ppm, and reduced dissolved oxygen content in the water lowered the EC50 values by about half as compared to normal oxygen levels. The tadpoles recovered from the narcosis. Malformations in Xenopus occurred at EC50 values between 2.8 and 4.6 mg/L.

NP may cause tail resorption with a 14-day NOEC of 25 ppb for *Xenopus laevis* (Fort and Stover 1997; cited in USDA FS, 2003). NP also increased the percentage of female *Xenopus* developing from tadpoles exposed to 22 ppb for 12 weeks, but did not produce this effect at 2.2 ppb.

During operational use of NPE surfactant, ambient levels of NP9E (including a small percentage of NP, NP1EC, and NP2EC) could average 12.5 ppb (range 3.1 to 31.2 ppb). The duration of these exposures from Forest Service use would generally be much shorter than those used in laboratory experiments, due to transport by flowing streams, dilution, and environmental degradation. These levels are not likely to adversely affect amphibians found in the Pacific Northwest for normal operations. However, overspray or accidental spills could produce concentrations of NP9E that could adversely affect amphibians, particularly in small stagnant ponds.

Endocrine Disruption

Recent information has highlighted the potential for certain synthetic and natural herbicides to affect endocrine glands, hormones, and hormone receptors (endocrine system). The endocrine system helps control metabolism, body composition, growth and development, reproduction, and many other physiological regulators. An endocrine disrupter is a substance that may exert effects to the body by affecting the availability of a hormone to its target tissue(s) and/or affecting the response of target tissues to the hormone (SERA, 2002). Estrogen is a prominent hormone in animal systems and substances that mimic estrogen or stimulate similar responses in target tissues are referred to as "estrogenic."

Scientists have expressed concern regarding estrogenic effects of synthetic herbicides since before the 1970s. The EPA (1997) reports effects of endocrine disruption in animals that "include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals."

Some of the more noted endocrine glands include gonads, adrenal, pancreas, thyroid and pituitary. Alteration in endocrine function may affect reproductive output (i.e. feminization, masculization), and therefore, could affect population numbers of affected species.

Of the herbicides analyzed in this EIS, NPE surfactants have been identified as potentially having estrogenic effects (USGS 1998, Bakke 2003). Triclopyr and glyphosate have been evaluated for endocrine disrupting effects, and while some data exists to the contrary (i.e. Yousef et al. 1995, testing glyphosate), the weight of evidence indicates that these herbicides cause no specific toxic effects on endocrine function (SERA, 2002).

Synergistic Effects

Certain herbicides may cause synergistic effects in the presence of other herbicides: that is, the total effect of two herbicides may be greater than that suggested by the sum of the effects from the individual components (USEPA, 2000). However, information regarding the existence or potential for synergistic effects from the herbicides discussed in this document is very limited.

Some of the herbicides analyzed for this EIS (e.g. picloram) have been investigated for possible synergistic effects but the study designs were insufficient for the assessment of toxicological interactions (SERA, Picloram, p.3-35). Some studies of some herbicides have noted statistically significant interactions (both synergistic and antagonistic) (Durkin, pers. com.). Even with excellent data, the complexity of the experimental designs necessary to properly assess interactions, and the uncertainties regarding the dose-response relationship for interactions, make the quantitative use of interaction data in risk assessments infeasible (ATSDR 2004, USEPA 2000).

USEPA (2000) did state that for exposures at low doses, with low risk for each component in the herbicide mixture, that the likelihood of significant interaction (e.g. synergistic effects) is usually considered to be low. Likewise, a report by ATSDR (2004) cited several studies using rats that found no synergistic effects for mixtures of four, eight and nine herbicides at low (sub-toxic) doses. However, some studies have found different results for some herbicides, the study of synergist effects is extremely complicated, and there can be substantial uncertainty in the risk characterization for herbicide mixtures (ATSDR, 2004; USEPA, 2000).

Site-Specific Effects Analysis Overview

The direct and indirect effects of herbicide treatment for this EIS were analyzed by 6th field subwatershed. The Proposed Action would treat up to 14,547 acres at 1,892 sites across the Ochoco NF, Deschutes NF and Crooked River National Grassland. On the ONF, DNF and CRNG invasive plant project area units (PAUs) are located in 180 subwatersheds that range from 6,391 acres to 47,959 acres. Cumulative effects are analyzed to the 5th field watershed level unless there was a reason to expand the analysis further. There are 51 watersheds within the analysis area. Approximately 5,664 acres of these invasive plant sites are within watersheds that could affect ESA listed bull trout, steelhead or Chinook salmon EFH.

Analysis was done for proposed treatments in watershed with listed steelhead or bull trout, using Risk Assessment Worksheets (SERA 2001, 2003, 2004). These local risk assessments were designed to adequately identify sub-lethal effects to fish and their significance to fish populations. Hazard Quotients (HQ) were calculated in each watershed with listed steelhead or bull trout for each herbicide proposed for use with soil type, precipitation and application rate as part of the input variables. Based on risk assessments developed during the Regional 6 FEIS (USDA 2005a) this project will use herbicides that can effectively treat the target invasive plant species and that have a HQ less than 1 for fish. Instances where the HQ exceeded the “level of concern” (LOC) for each species group as a result of predicted herbicide concentrations are presented in the SERA (2001, 2003, 2004) risk assessments. The LOC was defined as when the hazard quotient exceeded a value of 1. The HQ is defined as a ratio of the predicted environmental concentration to an effects threshold concentration presented in the SERA (2001, 2003, 2004) risk assessments. The LOC was defined as when the HQ exceeded a value of 1. The HQ is defined as a ratio of the predicted environmental concentration to an effects threshold concentration.

Details about how the worksheet calculates exposure based on local conditions, and the specific project, soils and weather variables entered into the worksheets are described in the Fisheries Report and Fisheries Biological Assessment.

Results in Table 69 display what locations, which herbicides and at what application rate the HQ of 1.0 was exceeded. The model can not take into account the local slope, water volume, forest vegetation, buffer zones, application locations or application method. These factors could influence the amount of herbicide that reaches a waterbody, its concentration once in the waterbody and consequently its effects to fish or other aquatic biota. In addition, the model assumed vegetation is grass, which would have less buffering effect than the forest vegetation types in the project area.

Table 69. Watersheds where SERA Worksheet outcomes for specific herbicides equaled or exceeded the hazard quotient of 1.0. Watersheds results were lumped together if they had similar rainfall and soil characteristics.

Watershed(s)	TES fish	Herbicide	Modeled Rainfall Scenario	Application Rate	Aquatic Biota Type	Hazard Quotient
Metolius, Whychus, Bridge,	Bull Trout Steelhead Redband	Chlorsulfuron	Storm	Highest	Aquatic Macrophytes	1.4
Metolius	Bull Trout Redband	Aquatic Glyphosate	Average	Highest	Sensitive Fish	2.0
Metolius	Bull Trout Redband	Aquatic Glyphosate	Storm	Highest	Sensitive Fish	5.0
Metolius	Bull Trout Redband	Aquatic Glyphosate	Storm	Typical	Sensitive Fish	1.5
Metolius	Bull Trout Redband	Aquatic Triclopyr	Average	Highest	Sensitive Fish	4.0
Metolius	Bull Trout Redband	Aquatic Triclopyr	Storm	Highest	Sensitive Fish	6.0
Trout Creek Upper John Day	Steelhead Redband	Aquatic Triclopyr	Average	Highest	Sensitive Fish	1.4
Odell/Davis	Bull Trout Redband	Chlorsulfuron	Average	Highest	Aquatic Macrophytes	18.0
Odell/Davis	Bull Trout Redband	Chlorsulfuron	Storm	Highest	Aquatic Macrophytes	24.0
Odell/Davis	Bull Trout Redband	Chlorsulfuron	Average	Typical	Aquatic Macrophytes	4.0
Odell/Davis	Bull Trout Redband	Chlorsulfuron	Storm	Typical	Aquatic Macrophytes	5.0
Odell/Davis	Bull Trout Redband	Chlorsulfuron	Storm	Highest	Algae	1.1
Odell/Davis	Bull Trout Redband	Picloram	Average	Highest	Sensitive Fish	1.7
Odell/Davis	Bull Trout Redband	Picloram	Storm	Highest	Sensitive Fish	1.9

Table 69 shows that hazard quotients were generally exceeded at the highest application rate, and in scenarios where a large storm event occurred within 24 hours after application. PDF 18 requires use of typical rates of herbicide applied within 100 feet of surface waters, which would eliminate the potential for these effects to occur. This model assume broadcast spraying will occur within 50 feet of the stream, however, the use of glyphosate in the Metolius Watershed (HQ for fish = 1.5 assuming a storm soon after treatment) and chlorsulfuron in the Odell/ Davis watershed (HQ for aquatic macrophytes = 4 under normal weather, and 5 with a storm soon after treatment) are the only site-specific situations that exceed the HQ of 1.0, assuming typical rates. These estimated HQs are likely overestimated because they assume broadcast spray within 50 feet of perennial water bodies, which is not allowed under any alternative. The total infested area in the Metolius is less than an acre.

The SERA Worksheets results indicate that effects to fish, macroinvertebrates, aquatic plants and algae not expected in most locations. If some mortality does occur to algae or aquatic plants which is the most plausible scenario, slight reductions in this portion of the food web would have limited indirect effects to fish populations by slightly reducing forage and cover for aquatic insects and young fry. These reductions in forage would most likely be localized and short term until algae and macrophyte populations recovered. After considering on the ground conditions that in most cases would lessen herbicide effects from what the model results show along with application of PDFs indicate herbicides proposed for use would not cause direct harm to individual fish or fish populations. The use of high risk herbicides such as picloram in proximity to waterbodies and sensitive fish populations have been modified on a subwatershed basis by using site specific PDFs. This adds an extra precautionary measure to ensure harm to fish is avoided.

Aquatic Buffers

Forested buffer zones provide protection from herbicides reaching streams and waterbodies through either spray, drift or runoff. Buffer widths in conjunction with application methods are listed in Tables 15 and 16, Chapter 2.4. Buffer widths were developed from looking at existing studies or from best professional judgment based on the literature. These buffers along with other PDFs that deal with application method and location should greatly reduce but not entirely eliminate the chance that some small amounts of herbicide will reach surface waters. Further discussion of mapped invasive plant sites and their location in proximity to streams with TE fish is included in site-specific watershed effects, Appendix H of this EIS. In many instances mapped invasive plant sites proposed for treatment, are much farther from waters with fish than the largest buffers.

Spray drift can be minimized by using larger droplet size and methods that get closer to the target plant. There is very little drift associated with methods such as wiping and wicking or injecting plants while spraying has a higher probability of drift. One study showed that a fine spray mist particle (100 micron droplet) traveled horizontally 77 feet when released from a height of 10 feet off the ground (USDC NOAA 2002b in Berg 2004). Using coarse sprays with larger droplets as is required under this document and by following minimum wind speed requirements should reduce the potential for drift in most application scenarios. Forested buffers will provide vegetation cover to help intercept herbicide droplets if drift does occur.

Amounts of herbicides reaching streams or waterbodies can occur depending on several factors. These include amount and type of herbicide applied, precipitation amount and timing after herbicide application, buffer distance and vegetative cover/organic matter associated with the buffer. Soil permeability will dictate how much herbicide can runoff or percolate through the soils. Sandy coarse soils generally don’t have as much runoff as clay or fine textured soils. Organic matter in soils holds more water than other soil components increasing the ability of the soil to hold dissolved herbicides in the root zone where plants can access them (Berg 2004). Organic matter also often holds more soil microbes that increase some herbicide degradation rates. Slope steepness and topography can impact the amount of herbicide that reaches a stream or waterbody. Even slightly soluble herbicides and those strongly absorbed to soil particles can be carried down slope in storm water, with steeper slopes elevating the hazard (Durkin 2003 in Berg 2004).

Models for buffer effectiveness have focused on drift primarily with aerial herbicide application and for runoff in agricultural croplands. Available models do not take into account forest canopy cover, droplet runoff from different foliar types and forest topography (Berg 2004). Different forest types along with soil types and topography can influence effectiveness of buffer strips and studies are lacking on effectiveness for all these scenarios. The effectiveness of buffers reducing runoff caused water quality effects has not been able to be modeled in forested situations because flow from runoff is concentrated only through parts of the buffer and channeling caused by micro-relief reduces the surface area of the buffer that comes in contact with flow. The complex characteristics of forested buffers are highly variable making them difficult to model.

Buffer widths and how they are determined vary by state and agency. The state of Oregon aggregates buffer width by stream type and by application method (generally 60 ft for aerial and 10 ft for ground). Other states and agencies use wind speed, application method, and toxicity to determine buffers. NCASI (2000) compared widths needed for 90 % effectiveness (measured LC 10 or as <0.1% of application rate) between aerial and ground application techniques and found that ground applications require considerably smaller buffer widths to achieve 90 % effectiveness. Comerford et al. (1992 in Berg 2004) concluded that for forestry application strips of 15 m (49.2 feet) or larger were effective in minimizing pesticide residue that may enter streams. These authors also added that subsurface macropore flow can cause much wider buffers to be ineffective at completely keeping residues out of surface waters.

Roadside Treatments

The SERA risk assessments do not specifically predict exposures from roadside treatments along ditches connected to streams. Road ditches on the DNF, ONF and CRNG generally do not run water during the late spring and summer months. Some roadside ditches at higher elevations can run water into the late spring depending on yearly snow pack and timing of melt off. Precipitation during this time period usually does not occur except for occasional thunderstorms, which can at times produce heavy precipitation for a short period of time. Soils with a volcanic ash and pumice component generally have good drainage and exist on the DNF except for the Northern half of the Sisters Ranger District. Soils on the ONF and CRNG generally have more of a clay component, which can allow for more surface water runoff.

Different factors affect the yield of herbicide applied within ditches and intermittent channels from that resulting from riparian application. The following information from recent studies helps to understand the different ditch/intermittent channel exposure risks. As stated in Huang et al. (2004), "the runoff potential of herbicides applied along highways may differ from those applied to agricultural plots because: 1.) the application zone is frequently a low organic carbon, coarse material such as gravel that would not be expected to retain herbicides as effectively as agricultural soils; 2.) many highway sites feature relatively steep slopes; and 3.) nearly all of the rain falling on the adjacent pavement becomes surface runoff. Herbicides applied within ditches and intermittent stream channels are delivered to fish-bearing streams primarily by leaching, dissolution directly into ditch or stream channel flow, and erosion. The contribution from erosion is likely to vary considerably among sites.

Application of all herbicides considered under this proposed action except for triclopyr BEE, picloram and sethoxydim are allowed within dry roadside ditches. All herbicides considered under this proposed action except for picloram, sethoxydim, chlorsulfuron, sulfometuron methyl, triclopyr BEE, non aquatic glyphosate and non aquatic imazapyr will be allowed within dry intermittent or ephemeral channels.

The primary determinants of exposure risk from ditch/intermittent channel treatments are soil type, herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat for listed salmonids.

Monitoring of storm runoff has documented that the highest concentrations of pollutants occur during the first storm following treatment (Caltrans 2005; USGS 2001). More specifically, the highest pollutant concentrations generally occur during the early part of storm runoff, relative to concentrations later in the runoff event (Caltrans 2005). The discharge of ditch/intermittent channel runoff in the early stages of the storm hydrograph is generally low, but is exposed to the greatest amount of pollutants available for dissolution. The ratio of low discharge to highest amount of available pollutant results in early runoff solute concentrations that are high relative to those occurring later in the runoff event. Runoff later in the hydrograph occurs at a higher discharge, and dissolved pollutant concentrations are lower, even though mass movement of pollutants can be greater. Exposure of listed salmonids and their critical habitat elements to the highest concentrations of herbicides resulting from application to ditches and intermittent channels could occur early in storm runoff. The most relevant exposure locations are at or near confluences with perennial streams. The type of herbicide, duration of time between herbicide application and rainfall, types and amounts soils and organics in the ditch and distance to a perennial stream all influence the amount of herbicide available and how much could be delivered during a runoff event.

The USGS (2001) monitoring report provides data for concentrations of sulfometuron and glyphosate in runoff from treated roadside plots into ditches in western Oregon. Sulfometuron was applied at a rate of 0.15 lbs/acre and resulted in runoff concentrations of 0.119 – 0.253 mg/l (corresponding to about 3 – 7 percent of amount applied) from simulated rainfall 24 hours following application. Glyphosate was applied at a rate of 1.45 pounds/acre and resulted in runoff concentrations of 0.323 – 0.736 mg/l (corresponding to about 1 – 2% of amount applied) from simulated rainfall 24 hours following application. The samples were collected in the initial 15 liters of runoff from simulated rainfall at a rate of 0.3 inches per hour, and lasting 0.5 – 1.4 hours. Given this sampling scenario, these concentrations are the best estimates available for what would occur in 24 hour post application runoff from ditch/intermittent stream applications from "first flush" events for these herbicides (per amount applied, per unit area).

Due to the generally patchy distribution of invasive plant infestations in ditches and intermittent channels, and use of conservative herbicide application methods, the treatment of such large, contiguous areas near the maximum application rate is expected to be rare. Treatments of ditch/channel lengths at the typical application rate under these conditions are likely to be infrequent. Subwatersheds with high numbers of miles in RR/RHCA include Upper Bridge/Bear, Upper Lake, First, Wolf, Lower Deep, Ochoco, Marks, and Upper McKay. Approximately 380 miles of road are proposed for treatment in RR/RHCA areas adjacent to waterbodies or wetlands.

Specific characteristics of soils located on the DNF are not necessarily descriptive of those located on the CRNG and ONF. Primary features of the ash soils on the Deschutes are a coarse textural class, low to moderate cation exchange capacity (CEC), relatively low organic matter content (1-10%) and rapid infiltration rates. The moisture retention of the sandy loam and loamy sand Mazama ash soils on the Deschutes are relatively high when compared to soils of similar texture derived from granitic parent materials. The low CECs are reflective of relatively low organic matter contents that are concentrated in narrow surface horizons and low clay contents of the mineral soil. The moderate and rapid infiltration rates of these soils minimize overland flow volumes and energies during rainfall events in uncompacted areas (Sussmann 2006).

Soils located on the CRNG and the ONF are finer textured and generally have higher clay content than the DNF soils. These soils have moderate CECs and moderate to slow infiltration rates as a result of these characteristics. Organic matter contents are also low and concentrated at the surface, generally ranging from 3 to 5.5% in the surface mineral soil horizon for a small subset of representative land types (Sussmann 2006). Soils type summaries more specific to sub-watersheds that contain TES fish for the project area are located in Table 70.

Table 70. Soil types and soil surface textures for sub-watersheds with TES fish. From National Forest soil resource inventories by Larsen (1976) and Paulsen (1977).

Watershed(s) and Owner	TES fish species	Soil Type	Soil Surface Textures
Bridge Creek (ONF)	Steelhead Redband Trout	Medium and coarse textured ashfall over fine textured clays	Loamy sands, sandy loams: deep soils over finer textured residuum
SF John Day (ONF)	Steelhead Redband Trout	Medium textured ashfall mixed with fine textured colluvium	Loams, silt loams and clay loams; shallow soils with variable gravel content
Trout Creek (ONF)	Steelhead Redband Trout	Medium and coarse textured ashfall over fine textured clays	Loamy sands, sandy loams: deep soils over finer textured residuum
Lower Whychus Creek (CRNG)	Steelhead Bull trout Redband Trout	medium textured ash or colluvium	Loams; shallow soils
Metolius River (DNF)	Steelhead Bull trout Redband Trout	Coarse textured ashfall over medium or coarse textured residuum, colluvium, till or outwash	Sandy loams, loamy sands and cindery sands; shallow to deep soils
Odell Lake and Creek (DNF)	Bull trout Redband Trout	Coarse textured pumiceous ashfall over coarse textured till or pumiceous sands	Pumiceous loamy sands; pumiceous sands; pumiceous ash

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

Concentration estimates of herbicides considered for this project have been modeled for ditch runoff by NMFS in their Biological Opinion for habitat restoration projects (USDC 2008). The average sulfometuron 24-hour post-application concentration reported by USGS (2001) was used to extrapolate likely concentrations and HQ values of the five herbicides chlorsulfuron, clopyralid, imazapyr, metsulfuron, and sethoxydim. The simulated 24 hour post application ditch runoff for glyphosate reported by NMFS was from those reported by the USGS (2001) study. This analysis by NMFS reports HQ levels for chlorsulfuron, metsulfuron, and sulfometuron ranging from a hundred to several thousand times greater than the HQ effects threshold of 1 for aquatic plants and algae.

These results seem to overestimate the potential for herbicide exposure from the roadside treatments proposed in this project. The herbicide concentration and HQ values predicted may be possible in the ditch immediately adjacent to the roadside treatment, however, by the time the herbicide reached the stream, it would be diluted with water from the ditch. Glyphosate would likely be rendered biologically inactive before it reached any fish bearing watershed because it readily would bond to organic material in the ditch. The potential for herbicide delivery to streams from roadside treatments would be reduced by limiting herbicide choice, application rate and method near intermittent streams and ditches that feed into waterbodies.

The duration of exposure to fish and aquatics organism are also not taken into account in the ditch model. The effects thresholds concentrations for fish and aquatic organisms have been derived in laboratory settings and use a 96 hour or a similar longer term exposure scenario. Exposure of fish and aquatic organisms from any herbicide coming from a roadside ditch would last from a few minutes to a few hours depending on the type of waterbody and the type and amount of mixing processes that are taking place.

The same USGS (2001) study used as the basis for the ditch model calculated a range of theoretical herbicide concentrations in Bull Creek (1.2 cfs) one day and one week after application. The high end of the sulfometuron concentrations were 0.0005 mg/l and 0.0001 mg/l for one day and one week following application, respectively. The high end of the glyphosate concentrations were 0.0015 mg/l and 0.0002 mg/l for one day and one week following application, respectively. The USGS (2001) sulfometuron theoretical concentrations slightly exceed effects threshold concentrations after one day but are under the effects threshold concentrations after one week. The USGS (2001) Glyphosate theoretical concentrations did not come close to exceeding effects threshold concentrations for any organism. These results more accurately depict concentrations that may be found in a small stream where effects to aquatic organisms could occur.

A recently published study by Giudice et al. (2008) showed that plots treated alongside a highway ditch during runoff produced an event mean concentration (EMC) in the ditch that often exceeded the minimum EPA ECOTOX endpoint for algae, water fleas and fish for several herbicides. However this study also noted that ditch runoff mixing with waterbodies would almost always dilute herbicide concentrations and the concentration an aquatic organism experiences would most likely be far less than the computed EMC for the ditch runoff. Giudice et al. (2008) also noted that the high concentrations may not be sustained for long enough to cause toxic effects. It is expected that if any effects did occur they would mostly be confined to the location where water from a ditch entered a waterbody. Beyond this point dilution would make any direct or indirect effects very unlikely. Michael (2004) reviewed several field studies and found that peak concentrations of herbicide runoff during storm events are short lived, generally lasted from a few minutes to half an hour. The most potential for indirect effects to aquatic plants appears to be from the three sulfonylurea herbicides proposed for this project. However, a recent study by Davies et al. (2003) concluded that results from field studies and modeled situations show worst case concentrations of sulfosulfuron (a sulfonylurea herbicide) in water after field application to be well below 0.01 mg/L and largely below .001 mg/L. Due to rapid breakdown in water and dilution by flowing water, the aquatic environment will only experience short pulses of exposure. The effects of sulfosulfuron on the three species of aquatic plants studied by Davies et al. (2003) indicated that at environmentally relevant concentrations and short exposure periods adverse effects to aquatic plants are not expected.

Giudice et al. (2008) also stated that width of grass adjacent to the ditch and amount of organic carbon present would help reduce the amount of herbicide runoff. Since many of the ditches on forest roads have vegetation and organic carbon present in the form of tree leaf litter this would help to reduce herbicides in runoff as it travels down the ditch. Using minimum or typical application rates along ditches near streams rather than the maximum rate almost always result in significant reductions to environmental risk (Giudice et al. 2008). PDFs will greatly reduce the chance for detrimental effects to aquatic organisms by reducing application rates and limiting types of herbicides applied to intermittent streams and ditches that feed into waterbodies.

Effects by Alternatives

Alternative 1 - Direct and Indirect Effects to Fisheries

The 1998 Deschutes and Ochoco Weed EAs concluded that there would be no significant impact and no direct impacts to fisheries or aquatic invertebrates, respectively. Continuing treatment of these sites under the No Action alternative is unlikely to adversely affect any fish species or aquatic biota. Many of the sites are being effectively controlled, and the use of herbicides at them has declined. However, infestations not covered under the 1998 EAs would not be able to be treated. Untreated populations of invasive plants in or adjacent to riparian areas would have the potential to indirectly affect fisheries and aquatic biota. Many species of invasive plants are not as effective at stabilizing soils or preventing erosion as native riparian species. The displacement of native vegetation increases the potential for fine sediments to enter the aquatic environment.

Reed canarygrass species have the highest potential to impact fisheries and aquatic biota since it generally grows in the riparian zone and along the waters edge. Although reed canarygrass does provide some cover and shade for fish along the margins there are several species of native sedges and plants that serve the same purpose. Areas with dense reed canary infestations could actually prohibit native deciduous shrubs such as alder, willow and ninebark from becoming established. These shrubs are important components of the riparian ecosystem for providing shade during the summer and nutrients to the stream when they lose their leaves in the fall. Certain feeding groups of aquatic insects rely on deciduous leaf litter as food while others would use the shrubs for habitat during their adult life stage.

Differences between Direct/Indirect Effects of Alternative 2 and 3

Both alternatives have Project Design Features (PDFs) that are expected to prevent any major adverse effect to any fish populations or their habitats with the exception of the Metolius ribbongrass treatment that will produce disturbance to fish along the margins and remove instream and overhead cover. Alternative 3 is more restrictive on how close chemicals can be used near perennial waterbodies and does not allow for chemical treatment of any intermittent channels. In alternative 2 only aquatic approved herbicides would be allowed in intermittent channels. Herbicide treatment of intermittent channels and ditches have been shown to be the most Alternative 3 also does not allow for any chemical to be broadcast spayed within 300 ft of a perennial waterbody or to be applied within 10 ft of any perennial waterbody. This would add a small buffer for any runoff, drift or overspray that could reach the water. The restrictions in alternative 3 would further reduce, but not eliminate, the chance for herbicide residue to reach a waterbody. There would be much less risk in alternative 3 for aquatic approved chemicals to wash downstream into fish bearing waters, before chemicals could completely break down. Actual differences in acres that could be treated are small (Table 71). Under alternative 3 plants within 10 feet of water would have to be pulled manually which would cause more soil disturbance, potentially leading to small localized sediment inputs near perennial streams and in intermittent channels. But even under alternative 3, hand pulling is not expected to produce enough sediment to affect fish or aquatic biota. Additional hand pulling would be more labor intensive and cost more money to treat these areas. Hand pulling will not be as effective in eradicating certain invasive species. Alternative 3 would make effective treatment and eradication of reed canary/ribbongrass sites unfeasible. Not treating reed canary/ribbongrass would negate any disturbance effects or effects to fish from the removal of instream or overhead cover.

Table 71. Acres of noxious weeds by alternative on intermittent stream, perennial streams, springs and lakes within the 100 foot and 300 foot buffers. These acres represent **chemical treatment only** which is usually combined with manual pulling or other treatment methods. These acres are for areas where weeds are located, actual acres of weed plants on the ground are less than this.

Alt.	Total treatment acres with mapped invasive plants	Treatment acres with mapped invasive plants on int. streams	Treatment acres with mapped invasive plants on int. and dry lakes	Treatment acres with mapped invasive plants within 100' of perennial streams, springs and lakes	Treatment acres with mapped invasive plants within 300' of perennial streams, springs and lakes
*1	0	0	0	0	0
2	13,587	30	0	724	1518
3	13,357	0	0	494	1288

* Does not show acres for treatment under the Ochoco or Deschutes 1998 Noxious weed EAs.

Direct and Indirect Effects Common to Alternatives 2 and 3

Herbicide Treatment – Areas of No Effect to Threatened or Sensitive Fish Species

Within 79 of the 180 subwatersheds covered by this analysis, all of the mapped invasive plant sites are 300 feet or more from any class 1, 2 or 3 streams or perennial lakes, ponds or reservoirs. (Appendix H, Table H-25 lists these subwatersheds). Many of these sites are located in subwatersheds where there are no perennial waterbodies at all or the watershed has a few small infested sites that do not cross any streams, including class 4 streams. A few of these subwatersheds have only non-herbicide methods proposed. The chance of having any effect to fisheries or aquatic biota is very remote because of the amount of filtration and dilution that would occur from the surrounding forests soils, vegetation, and organic matter that would break down or dilute any herbicide residue before it reaches a waterbody that sustains fish populations of other aquatic biota. Nevertheless, seven of these 79 subwatersheds were investigated further because they contain either listed fish species, have sites that cross intermittent class 4 streams, or have large infested areas proposed for herbicide treatment. The attributes of sites in these seven subwatersheds are listed in the following table. Because of the invasive plant site distances from perennial waterbodies and the use of PDFs in this project, measurable adverse effects to fisheries and aquatic biota is not expected in either alternative.

Table 72. Description of subwatersheds where herbicide use is not of concern for perennial waterbodies, but existence of intermittent streams or listed fish species in the subwatershed pose a concern.

Subwatershed	HUC6 Number	Species	Comments
Carcass Canyon	170703011102	Bull Trout Redband Trout	All Sites > 2.5 river mi from Deschutes R. Four medusahead sites that cross 3 int. streams totaling 651 ac, treat with sulfometuron. One knapweed site 30 ac, treat with clopyralid.
Lake Simtustus	170703060103	Bull Trout Redband Trout	All sites > 0.6 river mi from Lake Simtustus. Three sites with medusahead and knapweed that cross 1 int. stream, total 4.4 ac. Treat with sulfometuron and clopyralid.
Lower Crooked River Gorge	170703051102	Bull Trout Redband Trout	All sites > 0.2 mi from Crooked R. Four sites with Medusahead, knapweed and scotch thistle totaling 109 ac., ones site crosses 1 int stream. Treat with sulfometuron and clopyralid.
Middle Bridge Bear Creek	170703060205	Steelhead Redband Trout	All sites > 0.2 mi from unnamed stream. Ten road sites that total 1 ac. and cross no int. streams.
Upper Bridge Creek	170702040303	Steelhead Redband Trout	All sites > 600 ft from perennial steams and 450 ft from pond. Three road sites that total 28 ac. and cross no int. streams. Medusahead, star thistle and houndstongue. Treat with metsulfuron, sulfometuron and clopyralid.
Upper Mountain Creek	170702011301	Steelhead Redband Trout	All sites > 600 ft from perennial steams. Six sites that total 1.1 ac. and cross no int. streams. Musk thistle and medusahead. Treat with sulfometuron and clopyralid
Upper Mud Springs Creek	170703070401	Redband Grout	All sites > 450 ft from perennial steams. Eight sites that total 362 acres and cross 4 int. streams. Medusahead and knapweed. Treat with sulfometuron and clopyralid.

Eighty-six of the 180 subwatersheds contain infested weed sites within 100 feet of class 1, 2, and 3 streams and perennial lakes, ponds and reservoirs. Acres of mapped invasive plant sites and acres within each type of waterbody are presented in Appendix H, Table H-26. Streams and rivers with more flow than the two cfs used for SERA Worksheets will have a greater dilution effect if chemicals do reach the water. This is important in relation to the GLEAMS model outputs plus dilution estimates used to estimate herbicide concentrations that could enter streams, because streams and rivers with more flow will have a greater dilution effect if herbicides do reach the water.

A 300 foot buffer around road crossings was used to identify potential high risk roads segments where ditches could lead to herbicides entering streams if a rainstorm occurred following application and was added to the total amount of area to be treated near waterbodies.

Manual Treatment (Pulling)

Pulling of invasive plant would occur under both alternatives. More pulling would occur within 10 feet of waterbodies under alternative 3 where herbicides could not be applied. However, ribbongrass and reed canarygrass can not be effectively eradicated with pulling alone and this would not be attempted. Pulling of other non riparian dependant invasive plants would not measurably change amounts of disturbance from pulling and would still have no effect on fish or aquatics.

TES Listed Fish Populations and Their Habitats

Watersheds with Threatened Species (Bull Trout and Steelhead)

Subwatersheds that contain Threatened, Endangered, or Sensitive (TES) fish, EFH, lead to TES fish waterbodies or may have TES fish reintroduced to them in the next five years were analyzed for site specific effects from proposed invasive plant treatments. The effects to these populations were based on a combination of several factors including distance to occupied habitat, forest types, terrain and slope, risk of herbicides proposed for use, and size of waterbodies involved. The following table lists the watersheds included in the analysis with the listed fish species present or expected to be reintroduced in the near future.

Table 73. Watersheds and Subwatersheds where Effects of Invasive Plant Treatments are analyzed for Threatened Fisheries. Species in italics are proposed for reintroduction within the next five years.

Watershed	Subwatersheds	Species	Comments
Lower Deschutes Subbasin			
Willow Creek	Upper Willow Creek Rock Springs Middle Willow Creek Dry Canyon Lower Willow Creek	Bull Trout Steelhead	Long distance from project areas to occupied habitat.
Headwaters Deschutes River	Lake Simtustus	Bull Trout Steelhead	Long distance downstream from project areas to occupied habitat. Low and moderate risk herbicides.
Upper Trout Creek	Headwaters Trout Cr. Foley Creek, Opal Creek	Steelhead	Small sites, Sites where high risk herbicides may be used are small and away from streams.
Mud Springs	Upper Mud Springs Cr., Sagebrush Creek	Bull Trout Steelhead	Long distance from project areas to occupied habitat. Low and moderate risk herbicides.
Upper Deschutes			
Upper and Lower Metolius River	Dry Cr., Cache Cr., Upper Lake Cr., Lower Lake Cr., Headwaters Metolius River, First Creek, Jack Creek, Canyon Creek, Abbot Creek, Candle Creek, Middle Metolius River,	Bull Trout *Spring Chinook* *Sockeye*	Potential effects from treatment of ribbongrass.

	Upper Fly Creek, Lower Fly Creek, Juniper Cr., Lower Metolius River		
Lake Billy Chinook	Stevens Canyon, Carcass Canyon, Geneva, Round Butte Dam	Bull Trout *Spring Chinook* *Sockeye* Steelhead	Long distance from project areas to occupied habitat. Low and moderate risk herbicides.
Whychus Creek	Upper Whychus Cr. Middle Whychus Cr. Lower Whychus Cr.	Bull Trout Steelhead	Low and moderate risk herbicides.
Wickiup (Odell/Davis Lakes)	Odell Lake, Odell Creek, Moore Cr., Davis Lake	Bull Trout	Low and moderate risk herbicides.
Lower Crooked River Subbasin			
Lower Crooked River Valley and Crooked River National Grassland	Upper Crooked River Gorge, Lower Crooked River Gorge	Bull Trout Steelhead	Long distance from project areas to occupied habitat.
McKay Creek	Upper McKay Creek, Allen Creek	Steelhead	Project areas along streams that have low summer flows
Lower John Day Subbasin			
Bridge Creek	Headwaters Bridge Cr., Upper Bridge Cr., Upper Bridge Bear Cr., West Branch Bridge Cr.	Steelhead	Project areas along streams that have low summer flows; high risk herbicides proposed
Upper John Day Subbasin			
Mountain Cr., Rock Cr., Upper Middle John Day, and Lower South Fork	Wind Cr., Corner Cr., Black Pine Cr., Black Canyon Cr., Jackass Cr., Cottonwood Cr., Upper Mountain Cr., Middle Mountain Cr., Upper Rock Cr.	Steelhead	Low and moderate risk herbicides

Effects to each ESA listed fish species and their habitat were analyzed given factors of proximity, probability, magnitude, duration, nature, distribution, frequency, and timing of the alternatives. Detailed results are in the Fisheries Report and Biological Assessment. In both alternatives, restrictions on method, type, and location serve to limit the potential amount of herbicides that may 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 likelihood of meeting or exceeding levels of concern for fish is extremely low because herbicide use in the aquatic influence zone is limited to typical application rates, application methods are restricted to spot or hand/select, buffers will be used during herbicide applications, Project Design Features will be followed, and there is a low potential for herbicides proposed for use near water to move through soils.

There is a possibility for both existing and EDRR sites that some minor amounts of sediments may reach waterbodies however this is only expected to occur in locations where invasive plants are pulled along a streambank. For example, killing invasive plants would devegetate a portion of the streambank and result in a loss of roots that help to hold soil particles together. These soils may be exposed at higher flows and enter a stream. The total spatial extent of heavy infestations along streambanks within the action area is very low except in the Upper Metolius River area with ribbon/reed canarygrass. Along the Upper Metolius River approximately 0.9 acres of ribbon/reed canarygrass is located along 2.7 miles of the river, most of the infestation is within 6 feet of the waters edge. A few other reed canarygrass sites occur in redband trout only habitats (See Table 75). The amount of sediment released into any particular stream reach would depend on how extensive a particular invasive plant patch is and how close the invasive plant is to the actual wetted perimeter of the channel. Exposed streambanks surrounded by native vegetation are expected to revegetate during the spring/summer following treatment. In addition, site restoration and revegetation methods minimize erosion as a result of herbicide treatment. It is expected that most patches would be relatively small and any sediment released would be very localized and short-term. The probability of effect is moderate, and the overall magnitude is minor.

The table on the following page displays the watersheds where there is potential for negative effects to fish species. A detailed analysis and discussion for each watershed is contained in Appendix H. The discussionn focuses on effects to bulltrout and steelhead, but redband trout are also present in these watersheds, and effects to them and other antive fish is expected to be similar.

Table 74 Subwatersheds showing the areas where the potential effects to federally listed or Region 6 Sensitive fish species are analyzed (including those to be re-introduced within the next five years).

Watershed	Bull Trout	Steel-head	Spring Chinook	Sock-eye	Redband	Summary
Willow Creek	X	X	n/a	n/a	X	Approx. 8 acres herbicide treatment within 10 feet of perennial water. No effect from herbicide to listed fish populations because suitable and occupied habitat is several miles downstream. Site-Specific PDFs apply (Table 15). Redband trout in Rimrock Springs Wildlife Area.
Headwaters Deschutes River	X	X	n/a	n/a	X	Zero acres of invasive plants sites within 300 feet of perennial water. Long distance downstream from project areas to occupied habitat. Low and moderate risk herbicides. All invasive plant sites > 300 feet from perennial waterbodies.
Upper Trout Creek	n/a	X	n/a	n/a	X	Approx. 0.03 acres herbicide treatment within 10 feet of perennial water. Small sites, Sites where high risk herbicides may be used are small and away from streams.
Mud Springs	X	X	n/a	n/a	X	Zero acres invasive plant sites within 10 feet of perennial water. Long distance from project areas to occupied habitat. Low and moderate risk herbicides. potential for short-term indirect effects
Upper & Lower Metolius River Watersheds	X		X	X	X	Approx. 123 acres herbicide treatment within 10 feet of perennial water. Treatment of ribbongrass poses primary risk. Manual treatments can cause disturbance of sediment and cause disturbance to bull trout and redband trout juveniles along slow water margins. Herbicide concentrations calculated for areas where emergent vegetation would be treated.
Whychus Creek	X	X	X	n/a	X	Approx. 8 acres herbicide treatment within 10 feet of perennial water. Low and moderate risk herbicides. Annual limit on treatment within 300 feet of streams and where slopes > 10%. Indirect effects to aquatic plants and algae.
Lake Billy Chinook	X	X	X		X	Zero acres invasive plant sites within 10 feet of perennial water. Long distance from project areas to occupied habitat. Low and moderate risk herbicides.
Wickiup (Odell/Davis Lakes)	X	n/a	n/a	n/a	X	Approx. 1.25 acres herbicide treatment within 10 feet of perennial water. Low and moderate risk herbicides. Calculations on site conditions led to PDF that prohibits use of picloram in the watershed.
Lower Crooked R. Valley & Crooked R. National Grassland	X	X	X	X	X	Zero acres invasive plant sites within 300 feet of perennial water. Long distance from project areas to occupied habitat.
McKay Creek	n/a	X	n/a	n/a	X	Approx. 0.33 acres of herbicide treatment within 10 feet of perennial water. Project areas along streams that have low summer flows.
Bridge Creek	n/a	X	n/a	n/a	X	Approx. 1.71 acres herbicide treatment within 10 feet of perennial water. Project areas along streams that have low summer flows; high risk herbicides proposed. Picloram restricted to treating sulphur cinquefoil only. Long distance from

						steelhead usage.
Upper John Day Watersheds	n/a	X	n/a	n/a	X	Approx. 4 acres herbicide treatment within 10 feet of perennial water. Picloram restricted to treating sulphur cinquefoil only. Small sites and use of buffers prevents direct adverse effects to fish.

R6 Forest Service Sensitive Species – Redband Trout

Selected Redband Trout Watersheds

This section will cover effects to redband trout and other fish species where no federally-listed Threatened species are present. Effects will be discussed for selected subwatershed where there are large weed infestations close to waterbodies that may be treated with herbicides. Effects for all sites where ground disturbing methods such as scarifying and burning are proposed will be covered in this section. Effects to subwatersheds that contain redband trout or other fish but are not explained here will be less than the selected subwatersheds discussed in this section and previous sections with Threatened species.

The interior Columbia Basin redband trout is the only sensitive fish species in the analysis area and they are found in most perennial streams throughout the project area. The few exceptions being waterbodies they have been extirpated from or areas that were historically fishless.

Manual, Mechanical, and Cultural Treatments

The findings are similar to those for TE fish, in that manual, mechanical or cultural methods will have no effect on these populations except in areas treated for reed canary/ribbongrass. Weed whacking or pulling reed canarygrass may cause disturbance to juvenile bull trout and a temporary reduction in overhead cover which could cause fish to seek new rearing habitats exposing themselves to predation or other stresses that could lead to mortality. Under Alternative 3, effective treatment with herbicides would not be possible, so there is more potential for disturbance from manual pulling. This disturbance would be short term lasting 1 to 2 days a year for weed pulling or whacking and reduction in overhead cover for 1-2 years until native vegetation reestablishes itself or is replanted. Overhead cover reduced by pulling or weed whacking would be replaced in the long term with native vegetation and many of the native species would supply overhead cover throughout the year. Reed canary/ribbongrass does not provide much cover during the winter months when it dies back. A reduction in overhead cover may have some indirect effect to a few juvenile fish by disrupting their established rearing locations.

Ribbon Grass / Reed Canarygrass Sites

Effects to fish and aquatic biota from herbicide treatment of ribbongrass and reed canarygrass with aquatic glyphosate should be less or similar to those discussed for the Headwaters Metolius Subwatershed because other infested sites are less than half the size. The locations, fish species and size of all ribbongrass and reed canarygrass treatments are presented in Table 75. Numbers of redband trout present and habitat use of treatment sites in Table 75 is most likely much less than what is found on the Metolius River with the possible exception of site 11-10 which would be similar.

Table 75. Reed canarygrass treatment areas proposed for mowing and then hand wick and spot spray application of aquatic glyphosate. The infested % length of shoreline is based on available reproductive habitat for that fish population. Values are for mapped invasive plant sites.

Treatment Area (s)	Waterbody	Location	Trout Species **TES in Bold**	Shoreline Infested Length Ft.	%	Mapped Infested Area ac.
11-10*	Deschutes River	Island near Rd 42 crossing	**Redband**	NA	NA	0.3
11-24	Wickiup Res.	SE shore	**Redband**	3,290	1.23	5.3
11-33	Paulina Lake	West Shore	Brown	4,220	11.91	5.2
11-34	Hosmer Lake	West Shore	Brook	230	0.76	1.0
11-35	Deschutes River	Blue Lagoon	**Redband**	2,300	2.56	7.5
11-39	Lava Lake	Most of Shoreline	Rainbow	13,100	72.36	22.2

Treatment Area (s)	Waterbody	Location	Trout Species **TES in Bold**	Shoreline Infested Length Ft.	%	Mapped Infested Area ac.
11-54	South Twin Lake	West Shore	Rainbow	1,210	1.60	1.8
11-56 11-53	Crane Prairie Res.	West Shore Rd. 4285 and SE arm	**Redband**	10,370	8.80	26.4
11-66	Deschutes R.	Ryan Ranch Meadow	**Redband**	340	0.06	10.6
11-80	Deschutes R.	Rd. 44 at Bull Bend	**Redband**	230	0.02	1.1
12-05	Big Marsh	East Ditch	**Redband**	5,520	5.59	2.7
15-22	Trout Creek	Trout Creek Swamp	**Redband**	5,950	7.96	44.8
15-32**	Metolius River	Upper River	**Bull/Redband**	86,500	20.07	119.2

* Site 11-10 is not mapped but is estimated to be less than 0.3 acres and is located on an island of the Deschutes River between Crane Prairie and Wickiup Reservoir.
****** Actual on the ground surveyed values are much less than mapped values see Table H-10.

The redband trout subwatersheds listed in Table 76 have the greatest potential for effects from herbicide treatment because of the large size of infestations and the proximity of these infestations to intermittent streams and perennial waterbodies. Because of the use of primarily low and moderate risk herbicides and PDFs to protect aquatic resources, the effects to redband trout, aquatic biota and their habitats are expected to be similar or less than those in the previously analyzed TES watersheds of this document. For each site in these watersheds, restrictions under Alternative 3 would reduce, but not eliminate, the risk of herbicide contamination or sedimentation.

Table 76. Subwatershed with waterbodies at higher risk of herbicide contamination due to size of weed infestations and proximity to perennial water and fish bearing waterbodies.

Subwatershed Name	Subwatershed Number	Infested Weed Acres within 100' of Int. Streams	Infested Weed Acres within 100' of perennial water and fish bearing Streams	Infested Weed Acres within 300' of perennial water and fish bearing Streams
Upper Paulina Creek	170703030901	180.08	136.08	378.54
Crescent Lake	170703020204	0	46.91	95.22
McAllister Slough	170703051005	27.35	22.12	70.63
Dry Paulina Creek	170703030902	76.70	19.34	39.15
Cold Creek	170703020205	0	10.24	39.04
Lava Lakes	170703010104	0	18.80	38.12
Crane Prairie	170703010109	0	22.71	37.48
Upper Trout Creek	170703010803	0	10.32	24.04
Pringle Falls	170703010305	0	7.38	18.33
Lower Indian Ford	170703010807	0	4.63	16.68
Drake Creek	170703040602	0	3.52	10.24

Selected Herbicide and Manual Treatment Sites

The amount of fine sediments delivered to the stream using the manual pulling method will depend on the amount of disturbance, time of year and its proximity to a stream. Hand pulling will be used on small patches of weeds, where there are only a few scattered individuals distributed over large or sensitive areas or when the potential effects of hand pulling outweigh the potential effects of herbicide application. Hand pulling is not expected to add any measurable amounts of fine sediments to streams.

Scarify and Control Burning Sites

Scarify and control burning followed by herbicide treatment for houndstongue is proposed in portions of two treatment areas (72-15 and 72-37). These two treatment areas are both within the Dry Paulina Creek subwatershed (HUC: 170703030902), that is part of the Paulina Creek Watershed (Figure 8).

Scarifying is proposed in five locations that total 14.3 acres along or adjacent to two intermittent streams. The goal of scarifying will be to break up the soil surface, not to dig deep or turn over soil (see soils report for more discussion). These two intermittent streams feed into Dipping Vat Creek and an unnamed stream that contains redband trout. Following RHCA buffer guidelines for Infish non priority watershed, no discing will be allowed within 50 feet of the intermittent streams to prevent sediments from entering these channels and washing downstream into potential redband trout spawning areas.

Fire is proposed in the same five locations that scarifying will be used to reduce weed biomass and seed beds. Following RHCA buffer guidelines for Infish non priority watersheds, no ground disturbing or duff removing activities including the building of fire lines will be allowed within 50 feet of these intermittent streams under either action alternative to prevent sediments from entering these intermittent channels and washing downstream into potential redband trout spawning streams. Scarifying and herbicide application will be used in conjunction with the prescribed fire treatments. The scarifying and controlled burn activities will most likely occur once per season for no more than two seasons and will most likely be done during the spring when soil moisture and fuel moistures are appropriate. Herbicide application will be done later in the spring or summer.

Invasive plant species at these sites are primarily houndstongue and smaller infestations of Canada thistle. The herbicides of choice to treat these species are metsulfuron and clopyralid, respectively. These herbicides will not adversely affect Redband trout under either Alternative 2 or 3 because they are low toxicity to fish and are not expected to enter the perennial streams. However, if some herbicides do reach perennial streams some indirect effects to aquatic macrophytes and algae could be seen. These effects would only occur for a short period of time if herbicides were washed into these intermittent channels and downstream to areas containing redband trout. This would most likely occur if a large thunderstorm event occurred within a few weeks of the herbicide application.

Houndstongue infested sites proposed to be burned, scarified, chemically treated and revegetated.

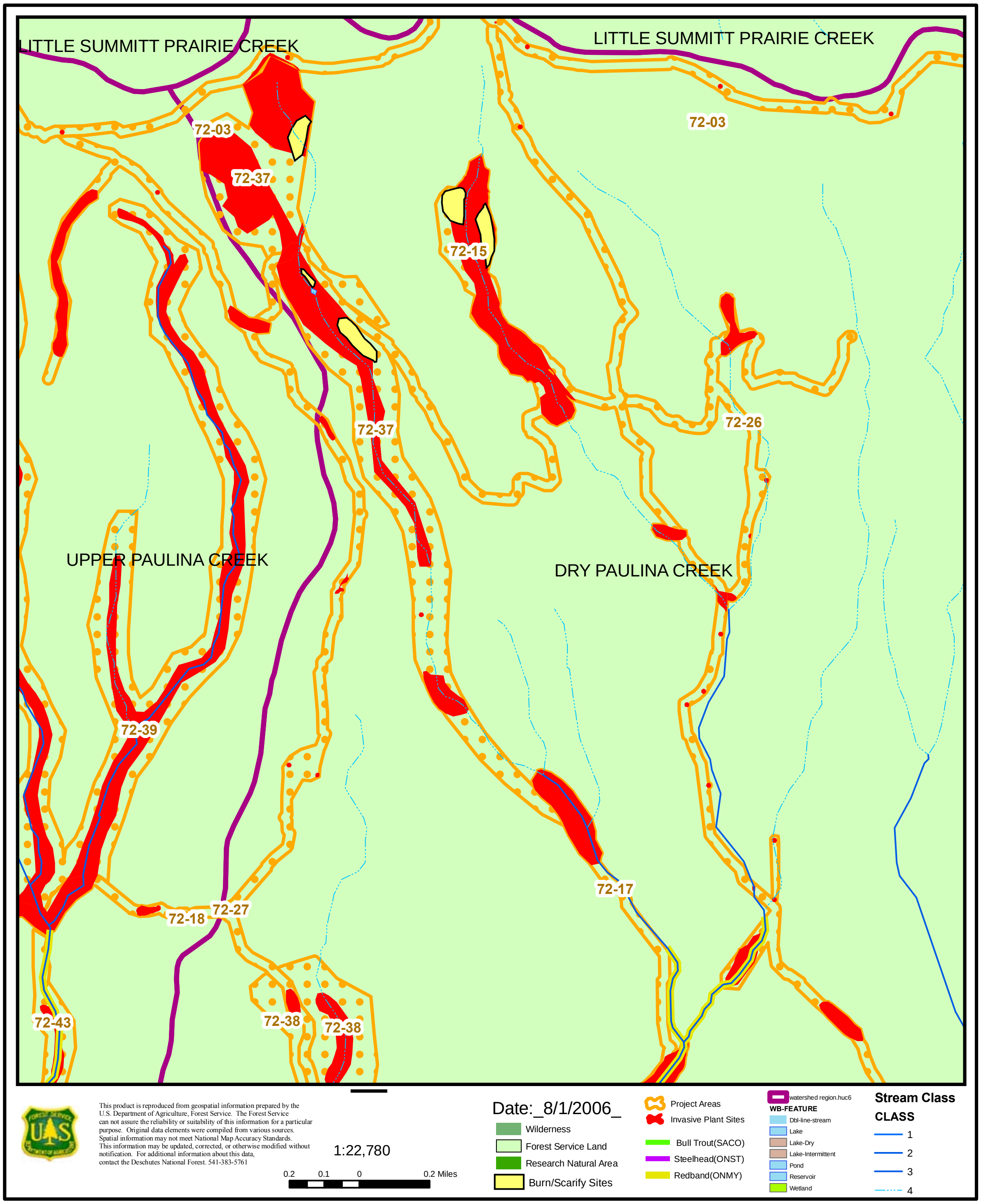

Figure 8. Sites proposed to be scarified and burned prior to herbicide treatment in the Dry Paulina Subwatershed.

Summary of Effects to Fish and other Aquatic Organisms

Manual, Mechanical and Cultural Methods

Hand pulling, mechanical and cultural methods for invasive plants will occur on scattered populations or individual plants and the amount of sediment produced by these actions would not be large enough to be measured against natural processes or other activities that have occurred in the planning area with the exception of ribbongrass/reed canarygrass treatments. Invasive plant species under this analysis are not water dependent and individuals may be found anywhere there seeds have been spread, usually in disturbed areas. Individual plants or populations may occur along waterbodies but disturbance to fish from pulling or sedimentation is expected to be very minimal and localized. Pulling of invasive plants below bankfull will occur outside of TES fish spawning seasons unless effects can be minimized and the instream work window is negotiated with ODFW. Areas with ribbongrass/reed canarygrass plants that are pulled may cause larger amounts of exposed soils directly adjacent to in the margins of the river. This would also reduce some instream and overhead cover primarily used by juvenile fish. A restoration plan accounting for these areas is in place and would use prescribed mulching, seeding and planting as needed to revegetate riparian areas. Invasive plants often colonize areas that are already disturbed and may already be sources of fine sediments or on gravel bars in which sediment disturbance is part of the streams normal hydrologic process.

Invasive plant (weed) whacking to reduce seed heads and biomass could be used on reed canary/ribbongrass populations. On the Metolius River at site 15-32 where invasive plant whacking or pulling reed canarygrass will likely cause disturbance to juvenile bull trout and a temporary reduction in instream and overhead cover which could cause fish to seek new rearing habitats exposing themselves to predation or other stresses that could lead to mortality. Overhead cover reduced by pulling or invasive plant whacking will eventually be replaced with native vegetation that will serve the same purpose. Many of the native species supply overhead cover throughout the year while reed canary/ribbongrass does not provide cover during the winter months when it dies back. This disturbance would be short term lasting 1 to 2 days a year for invasive plant pulling or whacking and reduction in overhead cover for 1-2 years until native vegetation reestablishes itself or is replanted.

The infestations from Lake Creek to House of the Metolius private land (2.7 river miles) currently only occurs on 7.6 % of the lineal stream banks. Below Gorge Campground ribbongrass populations become much less numerous and are found in scattered small clumps. From Wizard Falls Fish Hatchery to Candle Creek (4.3 river miles) only 0.1 % of the river banks were infested. Analysis of pulling or invasive plant whacking reed canary/ribbongrass along the upper Metolius River found that increases in water temperature would not occur from the reduction in shade after plant removal (See EIS hydrology report).

Other than reed canarygrass/ribbongrass sties the proposed action does not have the potential to influence stream flow, instream habitat or channel morphology due to the small portion of any watershed that would be treated. Treating invasive plants would improve long term riparian stability where invasive plants have taken over along stream channels and out-competed native species. All invasive plant treatments carry some risk that removing invasive plants could increase streambank erosion by removing plants and soil that is adhered to their roots. The amounts of disturbance are not large enough or concentrated enough next to waterbodies to produce substantial amounts of fine sediments.

Herbicide Treatment Methods

A primary issue for this analysis is the potential for herbicides to enter streams in levels high enough to adversely impact aquatic organisms. This section describes how PDFs minimize the possibility and amount in which herbicides could enter water and impact water quality. Streamside buffers were developed based on characteristics of herbicide movement and toxicity to fish and aquatic organisms.

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. This section addresses each of these delivery routes.

No direct application of herbicide to water is intended under this project, although some accidental overspray, drift or drips could occur when using aquatic approved glyphosate or imazapyr near the edge of waterbodies. Some invasive plants may grow in wetlands or stream channels and hand treatment of these plants may result in a very limited delivery to surface waters (particularly at ribbon/reed canarygrass and yellow iris). Formulations of herbicides approved for aquatic use would be used and concentrations of these herbicide should they reach streams from these treatments would most likely be well below levels of concern for aquatic organisms. Streamside buffers along perennial waterbodies would sufficiently protect fish and aquatic biota from adverse effects. The most likely route for herbicides to reach waterbodies in concentration high enough to have adverse effects to fish or aquatic biota would be from initial runoff in ditches or intermittent channels following application. If effects to macrophytes or algae did occur from ditch runoff these would likely be small and localized near the point where the herbicide entered the waterbody and would have no direct effects on fish. The GLEAMS Driver model was recently developed by SERA (2008) and this model was run for a representative small alcove (6 ft wide) with a small amount of flowing water (0.5 cfs) along the Metolius River. Results from the GLEAMS Driver model showed a maximum peak concentration of 0.0003 mg/L of glyphosate that could enter the alcove. This is well below the 0.1 mg/L threshold for olfactory effects to salmonids (Tierny et al. 2006). The implementation of all the PDFs and buffers outlined in this proposed action would ensure that effects to fish from application of herbicides near waterbodies would be negligible. The following paragraphs explain the analysis used to determining effects to fish and aquatic organisms.

Effects from drift, runoff and leaching were considered in the SERA (2001, 2003, 2004) herbicide risk assessments, prepared for the R6 2005 FEIS (USDA 2005a), assuming broadcast treatments occurring directly adjacent to streams. The SERA Worksheets was used to estimate the amount of herbicide that may potentially reach a reference stream via runoff, drift and leaching in a 96 hour period, assuming broadcast treatments on a sparsely vegetated 50-foot strip along about 1.6 miles of a 1.8 cfs perennial stream. SERA (2001, 2003, 2004) risk assessments evaluated the hazards associated with each herbicide based on the concentrations of herbicide predicted by the SERA Worksheets using these parameters.

With the exception of ditch and intermittent channel treatments the SERA Worksheets most likely overestimate the herbicide concentrations that would plausibly enter streams from this project because:

1. Broadcast treatments are prohibited directly adjacent to perennial streams. After conducting review of other herbicide research Michael (2004) found maximum concentrations of herbicides observed in streams is related to application method. Broadcast applications generate the highest concentration which is often observed on the day of application. Broadcast applications permit less control over herbicides and frequently result in herbicide application to ephemeral or intermittent stream channels (Michael 2004).
2. Broadcast applications inherently apply more herbicide to the ground than when using more selective spot spray or hand wick application methods that apply herbicide to individual plants.
3. Buffer strips used between broadcast application areas and streams would reduce or eliminate drift. Streamside buffers greatly reduce the amount of herbicide reaching streams and may not provide much additional protection to water contamination when larger than 10 meters on each side of the channel (Michael 2004). The SERA Worksheets should be an overestimate because there was no buffer on the stream

4. Vegetation and organic material on the ground in most forested buffer strips would provide greater protection to streams than the sparse grass vegetation used in the SERA Worksheets.
5. Herbicides would only be allowed to be applied at the typical application rate within 100 feet of perennial waterbodies. This would greatly reduce chances for effects as the SERA Worksheets generally only exceeded effects thresholds at highest application rates.
6. Herbicides proposed for use below the bankfull channel is limited to aquatic approved glyphosate and imazapyr. The emergent vegetation analysis (Appendix H, page 10) showed that glyphosate only slightly exceeded the threshold for effects if all the herbicide applied reached the stream which is highly unlikely. Most research done in field situations has shown that even when these herbicides are applied at rates several times higher than the highest amounts proposed for this project concentrations measured in streams would have little to no adverse aquatic ecosystem impacts (Michael 2004, Michael and Ruiz-Cordova 2006, Patten 2003, Michael 2000).

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 1 to 3 mg/m3). 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 (USDA HFQLG EIS, Appendix B, 2003). 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 (Berg 2004). The Berg (2004) study indicates that the greatest risk of herbicides moving off site is from large storms soon after herbicide application. If a large storm were to occur this would also raise water levels in fish bearing streams and provide more dilution should any herbicides reach the stream. Any exposure by aquatic organisms would most likely be localized near the location the herbicide residue entered the waterbody. The pulse of higher herbicide concentrations may not be sustained for long enough to cause toxic effects to fish or aquatic organisms (Giudice et al. 2007). Peak concentrations observed in streams following herbicide application are short lived and last from a few minutes to a few hours with concentrations in storm runoff greatest during peak discharge and lasting longer than 30 minutes (Michael 2004).

Berg (2004) 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 by intermittent and ephemeral channels having buffers for herbicides that are more toxic to fish and only aquatic approved imazapyr and glyphosate would be able to be applied to intermittent or ephemeral channels using spot spray or hand wick/wipe application methods. Herbicides less toxic to fish will be allowed for use in roadside ditches when ditches are dry. If a large rainstorm occurs sediment contaminated by herbicide could be carried into streams. Dry sediment contaminated by herbicide could plausibly be carried by wind and enter a stream or water body. This is an unlikely scenario as most of the analysis area is well vegetated and there are not large areas of bare soil exposed for movement by wind near streams with TES listed fish.

Accidental spills are not part of this projects proposed action. Project design features which include a spill plan 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 is a project requirement and would address spill prevention and containment.

Herbicides affect lakes and wetlands differently than streams. Dilution by flow or tributary inflow is generally less effective in lakes. Dilution is partially a function of lake size, but dilution could be rapid in small lakes with large water contributing areas. Decreases in herbicide concentration in lakes, ponds, and other lenthic water bodies are largely a function of herbicide and biological degradation processes rather than of dilution. Evaporation of water from a lake's surface can concentrate herbicide constituents but in most lakes and ponds some mixing of surface waters occur from wind and wave action. Some invasive plants may grow in wetlands along stream margins, pond margins or lake shores and treatment of these plants may result in very small amounts of herbicide reaching surface waters (primarily at ribbon/reed canarygrass infested sites). No specific wetlands are targeted for treatment but infestations of ribbon/reed canarygrass primarily occur within wetland habitats. Other invasive plant species are not wetland or riparian dependant and are distributed across the landscape often in dry sites away from waterbodies and stream channels

The Metolius ribbongrass and yellow iris emergent vegetation treatment analysis (Appendix H p. 10) and SERA Worksheets showed that treating these plants with glyphosate could contaminate a alcove pool just slightly above the threshold that would indirectly affect fish but this did not take into account water moving through the alcove and assumed that all herbicide applied on the plants would reach the water. Results from the use of the new GLEAMS driver model (SERA 2008) indicated that amounts of glyphosate entering an alcove from emergent vegetation treatment would be far below levels of concern (see Fisheries Report). Where Hazard Quotient results from the SERA Worksheets were found to be greater than 1 for fish specific PDFs were designed to mitigate the use of a particular herbicide in a certain location (See Table 14).

The disturbance of juvenile fish from workers treating ribbon grass along the margins and the reduction in cover from removal of ribbon grass plants could adversely affect bull trout and may impact any stray steelhead that might enter the system.

However these disturbances are not expected to be greater than what is experienced from anglers and recreationists along the river. Ensuring that the Metolius River continues to have a diverse riparian plant community to support these fish species and their habitat outweighs the chance of having a monoculture of reed canary/ribbon grass and yellow iris. Chinook salmon EFH would also be impacted for the same reasons for a few years until native vegetation becomes reestablished. The EDRR portion of this project could have similar effects if another population of aquatic dependant invasive plant is discovered in a new location and needs similar treatment.

The SERA Worksheets results for TES watersheds indicate that through the use of herbicides, along with buffers and PDFs that limit the use of certain herbicides and application rates in certain watersheds would make direct or indirect effects to fish very unlikely. Any indirect effects to macrophytes, or algae should they occur are expected to small and localized at the location where an herbicide may enter a waterbody.

Effects Determinations

The following bullets show all potential status, occurrence and affects determinations that could occur for threatened, endangered and sensitive species and Chinook EFH (Essential Fish Habitat).

Status

E = Federally **Endangered**
T = Federally **Threatened**
S = **Sensitive** species from Regional Forester's list
C = **Candidate** species under Endangered Species Act
MS = **Magnuson-Stevens Act** designated Essential Fish Habitat

Occurrence

HD = Habitat Documented or suspected within the project area or near enough to be impacted by project activities
HN = Habitat Not within the project area or affected by its activities

D = Species **Documented** in general vicinity of project activities
S = Species **Suspected** in general vicinity of project activities
N = Species **Not documented** and not suspected in general vicinity of project activities

Affects Determination Abbreviations

Threatened and Endangered Species
NE = **No Effect**
NLAA = May Effect, **Not Likely to Adversely Affect**
LAA = May Effect, **Likely to Adversely Affect**
BE = **Beneficial Effect**

Sensitive Species
NI = No Impact
MIIH = **May Impact Individuals** or **Habitat**, but Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species
WIFV = **Will Impact** Individuals or Habitat with a Consequence that the Action May Contribute to a Trend Towards **Federal** Listing or Cause a Loss of **Viability** to the Population or Species
BI = Beneficial Impact

Chinook Salmon Essential Fish Habitat (Magnuson-Stevens Act)
NAE = **No Adverse Effect**
AE = Adverse Effect on Essential Fish Habitat

Subwatersheds that contain TES listed fish, EFH, lead to TES fish waterbodies or may have TES fish reintroduced to them in the next five years were analyzed for effects and these were previously discussed and summarized. Results from this analysis for where effects were determined to be NLAA (Not Likely to Adversely Affect) or LAA (Likely to Adversely Affect) are presented for Alternative 2 in tables 77-81, and for Alternative 3 in tables 82-86.

Alternative 2 Affect Determinations

Table 77. Alternative 2 affect determinations for watersheds and subwatersheds with listed bull trout populations under. All bull trout populations in this analysis are federally listed as threatened.

Watershed (s)	Occurrence	Populations	Affects Call	Comments (See previous effects sections for full discussion)
Upper and Lower Metolius River, Lower Whychus Creek, Lower Crooked River, Lake Billy Chinook	HD, D	Metolius/Lake Billy Chinook	LAA	Possible disturbance and reduction in cover effects from treatment of ribbon/reed canarygrass and yellow iris at site 15-32 on the Metolius River. EDRR potential for future treatment of emergent vegetation at other sites similar to Metolius River site 15-32
Wickiup	HD, D	Odell/Davis	LAA	EDRR potential for future treatment of emergent vegetation at other sites similar to Metolius River site 15-32

Table 78. Alternative 2 affect determinations for watersheds and subwatershed where steelhead species are present. All Mid-Columbia River (MCR) steelhead populations within the project area are federally listed as threatened.

Watershed (s)	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
Upper Metolius River	HD, N	Upper Deschutes	LAA	Possible disturbance and reduction in cover effects from treatment of ribbon/reed canarygrass and yellow iris at site 15-32 on the Metolius River
Trout Creek	HD, D	Lower Deschutes	LAA	EDRR potential for future treatment of emergent vegetation sites similar to site 15-32 on the Metolius River
Whychus Creek, Lower Metolius River	HD, D	Upper Deschutes	LAA	EDRR potential for future treatment of emergent vegetation sites similar to site 15-32 on the Metolius River
Mckay Creek, Lower Crooked River	HD, D	Crooked River	LAA	EDRR potential for future treatment of emergent vegetation sites similar to site 15-32 on the Metolius River
Bridge Creek	HD, D	Lower John Day	LAA	EDRR potential for future treatment of emergent vegetation sites similar to site 15-32 on the Metolius River
Upper and S.F. John Day subasins	HD, D	Upper John Day	LAA	EDRR potential for future treatment of emergent vegetation sites similar to site 15-32 on the Metolius River

Table 79. Alternative 2 affect determinations for watersheds with redband trout. Redband trout are on the Regional Foresters' 2008 sensitive species list.

Watershed	Occurrence	Pop-ulation	Affects Call	Comments (See previous effects sections for full discussion)
Wickiup, Crane Prairie, Fall River, Pilot Butte, Whychus Creek, Upper Metolius River, Crescent Creek	HD, D	Upper Deschutes	MIIH	Possible disturbance and reduction in cover effects from treatment of ribbon/reed canarygrass and yellow iris sites
All other watersheds with redband trout	HD, D	All Others	MIIH	EDRR potential for future treatment of emergent vegetation similar to site 15-32 on the Metolius River

Table 80. Alternative 2 affect determinations for watersheds with Chinook and coho salmon EFH

Watershed	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
Upper Metolius River	HD, D	Upper Deschutes	AE	Ribbon grass treatment along the Metolius River at site 15-32 may have a short term impact on juvenile Chinook rearing habitat but will have a long term beneficial effect.
All other watersheds	HD, D	All others	AE	EDRR potential for future treatment of emergent vegetation similar to site 15-32 on the Metolius River. This would have a short term effect on juvenile Chinook rearing habitat but would have a long term beneficial effect.

Table 81. Alternative 2 affect determinations for Middle Columbia River steelhead and Columbia River bull trout critical habitat. Critical habitat has not been designated for the recently reintroduced Upper Deschutes and Crooked River steelhead populations.

Species	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)

Bull Trout	HD, D	Upper Deschutes	NE	Treatments under this project will not impact critical habitat on private land
Steelhead	HD, D	Lower Deschutes, Upper John Day, Lower John Day	NLAA	EDRR potential for future treatment of emergent vegetation similar to site 15-32 on the Metolius River. This would have a short term effect on juvenile steelhead rearing habitat but would have a long term beneficial effect.

Alternative 3 Affect Determinations

Table 82. Alternative 3 affect determinations for watersheds and subwatersheds with listed bull trout populations under. All bull trout populations in this analysis are federally listed as threatened.

Watershed (s)	Occurrence	Populations	Affects Call	Comments (See previous effects sections for full discussion)
Upper and Lower Metolius River, Lower Whychus Creek, Lower Crooked River, Lake Billy Chinook	HD, D	Metolius/Lake Billy Chinook,	NLAA	Possible indirect effects to aquatic plants or algae in small localized areas
Wickiup	HD, D	Odell/Davis Lakes	NLAA	Possible indirect effects to aquatic plants or algae in small localized areas

Table 83. Alternative 3 affect determinations for watersheds and subwatershed where steelhead species are present. All MCR steelhead populations within the project area are federally listed as threatened.

Watershed (s)	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
All with steelhead	HD, D	Lower Deschutes, Upper Deschutes, Lower John Day, Upper John Day, Crooked River	NLAA	Possible indirect effects to aquatic plants or algae in small localized areas. EDRR potential for future treatment of invasive plants but not for treatment of emergent vegetation.

Table 84. Alternative 3 affect determinations for watersheds with redband trout. Redband trout are on the Regional Forester's 2008 sensitive species list.

Watershed	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
All watersheds with redband trout	HD, D	All others	MIIH	Possible indirect effects to aquatic plants or algae in small localized areas. EDRR potential for future treatment of invasive plants but not for treatment of emergent vegetation.

Table 85. Alternative 3 affect determinations for watersheds with Chinook and coho salmon EFH

Watershed	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
All watersheds	HD, D	All others	NAE	Currently proposed treatments will not measurably alter habitat conditions.

Table 86. Alternative 3 affect determinations for Middle Columbia River steelhead and Columbia River bull trout critical habitat. Critical habitat has not been designated for the recently reintroduced Upper Deschutes steelhead population.

Species	Occurrence	Population	Affects Call	Comments (See previous effects sections for full discussion)
Bull Trout	HD, D	Upper Deschutes	NE	Treatments under this project will not impact critical habitat on private land
Steelhead	HD, D	All	NE	Currently proposed treatments will not measurably alter habitat conditions.

Cumulative Effects

Private lands that are adjacent to the ONF, DNF and CRNG range from small private parcels to private timberlands, grazing lands, destination resorts and agricultural lands. A majority of the private lands bordering with forest service and grasslands consist of smaller private parcels, timberlands and grazing lands. Herbicide application on private lands will most likely occur to treat invasive plants around private residences. Some treatment of invasive plants may occur on private timber or grazing lands. Herbicides are not generally used on the east side of the cascades to control competing native vegetation in plantations but on timberlands west of the cascades this is a common practice. On private lands the actual amount of herbicides, the time of year it is applied, the proximity to federal lands and the proximity to waterbodies is unknown.

Large tracts of agricultural lands primarily exist adjacent to the Crooked River National Grassland in the Madras area. The timing, amounts and types of herbicides used on these agricultural lands is unknown but this is the most likely place where large scale herbicide applications occur. These lands are arid with native vegetation consisting mostly of grass, bitterbrush and sage. Streams in these areas are small and contain redband trout and other native non-game fish.

Herbicide applications by the Forest Service adjacent to these private agricultural lands are not expected to enter these waterbodies in significant quantities that would cause measurable effects to fish or aquatic organisms beyond some indirect effects to aquatic plants and algae. These indirect effects would be confined to the location runoff with herbicide residue enters a waterbody (see previous direct and indirect effects discussion). The implementation of PDFs and buffers on channels and waterbodies ensure any potential effects would be eliminated or greatly reduced. Runoff from private agricultural land would have to occur in the same storm event and enter the stream at same time and place as herbicides applied under this project. Amounts of herbicide applied on private land would also have to be large enough and close enough to streams to cause detrimental effects to fish and aquatic organisms. Affects on private agricultural lands could occur regardless of any Forest Service treatments adjacent to these private agricultural lands. However, if label requirements and best management practices are followed on private lands affects to aquatic organisms should be inconsequential. Coordination with adjacent private landowners and other state, federal, or private entities with right of ways will be undertaken to ensure amounts of herbicide applied on Forest Service lands and directly adjacent to Forest Service lands do not exceed the actions and effects discussed in this document (PDF #6).

Cumulative effects to aquatic species from past Forest Service invasive plant sites within the project area that have been treated under ONF (USDA 1998b) and DNF (USDA 1998a) invasive plant EAs should be non existent for the following reasons:

1. This EIS will replace the existing 1998 invasive plant EAs so no duplicate treatments would occur in the same year.

2. Treatment timing from the last treatment at a given site under the existing 1998 EAs in most cases would be approximately one year before it would be retreated under this EIS. Herbicides from past treatments are unlikely to be detectable after one year because: The persistence of picloram has been measured to be around one year with a half life of 90 days (SERA 2003, USDA 1998a). Glyphosate persists for 3-12 months with an average half life of 30 days in soils (SERA 2003, USDA 1998a). Triclopyr persists for 8-10 months and rapidly disappears in forested settings from soil microbes and photodegradation (Norris et al. 1991 and USDA 1998a). Triclopyr TEA has a half life of 46 days while Triclopyr BEE is the more toxic version and it has a half life of 70 days (SERA 2003). The field dissipation half life of Triclopyr TEA and Tryclopyr BEE are 139 days and 39 days respectively (Ganapathy 1997). Dicamba was used under the 1998 EA but is not proposed for use under this EIS and it persists for less than one year (USDA 1998a). Herbicide residues from past treatments in most locations should be broken down or adhered to organic matter or soil particles within one year of application.
3. In the Ochoco EA (USDA 1998b) herbicide treatments at 72 sites ranged from less than an acre to 60 acres and only 6 of these sites were located in riparian areas. Herbicides used were picloram, glyphosate and dicamba. Application within 10 feet of any waterbody was restricted to wicking and from 10 to 50 feet was restricted to back pack sprayer. Herbicide residue that may have entered waterbodies via runoff or percolation should have been degraded and diluted during the first runoff event and subsequent runoff events in a year's time before any herbicide applications occur under this EIS. The Ochoco EA (page 25) determined that there would be no significant cumulative, direct or indirect impacts to the fisheries resource; therefore no cumulative impacts should occur from this project.
4. In the Deschutes EA (USDA 1998a) herbicide treatments were analyzed at 40 sites on 476 acres. Herbicides analyzed were picloram, triclopyr, glyphosate and dicamba. No herbicide application was allowed within 100 feet of riparian areas, perennial stream, intermittent streams or high water tables. The Deschutes EA (Ch 3, Page 28) determined that with mitigation measures short term entry of biologically significant levels of herbicides into surface waters should be prevented.

The types of herbicides that will be used under this EIS and the PDFs, that will be applied in relation to aquatic resources will prevent any additional cumulative effects to past invasive plant treatments. Herbicides such as picloram that can persist for more than one year would not have cumulative effects on aquatic organisms because picloram not taken up by soils or terrestrial plants would be washed off in the first few rain events and any wash off or erosion of soils containing this herbicide after the first few rain events would be at undetectable levels in aquatic organism. SERA (2003) determined there seems no plausible basis for asserting that the use of picloram in Forest Service programs is likely to lead to adverse effects in aquatic species. Therefore, there should be no cumulative effects from past treatments.

In many sites herbicide treatments are expected to occur more than once over the course of several years. This will especially be true for sites with larger infestations. The amount of plants treated each year at a given site is expected to decline after the initial treatment. Cumulative effects to fish and aquatic organisms are not expected from treating the same site or several sites within a watershed more than once for the following reasons:

1. Individual invasive plant sites will only be treated with herbicides up to the highest allowable application rate for a given location. In general herbicide application will be done usually during the most effective time of year for treatment of a particular invasive plant species.
2. The most effective treatment times should be similar or the same year to year.

3. It is not expected that herbicide runoff from one site will enter a waterbody and mix with herbicide runoff from other sites at the same time and location to create a cumulative effect. Indirect effects are expected to only occur at the location that herbicides enter a waterbody. Herbicides are expected to be at their highest levels during the first runoff event of the season based on the first flush phenomenon (Caltrans 2005, Huang et al. 2004, Giudice et al. 2007). However, if runoff does mix and herbicides are present in a waterbody from more than one site it is expected that other runoff from other areas would also be occurring at the same time adding additional water volume to a waterbody. This would dilute herbicide concentrations and eliminate the chance for adverse effects. Giudice et al. (2007) indicated that a first flush of herbicides would not be sustained long enough to cause toxic effects.
4. A reduction in overhead and instream cover will only occur where reed canary/ribbongrass treatments occur. Other invasive plants under this EIS are not riparian dependant and would not alter streamside habitat. Where reed canary/ribbon grass treatments occur no other projects are occurring or are proposed that decrease instream habitat and cover. Current and foreseeable instream projects on the forests are working toward increasing cover with additions of woody debris. Water temperatures would not be affected by removal of reed canary/ribbongrass (See EIS hydrology report).
5. The following list of herbicide properties and study results explains why herbicide residues from previous treatments will be undetectable or at low enough levels that effects would be insignificant:

- Chlorsulfuron degrades in aerobic soil and adsorption to soil particles, which affects the runoff potential of chlorsulfuron, is strongly related to the amount of organic material in the soil (SERA 2004). The half-life in the field averages 40 days (range 4-6 wks) and is shorter at lower pH levels (Bautista and Bulkin 2006). However, Walker and Welch (1989) found that chlorsulfuron could persist in subsurface soils for more than one year. Most residues on the surface soil layer should be degraded in less than one year. The surface soil layer would be the most likely to wash off and into a stream during storm runoff. Chlorsulfuron was sampled in Midwest streams at 71 sites following herbicide application and after storm events and the maximum concentration found was 0.000013 mg/L (Battaglin and Fairchild 2002). This is well below the 0.0007 mg/L EC50 threshold used by Battaglin and Fairchild (2002) for aquatic plants and the NOEC endpoint of 2 mg/L used in this EIS for effects to salmonids.
- Clopyralid has a half life in soils that averages 40 days (range 12-70 days) and an 8-40 day half life in water (SERA 2004, Michael 2004, Bautista and Bulkin 2006). Photo degradation and hydrolysis do not occur but relatively rapid breakdown by soil microbes reduces the potential for run-off or leaching. Increased soil temperatures have been found to increase the degradation rates of clopyralid and this was observed to be three times faster in clay loam soils than was seen in clay or sandy loam soils (Smith and Aubin 1989). Under certain soil conditions with cool temperatures and low levels of soil microbes clopyralid residues could persist for more than a year. Extensive offsite movements of clopyralid have not been a documented. From 0.01 % to 0.02 % of the clopyralid applied have been reported in the first runoff event (Tu et al. 2001). Peak concentrations were recorded by Leitch and Fagg (1985) from aerial application of 0.017 mg/L in a nearby stream that drained the area. This is well below the acute NOEC concentration of 5 mg/L used as the endpoint for potential effects to fish in this EIS and aerial application is not a proposed treatment method. Results from these studies and the fact that clopyralid is practically non toxic to aquatic organisms makes the potential for cumulative effects highly unlikely.
- Glyphosate persists for 3-12 months with an average half life of 30 days in soils (SERA 2003, USDA 1998a). A study by Dibyendu et al. (1989) found after 78 days glyphosate (Roundup

formulation) dissipated to 10% of what was applied. They also found no evidence of lateral movement or surface runoff of glyphosate on an 8 % slope with clay soils (Dibyendu et al. 1989).

- Imazapic is not a first choice herbicide to treat any invasive plants under this project but is the 2nd choice herbicide to treat field bindweed. It is degraded by soil microbes and is highly water soluble with an average half life of 120 days. It has been shown to persist in soils for over one year and in some cases up to three years (Cox 2003). Imazapic is of low toxicity to fish with exposure under Forest Service applications expected to be far below levels of concern (SERA 2004). Algae have not been shown to be sensitive to it but there is a potential risk to aquatic plants at the highest application rate (SERA 2004). Cumulative effects from persistence are not expected under this project because use of imazapic is expected to be minimal to not at all as it is not a first choice herbicide to treat any of the currently identified invasive plant sites.
- Imazapyr photodegrades in water and is degraded by soil microbes. It has a half life of 1-2 days in water and 25-142 days in soil (Bautista and Bulken 2006). Laboratory and field studies show exposure risk to North American fish species is far below levels of concern (SERA 2004). There is a potential risk to some species of aquatic plants at the typical application rates but no risk to algae. A field study by Michael and Ruiz-Cordova (2006) aerially applied imazapyr to clearcut areas with and without Streamside Management Zones (Buffers) and found that at all of the treated sites impacts to algae and macroinvertebrates were insignificant. This same study also sampled imazapyr concentrations in streams that were 1000 times lower than those amounts reported by SERA (2004) to affect fish and periphyton (Michael and Ruiz-Cordova 2006). Imazapyr was used to treat spartina in a Washington State estuary and levels found in the water following application were five orders of magnitude lower than levels needed to affect aquatic invertebrates or fish (Patten 2003). This study by Patten (2003) also found that imazapyr degraded to the point of being non detectable in water after five days and non detectable in sediment after 17 days.
- The persistence of Picloram has been measured to be up to one year with a half life of around 90 days (SERA 2003, USDA 1998a). Research done in the southern U.S. using injection and ground based broadcast methods at seven sites reported from 0.004 to 0.021 mg/L (Michael and Neary 1992). This is well below the most sensitive endpoint threshold (NOEC) of 0.04 mg/L for fish used in this EIS.
- Metsulfuron methyl degrades in soil, with a variable half-life up to 120 days (SERA 2004). There is an extremely low probability of exceeding levels of concern for fish, invertebrates, or algae under the proposed action because expected exposure concentrations in the SERA risk assessments did not exceed NOEC values (SERA 2004). Transport of Metsulfuron methyl in waterbodies to accumulate with this herbicide applied at other sites is very unlikely. Neary and Michael (1989) studied broadcast sprayed metsulfuron metyl on forest lands with 5 meter buffer strips along ditches with a storm 20 days after application that caused flow in the ditches and raised streamflow levels. They reported no significant downstream movement of metsulfuron metyl (Neary and Michaels 1989).
- Sethoxydim is not a not a first choice herbicide to treat any invasive plants under this project and the fact that it is highly toxic to fish from the petroleum inert in the formulation means it will most likely be seldom used if at all. SERA (2001) risk assessments incorporated the toxicity of the naptha solvent in the Poast formulation of this herbicide. The toxicity of the sethoxydim alone is about 100 times less for fish than that of the Poast formulation. Since the naptha solvent tends to volatilize or adsorb to sediments, using the Poast formulation data to predict effects from runoff may overestimate potential effects (SERA 2001). Sethoxydim

photodegrades, has low soil persistence and is rapidly degraded by soil microbes (SERA 2001). It has a half life of 5-25 days (average is 5 days)and photolysis can take place in <4 hours in soil and <1 hr in water (Bautista and Bulkin 2006). Since sethoxydim is mainly used to treat grasses and would not be used near water to treat reed canarygrass or ribbongrass it is expected the use of this herbicide will be very limited to not at all.

- Sulfometuron has an average half life of 20 days (USGS 2001). Michael and Neary (1992) found Sulfometuron methyl concentrations from 0.005 to 0.007 mg/L in surface waters following ground based broadcast application at two sites. This is well below the most sensitive endpoint threshold (NOEC) of 1.17 mg/L used for fish in this EIS.
- Triclopyr persists for 8-10 months and rapidly disappears in forested settings from soil microbes and photodegradation (Norris et al. 1991 and USDA 1998a). Triclopyr TEA the aquatic version has a half life of 46 days while Triclopyr BEE is the more toxic version and it has a half life of 70 days (SERA 2003). Studies conducted in a forested environment where buffers were used and triclopyr was not directly applied to waterbodies or intermittent streams detected amounts of triclopyr were undetectable or well below levels of concern for aquatic organisms (Ganapathy 1997).

Herbicide residues from past treatments in most locations should be broken down or adhered to organic matter or soil particles within less than one year of application. Herbicides such as chlorsulfuron, imazapic, or picloram that can persist for more than year could lead to some accumulation in soils at the invasive plant treatment site. Herbicides not taken up by soils or terrestrial plants would be washed off in the first few rain events following application. Any wash off or erosion of soils containing this herbicide after the first few rain events would be below levels of concern for effects to aquatic organisms. Acute exposure of herbicides is considered at the site scale for treatment of up to 10 acres that extends for 1.5 miles adjacent to streams, for the treatment of emergent vegetation next to and growing out of a waterbody and for treatment of roadside ditches. In most cases acute exposures are measured within 24 hours following application. Herbicides proposed for this project are metabolized and excreted faster than they can accumulate in aquatic organisms. Herbicides proposed for use in this project also do not accumulate in the fatty tissues of fish. SERA (2003, 2004) determined there is no plausible basis for asserting that the use of chlorsulfuron, imazapic, or picloram and in Forest Service programs is likely to lead to adverse effects in fish. Some indirect effects could occur to aquatic plants or algae from the use of chlorsulfuron but effects are expected to be localized and of short duration (see previous discussion on direct and indirect effects). The use of herbicides that could persist more than one year or could produce effects to aquatic organisms are also restricted in application method and rate near intermittent or perennial waterbodies to add a further layer of protection.

Manual Mechanical and Cultural Methods

Pulling, tarping or whacking invasive plants would not produce cumulative impacts to past invasive plant treatments or other ground disturbing or sediment producing activities occurring in the project area for the following reasons:

1. In most areas individual plants will be pulled producing a small divot and most invasive plant species are found scattered on the landscape.
2. Smaller infestations or scattered individual plants will be hand pulled while larger more dense infestations will generally be treated with herbicides reducing the potential for large areas of ground disturbance.

3. Species to be treated under this EIS are often located in the uplands or along roads and are not riparian dependent with the exception of ribbon/reed canarygrass.
4. Pulling reed canary/ribbongrass will be confined to plants that growing in the water, on logs or rocks. These clumps can often by pulled with little disturbance to bottom sediments. Fine sediments will not be added to waterbodies but sediments already in the streambed will be mobilized and redistributed. Unless negotiated with ODFW pulling of reed canary/ribbongrass will occur within the ODFW instream work window to avoid mobilizing any fine sediment that could wash into bull, trout, steelhead, kokanee, redband trout or Chinook redds. This will eliminate any chances for these sediments to have detrimental effects to fish and to be cumulative with other sediment generating mechanisms that may occur.

Cumulative effects of sedimentation to fish populations from hand pulling or tarping would be immeasurable against other sedimentation produced by natural processes, past agricultural practices, grazing, timber harvest, development and roads in the project area. This is primarily due to pulling occurring on scattered individual plants while large infestations are proposed for herbicide treatment until they are eliminated or become small enough that pulling could be cost effective. Invasive plant whacking would not reduce overhead cover or shade because this method is not proposed for riparian dependant invasive plant species.

3.8 Human Health – Worker and Public Exposure to Herbicides

This section focuses on the health effects to workers and the public if herbicides are used as proposed in the alternatives. The R6 2005 FEIS and its Appendix Q: Human Health Risk Assessment detailed the potential for health effects from the use of the herbicides proposed for this project. Herbicide active ingredients, metabolites, inert ingredients, and adjuvants and people with particular herbicide sensitivity were addressed. The R6 2005 ROD adopted standards to minimize herbicide exposures of concern to workers and the public based on the human health risk assessments. Herbicides are an important component of the integrated weed management methods needed to meet the purpose and need for this project.

Site-specific 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.

Many people express concern about the effects of herbicides on human heath. People wonder if they could be sickened by brushing up against contaminated vegetation or eating berries, mushrooms, fish or game that may have been exposed to herbicides. They worry that they might drink water contaminated by herbicides. People are concerned about the health and safety of forest workers who are more likely to be exposed to herbicides. Some believe that the potential cost to human health is too high and other methods should be used to control invasive plants.

Indeed, 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. Scientific risk assessments do not indicate that any person would be adversely affected in any way by these herbicides used in the manner proposed for this project. This applies to all alternatives.

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 for 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.

The human health hazards associated with each herbicide active ingredient were evaluated and estimated by a thorough review of available toxicological studies. Possible health effects may include short-term and long-term adverse effects. Short-term effects may include: nausea, headache, dizziness, eye or skin irritation, and coughing. Long-term effects may include: cancer; reproductive, endocrine, immunologic, neurological effects, and genetic mutations.

Estimates of potential health risks for each herbicide as proposed for use in each alternative are based on herbicide risk assessments prepared for the Forest Service by Syracuse Environmental Research Associates (SERA). Forest Service/SERA risk assessments use peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Specific methods used in preparing the Forest Service/SERA herbicide risk assessments are described in SERA, 2001. The risk assessment for the adjuvant NPE (nonylphenol polyethoxylate) was conducted and documented by David Bakke, Forest Service Pesticide-Use Specialist, consistent with the assumptions, methodologies, and protocols developed by SERA. The NPE Risk Assessment (Bakke, 2003), was peer-reviewed by SERA toxicologists and other Forest Service and independent experts; it is included in the "Forest Service/SERA herbicide risk assessments" used throughout this EIS.

The toxicological database for each herbicide was reviewed for acute, subchronic, and chronic effects in laboratory animal studies. Judgments about the potential hazards of herbicides to humans are necessarily based in large part on the results of toxicity tests on laboratory animals. Information on actual human poisoning incidents and effects on human populations supplements the laboratory animal test results, where such information is available. For a background discussion of all toxicological tests and endpoints considered in Forest Service Risk Assessments, refer to SERA, 2001.

Herbicide formulations may contain additional compounds besides the herbicide active ingredient; these are termed impurities or inert ingredients. Other additives, called adjuvants and surfactants, may be mixed with the diluted formulation before spraying to either enhance the herbicide activity or to modify undesirable properties of the spray mixture. Additionally, when organisms in the environment internalize chemical herbicide formulation in their physiologic systems, they may transform them into other compounds called metabolites. Of these categories of substances, only the NPE group of surfactants has been tested and data produced that identify specific and quantifiable hazards to human health (Bakke, 2004).

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 Forests that is included in the EPA testing. Endocrine disruption and glyphosate was studied by SERA in 2002 (SERA 2002) and considered in the R6 FEIS and its Appendix Q.

SERA report "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."

The following terminology describes relative toxicity of herbicides proposed for use.

Exposure Scenario: The way a person may be exposed to herbicides' active ingredients or additives. The application rate and method influences how much herbicide a person may be exposed to.

Threshold of Concern: A level of exposure below which the potential for adverse effects to a person is low. This level was made more conservative in the R6 2005 FEIS to add a margin of safety to the risk assessment process (see Figure 12, section 3.1.2).

Hazard Quotient (HQ): The Hazard Quotient is the amount of herbicide or additives to which a person may be exposed over a specified period divided by the estimated daily exposure level at which no adverse health effects are likely to occur. An HQ less than or equal to one indicates an extremely low level of risk; therefore, an HQ less than or equal to one is presumed to indicate a level of exposure below the threshold of concern for adverse health effects.

All alternatives are designed to limit exposures to herbicides by workers and the public to levels below a HQ of 1, meaning that adverse health effects are unlikely to occur. This is done by limiting the potential for exposure so that it is below a threshold of concern, based on the risk assessment information. Even with an HQ of less than 1, a person could conceivably become sick. Some people may be particularly sensitive to individual chemicals and affected at very low doses.

People live near, spend time, work in, drink water from, and depend on forest products from the Deschutes and Ochoco National Forests and the Crooked River Grassland. Thus, while the likelihood of harmful exposures is very low, there remains high concern about the impact on herbicide use to public and worker health.

3.8.1 Affected Environment

Many people live near, spend time, work in, drink water from, or depend on forest products from the Deschutes and Ochoco National Forests and Crooked River National Grassland. These people may be inadvertently exposed to herbicides from invasive plant management projects on the Forests. 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.

Many groups use the forest to collect personal use and commercial forest products routinely and seasonally. Special forest products found here include a variety of mushrooms, blackberries, huckleberries, roots, and herbs. American Indian Tribes use the Forests and Grassland for collecting plants that are used to make things, such as basketry, and for eating. The Forests also have extensive pine cone collection for the commercial decoration market, firewood gathering, and quarry sites where red cinder, lava and tabular rocks are gathered for landscaping or ornamentation. Some of these products are targeted commercial species for export, such as matsutake mushroom, but more are not. Matsutake mushroom harvesters are a large group that come together on the Deschutes National Forest, primarily Crescent Ranger District, during a specified commercial season in the fall. The majority of invasive plant sites are along roadsides, whereas special forest products are more often found in natural settings. Special forest product harvesters may have more contact with contaminated vegetation than the general public.

Recent studies 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 American Indian Lands, commercial forestlands, or other private parcels. Several municipal watersheds lie on the Forest (see Soil and Water section above).

Infested sites are scattered and occupy less than 3 percent of Deschutes & Ochoco National Forest system lands. Invasive plant treatments on the Forests 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).

3.8.2 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 a rage of exposure scenarios.

Accidental worker exposures are most likely to involve splashing a solution of herbicides into the eyes or on the skin. Two general types of exposure were modeled: one involving direct contact with a solution of the herbicide and another associated with accidental spills of the herbicide concentrate onto the surface of the skin. For this risk assessment, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical/kg body weight.

Exposure scenarios involving direct contact with herbicide solutions are characterized by immersing unprotected hands for 1 minute or wearing contaminated gloves for 1 hour. While it is unlikely that workers would immerse their hands in herbicide solutions, the contamination of gloves or other clothing is possible. For these exposure scenarios, the key element is the assumption that wearing gloves saturated with a chemical solution is equivalent to immersing the hands in a solution.

In either case, the concentration of the chemical in solution that is in contact with the surface of the skin and the resulting dermal absorption rate are essentially constant. Exposure scenarios involving chemical spills onto the skin are characterized by a spill onto the lower legs as well as a spill on to the hands. In these scenarios, it is assumed that a solution of the chemical is spilled on to a given surface area of skin and that a certain amount of the chemical adheres to the 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 worker or a member of the public. In most cases, even when maximum rates and exposures were considered, HQ values were below the threshold of concern (HQ values ranged from 0.01 to 1).

Appendix Q did 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 a period of time) 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. Below the threshold of concern, the risk is extremely low for any observable adverse effects due to the particular exposure scenario. 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, through notification and/or signing. For all herbicides except triclopyr, direct contact with sprayed vegetation would not exceed a level of concern. The exception is triclopyr: exposures exceeding a conservative level of concern could occur if a person accidentally contacts vegetation spot-sprayed with triclopyr (especially Garlon 4). The use of Garlon 4 is 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; and in special forest product areas, triclopyr will only be applied using a direct targeted application to individual invasive plants). Gathering areas, campgrounds and administrative sites may be closed during and after triclopyr application to eliminate accidental exposures.

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. (see Section 3.7)

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.

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 a threshold of concern.

Appendix Q of the R6 FEIS 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 or cultural-use plants (Table 87) 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).

Table 87. Some culturally-important plants in Central Oregon.

Scientific Name	Common Name	Plant Family Common Name	Cultural Use
Achnatherum hymenoides (= Oryzopsis hymenoides	Indian ricegrass	Grass family	Food
Allium spp.	Wild onions	Lily family	Food
Asclepias spp.	Milkweed	Milkweed family	Basketry materials
Camassia spp.	camassia	Lily family	Food
Cornus sericea	Redosier dogwood	Dogwood family	Basketry materials
Daucus carota	Wild carrot	Carrot family	Food
Lewisia rediviva	Bitterroot	Purslane family	Food
Leymus cinereus (= Elymus cinereus)	Basin wildrye	Grass family	Food
Lomatium canbyi	Canby's biscuitroot; Canby's lomatium	Carrot family	Food
Lomatium spp.	Lomatiums	Carrot family	Food

Scientific Name	Common Name	Plant Family Common Name	Cultural Use
Nuphar polysepalum	Pond lily; wokas, wada	Water-lily family	Food
Perideridia spp.	Yampah	Carrot family	Food
Prunus virginiana	Chokecherry	Rose family	Food
Ribes spp.	Currants	Currant family	Food
Rosa spp.	Wild rose	Rose family	Food
Sagittaria cuneata	Wapato, arumleaf, arrowhead	Water plantain family	Food
Salix spp.	Sometimes called red & coyote willows	Willow family	Basketry materials
Sambucus spp.	Elderberry	Honeysuckle family	Food
Scirpus spp. (some species now in the genus *Schoenoplectus*)	Tule	Sedge family	Basketry materials
Thuja plicata	Western red cedar	Cypress family	
Typha spp.	Cattail	Cattail family	Basketry materials
Vaccinium spp.	Huckleberries	Heath family	Food
Xerophyllum tenax	Beargrass	Lily family	Basketry materials

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, contaminated with herbicide residues 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.

Section 3.6 details the existing water sources in use across the Forests and effects in terms of water contamination.

Environmental Justice

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. The season that matsutake are harvested is generally outside the timeframe that herbicides are used for treatments. However, no mushrooms are target species and Project Design Features are in place to protect fungi. Whenever herbicide treatment is scheduled to occur, 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. Information about invasive plant treatments would be added to the multi-lingual mushroom gathering permit material to eliminate inadvertent exposures. Some areas may be closed to gathering following treatment to avoid exposures. Even given plausible inadvertent exposures, minority forest workers or subsistence gatherers are not likely be exposed to a dose which exceeds a 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 EAs and found to pose no significant potential risks to health for workers or the public.

Action Alternatives

Both alternatives similarly resolve issues related to human health. No individual worker or public exposures of concern are predicted for any alternative. Alternative 3 has the least risk of adverse effects from herbicide use of the action alternatives because it eliminates or restricts herbicide on those portions of invasive plants sites that are near streams and other water bodies. However, the Project Design Features, particularly the perennial stream buffers, and limitations on application rate of some herbicides also eliminate plausible exposures of concern in Alternative 2. No adverse effects to public drinking water supplies or health and safety are predicted in any alternative.

Table 88. How Human Health Concerns are Addressed

	Project Design Feature to Address 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 Projects	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.
Cultural Use Plants	Where an area is known as a collecting area, the use of herbicides will be avoided during season of collection and when the cultural use plants are present. Annual consultation with American Indian tribes will help ensure notification.
Drinking Water	Reduced application rates of some herbicides; Transportation and Handling Safety Plan and Spill Plan. Detectable impacts are implausible except in the event of a spill.

Cumulative Effects of All Alternatives

Workers and the public may be exposed to the 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 the chemistry of the herbicides considered for use and the mechanisms by which exposures of concern might occur.

The proposed use of herbicides in all alternatives could result in multiple or additive doses of the same or different herbicides to workers or the general public. People could conceivably be exposed to herbicides in more than one place on the Forest, or elsewhere. However, the herbicides proposed for use do not bioaccumulate in humans and are rapidly eliminated from the body.

Chronic (daily over a period of time) worker exposure was considered in SERA Risk Assessments; no chronic exposures reach a level of concern. Chronic public exposure was also assessed, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish. No chronic exposure scenarios were over a level of concern for the public.

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 HQs for each exposure scenario. Using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined (acute) HQ of 0.012. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to HQs that are two orders of magnitude less than 1, indicating an acceptable level of cumulative risk even with multiple exposure scenarios. .

Even if an herbicide with a greater hazard quotient than glyphosate were used, berry harvesting (dermal exposure) and the subsequent eating (oral exposure) would allow the body to metabolize some of the initial dose before receiving the second dose, thus reducing the cumulative dose. These factors make the risk implausible that a combined dose would exceed the threshold of concern.

The R6 Invasive Plant FEIS considered the potential for synergistic effects of exposure to two or more herbicides: “Combinations of chemicals in low doses (less than one tenth of RfD[15]) have rarely demonstrated synergistic effects. Review of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (ATSDR, 2004; U.S.EPA/ORD, 2000). Based on the limited data available on chemical combinations involving the twelve herbicides considered in this EIS, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis. Synergistic or additive effects, if any, are expected to be insignificant.” (USFS 2005a, p. 4-3).

Herbicides are sometimes used in combination with additives such as surfactants. NPE surfactant has been associated with human health risks at certain exposure levels. NPE has estrogen-like properties, although they are much weaker (1,000 to 100,000 times weaker) than natural estrogen. NPE is widely used and present in personal care products (moisturizers, deodorants, perfumes, shampoos, and soaps) and detergents. Animal studies suggest that acute exposures at high levels may cause subclinical effects to the liver or kidneys.

The risk analysis for NPE (Bakke 2004) found that typical backpack application of herbicide containing NPE surfactant at typical exposures and a rate of 1.67 lbs/acre would add 0.1 to the cumulative HQ for these types of chemicals. For the public, values ranged between 0.00001 (eating contaminated fish) to 0.2 (consuming a pound of berries at typical exposures). These are relatively small increases in hazard and do not significantly increase the potential for cumulative effects from use of NPE surfactant and herbicides. The R6 Invasive Plant FEIS considered the potential for synergistic effects of exposure to two or more herbicides: “Combinations of chemicals in low doses

[15] RfD = A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. Environmental Protection Agency.

(less than one tenth of RfD[16]) have rarely demonstrated synergistic effects. Review of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (ATSDR, 2004; U.S.EPA/ORD, 2000). Based on the limited data available on chemical combinations involving the twelve herbicides considered in this EIS, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis. Synergistic or additive effects, if any, are expected to be insignificant." (USFS 2005a, p. 4-3).

All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

[16] RfD = A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. Environmental Protection Agency.

3.9 Terrestrial Wildlife Species of Local Interest

Introduction

The varied habitats of the Deschutes and Ochoco National Forests and Crooked River National Grassland (hereinafter referred to as the "project area") provide for a diverse array of wildlife species.

The project area provides important habitat for several rare species, including one federally listed threatened species, three species that are federal candidates, and several species included on the Regional Forester's Sensitive Animal List (USFS 2004b). No federally listed endangered species occur in the project area. In addition, the forests and grassland have identified several animals as Management Indicator Species in their respective land management plans and the project area provides habitat for species included in Birds of Conservation Concern and Landbird conservation efforts.

Invasive plant species have become established in the project area 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 Deschutes and Ochoco National Forests and the Crooked River National Grassland have proposed to conduct invasive plant control projects within their administrative boundaries. This section will summarize the effects on wildlife from invasive plants and methods used to control invasive plants.

Regarding effects to wildlife from invasive plant treatments, the primary life history traits that are used to determine risk of effects are 1) presence during treatment seasons, 2) habitat use (breeding, foraging, daytime resting) and 3) food or prey. It is primarily these three items that are summarized below. Much more detailed accounts can be found in the Wildlife Specialist Report / Biological Evaluation in the project file, and the Wildlife Report and Biological Assessment prepared for the Regional Invasive Plant Program (USFS 2005d). This Biological Assessment is incorporated by reference.

Additional discussions on amphibian decline and colony collapse disorder are found at the end of the Affected Environment section

3.9.1 AFFECTED ENVIRONMENT

Invasive Plants and Wildlife Resources

Some wildlife species utilize invasive plants for food or cover. For example, American goldfinch (*Carduelis tristis*), and red-winged blackbird (*Agelaius phoeniceus*) utilize purple loosestrife (Kiviat 1996; Thompson, Stuckey, and Thompson, 1987), and native bighorn sheep will utilize cheatgrass (Csuti et al., 2001). It has been reported that elk, deer and rodents eat rosettes and seed heads of spotted knapweed. Doves, hummingbirds, honeybees, and the endangered southwestern willow flycatcher (*Empidonax trailii extimus*) are known to use saltcedar (Barrows 1996). However, the few uses that an invasive plant may provide do not outweigh the adverse impacts to an entire ecosystem (Zavaleta 2000).

Invasive plants have adversely impacted habitat for native wildlife (Washington Dept. 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. Species restricted to very specific habitats, for example pond-dwelling amphibians, are more susceptible to adverse effects of invasive plants.

Displacement of native plant communities by non-native plants results in alterations to the structure and function of ecosystems (MacDonald et al., in press), and constitutes a principal mechanism for loss of biodiversity at regional and global scales (Lacey and Olsen, 1991; Risser 1988 as cited in Johnson et al., 1994). Mills et al. (1989) and Germaine et al. (1998) found that native bird species diversity and density, were positively correlated with the volume of native vegetation, but were negatively correlated or uncorrelated with the volume of exotic vegetation. Invasive plants can adversely affect wildlife species by eliminating required habitat components, including surface water (Brotherson and Field, 1987; Dudley, 2000; Horton, 1977), reducing available forage quantity or quality (Bedunah and Carpenter 1989; Rice et al., 1997; Trammell and Butler 1995); reducing preferred cover (Rawinski and Malecki, 1984; Thompson et al., 1987); drastically altering habitat composition due to altered fire cycles (D'Antonio and Vitousek, 1992; Mack 1981; Randall 1996; Whisenant 1990); and physical injury, such as that caused by long spines or "foxtails" (Archer, 2001). In the case of common burdock (*Arctium minus*), the prickly burs can trap bats and hummingbirds and cause direct mortality to individuals (Raloff 1998; and documented in photo by Clay Grove, USFS, and Rosa Wilson, NPS). Invasive plants that grow large and densely (e.g., giant reed, Himalayan blackberry) can act as physical barriers to water sources and essential habitat (Bautista, S., personal observation; Fiedler, C., personal observation).

Invasive plants can act as a population sink by attracting a species and then exposing them to increased mortality or failed reproduction (Chew 1981). For example, Schmidt and Whelan (1999) reported that native birds increased their use of exotic *Lonicera* and *Rhamnus* shrubs over native trees, even though nests built in the exotic shrubs experienced significantly higher mortality rates.

Some invasive plants (such as knapweed) contain chemical compounds that make the plant unpalatable to grazing animals. Chemical compounds in these invasive plants disrupt microbial activity in the rumen, or cause discomfort after being ingested, resulting in a reduced or avoided consumption of the invasive plant (Olson 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 noxious weeds, such as yellow starthistle and knapweed, as threats to upland game bird habitat. Some hunters and wildlife managers are concerned that invasive plants are degrading the quality of remaining habitat for deer and elk and are adversely affecting the animal's distribution and hunting opportunities. Trammell and Butler (1995) found that deer, elk, and bison avoided sites infested with leafy spurge (*Euphorbia esula*). Tamarisk stands have fewer and less diverse populations of mammals, reptiles, and amphibians (Jakle and Gatz, 1985; Olson, 1999). Invasion by purple loosestrife makes habitat unsuitable for numerous birds, reptiles and mammals (Kiviat 1996; Lor, 1999; Rawinski 1984; Thompson, Stuckey, and Thompson, 1987; Weihe and Neely, 1997; Weiher et al., 1996). Reed canarygrass has been implicated in the loss of Oregon spotted frog habitat may have contributed to contractions in the range of the Oregon spotted frogs in western Oregon (Hayes 1997, McAllister and Leonard 1997, Watson 2003).

Of the federally listed species that occur in the project area, 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 cyanobacteria that grows on the invasive aquatic plant, *Hydrilla verticillata* (Wilde 2005).

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. (Schmidt and Whelan 1999)

- Change to effective population size 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 and nutrient cycling (Allison and Vitousek 2004, Ehrenfeld 2003).
- Source-sink population demography, with more demographic sinks than sources.
- Lack of proper forage quantity or nutritional value at critical life periods.

Threatened, Endangered, and Sensitive Species

Federally Listed Species

One species listed as "threatened" under the Endangered Species Act of 1973 (as amended) (ESA), is found in the project area. In addition, the U.S. Fish and Wildlife Service (FWS) maintains a list of "candidate" species. Candidate species are those taxa which 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 2006a).

Threatened or candidate species thought to occur presently or historically on the Deschutes and Ochoco National Forests and the Crooked River National Grassland include the northern spotted owl (*Strix occidentalis*), Oregon spotted frog (*Rana pretiosa*), Columbia spotted frog (*Rana luteiventris*), and the fisher (*Martes pennanti*). The bald eagle (*Haliaeetus leucocephalus*) is no longer Threatened under the Endangered Species Act, and is discussed under Regional Forester's Sensitive Species. The Canada lynx (*Lynx canadensis*) has not been documented in the project area and Forest Service review found there is insufficient habitat to support lynx. Lynx will not be discussed further. Listed and candidate species found in the project area are included in the following table.

Table 89. Federally listed or candidate species potentially within the project area.

Species	Status	Critical Habitat	Presence*
Northern spotted owl	Threatened	Designated	DES
Oregon spotted frog	Candidate	None	DES
Columbia spotted frog	Candidate	None	OCH, CRNG
Pacific fisher	Candidate	None	DES

*DES = Deschutes National Forest; OCH = Ochoco National Forest, CRNG = Crooked River National Grassland

The bald eagle was removed from the endangered species list (delisted) on June 28, 2007 (USFWS 2007). As per Forest Service policy, it is now included on the Region 6 Regional Forester's Sensitive Species List.

The Oregon spotted frog, Columbia spotted frog, and Pacific fisher are also included in the Regional Forester's Sensitive Species List (USFS 2004) and are discussed in the section titled "Forest Service Sensitive Species."

Northern Spotted Owl

Information regarding the environmental baseline and critical habitat in the project area can be found in the Programmatic Biological Assessment for the Forests' activities (USDA/USDI 2006). This information is incorporated by reference and is summarized in the Action Area Information section.

Action Area Information

Northern spotted owls do not occur on the Ochoco National Forest or the Crooked River National Grassland. They are resident year-round on the Deschutes National Forest. Nesting, roosting, and foraging (NRF) habitat for the northern spotted owl on the Deschutes National Forest includes stands of mixed conifer, ponderosa pine with white fir understory, and mountain hemlock with subalpine fir. Suitable nest sites are generally in cavities in the boles of either dead or live trees. Platform nests may also be used (but more rarely), which include abandoned raptor nests, broken treetops, mistletoe brooms, and squirrel nests. Relatively heavy canopy habitat with a semi-open understory is essential for effective hunting and movement.

An analysis of local spotted owl pellets showed the primary prey species is the northern flying squirrel with red-backed vole, busy-tailed woodrat (*Neotoma cinerea*), western pocket gopher (*Thomomys mazama*), Douglas squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), voles, mice, and insects as secondary prey items.

Recurring wildfires have impacted spotted owl habitat on the Deschutes National Forest. For example, the Link and B&B fires in 2003 destroyed a total of 10,492 acres of habitat for spotted owls, including 2,710 acres of critical habitat. Smoke from very large wildfires was implicated in increased mortality to spotted owls in one study area in California (Tilghman and Paton 1988).

A Programmatic Wildlife Biological Assessment (Programmatic BA) for the Deshcutes and Ochoco National Forests (USDA Forest Service 2006) identifies breeding season limited operating periods near northern spotted owls. Table 92 lists the disturbance and disruption distances for nesting spotted owls. If disturbance-causing activities occur farther away from nesting spotted owls than the distances specified in Table 90, then no adverse effect will occur. Breeding period is from March 1 – September 30.

Table 90. Disturbance and disruption distances for nesting spotted owls.

Activity	Disturbance Distance		
	Breeding period (March 1 – Sept. 30)	Spotted owl critical breeding period (March 1 – July 15)	Remainder of the spotted owl breeding period (July 16 – Sept. 30)
Use of Chainsaws	440 yards (0.25 mile)	65 yards	0 yards
Use of Heavy Equipment	440 yards (0.25 mile)	35 yards	0 yards

There are a total of 1,275 acres of nesting, roosting, and foraging habitat within 40 project area units for invasive plant treatment, the majority of which are roadside treatments. Of these suitable acres, there are only 413 acres of project area units that plan to use mechanical treatments, in combination with other treatments.

Three project area units propose some mechanical treatment within 35 yards of spotted owl core areas. A total of 181 acres of these spotted owl core areas are in these project area units.

Critical Habitat in the Action Area

The critical habitat acres discussed here use the 2008 designation of critical habitat (U.S. Fish and Wildlife Service 2008). Primary constituent elements for owl critical habitat consist of habitat features that support nesting, roosting, foraging, and dispersal.

The attributes of nesting and roosting habitat include moderate to high canopy closure (60 to 80 percent); a multi-layered, multi-species canopy with large (>30 inches dbh) overstory trees; a high incidence of large trees with various deformities; large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for owls to fly (Thomas et al. 1990).

Foraging habitat varies across the range of the owl and contains attributes similar to nesting and roosting habitat, but may also include more open fragmented habitat. Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities.

There is designated critical habitat only on the Deschutes National Forest. Twenty-eight project area units (PAUs) include portions of the Eastern Oregon Cascade province critical habitat (unit 11). A total of 2,852 acres of critical habitat are included within project area units (project file GIS query). A total of about 1069 acres of weed sites on 27 PAUs are currently located within designated critical habitat. The total critical habitat within PAUs represents less than three percent of the total critical habitat (106,685 acres) on the Deschutes National Forest. Proposed treatments are located primarily along roads and limited to invasive plants only and will not include native trees or understory vegetation.

Forest Service Sensitive Species

Terrestrial wildlife species found in the project area that are included in the Region's "Special Status/Sensitive Species Program" are listed in Table 93. 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 91. Wildlife species within the project area that are included on the Regional Forester's Sensitive Animal List (July 2004).

Common Name	Scientific Name	Occurrence[1]		
Mammals		**DES**	**OCH**	**CRNG**
California wolverine	*Gulo gulo*	D	D	
Pacific fisher	*Martes pennanti*	D		
Pygmy rabbit	*Brachylagus idahoensis*	S	S	S
Birds				
Bald eagle[2]				
Horned grebe	*Podiceps auritus*	D		
Red-necked grebe	*Podiceps grisagena*	S		
Bufflehead	*Bucephala albeol*	D	D	D
Harlequin duck	*Histrionicus histrionicus*	D		
Yellow rail	*Coturnicops noveboracensis*	D		
Upland sandpiper	*Bartramia longicauda*		S	
Greater sage grouse	*Centrocercus urophasianus*	D	D	Extirp
American peregrine falcon	*Falco peregrinus anatum*	D	S	
Gray flycatcher	*Empidonax wrightii*	S	D	D
Tricolored blackbird	*Agelaius tricolor*	D	S	S
Amphibians				
Oregon spotted frog	*Rana pretiosa*	D		
Columbia spotted frog	*Rana luteiventris*		D	D
Invertbrates				
Crater Lake tightcoil	*Pristiloma arcticum crateris*	D		

Common Name	Scientific Name	Occurrence[1]

1 – **DES** = Deschutes NF; **OCH** = Ochoco NF; **CRNG** = Crooked River National Grassland;
D = Documented – in the context of the Forest Service sensitive species program, an organism that has been verified to occur in or reside on an administrative unit.
S = Suspected – in the context of the Forest Service sensitive species program, 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.
Extirp = extirpated from the CRNG in 1950s.
2- Included due to delisting from Endangered Species List.

Bald Eagle

The project area provides habitat for residents as well as wintering migratory eagles.

Life History and Habitat Description

Detailed accounts of habitat requirements of the bald eagle may be found in the Pacific Bald Eagle Recovery Plan (U.S. Fish and Wildlife Service 1986).

Bald eagles are most common along coasts, major rivers, lakes and reservoirs (U.S. Fish and Wildlife Service 1986), and require accessible prey and trees for suitable nesting and roosting habitat (Stalmaster 1987). Bald eagles feed primarily on fish during the breeding season, and eat waterfowl, seabirds and carrion during the winter (U.S. Fish and Wildlife Service 1995).

Bald eagles usually nest in trees near water, but are known to nest on cliffs and (rarely) on the ground. Adults tend to use the same breeding areas year after year, and often the same nest, though a breeding area may include one or more alternative nests (U.S. Fish and Wildlife Service 1999).

Wintering eagles can be found concentrated at salmon spawning areas and waterfowl wintering areas. Wintering eagles can sometimes be found in large communal roosts during the winter. Isolation is an important feature of winter habitat and night roosts are usually in remote areas with less human disturbance. In Washington, 98 percent of wintering eagles tolerated human activity at a distance of 300 m (328 yards), but only 50 percent tolerated activity within 150 m (164 yards) (Stalmaster and Newman 1978).

Threats

Currently, mortality to bald eagles occurs from habitat loss, disturbance by humans, pesticide and mercury contamination, decreasing food supply, electrocution, impacts with wind turbines, and illegal shooting (U.S. Fish and Wildlife Service 1999, Wiemeyer et al. 1993). Human disturbance can flush eagles from a nest. Nesting can fail if disturbance is frequent (U.S. Fish and Wildlife Service 1999).

A recent threat to bald eagles in the eastern and southern U.S. is mortality caused by a new disease, avian vacuolar myelinopathy (AVM) (USDI Fish and Wildlife Service 1999). This disease has been linked to a toxin produced by cyanobacteria that grows on the invasive aquatic plant, *Hydrilla verticillata* (Wilde 2005).

Conservation

With the delisting of the bald eagle imminent, the Fish and Wildlife Service released new National Bald Eagle Management Guidelines (USFWS 2007). The guidelines contain recommendations for avoiding disturbance to nesting, roosting, and foraging eagles. The activity and distance recommendations are generally 660 feet away from nest for activities such as building construction, mining, chainsaw operation, and clearing of vegetation. Topography, visibility from the nest, and ongoing similar activities in the area are modifying factors and some activities may occur as close as 330 feet from the nest.

Action Area Information

The Deschutes National Forest LRMP (USFS 1990c) identified Bald Eagle Management Areas (BEMAs), which have specific requirements for maintenance and protection of eagle habitats. A total of 21,891 acres are included in 33 BEMAs across the Deschutes, Ochoco, and Crooked River National Grassland. There are specific standards and guidelines in the Deschutes National Forest LRMP (WL-1-3 and M3-1-38) that provide management direction for BEMAs.

The Ochoco National Forest LRMP (USFS 1989, Part 1) contains direction specific to bald eagle winter roost sites (MA-F12) and does not contain specific direction for nest sites.

Table 92 summarizes the occurrence and number of bald eagle BEMAs, nest sites, and roosts within the project area.

Table 92. Approximate numbers of bald eagle nest sites and roosts in the project area.

Administrative Unit	BEMAs	Nest Sites	Winter Roosts
Deschutes	33	46	unknown
Ochoco	2	5	5
CRN Grassland	0	0	0

A Programmatic Wildlife Biological Assessment (Programmatic BA) for the Deschutes and Ochoco National Forests (USDA/USDI 2006b) identifies nesting and winter limited operating periods near bald eagles. Table 93 lists the disturbance distances for nesting and wintering eagles. If disturbance-causing activities occur farther away from nesting or roosting eagles than the distances specified in Table 70, then no adverse effect will occur. These distances are greater than those recommended in the new Bald Eagle Management Guidelines (USFWS 2007). Nesting season is January 1 to August 31. Winter roosting occurs between November 1 and April 30th.

Table 93. Disturbance distances for bald eagle within which adverse effects may occur, as specified by FWS office in Bend, Oregon.

Activity	Dates	Distance
Human disturbance above base levels	January 31 – August 31	0.25-mile no line-of sight, or 0.50-mile line-of-sight
Activities with potential to disturb winter roosts	November 1 – April 30	400 m

There are a total of 27 bald eagle sites within 0.5 mile of treatment areas and 17 sites within 0.25 mile. All sites will involve the presence of operators or crews. Eight sites within 0.25 mile propose the use of mechanical equipment (motorized string trimmers). One additional project area proposing use of a string trimmer is located within 0.5 mile of an eagle site.

The proposed treatments within 0.5 miles of eagle sites are primarily along roads that have infestations of invasive plants; two project areas are along lake shores and one is in a meadow.

Currently, there are no invasive plants adversely affecting bald eagles in the project area.

California Wolverine

In California, Oregon and Washington, the wolverine inhabits various forest types in remote wildernesses with adequate food (Banci 1994). Wolverines inhabit dense coniferous forests and use open sub-alpine forests up to and beyond timberline. Typically, they use high elevation alpine wilderness areas in the summer and montane forest habitats in the winter. Prey items include small and medium-sized mammals, birds and their eggs, insects, fish, roots, berries, and carrion. Wolverines are known to regularly avoid human generated disturbance, and are sensitive to any disturbance; they will move natal den-sites several miles if disturbance is in the area of their den.

Action Area Information

Carnivore surveys were conducted across the Crescent District in 1993-1996 and 1998 using baited camera sets, snow tracking and track plates. There were no detections of wolverine from these surveys. There are past records of wolverines from both the Deschutes and Ochoco National Forests. Wolverine habitat is not mapped on the forests. The higher elevation and more dense forests preferred by wolverines are not typically impacted by invasive plants, except along road shoulders. Wolverines generally are not found in the disturbed sites in which invasive plants occur.

Fisher

In Oregon, the fisher apparently has been extirpated from all but two portions of its historical range (Aubry and Lewis 2003). Within Oregon the two known extant populations are in the southwestern portion of the state: one in the southern Cascade Range that was established through reintroductions, and one in the northern Siskiyou Mountains.

Fishers use landscapes containing primarily coniferous forests with dense canopies, old growth (or large trees), and ample downed woody material (Powell and Zelinski 1994), yet ecological relationships between fisher and habitat are largely unknown.

Fishers are opportunistic hunters and will eat a wide variety of prey. Prey items used by fisher include porcupines, small mammals, birds and their eggs, a few reptiles and amphibians, insects, nuts, fruit, and carrion (Powell and Zielinski 1994). Fishers use a variety of resting sites such as hollow logs, rock piles, and snow dens, but the maternal den is almost always in a tree.

Action Area Information

Carnivore surveys were conducted across the Crescent District in 1993-1996 and 1998 using baited camera sets, snow tracking and track plates. There were no detections of fishers from these surveys. A study by Aubry et al (2005) found one collared male that traveled to the Crescent Ranger District in the summer of 1999 from the Rogue River National Forest.

There is no known or confirmed reproducing population of fishers within the action area. Any fishers that could occur within the project area are likely to be solitary transient individuals. Like the wolverine, the dense canopy forests most likely used by fishers are not heavily impacted by invasive plants, except along road shoulders. They would not be expected to be found in disturbed sites in which invasive plants occur.

Pygmy Rabbit

The pygmy rabbit is an extreme habitat specialist and typically occur in dense stands of big sagebrush growing in deep loose soils. Pygmy rabbits within the Great Basin in Oregon are not federally listed.

Big sagebrush is the main food of this species, native grasses and forbs are also eaten in mid-late summer. These rabbits may be active at any time of the day or night. Invasive plants are one factor degrading their habitat. The invasive cheatgrass (*Bromus tectorum*) is of particular concern because it invades the understory of big sagebrush shrubs making a critical habitat site unsuitable for the rabbit (Weiss and Verts 1984). Cheatgrass and other invasive plants replace important forage species, introduce a perpetuating fire cycle into big sagebrush habitat (Whisenant 1990), may reduce predator detection, impede movement, and limit dispersal of the pygmy rabbit. McAdoo et al. (2004) stated that weed control is an example of the highest priority habitat treatments for sagebrush-associated wildlife.

Action Area Information

Pygmy rabbits are suspected to occur on both the Deschutes and the Ochoco National Forests where suitable habitat exists, but none have been documented. Most suitable habitat occurs on the Crooked River National Grassland. All but one of the potential pygmy rabbit sites are within grazing exclosures on the Grassland (Roberts, A., pers. comm. 2006).

Invasive plants are currently degrading habitat for the pygmy rabbit within the action area. Two treatment area units are within suitable pygmy rabbit habitat on the Crooked River National Grassland. One unit, 75-44, is infested with spotted knapweed and is within suitable vegetation, but not in suspected burrow habitat. This site is outside of any exclosures for pygmy rabbits. This site would likely be treated with people utilizing backpack sprayers, or with a horse-mounted spray hose. It may be treated with an ATV-mounted spray hose if an exception to off-road vehicle use is obtained. In all cases, the application would be a spot spray on the target vegetation and non-target vegetation would be avoided to the fullest extent practical.

The other site on the Crooked River National Grassland, project area unit 75-54, is within an exclosure, but not within the suspected burrow site. The infestation is diffuse knapweed that is growing in a previously burned area. Recent burn areas are not suitable pygmy rabbit habitat (U.S. Fish and Wildlife Service 2004b). This site would be treated using backpack sprayers.

Horned Grebe

Nesting habitat is found in tall vegetation in shallow water. Horned grebes eat fish, crayfish and aquatic insects.

Action Area Information

Horned grebes migrate through the Deschutes National Forest, and may be observed at Wickiup Reservoir during October and November as they move to winter habitat areas. Potential breeding habitat for both grebe species exists at high-elevation lakes and ponds within the action area, but no known breeding sites are located within the project area.

There are seven project areas that include or are adjacent to grebe winter locations or potential habitat. One site proposes to use biological controls and the other six sites propose to use a combination of herbicide, manual, mechanical, and cultural techniques.

Red-necked Grebe

The only consistent breeding population in Oregon is found at the Upper Klamath Lake National Wildlife Refuge (Spencer 2003). They nest on a floating platform of fresh and decaying reeds which is built by both parents in shallow water on marshy lakes and ponds, and winter along the Pacific Coast. They feed on small fish, aquatic insects and their larvae, amphibians, and mollusks (Spencer 2003).

Action Area Information

Potential breeding habitat for both grebe species exists at high-elevation lakes and ponds within the action area, but no known breeding sites are located in the project area.

There are seven project areas that include or are adjacent to grebe winter locations or potential habitat. These are the same sites listed above for the horned grebe. One site proposes to use biological controls and the other six sites propose to use a combination of herbicide, manual, mechanical, and cultural techniques.

Bufflehead

The bufflehead uses mountain lakes surrounded by woodlands with snags (mostly aspen, but it will use Ponderosa Pine and Douglas-Fir) for nesting. Buffleheads are common in Oregon and Washington during winter, but are rare during the breeding season. Buffleheads eat animal matter, with common diet items including aquatic insects and larvae, physid snails, fish and sometimes herring eggs or salmon carrion. They also eat seeds of aquatic plants, such as smartweed, alkali bulrush, and sago pondweed (Marshall et al. 2003).

Action Area Information

Buffleheads have been documented on the Crooked River National Grassland as winter migrants and consistently at Haystack and Rimrock Springs Reservoirs (Roberts, A., personal communication, 2006). On the Crescent Ranger District buffleheads are commonly seen on Odell Lake, Crescent Lake, Davis Lake, and on the nearby Wickiup Reservoir nearly year-round or until freeze-up. Bufflehead have been observed year-round on large reservoirs, including Crane Prairie. They have also been observed on some of the high elevation lakes and ponds in the Oregon Cascades Recreation Area during the summer months. Nesting occurrence is unknown. Buffleheads have routinely been observed on many of the small lakes on the Sisters RD with the potential for breeding habitat to occur in the Meadow Lakes area and Round Lake.

Harlequin Duck

Harlequin Ducks nest along fast-flowing rivers and mountain streams in the Cascade Range of Oregon and Washington. It is hunted in Washington and Oregon. Harlequin ducks forage heavily on caddisflies, and will also eat some mayflies and stoneflies (Marshall et al. 2003). They apparently eat fish only rarely.

Action Area Information

Harlequin ducks are not known or suspected to occur on the Ochoco National Forest. On the Deschutes, potential breeding habitat includes areas along the Deschutes and Little Deschutes Rivers, and perhaps along some creeks.

Yellow Rail

Yellow rails inhabit freshwater marshes and wet meadows with a growth of sedges, usually surrounded by willows, and often with standing water up to a foot deep during the breeding season. Yellow rails begin nesting in Oregon by May. Yellow rails are reported to eat invertebrates, seeds of sedges and rushes, and freshwater snails (Stern and Popper 2003), but diet information for Oregon is not available.

Action Area Information

There is a small breeding population of yellow rails at Big Marsh on the Deschutes National Forest, Crescent District. There are about three acres of reed canarygrass proposed for treatment at Big Marsh, primarily in ditches that are part of a hydrologic restoration program. The majority of reed canarygrass infestation at Big Marsh is not proposed for treatment at this time. The infestations nearest the yellow rail nesting habitat are not scheduled for treatment. However, actually nesting locations of yellow rails varies annually based on available water in the marsh. Invasive plants will be treated with manual and cultural methods.

Since yellow rails do not nest in reed canarygrass (Kittrell, personal communication), reed canarygrass may be reducing available nesting habitat for yellow rails at Big Marsh.

Upland Sandpiper

Preferred habitat includes large areas of short grass for feeding and courtship with interspersed or adjacent taller grasses for nesting and brood cover. The species migrates along shores and mudflats, and winters in South America (NatureServe 2006).

They are not found in Oregon away from breeding grounds. Insects are their primary food.

Action Area Information

Upland sandpipers are not known to occur within the action area on either forest or the Crooked River National Grassland, but are suspected to occur on the Ochoco. They occur on private land adjacent to the forest, and the forest has some potential habitat, but upland sandpipers have not been verified to occur on the Ochoco National Forest (Steele, D., personal communication, 2006).

Greater Sage Grouse

Greater sage grouse (hereafter simply called sage grouse) in Oregon were common to abundant in the non-forested areas east of the Cascades during much of the 19th century, but began to decline by the late 1890s (Crawford 1982). Prineville District BLM has local sage grouse information associated with the High Desert of Central Oregon (Hanf et al. 1994).

Sage grouse breed on sites called leks (strutting grounds) in March-April. The same lek sites tend to be used year after year. They are established in open areas surrounded by sagebrush, which is used for escape and protection from predators. Breeding habitat provides forbs for nutritious forage and sagebrush for nest cover. Sage grouse nesting and early brood-rearing occurs in April-June. Hens with broods tend to select habitats having a wide diversity of plant species that tend to provide an equivalent diversity of insects that are important chick foods.

As fall progresses, sage grouse move towards their winter ranges and shift their diet primarily to sagebrush leaves and buds (Connelly et al. 1988, Connelly and Markham 1983, Patterson 1952, Wallestad 1975).

Sage grouse are adversely impacted by habitat conversion and degradation invasions of exotic species (Blus et al. 1989; Braun 1987; Braun 1998; Connelly et al. 2000; Mack and Thompson l982; Pellant 1990; Peterson 1970; Quigley and Arbelbide 1997; Swensen et al. 1987; Valentine 1990; Wallestad 1975; Wisdom et al. 2002).

Cheatgrass (*Bromus tectorum*) invasion has particularly degraded sage grouse habitat by altering fire cycles in the sagebrush-steppe ecosystem and converting sagebrush habitat to rangeland dominated by an annual exotic grass (Connelly et al. 2000). The presence of cheatgrass fills in voids between shrubs and will carry frequent fires in the same areas. The frequent fires prohibit re-establishment of the big sagebrush and create cheatgrass monocultures that are unsuitable for sage grouse. Cheatgrass and medusahead (*Taeniatherum caput-medusae*) may also fill in leks and make them unsuitable as breeding grounds.

Available literature on the effect of herbicide applications is limited to the effects of sagebrush reduction or removal (Braun 1998; Connelly et al. 2000; McCarthy and Kobriger 2005).

Action Area Information

Sage grouse were extirpated from the Crooked River National Grassland in the 1950s. Sage grouse occur on a few areas on the Ochoco National Forest. The use on the forest is limited to chicks and brooding females, there are no known leks. There are several leks on private land near the forest that serve as the source for the birds that occur on the forest. These leks are monitored annually and are generally stable in size (Steele, pers. comm., 2006). Sage grouse on the Deschutes National Forest are limited to the Bend/Fort Rock District. Sage grouse use in this area consists of nesting and brooding (Zalunardo, pers. comm., 2006).

Proposed treatments include treatment of non-native invasive plants only and will not treat native sagebrush or forb habitat. There are seven project area units containing or within 300 feet of potential sage grouse habitat. These are roadside treatments; some include treatments within forest or disturbed areas adjacent to roads. All units propose a combination of herbicide and manual treatments and three units also include some biological controls.

American Peregrine Falcon

Peregrine falcons inhabit cliffs located within approximately 0.5 mile of riparian habitat. Peregrines nest on ledges and are aerial predators who feed mostly on birds. Much of the prey consists of species the size of pigeons and doves; however avian prey ranges in size from hummingbirds to Aleutian Canada geese (Pagel, unpub. data).

Peregrines lay 2-4 eggs in March-May, eggs hatch after an incubation period of 31-33 days. Fledging occurs when the young are between 37 and 45 days of age (56 days at the upper end). Juveniles continue to be fed and protected by the adults until they disperse, which can range from 3 weeks to 3 months (Davis unpub. data, Pagel unpub. data).

Peregrine falcons can be disturbed by human activity during the nesting season (Pagel unpub.data). Disturbance can cause: nest sites and new territories to be abandoned; active nesting attempts to fail due to egg breakage; or divert adult attention from opportunities to forage and feed nestlings (Pagel unpub. data).

Peregrine falcons were delisted in 1999 and the FWS has committed to monitor populations nationwide five times at three-year intervals and report results. Invasive plants do not directly affect peregrine falcons. Peregrine falcons in the Pacific Northwest are most affected by bioaccumulation of contaminants, and direct disturbance to their nesting at known or suspected nest sites; both which have caused numerous nesting failures during the previous 20 years of observation (Pagel unpub. data).

Action Area Information

There are no known peregrine falcon nests within the action area, but individual birds have been sighted. Potential nesting habitat is present in the lava flow near Davis Lake, in the upper Little Deschutes River canyon, and on Maiden Peak. One survey for nesting peregrines was conducted on the Crescent RD in April 2005 on the lava flow near Davis Lake but no peregrines were observed. Peregrines have been sighted in the Tumalo Creek drainage, Benham Falls and possibly Pine Mountain. Surveys were conducted on the Bend Fort Rock District according to the Regional protocol in 2001 however, no peregrines were detected. One historic eyrie occurs near Benham Falls. Surveys were conducted on the Sisters RD near Castle Rocks with negative results. The Crooked River National Grassland conducted surveys for peregrine falcons in 1994 and the Ochoco National Forest conducted surveys in the 1980s; no peregrine nests were found.

Gray Flycatcher

Gray flycatchers are uncommon in Oregon and Washington, but may be fairly common in specific locations (Marshall et al. 2003). In central Oregon, they are commonly found in juniper, sage, and bunchgrass habitat. They are migratory and spend winters in Arizona and Mexico, leaving breeding grounds by the end of September (Csuti et al. 2001). Gray flycatchers take insects on the wing and by foraging on the ground.

Action Area Information

Gray flycatchers have been documented on the Crooked River National Grassland and Ochoco National Forest. On the Grassland, surveys conducted in 2003 and 2004 found gray flycatchers nesting and foraging on the edge between juniper woodlands and openings with grass and shrubs (USFS 2004e).

Tricolored Blackbird

Tricolor blackbirds are rare in Oregon, and prefer to breed in freshwater marshes with emergent vegetation (cattails) or in thickets of willows or other shrubs. Tricolor blackbirds breed in April after migrating to Oregon breeding grounds. Most of Oregon's tricolored blackbirds winter in California (Beedy and Hamilton 1999).

Tricolored blackbirds forage in pastures, lightly grazed rangelands, grain fields, and hay fields for insects, seeds and grass (Spencer 2003). Insect availability is an important factor in breeding colony location.

Action Area Information

Tricolored blackbirds are listed as "occasional" during fall, spring, and summer and "uncommon" during winter in the local brochure, "Common Birds of the Ochoco Region" (USDA 2001). There are no known sightings on the Crooked River National Grassland, although there are some known colonies within one half mile from the Grassland boundary in the Lone Pine area (Shunk 2003). Tricolored blackbirds generally are found in the Ochoco and Crooked River National Grassland area during migration. There is insufficient suitable breeding habitat to support nesting colonies (Steele, pers. comm. 2006).

Tricolored blackbirds are documented on the Deschutes National Forest, but sightings are extremely rare and there are no known breeding colonies. Potentially suitable habitat is present along the shoreline of Davis Lake, Wickiup Reservoir, Big Marsh, and along the Little Deschutes River. No formal surveys for this species have been conducted.

Oregon Spotted Frog

The Oregon spotted frog currently occurs in approximately 24 localities in Oregon. It is associated with relatively large wetland complexes in relatively un-shaded marshes, or ponds and streams with sedges, rushes, and grasses. After breeding, adults disperse into adjacent wetland and riparian habitats. It deposits egg masses in still, shallow waters atop submergent herbaceous vegetation or among clumps of herbaceous wetland plants. Oregon spotted frogs eat arthropods, earthworms and other invertebrate prey, as well as occasional vertebrate prey. They are apparently one of the few frog species that will prey on the larvae of western toads (*Bufo boreas*) (Pearl and Hayes 2002).

Invasive plants may have negatively affected Oregon spotted frogs at some locations. For example, the Oregon spotted frog is no longer found where reed canarygrass has invaded several historical sites in the Willamette Valley and Puget Lowlands (Hayes 1997). Observations in Oregon suggest spotted frog breeding may be more susceptible to desiccation in reed canarygrass-dominated microhabitats (C. Pearl, R. Roninger, personal communication, 2007). In one study in Washington, transmittered Oregon spotted frogs used areas of reed canarygrass less than would be expected by its coverage and strongly avoided it during the breeding season (Watson et al. 2003).

Environmental stressors such as insecticides (Bridges and Semlitsch 2000, Bridges 1999), fertilizers (Marco et al. 1999), and heavy metals (Lefcort et al. 1998) may slow reactions or cause behavioral changes that make spotted frog tadpoles more vulnerable to predation. One study suggests that the herbicide formulation Roundup combined with stress from predator cues may be more lethal to some amphibian species than Roundup alone (Relyea 2005). However, this study did not report the effects from the aquatic formulations that contain glyphosate alone, so the effect reported could be due to the surfactant (polyethoxylated tallowamine) found in Roundup, rather than from the active ingredient glyphosate. Studies comparing toxicity of Roundup to aquatic formulations, which contain only glyphosate and water, demonstrate that the surfactant is responsible for the toxicity (Mann and Bidwell 1999, Perkins et al. 2000).

Other life history, habitat requirements, diet, predators, threats, causes of population decline, and population information can be found in U.S. Fish and Wildlife Service (2004c) and is incorporated by reference.

Action Area Information

In the project area, the species can be found in areas of the Upper Deschutes Watershed including the Little Deschutes River, Crescent Creek, Long Prairie Creek, headwaters of the Deschutes River, Snowshoe Lakes, Crane Prairie Reservoir, Wickiup Reservoir, the Deschutes River between the reservoirs, Little Cultus Lake Marsh, Big Marsh and Big Marsh Creek, Odell Creek, and Davis Lake. The greatest concentration of Oregon spotted frogs on the Crescent district occurs within Big Marsh. Inventories conducted in Big Marsh every year since 1997 with the exception of 2002. In the spring of 2006 counted over 1,600 egg masses. Big Marsh is the site of an active wetland restoration program.

Invasive plants such as reed canarygrass are capable of eliminating suitable habitat for the frog (Hayes 1997, Pearl and Hayes 2004, Cushman and Pearl 2007) and reed canarygrass poses a primary threat to spotted frog habitat from invasive plants within the project area (C. Pearl, personal communication). Small populations of reed canarygrass throughout the Upper Deschutes watershed are recommended to be high priorities for management (C. Pearl, personal communication).

The Programmatic Biological Assessment (USDA Forest Service and USDI Bureau of Land Management 2006b) includes project design criteria (equivalent to PDF) for Columbia and Oregon spotted frogs. Most of the project design criteria discuss maintaining habitat features, such as hydrologic regime, required by the frogs. One project design criteria states, “Use of pesticides, herbicide, and similar potential contaminants are prohibited in and immediately adjacent to wetland habitat. Applications of these herbicides should be conservative when estimating drift to avoid any contamination.” The application of this project design criteria from the programmatic BA must be qualified in regards to invasive plants. It is important to maintain suitable habitat by controlling invasive plants in spotted frog habitat. There is no mandated regulatory response required for deviating from the project design criteria in the Programmatic BA because Oregon spotted frogs are not federally listed or proposed. However, consultation with FWS biologists is being conducted for this project and the analysis for spotted frogs will be made available to FWS. Local biologists will be consulted prior to implementation of invasive plant treatments (spotted frog PDF).

There are 10 project area units that include or are within 100 feet of Oregon spotted frog habitat. Project area units are proposed to be treated with a combination of manual, cultural, mechanical, and herbicide methods. The project area units include lakeside and wetland areas as well as roadsides and one quarry. The lakeside and wetland treatments have the greatest potential to include areas where Oregon spotted frogs may be present.

Columbia Spotted Frog

The Columbia spotted frog has been documented on the Malheur, Ochoco, Umatilla, and Wallowa-Whitman National Forests. Columbia spotted frogs are highly aquatic and usually stay near permanent, quiet water. They occur along the grass and sedge margins of streams, lakes, ponds, springs, and marshes. Breeding habitats include a variety of relatively exposed, shallow-water (<60 cm), emergent wetlands. After breeding, adults often disperse into adjacent wetland, riverine and lacustrine habitats. Columbia spotted frogs are capable of long movements, including across uplands (Bull and Hayes 2001).

Other aspects of life history, habitat requirements, diet, predators, and causes of population decline are likely to be similar to those of the Oregon spotted frog.

Action Area Information

Columbia spotted frogs occur on the Crooked River National Grassland and Ochoco National Forest. The species is widespread within the upper Crooked River watershed and is found in the Ochoco and the Maury Mountains as well as in lower elevation ponds and streams including the upper Crooked River mainstem and tributaries of the Crooked River. It can also be found in stock ponds.

Invasive plants such as reed canarygrass are capable of eliminating suitable habitat for the frog (Hayes 1997, Pearl and Hayes 2004, Cushman and Pearl 2007) and reed canarygrass poses a primary threat to spotted frog habitat from invasive plants within the project area (C. Pearl, personal communication).

The discussion of the project design criteria in the Programmatic BA and its applicability to this project are as discussed above for the Oregon spotted frog.

There are 46 project area units that include or are within 100 feet of Columbia spotted frog habitat. Project area units are proposed to be treated with a combination of manual, cultural, mechanical, and herbicide methods. Project area units are primarily roadside treatments.

Crater Lake Tightcoil Snail

The Crater Lake Tightcoil may be found in perennially wet situations in mature conifer forests, among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m of open water in wetlands, springs, seeps and riparian areas, generally in areas which remain under snow for long periods during the winter. Riparian habitats in the Eastern Oregon Cascades may be limited to the extent of permanent surface moisture, which is often less than 10 m. from open water (Duncan et al. 2003).

Most *Pristiloma* on the Deschutes National Forest (Sisters RD) have been located along perennial streams within 15 feet of the water's edge. Streams within the project area that are intermittent, lack of riparian vegetation, and have low moisture content in adjacent areas do not contain suitable habitat for mollusk species.

Due to the well draining pumice soils on the Crescent Ranger District, areas that retain permanent surface moisture are very narrow margins along the edge of springs, seeps, or streams. Ranger Creek, Odell Creek, Maklaks Creek, Crescent Creek, Little Deschutes River, Trapper Creek, Dell Springs, and the shorelines of Odell Lake, Crescent Lake, and Davis Lake provide permanent sources of water. At the present time there is only one confirmed population of Crater Lake Tightcoil snails on the Crescent Ranger District. That population was located near the confluence of Princess Creek and Odell Lake in June 1999.

Inventories for this species are incomplete; not all suitable habitat has been surveyed. Based on available data, riparian areas on the Sisters RD will be considered suitable habitat for the Crater Lake tightcoil. Current and future treatment projects can be expected to occur in suitable habitat.

Invasive plant species that tend to dry out sites more than native vegetation may degrade habitat. Invasive plants in riparian zones that do not alter soil moisture or the substrate preferred by these snails may not affect their habitat.

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 94 includes those species that were identified as MIS for the Deschutes and Ochoco National Forests, and the Crooked River National Grassland (USFS 1990, and USFS 1989). Aquatic MIS are discussed in the aquatic species specialist's report.

Species identified as MIS were selected because their welfare could be used as an indicator of other species dependent upon similar habitat conditions. Indicator species can be used to assess the impacts of management actions on a wide range of other wildlife with similar habitat requirements.

MIS are discussed below. The bald eagle is sensitive to management in riparian areas. The northern spotted owl represents wildlife species associated with mature and older coniferous forests. The bald eagle and northern spotted owl have been discussed above under the section titled "Federally Listed Species." Peregrine falcon and wolverine have been discussed above under the section titled "Forest Service Sensitive Species."

Table 94. Deschutes and Ochoco National Forest Management Indicator Species.

Common Name	Scientific Name	Deschutes	Ochoco	CRNG
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	X		
Golden Eagle	*Aquila crysaetos*	X		
Northern Goshawk	*Accipiter gentilis*	X		
Cooper's Hawk	*Accipiter cooperii*	X		
Sharp-shinned Hawk	*Accipiter striatus*	X		
Red-tail Hawk	*Buteo jamaicensis*	X		
Northern Spotted Owl	*Strix occendentalis caurina*	X		
Great Gray Owl	*Strix nebulosa*	X		
Peregrine Falcon	*Falco peregrinus anatum*	X		
Osprey	*Pandion haliaetus*	X		
Great Blue Heron	*Ardea herodias*	X		
Pileated Woodpecker	*Dryocopus pileatus*		X	
Northern Flicker	*Colaptes auratus*		X	X
Primary Cavity Excavators	see below	X	X	
Waterfowl	see below	X		
Mammals				
American Marten	*Martes martes*	X		
Deer and Elk	see below	X		
Townsend's Big-eared Bat	*Corynorhinus townsendii*	X		
Wolverine	*Gulo gulo*	X		

Golden Eagle

Golden eagles inhabit open country with cliffs and are found in all counties east of the Cascade Range (Carey 2003). It also inhabits some areas within and west of the Cascades. Golden eagles forage primarily in open shrub habitat that provides food and cover for their prey. Prey items include lagomorphs, squirrels, woodrats, salmon and medium to large birds. Nests are primarily on cliffs and ledges, but some tree nests are also used. Golden eagles vary in response to disturbance near nest sites. Some eagles can become accustomed to significant recreation disturbance near nests, while others pairs may move away or abandon nests if disturbed (Carey 2003).

Golden eagles are relatively common within the project area. Many project area units include or are adjacent to suitable foraging habitat. Two project area units are near historic nest sites on the Deschutes National Forest. No project area units are in close proximity to currently known nest sites.

Invasive plants are not known to be specifically affecting golden eagle habitat.

Northern Goshawk

The goshawk is associated with mature and late-successional forests. Goshawk prey varies by region and consists of a variety of small to large birds and chipmunks, squirrels and hares. Surveys have been conducted on the Deschutes National Forest and goshawk nest territories occur near Willamette Pass and Ringo Butte. Individual goshawks have been seen on Hamner Butte and Royce Mountain, but no nests were found. Additional goshawk sites include Black Pine spring, Merideth, Indian Ford, Jack Creek, Lower Bridge, and Six Creek.

Invasive plants are not affecting northern goshawk habitat.

Cooper's and Sharp-shinned Hawks

These hawks often use dense cover in which to hunt and nest. Generally, nesting habitat has been grouped into 3 types by Reynolds (1976): young, even-aged conifer stands with single-layered canopies; mature, old-growth stands of mixed conifer with multi-layered canopies; and dense stands of aspen.

In Oregon, the diet of the sharp-shinned hawk is almost entirely small birds, but occasional small mammals are taken. Cooper's hawks eat more mammals than sharp-shinned hawks and prey on birds as well.

No formalized surveys have occurred for these two species in the project area, however, both have been documented on the Deschutes National Forest, with 25 locations for Cooper's hawks and 14 for sharp-shinned hawks. Known nest sites are rare, with a total of four for Cooper's hawk and one for sharp-shinned hawk. Invasive plant treatment sites in proximity to known sites for these hawks include treatment areas 11-26, 11-38, the Road 22 corridor and treatments along Pine Street in Sisters.

Invasive plants are not affecting habitat for these two hawks, although some of their prey could be adversely affected by large infestations.

Red-tail Hawk

The red-tailed hawk is found throughout the state in every habitat and at every elevation, although they are scarce in dense forests (Marshall et al. 2003 p. 156). They are perch hunters (trees, utility poles, etc.) and inhabit mixed country of open areas interspersed with woods. They nest in large conifer snags often in the tallest tree on the edge of the timber (Jackman and Scott 1975). They feed mainly on small to medium prey including ground squirrels, cottontails, voles, pocket gophers, snakes (Marshall et al. 2003 p.157) but may also take larger mammals (skunks), birds, reptiles, and insects (Jackman and Scott 1975).

Numerous sightings have occurred throughout the project area although no formal surveys have been conducted.

Invasive plants are not affecting habitat for red-tailed hawks, but some of their prey could be adversely affected by large infestations.

Great Gray Owl

This species is found in mature stands associated with meadows or openings. Great gray owls hunt from perches and utilize small prey, primarily pocket gophers and voles. They forage in openings, along forest edges, or in open understory stands. Great gray owls in this region show a high site fidelity to their nest site and exhibit only short seasonal movements.

Potential nesting habitat within the project area occurs in mature to old stands in close proximity to foraging habitat. Foraging habitat is widespread.

Great gray owl surveys have been conducted on the Deschutes National Forest. In addition, responses have been detected while conducting spotted owl surveys. Known locations include the Metolius Basin, Eyerly, and the B&B Fire Recovery Area.

Some species of invasive plants (e.g. Scotch broom, blackberry) may degrade foraging habitat for great gray owls and possibly adversely affect prey populations in specific meadows.

Osprey

Ospreys are specialized for catching fish. They nest near lakes and rivers in the tops of large snags or they may use artificial platforms if available. Their main prey is live fish – slow-moving species that swim near the surface. However, they may also take other vertebrate species (birds, reptiles, and small mammals) but this represents a very small proportion of their diet (Csuti et. al. 2001).

More than 40 nest sites are documented within the Deschutes National Forest, and upwards of fifteen historic nests were present along the Metolius River (district files). It is unknown how many nests are actually present or active each year as annual surveys are not conducted and nest sites frequently shift. Larger lakes with fish (Suttle, Dark, Blue, Scout, Round) and larger streams provide suitable habitat for ospreys for both nesting and foraging. Proposed invasive plant treatments are within ¼ mile of 13 nest sites along the Metolius River and potentially near nest sites at Odell Lake, Crescent Lake, Davis Lake and others.

Invasive plants are not affecting habitat for osprey.

Great Blue Heron

The great blue heron are found along estuaries, streams, marshes and lakes throughout the state. Great blue herons nest in colonies within shrubs, trees and river channel markers where there is little disturbance (Marshall et al. 2003). They hunt shallow waters of lakes and streams, wet or dry meadows feeding on fish, amphibians, aquatic invertebrates, reptiles, mammals and birds. There is one active rookeries on the Deschutes National Forest on the western shore of Crane Prairie. Project area unit 11-77 is located near this rookery.

Invasive plants such as reed canarygrass could adversely affect foraging habitat for great blue herons when infestations get large enough to fill in ponds and wetlands. Whether this potential effect has actually occurred within the project area is unknown.

Pileated Woodpecker

The Ochoco National Forest LRMP uses the pileated woodpecker as an indicator for moderate-sized areas (300 acres) of mature and old growth coniferous forest. The pileated woodpecker nests in cavities of large trees or snags. A major food source for the pileated woodpecker includes carpenter ants found in decaying snags and logs (Bull et al. 2005).

Pileated could occur near any treatment areas within or adjacent to suitable habitat. Invasive plants are not affecting habitat for pileated woodpeckers.

Northern Flicker

The northern flicker uses many habitats, but are most common in open forests and forest edges (Simmons 2003). They nest in large-diameter decaying snags. Their diet is primarily ants, crickets, beetles, berries, and seeds, obtained by foraging on the ground in open areas and on trees.

Invasive plants are not currently affecting habitat for northern flickers.

Primary Cavity Excavators/Nesters

A large number of species rely on cavities in trees for shelter and nesting. Primary cavity excavators for the Deschutes, Ochoco, and Grassland are represented by the following species: northern Flicker, Lewis' woodpecker, red-naped, Williamson's sapsucker, downy woodpecker, hairy woodpecker, white-headed woodpecker, three-toed woodpecker, black-backed woodpecker, red-breasted nuthatch, white-breasted nuthatch, and pygmy nuthatch. Detailed information on their habitats and diets, taken from Marshall et al. (2003), is found in the project file Wildlife Specialist Report/Biological Evaluation. All of the species eat insects and some eat conifer seeds, acorns and other vegetation as well. Most forage in trees.

Invasive plants are not affecting habitat for primary cavity excavators or nesters.

Waterfowl

Open lakes, ponds, streams, rivers, and wet/dry meadows provide foraging habitat for most waterfowl species. Some species utilize large snags for nesting, while others utilize open grassy areas near the water's edge. Most waterfowl diets consist primarily of vegetation although some animal matter (caddisflies, crustaceans, and mollusks) may be consumed (Csuti et. al 2001 pp. 66, 84-87, 89, 96, 99-102).

Many waterfowl species have been documented in the project area, including mallard, common merganser, hooded merganser, wood duck, green-winged teal, blue-winged teal, ring-necked duck, northern pintails, cinnamon teal, northern shovler, widgeon, scaup, Barrow's goldeneye, common goldeneye, common loon, western grebe, and Canada goose. Potential habitat exists along major streams, lakes and some meadow areas. Much of the suitable meadow habitat occurs on private land. No formal surveys have occurred for most waterfowl species to date.

Invasive plants such as reed canarygrass can adversely affect nesting and foraging habitat for some species of waterfowl. Whether this potential effect has occurred within the project area or not is unknown.

American Marten

The American marten (aka pine marten, *Martes americana*) represents species that inhabit mature coniferous forest habitats. American martens occur in forests containing snags and down logs, which provide suitable denning sites. They tend to avoid areas that lack overhead protection and the young are born in nests within hollow trees, stumps, or logs. Martens do not tolerate concentrated human use or habitat modification (Maser et al. 1981).

They eat a variety of small mammals, particularly squirrels, as well as voles, mice, pika, and rabbits. Surveys on the Deschutes National Forest were conducted in the winters of 1997/1998 (Dec. through March) and 1999 (Feb. through April) according to the protocol outlined in Ruggiero et al. (1994). Marten were found during these surveys.

Invasive plants are not affecting habitat for American marten.

Townsend's Big-eared Bat

The Townsend's big-eared bat inhabit a wide variety of habitats from old-growth forests to extreme desert. It roosts in caves, mines, rock crevices, buildings, and bridges, but is primarily cave-dependant. This bat feeds primarily on moths, but will also eat beetles, true bugs, and flies. It captures prey in flight or by gleaning from foliage (Csuti et al. 2001). These bats are very intolerant of human disturbance at either winter hibernacula or summer roosts (Csuti et al. 2001).

The Townsend's big-eared bats have been confirmed on the Sisters and Bend/Fort Rock Ranger Districts. No proposed project area units are associated with the known locations of these bats, although bats could forage along the Metolius River. Additional suitable habitat in the form of bridges is present at many locations in the project area.

Invasive plants are not adversely affecting habitat for Townsend's big-eared bat.

Rocky Mountain Elk and Mule Deer

These important game animals occur throughout the project area, and both species use a combination of habitats comprised of cover and forage areas that are not too fragmented by road systems. Deer and elk eat a wide variety of plants including grasses, forbs, aspen, and woody shrub species. In general, elk eat primarily grasses while deer eat more browse species. Both summer and winter range habitats are present on the Deschutes and Ochoco National Forests. Meadows provide important foraging areas, especially in the spring and early summer.

Invasive plants and treatment sites are located in known winter range, but occur almost exclusively along roads. Invasive plants on the forest are present in important foraging areas and if infestations expanded, the quality and quantity of available forage could be reduced.

Birds of Conservation Concern

In January 2001, President Clinton issued an executive order on migratory birds directing federal agencies to avoid or minimize the negative impact of their actions on migratory birds, and to take active steps to protect birds and their habitat. The U.S. Fish and Wildlife Service's (2002) Birds of Conservation Concern (BCC) identifies species, subspecies, and populations of all migratory non-game birds that without additional conservation actions are likely to become candidates for listing under the Endangered Species Act of 1973. The 2002 report provides species lists by Bird Conservations Regions. The project area includes Bird Conservation Regions 9 and 10.

The golden eagle, peregrine falcon, sage grouse, yellow rail, Lewis's woodpecker, Williamson's sapsucker, white-headed woodpecker, pygmy nuthatch, and tricolored blackbird have been covered in previous sections of this report. The following species do not occur in the project area and will not be discussed further: ferruginous hawk, yellow-billed cuckoo, black swift, gray vireo, Virginia's warbler, McCown's longspur, whimbrel, sanderling, snowy plover, American golden-plover, mountain plover (Ridgley et al. 2003).

The remainder of the species may occur near project area units based on their range, known occurrences, or presence of potentially suitable habitat in the project area. Distribution, habitat and diet information for each species is taken from Marshall et al. (2003) and located in the project file (Wildlife Specialists Report/Biological Evaluation).

Landbirds

The Forest Service has prepared a Landbird Strategic Plan (January 2000) to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations to achieve biological objectives. The project area is included in "Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington" (Altman 2000a), "Conservation Strategy for Landbirds in the Columbia Plateau In Oregon and Washington" (Altman and Holmes 2000) and "Conservation Strategy of Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington" (Altman 2000b). These plans are intended to help facilitate land management planning for healthy populations of native landbirds. They focus on landscape-scale management, with emphasis on habitat structure.

All three plans identify invasion by exotic plants as an important issue adversely affecting landbird populations. The Columbia Plateau plan states, “One of the most severe impacts in shrub-steppe has been the increased spread of exotic plants” (Altman and Holmes 2000).

Detailed information on focal species, their associated habitat attributes and conservation strategies for the species and habitat is located in the project file (Wildlife Specialists Report/Biological Evaluation).

The effects of the proposed alternatives on the habitat features and consistency with relevant conservation strategies are discussed in the Environmental Consequences section.

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, 1999), 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 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), pesticides (Bridges and Semlitsch 2000, Hayes et al. 2006), climate change (Blaustein et al. 2001, Crump 2005), and ultraviolet radiation (Starnes et al. 2000, Adams et al. 2001), among others. Results of studies are variable and some populations are in decline while others are not. There is no “smoking gun” at the global scale and all the causes are implicated to some degree (Halliday 2005).

The herbicide atrazine has been implicated in feminization of some amphibians (Hayes et al. 2002, 2003, 2006). This affect has not been demonstrated for herbicides considered in the alternatives for this document (atrazine is not included as a proposed or currently used herbicide).

Herbicides proposed for use in the project area have little potential to adversely affect amphibians and contribute to amphibian decline because of either their low toxicity to amphibians or the very low exposures likely to occur. Low exposures are due to the application rates and physical properties of the herbicides, or use restrictions (PDFs) required for all alternatives. Relyea (2005a,b) has demonstrated that glyphosate with POEA surfactant is lethal to amphibians, but his studies mimicked aerial applications or illegal use directly in water, and conducted exposures in the absence of soil. Because glyphosate binds tightly and quickly to soil, realistic field applications would result in much lower exposures. The influence of soil on the movement of glyphosate into water is dramatically demonstrated by Ramwell et al. (2002), which showed that even dust on an asphalt road with concrete curb reduced expected concentrations in rainwater runoff.

The use of herbicides as proposed in the action alternatives will not contribute to amphibian decline and therefore this issue is not discussed further in this document.

Collony Collapse Disorder

Pesticides are one of several factors thought to possibly contribute to catastrophic losses of honey bees (“colony collapse disorder” or CCD) reported since 2006. Since the proposed action proposed to use herbicides, a class of pesticides, a discussion of the possible connection of herbicide use and CCD is warranted.

The European honey bee (*Apis mellifera*) is not native to the American continents, but was introduced by European settlers in the 1600’s. It is widely distributed and commercially produced in the U.S.

with escaped feral colonies formerly present across most of the country (parasitic mites have destroyed most of the feral honey bees across the United States (CCD Steering Committee 2007)). The honey bee is used to pollinate agricultural crops and produce honey. The honey bee adds about $15 billion in value to agricultural crops each year (Morse and Calderone 2000).

In 2006-2007, commercial honey bees in North America, and other parts of the world, experienced alarming declines characterized by the disappearance of adult bees from the hives with no or few dead bees near the hive; healthy, capped brood; food reserves that have not been robbed; minimal evidence of wax moth or hive beetle damage; and a laying queen with immature bees and newly emerged attendants (CCD Steering Committee 2007, Winfree et al. 2007). This phenomenon has been termed "colony collapse disorder." By 2007, almost 30 percent of beekeepers in the U.S. reported losses of up to 90 percent of their colonies (Cox-Foster et al. 2007; Winfree et al. 2007). CCD has not been reported in wild native bees (Winfree et al. 2007).

Suspected causes of CCD include the following factors, alone or in combination: 1) environmental and nutritional stress; 2) new and /or re-emerging pathogens; 3) pests that attack bees; and 4) pesticides (CCD Steering Committee 2007). Several major setbacks to honey bee populations over the last two decades have combined to increase stress on the remaining hives, as they are moved and worked for their pollination services over longer seasons and larger geographic areas. Climate change, drought, and unseasonably cold weather combine to create increased stress on bee populations. Commercial bees are often fed high fructose corn syrup, which may contribute to some nutritional deficiencies. Nutritional deficiencies are thought to make the bees more susceptible to attack from pathogen and anecdotal evidence indicates that hives that are fed nutritional supplements over the winter are more resistant to CCD (Anonymous 2009).

Pathogens are primary suspect because CCD is transmissible to other hives through the reuse of equipment from CCD-affected colonies, and such transmission can be broken by irradiation of the equipment before use (Pettis et al. 2007). A recent paper using current gene technology has indicated that Israeli acute paralysis virus is strongly correlated with CCD and is a current leading candidate for its cause, alone or in combination with other factors (Cox-Foster et al. 2007, Kaplan 2008). Another recent paper implicates an infection from the parasite *Nosema ceranae*, but losses from CCD in hives treated for this parasite may differ between European and American hives (Higes et al. 2009, Goodman 2009).

Pests including the varroa mite, small hive beetle, wax moth, and others stress bees and may harbor infectious agents. In particular, the varroa mite has been responsible for catastrophic losses of 50 to 100 percent in many beekeeping operations and has eliminated most feral bee colonies. In addition, the varroa mite is known to carry pathogens transmitted to bees and is thought to suppress the immunity of honey bees (Shen et al. 2005).

Pesticide exposure may affect bees through direct toxicity or by adding additional stress. Beekeepers treat hives with miticides and fungicides and bees may be exposed to pesticides while foraging on agricultural crops. Currently, the classes of pesticides thought to be the most likely contributors to, and being researched for correlation with, CCD include insecticides, miticides, and fungicides (CCD Steering Committee 2007). Recent research has found higher-than-expected levels of miticides and traces of a wide variety of agricultural chemicals in bee hives, but no consistent pattern in levels or types of chemicals identified (Kaplan 2008).

Management Direction

Recent amendments to the Deschutes and Ochoco Forest Plans occurred as a result of the Pacific Northwest Region Invasive Plant Program Record of Decision (USFS 2005b). One standard added to the Forest Plans requires the use of project design features to minimize or eliminate adverse effects to federally listed species. The project design features listed in Chapter 2.4 fulfill this requirement and will minimize or eliminate adverse effects to spotted owls. These design features are part of the proposed action and are mandatory in order to stay within the scope of this effects analysis. The design features will also minimize adverse effects to FS Sensitive Species, MIS, and other "species of local interest."

Refer to the discussion of Oregon and Columbia spotted frogs above for information regarding project design criteria for these two species in the Forests' Programmatic BA.

3.9.2 ENVIRONMENTAL CONSEQUENCES

The following section is a general overview of the potential impacts to federally listed wildlife from all control methods included in the proposed action. For all methods, project design features could be used to mitigate the majority of these impacts.

Effects Analysis Methods

The herbicides considered for use under the Proposed Action, and the typical and highest application rates used for the analysis are found in Table 12, Chapter 2. Characteristics for each herbicide are found in the R6 FEIS (USFS 2005a) and in Appendix D of this FEIS.

Herbicide Risk Assessments

Because herbicides have the potential to adversely affect the environment, the U.S. Environmental Protection Agency (EPA) must register all herbicides prior to their sale, distribution, or use in the United States. In order to register herbicides for outdoor use, the EPA requires the manufacturers to conduct a safety evaluation on wildlife including toxicity testing on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. An ecological risk assessment uses the data collected to evaluate the likelihood that adverse ecological effects may occur as a result of herbicide use.

The Forest Service conducts its own risk assessments, focusing specifically on the type of herbicide uses in forestry applications. Syracuse Environmental Research Associates, Inc. (SERA) produces the FS human health and ecological risk assessments for herbicides that may be proposed for use on National Forest System lands. The information contained in this FEIS and the Biological Assessment relies on these risk assessments. All toxicity data, exposure scenarios, and assessments of risk are based upon information in the FS/SERA risk assessments unless otherwise noted. FS/SERA risk assessments use peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Specific methods used in preparing the FS/SERA risk assessments are described in SERA, 2001-Preparation. The risk assessments and associated documentation are available in total in the administrative record for the EIS. Estimates of risk are not absolute; rather, they are relative and based on assumptions contained in generic "worst case" scenarios. Risk assessments have inherent limitations; these are discussed later in this chapter.

Herbicide Analysis

The risk assessments prepared by SERA (2001, 2003, 2004) contain the detailed analysis of the potential effects of each herbicide. Portions of the risk assessments pertaining to terrestrial wildlife are summarized in USDA Forest Service (2005d, Appendix B). This summary contains a detailed description of factors influencing exposure and dose, use of surrogate species for toxicity data, field studies, and analysis results for each individual herbicide. Refer to this summary, found in Appendix B, for more information on analysis methods used to determine the potential effects to listed species.

Toxicity data found in the risk assessments, exposure scenarios, and project worksheets were used to derive quantitative estimates of dose for worst-case situations. The worksheets used in the analysis may be found in the project record for the EIS.

When enough data was available for a particular type of animal, an exposure scenario was developed, and a quantitative estimate of dose received by the animal type in the scenario was calculated (SERA 2007). The quantitative estimates of dose were compared to available toxicity data to determine potential adverse impacts. We used the most sensitive response (i.e. a sub-lethal effect that occurred at the lowest dose) from the most sensitive species to determine the "toxicity indices" for each herbicide[17]. Adverse affects to wildlife health such as lethargy, weight loss, nausea, and fluid loss due to diarrhea or vomiting, can affect their ability to compete for food, locate and/or capture food, avoid or fight off predators, or reproduce. The following analysis relies on these types of effects, when sufficient data exists, rather than directly lethal doses, to determine the potential for doses to cause an "adverse effect" to wildlife.

The estimated dose (from the scenarios) was divided by the "toxicity index" and the result is known as the Hazard Quotient. When the Hazard Quotient is less than 1.0, the dose is les than the toxicity index. Potential effects from doses calculated to be below the toxicity indices are discountable. When a calculated dose was greater than the toxicity index, we stated that there was a potential for adverse effects. This very protective approach constitutes a "worst-case" analysis for potential effects of herbicides.

Whenever sufficient data were available to determine the dose that resulted in no observable adverse effects (NOAEL), the NOAEL was used as the toxicity index. If data were not sufficient to determine a NOAEL, other endpoints of toxicity were used, such as the lowest-adverse-effect level (LOAEL), or the dose that was lethal to 50 percent of the test population (LD50). When a LOAEL or LD50 was used as the toxicity index, standard EPA methods for applying an uncertainty factor to the toxicity index to determine a level of concern were used. The standard EPA method for listed terrestrial species is to take 0.1 of the LD50 (EPA/OPP 2004), which is the protocol used in this analysis when a NOAEL is not available.

Herbicide Mixtures

A Standard in the Deschutes National Forest and Ochoco National Forest Land Management Plans limits mixtures to three herbicides or fewer and requires the use of a dose addition analysis at the project scale to determine if a particular mixture may be used. Under specified conditions, dose addition analysis is believed to provide a reasonable estimate of the cumulative toxicity of chemical mixtures. The hazard index (HI) method of assessing dose addition is relatively simple and straightforward. The approach is used or recommended by a number of agencies, including EPA, National Academy of Sciences, National Research Council, and Occupational Health and Safety Administration (ATSDR 2004).

The individual herbicides in each mixture are analyzed to determine estimated dose, which is then divided by the respective "toxicity index" to produce a hazard quotient (HQ). When the HQ is less than 1.0, then the dose is less than the toxicity index. The HI is calculated by adding all the HQ's for the herbicides in the mixture. This is known as dose addition. If the HI is < 1.0, then an acceptable level of mixture toxicity risk is assumed to be present. A HI would be calculated at the project level to assess potential effects to listed species in a project area.

[17] For example, the most sensitive response to picloram in mammals is weight loss in rabbits. We used the dose of picloram that did not cause weight loss in rabbits as the toxicity index. This dose was reported in scientific literature or toxicity studies as the no-observable-adverse-effect-level (NOAEL).

Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al. 2000). The precise toxic mechanism(s) in birds and mammals are not known for all of the 10 herbicides contained in the proposed action. But in terrestrial wildlife, effects to the kidney and liver are typical endpoints.

Dose addition analysis is also a reasonable assumption when analyzing mixtures of chemicals with different or unknown toxicity mechanisms, when expected doses will be below known toxic levels (ATSDR, 2004). This is also supported by data from Feron et al. (1995, as cited in EPA Choudhury et al., 2000), which showed interaction when mixture chemical components were present in concentrations at or near their respective LOAELs. No interaction was observed between chemical components when present at concentrations 1/10 or 1/3 or their respective LOAELs.

The dose addition analysis described in this document is believed to produce conservative estimates of mixture toxicity for several reasons. First, the assumption of dose addition in itself is conservative; the dose addition protocol assumes an additive response for all chemicals in the mixture, when in fact some chemicals may produce independent, non-additive responses. For example, the EPA description of dose addition analysis in Choudhury et al. (2000) states that separate dose addition analyses should be performed for each affected organ. This protocol utilizes one HI that includes all herbicides, regardless of toxicity site, potentially resulting in a higher HI value than if mixture components were analyzed in smaller groups by affected organ.

Also, by requiring the HI for the mixture to be less than 1.0, the Hazard Quotients of each component in the mixture must be below known toxic levels and will meet the criteria cited in ATSDR (2004) and Choudhury et al. (2000).

The primary sources of uncertainty in utilizing dose addition analysis in the proposed manner are the lack of mixture analysis studies utilizing more than two chemicals. The risk of adverse effects, with respect to the lack of information on mixtures involving more than two chemicals, increases with the number of mixture components. In an effort to minimize these risks, the proposed action states the mixtures will contain no more than three active herbicide ingredients.

Uncertainty and Data Gaps

Generally, active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects that must be considered, laboratory experiments do not account for wildlife in their natural environments. Environmental stressors can increase the adverse effects of contaminants, but the degree to which these effects may occur for various herbicides is largely unknown. Various wildlife species may also be more or less sensitive to a particular herbicide than laboratory animals. This leads to uncertainty in the risk assessment analysis. Additional discussion of incomplete and unavailable information can be found in the EIS. In response to this uncertainty, the effects analysis has relied upon data from the most sensitive effect from the most sensitive species and has used the maximum exposure estimates from exposure calculations to determine potential for risk.

The Use of Surrogate Species

Most toxicity testing utilizes surrogate species. Surrogate species serve as a substitute for the species of interest, because all species of interest could not be tested. Surrogate species are typically organisms that are easily tested using standardized methods, are readily available, and inexpensive. The physiological requirements for some organisms prohibit their use in toxicity testing because these requirements cannot be met within the test system. Rare or federally listed species are not used for a variety of reasons, including legal restrictions and having only a limited numbers of individuals available. On the rare occasions when data can be obtained from federally listed species, the limited conditions under which they are taken may bias the results (e.g. see Wiemeyer et al., 1993).

Even when desired species are available (e.g. salmon), researchers may choose a surrogate, like zebrafish (Danio rerio)(aka zebra danio), because test results are more easily discerned with the surrogate, and reproductive capacity allows testing of large numbers of individuals, among other reasons (Scholz et al. 2005).

However, caution should to be taken when addressing ecological risk and the use of surrogates when analyzing those ecological risks. Some herbicides demonstrate more variation than others in effects among different species, and very limited numbers of species have been tested.

Because of the variation of responses among species, and the uncertainty with regard to how accurately a surrogate species may represent other wildlife, the FS/SERA risk assessments use the most sensitive endpoint from the most sensitive species tested as the toxicity index for all wildlife. This does not alleviate concerns over interspecies variations in response.

Doses and Responses

The likelihood that an animal will experience adverse effects from an herbicide depends on: (1) the inherent toxicity of the chemical, (2) the amount of chemical to which an animal is exposed, (3) the amount of chemical actually received by the animal (dose), and (4) the inherent sensitivity of the animal to the chemical.

The amount of chemical to which an animal may be exposed is influenced by several factors, such as the presence of fur or feathers, environmental conditions, and foliar interception of spray. When an animal is exposed to a chemical, only a portion of the chemical applied or ingested is actually absorbed or taken in by the animal (the dose). Various absorption rates for wildlife are not available, so direct spray scenarios assume 100 percent absorption for this analysis.

In this analysis, only the highest ranges of exposure assumptions are included, although a more complete range of possible values is included in the FS/SERA risk assessments and in all worksheets attached to Appendix B. For example, for a given herbicide, residues of the herbicide on vegetation that are reported in the literature will vary between studies and by vegetation type. A range of residue rates is used in the FS/SERA risk assessment worksheets, but only the highest reported rates are used in the data reported here. Only the highest values are used here to reduce length and complexity of this document and also to present a reasonable "worst-case" exposure analysis. It should be noted, however, that reporting only the upper estimates of exposure assumptions could distort the risk (by potentially over stating it) and does not adequately encompass the uncertainties involved (Durkin, pers. comm.).

Non-herbicide Treatment Effects

The effects of other methods of invasive plant treatment to listed wildlife were evaluated by consulting peer-reviewed literature, previous Biological Opinions, and species experts, as well as using professional judgment and common sense.

General Effects of Invasive Plant Treatment

Wildlife species may be adversely affected by invasive plant treatment methods. All treatment methods have the potential to disturb, temporarily displace, or directly harm various wildlife species. Successful control of invasive plant infestations provides long-term benefits by restoring and preventing further loss of native habitat. Treatment of larger infestations may create more disturbances for longer periods than small infestations, but the specific amount and duration is largely dependant upon specific treatment method. Several techniques can create bare ground, which may reduce cover and expose certain species to increased predation. Large tracts of bare ground can alter migration and dispersal of some species (Semlitsch 2000). The likelihood of these effects depends on the size and distribution of bare ground created.

The effects of the invasive plant treatment are also relative to the size and locations of existing and future invasive plant infestations. Treatments of infestations along disturbed roadsides are not likely to substantially affect terrestrial wildlife populations, since this vegetation type does not provide essential habitat for native wildlife species, and it consists of long, narrow areas spread over large distances. Adverse effects to individuals using the roadside vegetation at the time of treatment could occur.

Treatments of moderate-sized infestations may pose the greatest risk to native wildlife. In moderately infested areas, enough native habitats may remain to support some native wildlife, and the infestation may be large enough to require more intensive and extensive treatment techniques. Very large infestations and monocultures of invasive plants do not support native wildlife populations and the presence of native wildlife in these areas is greatly reduced in comparison to native habitat.

Manual

Manual treatments can result in disturbance caused by human presence. The degree of threat and effect from manual treatments depends on the number of workers present and the size of the area being treated. Because manual techniques are slower than mechanical or herbicide methods, the duration of disturbance, caused by the presence of people, may be longer in the treatment area.

Mechanical

Mechanical treatments may generate loud noises that could flush birds from a nest or interfere with feeding of nestlings. Noise generated by mechanical equipment varies, with large chainsaws generating noise levels that could disrupt nesting or feeding when conducted in proximity to nests. Other equipment, like string trimmers, mowers, herbicide spray rigs, or heavy equipment, may generate less noise than large chainsaws.

Biological

Biological control methods will not directly affect native wildlife species, however, recent studies have found that native rodents may take advantage of the food source provided by biological control agents (Pearson et al., 2000). Biological control methods that reduce invasive plant populations, increase native plant populations, and provide a supplemental food source are indirectly beneficial to wildlife. Any biological control agents that affected native plant species could adversely affect wildlife. No biological control agents are known to directly or indirectly affect bald eagles, northern spotted owls or their habitats.

Prescribed Fire

The potential effects to wildlife from prescribed fire, depend on the size, intensity, duration, and season of the burn. For invasive plant treatment, fire is used primarily when there are homogenous stands of invasive plants and fire is needed to remove biomass, reduce seed production, or reduce the seed bank on the surface of the soil. Prescribed fire is useful as a prelude to control with other methods because fire can increase germination of and access to invasive plants. The heat from the fire can destroy bird nests, or kill small mammals and reptiles that cannot escape the burn. Smoke may affect some species of birds, but effects from smoke have generally only been reported for very large wildfires where heavy smoke was present for almost one month (Tilghman and Paton 1988). If the prescribed fire kills trees, nesting or foraging habitat may be reduce for some animals but may be increased for snag and cavity-dependent animals. Predatory birds often hunt in recently burned areas because of increased visibility of and access to prey.

Site Restoration/Revegetation

Reseeding or revegetation to increase competition with invasive plants can cause short-term disturbance to wildlife similar to manual or mechanical treatments, depending on specific methods used. If native or non-native, non-invasive forage species are used in restoration or competitive plantings, increased food and native habitat could benefit wildlife. Restoration activities have the potential to restore important wildlife habitat faster than natural or passive revegetation.

Effects of Herbicides

Herbicides vary in their environmental activity and physical form. Some may be oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), volatilization (moving through air as a dissolved gas), or adsorption (attached by molecular electrical charges to soil particles that are moved by wind or water).

In soil and water, herbicides may persist or decompose by sunlight, microorganisms, or other environmental factors. Soil properties, rainfall patterns, slope, and vegetative cover greatly influence the likelihood that an herbicide will move off-site, once applied.

In combination with other site and biological factors, these characteristics influence both the probability of meeting site-specific goals for invasive plant control, and the potential of impacting non-target components of the environment.

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. Risk to wildlife can be reduced by choosing herbicides with lower potential for toxic effects when exposure may occur. Exposure of wildlife to herbicides can be greatly reduced or increased depending on site-specific implementation techniques and timing used in herbicide application projects. Exposure can be reduced by such methods as streamside buffer zones, timing applications to avoid sensitive seasons, varying application methods used, and combining herbicide treatments with non-herbicide treatments to reduce overall use. These project design features, or criteria, are typically used in current projects and the expectation is that they will continue to be used to reduce potential exposures to wildlife. A Standard in the Land Management Plans requires the use of project design criteria to reduce effects to listed and proposed species.

The hazards associated with each herbicide active and inert ingredients, impurity or metabolite, were determined by a thorough review of available toxicological studies. For a background discussion of all toxicological tests and endpoints considered in Forest Service Risk Assessments, refer to SERA, 2001.

Herbicides are not pure compounds and they contain the active ingredient, impurities, adjuvants, inert ingredients, and may also contain surfactants. The effects of inert ingredients, adjuvants, impurities, and surfactants to wildlife are discussed first, followed by a discussion of the effects of the active ingredients.

Inerts, Adjuvants and Impurities

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. They 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.

Inerts and adjuvants, including surfactants, are not under the same registration guidelines as are pesticides. The EPA classifies these compounds into four lists based on the available toxicity information. If the compounds are not classified as toxic, then all information on them is considered proprietary and the manufacturer need not disclose their identity. Therefore, inerts and adjuvants generally do not have the same amount of research conducted on their effects, especially to wildlife species, compared to active ingredients.

Impurities and Metabolites

All herbicides likely contain impurities as a result of the synthesis or production process. The toxic effects of impurities are addressed in toxicity tests using the technical grade product, which would contain the impurities.

Hexachlorobenzene is an impurity in the technical grade products of clopyralid and picloram. Hexachlorobenzene is a ubiquitous and persistent chemical in the environment, as it is used or present in a wide variety of manufacturing processes. It has been shown to cause tumors in mice, rats and hamsters, and EPA has classified it as a probable human carcinogen (SERA, 2003 Picloram). The amount of hexachlorobenzene released into the environment from Forest Service use of picloram and clopyralid is inconsequential in comparison to existing background levels and the annual release from manufacturing processes (SERA, 2003 Picloram). The use of picloram and clopyralid in remote forest locations could constitute the primary source of localized contamination. The projected amounts of hexachlorobenzene released during invasive plant treatments is calculated to be well below the level that poses a risk to cancer in mammals.

POEA surfactant used in Roundup and Roundup Pro contain 1,4-dioxane as an impurity, which has been classified by EPA as a probable human carcinogen. Based on current toxicity data and an analysis by Borrecco and Neisess (1991), the potential effects of 1,4-dioxane are encompassed by the available toxicity data on the Roundup formulation (SERA, 2003 Glyphosate). Borrecco and Neisess (1991) also demonstrated that the upper limit of risk of cancer from this impurity was less than one in a million.

Triclopyr contains an impurity, 2- butoxyethanol (aka EGBE), that is a major industrial chemical used in a wide variety of industrial and commercial applications. It is known to cause fragile red blood cells in rodents (Borrecco and Neisess 1991). EPA has classified EGBE as moderately toxic. Borrecco and Neisess (1991) found that potential doses of EGBE to mammals were less than 0.001 of the lowest LD50 and did not substantially increase risk over the risk identified for triclopyr, even under worst-case scenarios. Data on toxicity of EGBE to birds was lacking, but the authors conclude that comparative sensitivities between birds and mammals, and the extremely low doses indicated a low risk to birds.

Similar to impurities, the potential health effects of herbicide metabolites are often accounted for in the available toxicity studies, assuming that the toxicological effects of metabolism within the test animal species would be similar to those in other animals. The potential toxic effects of environmental metabolites (those formed as a result of processes outside of the body) may not be accounted for by laboratory toxicity studies.

TCP (3,5,6-trichloro-2-pyridinol) is an environmental metabolite of triclopyr. It is substantially more toxic to fish than either triclopyr acid or triclopyr TEA, and is similar to the toxicity of triclopyr BEE (SERA, 2003 Triclopyr). For fish, the risk characterization for TCP was considered quantitatively, using available toxicity data. SERA (2003, Triclopyr) found that worst-case exposures of fish to TCP did not exceed levels of concern when triclopyr is applied at the typical application rate. However, at higher application rates, the level of concern is substantially exceeded and adverse effects to fish are plausible (using worst-case exposure assumptions) from this metabolite.

In mammals, TCP has about the same toxicity as triclopyr. No quantitative estimate of exposure to mammals or birds was calculated in the SERA risk assessment, due to the lack of appropriate data. However, since TCP is as toxic as triclopyr, the risk characterization for triclopyr could be applied to TCP.

Site-specific analysis is necessary to further evaluate the risk of toxic effects from TCP. The Proposed Action restricts use of triclopyr to specific application methods, such as spot spray or cut stump applications. Since the worst-case exposure estimates were done using either an accidental spill of 200 gallons of triclopyr, or a broadcast spray of triclopyr to a 10-acre area, it does not appear plausible for the resulting estimates of TCP concentration to occur given the restrictions contained in the Proposed Action. Exposure of mammals or birds to TCP would also be minimal.

Inert Ingredients

An inert ingredient in an herbicide is any ingredient that does not kill plants. Surfactants are a special type of inert ingredient discussed in a following section.

The EPA has categorized approximately 1,200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of known or suspected toxicological concern. List 4 contains non-toxic substances such as corn oil, honey and water. List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4).

None of the inert ingredients included on EPA's List 2, 3, or 4 need to be disclosed on the herbicide label, despite evidence that some compounds on these lists may cause adverse effects to laboratory animals and humans (Anonymous 1999; Cox 1999; Knight 1997; Knight and Cox 1998; Marquardt et al., 1998). EPA's own website (http://www.epa.gov/opprd001/inerts/) states, "Since neither federal law nor the regulations define the term "inert" on the basis of toxicity, hazard or risk to humans, non-target species, or the environment, it should not be assumed that all inert ingredients are non-toxic." Northwest Coalition for Alternatives to Pesticides (NCAP) obtained the identity of many inert ingredients through a Freedom of Information Act request; the list of inerts they obtained can be found at http://www.pesticide.org/FOIA/

Use of formulations containing inert ingredients on List 3 and 4 is preferred for invasive plant treatment under current Forest Service policy. A Standard in the Land Management Plans requires review of inert ingredients in a risk assessment prior to formulations being approved for use on FS projects.

Most information about inert ingredients that is submitted to EPA for pesticide registration is classified as "Confidential Business Information" (CBI). CBI is not generally released or available for public review. SERA risk assessors obtained clearance to review the identity and data on inerts in the CBI files, as well as used publicly available data, when preparing herbicide risk assessments. However, even when the inert ingredients can be identified, toxicity data on the ingredient may be lacking. This leads to substantial uncertainty in the assessment of hazard or risk posed by the inert ingredients. This is particularly true for wildlife species, as there is very little data regarding the effects to most wildlife species from inert ingredients contained in the 10 herbicides considered in the Proposed Action.

FS/SERA Risk Assessments analyze the effects of inert ingredients and full formulations by the process described below:

- Compare acute toxicity data between the formulated products (includes inert ingredients) and their active ingredients alone;
- Disclose whether or not the formulated products have undergone chronic toxicity testing; and

- Identify, with the help of EPA and the herbicide registrants, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers who have studied the relationships between acute and chronic toxicity have found that relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al., 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decision maker to make a reasoned decision. *In* *SRCC v. Robertson*, Civ.No. S-91-217 (E.D. Cal., June 12, 1992) and again in *CATs v. Dombeck*, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001) the district court upheld the adequacy of the methodology described above for disclosure of inert ingredients and additives.

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

Chlorsulfuron – The identity of inerts used in chlorsulfuron are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2004 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, 2004 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 formulstions are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2004 Metsulfuron methyl). None of the inerts are classified by EPA as toxic.

Picloram formulations, 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 to wildlife (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, 2004 Sulfometuron methyl). 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 wildlife.

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) for wildlife.

The amount of inert ingredients in the formulations is generally not known, so exposure and dose estimates cannot be calculated. Use of formulations containing toxic inert ingredients may increase the risk of toxic effects to wildlife above that, or in addition to, the risk discussed for the active ingredient.

Surfactants

Surfactants, or surface-acting agents, facilitate and enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of herbicides. There is a fair amount of research on the effects of surfactants to terrestrial and aquatic organisms because they are widely used in detergents, cosmetics, shampoos and other products designed for human exposure.

The following information is taken from “Analysis of Issues Surrounding the Use of Spray Adjuvants With Herbicides” (USDA FS, 2003) and “Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications” (USDA FS, 2003). Refer to these documents for more complete discussions.

Some glyphosate formulations contain polyethoxylated tallow amine (POEA) surfactant, which is substantially more toxic to aquatic species than glyphosate or other surfactants that may be used with glyphosate (SERA, 2003 Glyphosate). In the SERA risk assessment, the toxicity of glyphosate is characterized based on the use of a surfactant, either in the formulation or added as an adjuvant in a tank mixture (SERA, 2003 Glyphosate).

Polyglycol 26-2, used in picloram, will impact mitochondrial function in vitro, but information is insufficient to evaluate risks to wildlife in vivo from field applications at plausible levels of exposure (SERA, 2003 Picloram).

The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as NonylPhenol polyEthoxylate (NPE). NPE is found in these commercial surfactants at rates varying from 20 to 80 percent. NPE is formed through the combination of ethylene oxide with nonylphenol (NP), and may contain small amounts of un-reacted NP. Nonylphenol is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA’s inerts List 1). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen, estradiol.

Data is insufficient or lacking on the toxic effects of NP or NPE to birds and terrestrial invertebrates. NPE and NP are slightly toxic to practically non-toxic to mammals.

NP and NPE are weakly estrogenic in aquatic and terrestrial organisms (1000 to 100,000 times weaker than natural estrogen). NP and NPE are not toxic to soil microbes. NP is highly toxic to many aquatic organisms at low concentrations (currently on U.S. EPA’s Inert List 1).

The use of NPE-based surfactants in any of the 12 herbicides considered in this EIS could result in toxic effects to some mammals at typical and high application rates (USDA FS, 2003). The exposure scenarios and calculated doses used in the analysis represent worst-case scenarios and are not entirely plausible. Wildlife at most risk from adverse effects of NPE surfactants, at the typical application rate, include small mammals that may be directly sprayed, and large mammals consuming contaminated vegetation. At the highest application rate, small mammals that may be directly sprayed, and large or small mammals consuming contaminated vegetation may be at risk of adverse effects. No chronic exposures result in plausible risk to mammals.

NP and NPE have been studied for effects to aquatic organisms. NP is more toxic than NP9E, by one to three orders of magnitude (USDA FS, 2003). The toxicities of the intermediate breakdown products, NPEC and others, are intermediate between NP and NPE. In the aquatic environment, the breakdown products NP1EC and NP2EC are likely to be present also. These two metabolites are known to affect vitellogenin (a precursor for egg yolk) production in male fish, but NP, which is a more potent estrogenic compound, did not cause vitellogenin increases in male Xenopus laevis, or leopard frogs (Selcer et al., 2001; cited in USDA FS, 2003).

Mann and Bidwell (2000, 2001) tested several Australian frogs and Xenopus for effects to NP8E. They found that Xenopus was the most sensitive to toxic effects, with an LC50 of 3.9 ppm (3.9 mg/L). Similar to studies with herbicides, the LC50 values for the frogs are comparable to those for fish (USDA FS, 2003). NP8E inhibited growth at concentrations as low as 1 ppm (Mann and Bidwell, 2000, 2001). Mild narcosis of tadpoles can occur at EC50 values as low as 2.3 ppm, and reduced dissolved oxygen content in the water lowered the EC50 values by about half as compared to normal oxygen levels. The tadpoles recovered from the narcosis. Malformations in Xenopus occurred at EC50 values between 2.8 and 4.6 mg/L.

NP may cause tail resorption with a 14-day NOEC of 25 ppb for Xenopus laevis (Fort and Stover 1997; cited in USDA FS, 2003). NP also increased the percentage of female Xenopus developing from tadpoles exposed to 22 ppb for 12 weeks, but did not produce this effect at 2.2 ppb.

During operational use of NPE surfactant, ambient levels of NP9E (including a small percentage of NP, NP1EC, and NP2EC) could average 12.5 ppb (range 3.1 to 31.2 ppb). The duration of these exposures from Forest Service use would generally be much shorter than those used in laboratory experiments, due to transport by flowing streams, dilution, and environmental degradation. These levels are not likely to adversely affect amphibians found in the Pacific Northwest for normal operations. However, overspray or accidental spills could produce concentrations of NP9E that could adversely affect amphibians, particularly in small stagnant ponds.

Endocrine disruption

Recent information has highlighted the potential for certain synthetic and natural chemicals to affect endocrine glands, hormones, and hormone receptors (endocrine system). The endocrine system helps control metabolism, body composition, growth and development, reproduction, and many other physiological regulators. An endocrine disrupter is a substance that may exert effects to the body by affecting the availability of a hormone to its target tissue(s) and/or affecting the response of target tissues to the hormone (SERA, 2002). Estrogen is a prominent hormone in animal systems and substances that mimic estrogen or stimulate similar responses in target tissues are referred to as "estrogenic."

Scientists have expressed concern regarding estrogenic effects of synthetic chemicals since before the 1970's. The EPA (1997) reports effects of endocrine disruption in animals that "include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals."

Some of the more noted endocrine glands include gonads, adrenal, pancreas, thyroid and pituitary. Alteration in endocrine function may affect reproductive output (i.e. feminization, masculinization), and therefore, could affect population numbers of affected species.

Many of the known endocrine disrupting contaminants have been banned or are regulated (e.g. DDT/DDE, PCB, TCDD). Some endocrine disrupting compounds are persistent and are still found within the living tissue of wildlife; their decomposition half-life is lengthy, they bioaccumulate, and are present in the environment at high background levels. A local example is the high level of DDT/DDE and PCB that are found within peregrine falcons in the Pacific Northwest (Pagel, unpub. data). Research has suggested that embryonic exposure to endocrine disrupters may cause permanent health effects to adult animals. Some of these effects may include altered blood hormone levels, reduced fecundity, reproductive behavioral alterations, reduced immune function, masculinization and feminization, undescended testicles, increased cancer rates, altered bone density and structure, and malformed fallopian female reproductive tract (Kubiak et al., 1989; Colborn et al. 1993; White et al., 1994; Fry, 1995; LeBlanc, 1995). Examples of wildlife species that have been adversely affected by endocrine disrupters include wood ducks in Arkansas, wasting and embryonic deformities of Great Lakes piscivorous birds, reproductive abnormalities of snapping turtles, gulls, trout and salmonids, alligators, mink, and Florida panther (Bishop et al., 1991; Colborn, 1991; Facemire et al., 1995; Fox et al., 1978, 1991 (a, b), Fry and Toone, 1981; Fry et al. 1987; Gilbertson et al., 1991; Guillette et al., 1994, 1995; Kubiak et al., 1989; Mac and Edsall, 1991, 1993; Leatherland, 1993; Peakall and Fox, 1987; and Wren, 1991).

Recently, evidence of endocrine disruption in African clawed frogs and leopard frogs have been attributed to the herbicide Atrazine from field and laboratory exposures (Hayes 2002a, 2002b , 2003, 2006).

Of the herbicides analyzed for this EIS, only NPE surfactants have been identified as potentially having estrogenic effects (USGS 1998; Bakke 2003). Triclopyr and glyphosate have been evaluated for endocrine disrupting effects, and the weight of evidence indicates that these herbicides cause no specific toxic effects on endocrine function (SERA, 2002).

Synergistic Effects

Certain chemicals may cause synergistic effects in the presence of other chemicals: that is, the total effect of two chemicals may be greater than that suggested by the sum of the effects from the individual components (USEPA, 2000). However, information regarding the existence or potential for synergistic effects from the herbicides discussed in this document is very limited.

Some of the herbicides analyzed for the EIS (e.g. picloram) have been investigated for possible synergistic effects but the study designs were insufficient for the assessment of toxicologic interactions (SERA, Picloram, p.3-35). Some studies of some chemicals (not necessarily herbicides) have noted statistically significant interactions (both synergistic and antagonistic) (Durkin, pers. com.). Even with excellent data, the complexity of the experimental designs necessary to properly assess interactions, and the uncertainties regarding the dose-response relationship for interactions, make the quantitative use of interaction data in risk assessments infeasible (ATSDR 2004, U.S. EPA 2000b).

U.S. EPA (2000b) did state that for exposures at low doses, with low risk for each component in the chemical mixture, that the likelihood of significant interaction (e.g. synergistic effects) is usually considered to be low. Likewise, a report by ATSDR (2004) cited several studies using rats that found no synergistic effects for mixtures of four, eight and nine chemicals at low (sub-toxic) doses. However, some studies have found different results for some chemicals, the study of synergist effects is extremely complicated, and there can be substantial uncertainty in the risk characterization for chemical mixtures (ATSDR, 2004; USEPA, 2000).

Effects of Active Ingredients in Herbicides

The most sensitive effect from the most sensitive species tested was used to determine the toxicity values for each herbicide for birds and mammals. Quantitative estimates of dose from each exposure scenario were compared to the corresponding toxicity value to determine the potential for adverse effect. Doses below the toxicity value resulted in a conclusion of no likely adverse effects, while doses above the toxicity value indicated a potential for adverse effects. Specific toxicity values used for each herbicide for birds and mammals are in the project file Wildlife Specialists Report/Biological Evaluation.

Summary

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 (USFS 2005d), 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.

For spotted owls, 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 devices 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 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. amphibians, mollusks) are vulnerable to crushing or injury from people or equipment. The mechanical treatments proposed are primarily the use of string trimmers (weed whacking), with two areas identified for roadside mowing/brushing and two areas for disking. The potential for this effect can often be minimized by the seasonal timing of treatments. This is discussed in more detail in the following sections.

Prescribed fire may remove habitat for some animals but improve it for others. Fire could kill small species that are unable to escape the burn. Burns involving large acreages are more likely to result in mortality or habitat loss than burns involving small acreages. The prescribed burns proposed in this document for invasive plant control are unlikely to have adverse effects, including mortality, to wildlife because the burns are in very small patches and areas dominated by houndstongue, which does not provide suitable habitat for any TES, MIS or any other species of local interest.

Invasive plant treatments will not alter native habitat structure or composition for terrestrial wildlife species, including MIS, or bird species included in Birds of Conservation Concern (U.S. Fish and Wildlife Service 2002) or the Partners in Flight strategy for landbirds (Altman 2000). In some cases, removal of invasive plants could cause a very localized decrease in the amount of vegetative cover provided. Due to the patchy nature of the invasive plant infestations, the amount of cover lost would be so small that it is not measurable in a meaningful manner. Unlike other management activities, such as grazing or timber harvest, invasive plant treatments do not reduce habitat available to native wildlife. Likewise, prey availability would not be reduced because invasive plants are located in relatively small patches, or along narrow road corridors, within and adjacent to the much larger natural habitats in which the prey reside.

Risk from herbicide exposure was determined using data and methods outlined in the SERA risk assessments. Tables 8 and 9 in the Biological Assessment (USFS 2005d, 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. The toxicity indices are used as a potential effect threshold; doses below the thresholds indicated no plausible adverse effect. The toxicity indices used for each species group were the most sensitive effect endpoint from the most sensitive species from available data. 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-eater, fish-eater, plant-eater). Quantitative estimates of dose for each animal grouping for each herbicide are contained in the project file worksheets.

Data is very limited or lacking on potential adverse effects of herbicides to mollusks and amphibians. There is some data to suggest that amphibians may be as sensitive to herbicides as fish (Berrill et al. 1994; Berrill et al. 1997; Perkins et al. 2000), so for this analysis, herbicides that pose potential risk to federally listed fish (as determined by the quantitative estimates from exposure scenarios) will also be considered to pose a risk to amphibians. Glyphosate, picloram, and sethoxydim were identified as posing potential risks to fish in the aquatic species BA (USFS 2005d). Sulfometuron methyl was specifically tested on amphibians and it may cause malformations, but only at very high application rates. Triclopyr used in a broadcast spray scenario may pose a risk to fish and amphibians, but a Standard in the Forest Plan restricts triclopyr to selective application methods only, almost eliminating the opportunity for exposure.

Relyea (2005) found no effect to three species of aquatic snails from the glyphosate formulation Roundup. Only glyphosate and picloram have been tested on a terrestrial mollusk; the brown garden snail (*Helix aspersa*). Neither glyphosate nor picloram appeared to pose a risk to the snail (see USFS 2005d, Appendix B).

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 Criteria. 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 for a quantitative risk assessment. For instance, there is no quantitative scenario for a predatory bird that eats primarily other birds, such as the peregrine falcon, so the “fish-eating bird” scenario was used as a surrogate. This scenario likely overestimates the dose to the peregrine falcon because the hypothetical fish consumed are from a pond contaminated by a large spill of herbicide. These hypothetical fish likely have higher concentrations of herbicide in their bodies (and thus a higher dose to the predatory bird) than would a small bird that incidentally ingested herbicide before it was preyed upon. Also, 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.

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 (PDF) place restrictions on how and where herbicides are applied. For example, PDFs eliminate broadcast herbicide treatments near perennial streams; minimize disturbance to certain habitats during certain times of the year; and prohibit the use of certain surfactants in some habitats. 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.

Alternative 1 - No Action

There are existing NEPA documents that allow treatment of some invasive plants with manual and herbicide methods on the Forests and Grassland. Approximately 275 acres per year are treated with herbicide and 1,265 acres per year are treated manually. Only the herbicides glyphosate, dicamba, and picloram are approved for use. Environmental analysis for these existing projects concluded that there would be no adverse effects to any federal listed, Forest Service Sensitive, or MIS.

Project design features listed in this document are consistent with those required in the existing NEPA documents, or, the project sites in the existing NEPA documents do not include potential habitat for the wildlife discussed below.

Under the No Action alternative, the sites analyzed in these previous NEPA documents would be the only areas treated for invasive plants. The remaining infestations would go untreated and would likely expand. Habitat for a variety of wildlife, including some of the FS sensitive species, would likely degrade to a point that it becomes unsuitable. Infestations that become so well-established that future treatment is cost-prohibitive can result in a permanent loss of wildlife habitat (Asher 2000).

Habitat loss via invasive plant infestation has been reported to occur in Oregon spotted frog habitat that is invaded by reed canarygrass (McAllister and Leonard 1997, Watson et al. 2003)). Currently, the Deschutes and Ochoco National Forest have a Programmatic Biological Assessment that prohibits use of herbicides in and immediately adjacent to wetland habitat for Columbia and Oregon spotted frogs. Further loss of Oregon and Columbia spotted frog habitat, as well as other amphibian habitat, can be expected to occur in the project area for this alternative due to lack of proposed treatments, and prohibition on effective treatments, in their habitat.

Reed canarygrass infestations at Big Marsh may be reducing available nesting habitat for yellow rails, and if the infestation spreads to preferred nesting sites, yellow rail populations could be affected. Conclusive data supporting this hypothesis has not been collected.

Continued loss of habitat for sage grouse as well as pygmy rabbit can be expected with expansion of invasive plants (Connelly et al. 2000, Weiss and Verts 1984). Some decrease in available foraging habitat for elk and other big game is possible (Rice et al. 1997). The spread of wetland invasive plants will likely reduce waterfowl nesting habitat (Blossey 1999). Spread of burdock could result in additional instances of direct mortality to bats and hummingbirds.

With only 1,540 acres of proposed treatment within 14,546 acres of mapped infestations, at projected rates of spread (10-15% annually on western federal lands; Asher and Dewey 2005), this alternative could result in a substantial loss of habitat over time for several wildlife species.

Effects of Alternatives 2 and 3

The two action alternatives both utilize manual, mechanical, cultural, biological, prescribed fire, and herbicide tools and methods for invasive plant treatment. Alternative 2 permits a wider variety of treatments in Riparian Reserves (RR) and Riparian Habitat Conservation Areas (RHCAs). Alternative 3 restricts the types of herbicides permitted within RR and RHCAs. A 300-foot buffer would be applied to all perennial streams, lakes, ponds, and reservoirs and to all fish-bearing streams. Inside the 300-foot buffer, there would be no broadcast spraying of herbicides permitted, no use of triclopyr, picloram, or sethoxydim at all, and no herbicide application within the channel of dry intermittent streams. Also, no herbicide application would occur within 10 feet of perennial or fish-bearing waters when water is present. Machinery or equipment that could cause substantial sedimentation would not be permitted within the buffers. Otherwise, the Proposed Action and Alternative 3 permit the same amount and types of invasive plant treatments. Effects to many wildlife species are not different between the alternatives because adverse effects from herbicide exposure are not plausible, required project design features avoid or minimize adverse effects from manual and mechanical techniques, the species are not limited to riparian habitats, or the wildlife species are not present within project area units or likely to be present in future areas treated under EDRR.

The project design features listed for bald eagles, spotted owls, and other species, apply to all alternatives (including the No Action). Because the project design features are required, and because they are effective at eliminating adverse effects from disturbance to these species, none of the action alternatives will result in adverse effects to these species from disturbance.

For bald eagles, which feed upon fish, adverse effects from herbicide or NPE surfactant exposure are not plausible because 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) (project file worksheets). 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 (project file worksheets). 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.

Therefore, no invasive plant treatments in any alternative results in adverse effects to spotted owl or bald eagle. The following discussion contains the details of the analysis and rational for this conclusion.

Other federally listed species do not occur within the project area and therefore will not be impacted, regardless of alternative.

Federally Listed Species

Effects to 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 levels 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 (USDA/USDI 2006b).

Projects that generate noise or activity above ambient levels and occur within the 1/4 mile, from an active spotted owl nest may cause harassment effects (USDA/USDI 2006b). 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 disruption 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 unsurveyed 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, pers. comm. 2005, D. Durfey, pers. comm. 2005). The gasoline-powered pump engines will be quieter than the diesel pump engines that we measured.

There are no spotted owls on the Ochoco National Forest or Crooked River National Grassland. On Deschutes National Forest system lands, there are 1,367 acres of suitable nesting, roosting, and foraging habitat within proposed project area units, only a portion of which is likely to be suitable for nesting. There are 18 core areas for spotted owls within proposed project area units. However these treatment areas do not propose mowing or brushing. 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 543 acres of suitable habitat for spotted owls. The mandatory PDF for spotted owls requires that these methods, or others that generate sufficient noise (greater than 92 dB), 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 has been included in several Biological Opinions throughout the region and has been found to be effective at minimizing 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.

Biological Control

No biological control agent that is currently present in the project area is adversely affecting northern spotted owls or their habitat. Future biological control agents used for invasive plant control are not likely to target or inadvertently affect habitat or pretty of northern spotted owls, because they would not affect forest trees nor influence prey availability.

Prescribed fire

Burning of 14.3 acres of houndstongue in the Dry Paulina Creek watershed will have no effect on spotted owls because no spotted owl nests occur on the Ochoco national Forest.

Effects of Herbicides

Exposure scenarios used to analyze potential effects from herbicides are discussed in the USFS 2005d, 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 on the Deschutes National Forest prey primarily on northern flying squirrels. Western red-back voles, bushy-tailed woodrat, and other small mammals are secondary prey items. These prey items are nocturnal and hide under cover during the day. Flying squirrels are chiefly arboreal. Red-backed voles and flying squirrels feed primarily on fungi and lichen. Other voles, mice and woodrats eat primarily vegetation and seeds. While it is not plausible for the arboreal owls or their primary prey to be exposed to herbicides used within the owl's activity centers, some of their other prey, like mice and woodrats, could be exposed to treated vegetation. Prey are unlikely to be directly sprayed because they are largely nocturnal, hide under cover during the day, and would likely flee areas with human activity. However, a worst-case exposure scenario for the spotted owl was conducted using consumption of prey that had been directly sprayed, with the assumption that 100 percent of the herbicide is absorbed by the prey, and the prey is ingested immediately by the owl. Direct spray of the prey is used because that scenario results in a higher dose to the prey and owl than would ingesting a prey item that had consumed treated vegetation.

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 acute doses from the exposure scenarios are all less than the reported NOAELs (no-observable adverse effect level) for all herbicides and NPE. The estimated dose from an NPE-based surfactant applied at the highest rate did exceed the NOAEL. Project design feature number 37 limits use of NPE-based surfactants to the typical application rate, so exposures exceeding the NOAEL will not occur. Chronic doses in this scenario are highly unlikely to occur because it is very unlikely that even one prey item could be directly sprayed and then immediately consumed, let alone a long-term diet of contaminated prey. 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.

Summary of Effects to Northern Spotted Owl

Effect determinations are summarized in Table 110. Disturbance by humans and vehicles during project implementation is the primary adverse effect that is plausible for northern spotted owls. Treatments included in the No Action alternative will have no effect on spotted owls. Project design features in all action alternatives for activities conducted within or adjacent to occupied or un-surveyed suitable habitat will minimize adverse effects from disturbance. There are no invasive plant locations or species that cannot be adequately treated using the project design features. If new sites found under the Early Detection/Rapid Response approach could not be adequately treated with the project design feature, it would be considered outside the scope of the EIS and the corresponding consultation. New NEPA analysis and consultation would be conducted.

Conducting invasive plant treatments "may affect, but are not likely to adversely affect" the northern spotted owl. This determination is based on:

- The project design feature required for northern spotted owl sites or potential habitat will eliminate adverse effects from disturbance.
- Spotted owls do not occur on the forest where prescribed burning is proposed and will not be affected.
- Exposure of spotted owls or their prey to herbicides is not plausible because:
  - Spotted owls and the majority of their prey are arboreal and/or nocturnal, and not likely to be exposed to herbicides.
- Even if an owl immediately consumed a prey item that had been directly sprayed, the resulting dose would be below those known to cause any adverse effects in birds.
- Invasive plant treatment projects conducted according to the project design feature will not affect critical habitat for the northern spotted owl. This determination is based on:
  - No primary constituent elements are affected by invasive plant treatments.

Table 95. Effects determinations for northern spotted owl for all alternatives.

		Effects Determinations		
Species	**Status**	**No Action**	**Action Alternatives**	**Critical Habitat – All Alternatives**
Northern spotted owl	Threatened	No Effect	May Affect, Not Likely to Adversely Affect	No Effect

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. Alternative 3 reduces the likelihood of exposure to herbicides for species that reside within Riparian Reserves or Riparian Habitat Conservation Areas, but it increases the likelihood of disturbance and/or trampling. This replaces potential effects from herbicide treatment methods with effects from non-herbicide treatment methods. When analysis was conducted by alternative, results indicated that effect determinations for each species were the same for all action alternatives.

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 Forests and Grassland have suitable habitat along roads, although in small amounts relative to the amount of suitable habitat that is not within a road corridor.

No indirect effects (those occurring later in time) are likely for wildlife species analyzed in this report. Invasive plant species do not provide habitat for sensitive species nor do they forage substantially on invasive plants or upon insects on or around them[18]. Control of invasive plants will not reduce their available habitat or food nor affect any life history attributes. Herbicides proposed in this EIS do not store in body fat, so they are rapidly eliminated from the body even if exposure does occur. They do not bioaccumulate so no effects are likely to occur much later in time.

Effects to Bald Eagle

Manual, Mechanical, and Cultural Methods

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, and occur at greater distances from the project site, because machinery creates louder noise.

The critical period in Oregon and Washington when human activities could disturb occupied nests extends from January 1 to August 31 (U.S. Fish and Wildlife Service 1981). Bald eagles are sensitive to human disturbance during this time, particularly within sight distance of nest sites. Disturbance near winter roost sites is not likely to occur because invasive plant treatments generally do not occur during the winter. Invasive plant treatments in the project area will avoid conducting the project in proximity to an occupied nest during these time-frames.

Projects conducted at anytime that are more than 1/4 mile, or ½ mile line of sight, from eagle use areas, and which do not result in the modification of use areas or the eagles' food resource, and noise is below ambient levels, will have no effect on bald eagles. Activities that occur within 1/4 mile, or ½ mile line of sight, from eagle use areas and produce noise above ambient levels, and do not result in degradation of use areas or the eagles' food resource, but implement the limited operating period in the project design feature (January 1 to August 31 for nesting and rearing, and November 1 to April 30 for winter roosting and foraging), are not likely to adversely affect bald eagle.

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, but would comply with the above PDF, therefore invasive plant treatment projects proposed may affect but will not adversely affect bald eagles.

Prescribed Fire

Both action alternatives propose burning 14.3 acres of houndstongue in four discrete spots in the Dry Paulina Creek watershed (Figure 8). Burning will take place in spring. No bald eagle nests occur in this area, so the prescribed burning will have no effect on bald eagles.

Herbicides

Exposure scenarios used to analyze potential effects from herbicides are discussed in USFS 2005d, 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 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

[18] Deer mice have been found to feed extensively on the larvae of biocontrol insects in spotted knapweed (Pearson et al. 2000, Pearson and Callaway 2006). Deer mice are not a sensitive species and no other species have been reported to heavily utilize invasive plants or insects upon invasive plants.

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 in 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 USFS 2005d, 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.

Summary of Effects to Bald Eagle

The No Action alternative will have no impact on bald eagles. There are 27 bald eagle locations within 0.5 mile, and 17 locations within 0.25 mile, of proposed treatment areas on the Deschutes and Ochoco National Forests. Disturbance by humans and vehicles during project implementation is the primary adverse effect that is plausible for bald eagles. The project design features required for bald eagles, which imposes a seasonal restriction on activities near or within line-of-sight of nesting or roosting eagles, will eliminate adverse effects from disturbance.

Conducting invasive plant treatments as per either action alternative would have "no impact" to bald eagles. This conclusion is based on:

- The project design features required for areas near or within line-of-sight of bald eagle sites will minimize adverse effects from disturbance.
- Proposed prescribed burning will have no effect on bald eagles because they are not in or near the treatment area.

Adverse effects to bald eagles from herbicide exposure are not plausible because:

- Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide, they would not receive a dose that exceeds any known NOAEL.
- Proposed treatments, and treatments under EDRR, do not have the potential to create herbicide exposure above that which was quantified for the accidental spill scenario.

California Wolverine

Wolverines occur in remote areas of the Deschutes and Ochoco National Forests. No treatment areas are located in likely wolverine habitat and short duration, low intensity invasive plant treatments are unlikely to disturb wolverines. Therefore, “no impact” to California wolverine will occur for all action alternatives.

Pacific Fisher

There are no known resident populations of fisher on the Forests or Grassland. Only one transient individual has been documented within the project area. Proposed project area units that would be treated within suitable fisher habitat would consist of roadside treatments and those within previously harvested areas. These areas are subject to more disturbance and are not the typical habitat in which fishers are found. Areas infested with invasive plants do not provide habitat for Pacific fishers. It is highly unlikely that any proposed treatments would occur in the vicinity of individual fishers, therefore the treatments in all alternatives will have “no impact” on the Pacific fisher.

Pygmy Rabbit

Pygmy rabbits are not associated with riparian areas, so the differences in alternatives will not produce any differences in potential effects to the pygmy rabbit. Two treatment areas on the Crooked River National Grassland contain pygmy rabbit habitat. Neither of the infestations proposed for treatment is located in a burrow area, so crushing of burrows or rabbits will not occur. Both areas propose herbicide use (clopyralid) applied as a spot spray. Site 75-54 is within a previously burned area, so if rabbits were present on the Crooked River National Grassland in this general area, they would not utilize the treatment site due to lack of cover and forage. There is no likely exposure to herbicide that would occur. The other site, 75-44, has been surveyed and there is no indication of occupancy by pygmy rabbits, so no herbicide exposure would occur on this site.

There is potential pygmy rabbit habitat elsewhere on the Deschutes and Ochoco National Forests where herbicide may be used. Potential effects to rabbits from herbicide exposure was conducted using a worst case exposure scenario for a small mammal that consumed contaminated vegetation for an entire day (acute exposure) or for 90-days (chronic exposure) (see Appendix P of the R6 2005 FEIS). The dose the small mammal received from consuming contaminated vegetation was compared to doses identified at the “no-observable-adverse-effect-level” (NOAEL) from toxicity studies. Dose to the small mammal was calculated for both application rates that are typical in Forest Service invasive plant treatments and at the highest reported use rates. No chronic doses exceed the NOAEL for any of the herbicides available for use in the proposed project. The estimated dose from an NPE-based surfactant also did not exceed the NOAEL in chronic exposure scenarios.

For acute exposures, no herbicide available for use exceeded the NOAEL at either typical or highest application rates. The estimated dose from an NPE-based surfactant did exceed the NOAEL, but only at the highest application rate. Project design feature number 37 limits use of NPE-based surfactants to the typical application rate, so exposures exceeding the NOAEL will not occur.

The herbicides available for use in the proposed action, or in Alternative 3 do not bioaccumulate nor do they biomagnify up the food chain. These herbicides do not store in body fat and are rapidly excreted in urine from mammals, often within hours of consumption (see Appendix B of USDA Forest Service 2005d). No additive doses are likely because herbicide is excreted before another exposure is likely to occur. No doses exceeding that which was estimated are probable.

Available data indicates that there is no likely negative effect to pygmy rabbits from exposure to herbicides proposed for use in Alternatives 2 or 3. Exposure to NPE-based surfactants is limited to typical application rates, so no doses exceeding the NOAEL will occur and no adverse effects are likely.

There are no known project area units currently occupied by pygmy rabbits and several surveys of suitable habitat have been conducted. Suitable burrow sites have been identified and in most cases protected by exclosures. There is only one treatment proposed in burrow habitat. Future projects under EDRR could also occur in suitable burrow habitat. The pygmy rabbit PDFs restrict treatments in burrow habitat to only one or two individuals, to minimize the possibility of collapsing burrows. If pygmy rabbits did occur within treatment areas, no exposure to herbicide is likely to cause an adverse effect. Potential adverse effects from NPE-based surfactants are avoided by a pygmy rabbit PDF prohibiting use of NPE in breeding or foraging areas.

The proposed prescribed fire treatment does not occur in pygmy rabbit habitat and will not affect pygmy rabbits. Fire can adversely affect pygmy rabbit habitat, so future prescribed burns for invasive plant control would have to be evaluated for potential effect to pygmy rabbits or their habitat.

Invasive plant treatments will improve existing habitat, help protect sagebrush habitat from adverse modification due to future spread of invasive plants, possibly reduce likelihood of habitat loss from fires. Neither the likelihood of disturbance or exposure to herbicides differs between alternatives. Therefore, treatments proposed "may impact, but are not likely to lead to a trend toward federal listing" for pygmy rabbits regardless of alternative chosen.

Greater Sage Grouse

Sage grouse are not associated with riparian areas, so the differences in alternatives will not produce any differences in potential effects to the sage grouse. Invasive plants are well-documented to degrade sage grouse habitat and invasive plant treatments are recommended in sage grouse and sagebrush management publications.

Disturbance

Sage grouse are sensitive to disturbance in breeding habitat (leks and other areas used in the spring). PDFs for sage grouse prohibit activities within 0.3 mile of leks during the dawn and dusk periods and within breeding habitat from February 15 to June 30. These PDFs will effectively avoid disturbance to breeding sage grouse. Invasive plant treatments are not conducted during the winter, so disturbance to wintering sage grouse will not occur.

Prescribed fire

Both action alternatives propose burning 14.3 acres of houndstongue in four discreet spots in the Dry Paulina Creek watershed. Burning will take place in spring. This general area receives incidental use by an occasional sage grouse in late summer (August/September) (M. Feiger, pers. comm. 2007). Use of the area appears to be foraging by individual males, females without broods, nor will it include native habitat, so the proposed prescribe fire treatment will have no effect on sage grouse. Future prescribed fire projects would need to be evaluated for potential effect to sage grouse or their habitat.

Herbicide

Sage grouse are large vegetation-eating birds, so a worst-case scenario was used that estimated herbicide exposure for a large bird eating contaminated vegetation. At typical and highest application rates and acute exposures, only NPE surfactants exceeded toxicity thresholds (see Appendix P of R6 2005 FEIS). Data on toxicity of NPE to birds is lacking, so a toxicity threshold for mammals were used in the analysis (see Bakke 2003). The estimated dose to a four-kg bird exclusively consuming vegetation sprayed with NPE-based surfactant for one entire day exceeded the dose that created a slight reduction in polysaccharides in the liver of rats. Whether this type of effect could be expected in birds is unknown.

One paper (APERC 2000, cited in Bakke 2003) stated that no behavioral changes or mortality to quail occurred when they were fed up to 5,000 ppm of NPE for five days. The authors concluded that the lethal dose (LC_{50}) for quail was greater than 5,000 ppm, which is at the higher range or well above the reported range of LC_{50} values for mammals. However, with only one study on birds available, data is insufficient to state whether or not birds are less susceptible to NPE than are mammals.

Using the limited data available, including toxicity thresholds from mammal data, it appears that some adverse effects from consuming contaminated vegetation are plausible from NPE surfactants.

No herbicides at the typical application rate in the exposure scenario analysis produced exposures that exceeded the toxicity thresholds for birds. Triclopyr cannot be broadcast sprayed due to a standard added to the forest LRMP by the R6 2005 ROD, and would not be spot sprayed on sagebrush (their primary food), so exposures of concern are not likely.

Sage grouse chicks depend heavily upon insects, so estimates of dose for small birds consuming contaminated insects were also used. At typical application rates, NPE surfactants exceeded toxicity thresholds. Data on NPE is limited for birds as discussed above. Triclopyr cannot be broadcast sprayed, so contamination of a substantial amount of insects within a foraging area is unlikely. Also, triclopyr is used on invasive woody vegetation, like blackberries and Scotch broom, neither of which are present in sage grouse habitat and if they were, sage grouse would be unlikely to forage for insects exclusively on or near these plants. Exposures of concern for triclopyr are not likely.

At highest application rates, glyphosate, in addition to NPE, exceeded the toxicity threshold for small birds eating contaminated insects. The estimated dose somewhat exceeded the dose of glyphosate that caused weight loss in zebra finches (Evans and Batty 1986 as cited in SERA Glyphosate 2003). Glyphosate is not sprayed at the highest rate analyzed, as previously discussed, because it hampers effectiveness and wastes money.

Chronic exposures were also evaluated for herbicides. There are no long-term residue rates on vegetation for NPE, nor any exposure data on birds, so a quantitative estimate for chronic exposures is not available for NPE. There are no long-term residue rates for herbicides on insects, so quantitative estimates are not available for small birds consuming contaminated insects. The estimated dose of glyphosate applied at the highest application rate exceeded the chronic NOAEL for effects to reproduction. In order to receive this dose, sage grouse would have to consume nothing but contaminated vegetation for 90 days. This scenario seems highly unlikely given that only patches of invasive plants would be treated, sage grouse do not feed extensively on invasive plant species if at all, and sage grouse are unlikely to feed exclusively within treated patches for three months. Also, glyphosate is not sprayed at the highest application rates because it is effective at much lower rates and use of higher rates wastes money, very high rates can hinder translocation to the roots where the desired effect takes place, and glyphosate is rarely used in dry habitat because it is non-selective.

Table 96. Summary of exposure scenario results showing the herbicides and NPE, scenario, and application rates that produce risk to sage grouse. Symbol meanings are as follows: -- estimated dose below the NOAEL; ★ estimated dose exceeds the NOAEL at both typical and highest application rates; ◆ estimated dose exceeds the NOAEL at only the highest application rates. N/A – data not available

Animal/diet	Glyphosate	NPE
ACUTE EXPOSURE (1-day)		
Large bird / contaminated vegetation	--	★
Small bird / contaminated insects	◆	★
CHRONIC EXPOSURE (90-DAYS)		
Large bird / contaminated vegetation	◆	N/A

The majority of treatments within or adjacent to suitable habitat for sage grouse occurs along road shoulders. Brooding sage grouse will utilize road shoulder habitat, especially ditches, in search of green vegetation and insects (Steele, D., pers. comm. 2006). Proposed roadside treatments involve spraying the patch of invasive plants with truck-mounted nozzles or with hand-held sprayers. If sage grouse were to forage within patches treated solutions containing NPE-based surfactants at typical application rates, exposures of concern could result. Glyphosate is not likely to be used at high application rates in sage grouse habitat as explained above. A sage grouse PDF prohibits use of NPE-based surfactants within areas where sage grouse may forage. Therefore, no herbicide or surfactant use is likely to result in adverse effects to sage grouse.

The PDFs effectively minimize risk to sage grouse from disturbance or exposure to herbicides or surfactant. Invasive plant treatments will improve existing habitat, help protect sagebrush habitat from adverse modification due to future spread of invasive plants, possibly reduce likelihood of habitat loss from fires. Therefore, invasive plant treatments "may impact, but are not likely to lead to a trend toward federal listing" for sage grouse, regardless of alternative.

Horned and Red-necked Grebe

These species are not usually present during the breeding season when most invasive plant treatments would occur. Risk from herbicide exposure is evaluated using a "fish-eating bird" scenario. A quantitative estimate of dose was calculated for a bird eating contaminated fish for one day (acute) and for a lifetime (chronic). The fish are from a pond (1000 m^2 by 1 m deep) that has been contaminated by a spill of 200 gallons of herbicide. No herbicide or NPE exceeded a dose of concern for any exposure (acute or chronic) at any application rate (typical or highest). Based on available data, adverse effects to fish-eating birds from the herbicides in this analysis are not likely.

There are seven project area units that intersect potential grebe habitat at Wickiup Reservoir and Davis Lake. Mechanical treatments are proposed in three of these units. Only the use of string trimmers is included in the mechanical treatments proposed. The mechanical treatments proposed would not differ between alternatives and no herbicide or NPE has the potential for plausible adverse effects, so there would be no difference in effects to these grebes between alternatives. Grebes do not nest in invasive plants targeted for treatment and are not likely to be present during treatment. Therefore, invasive plant treatment projects will have "no impact" on horned or red-necked grebes regardless of alternative.

Bufflehead

Buffleheads are rare in Oregon during the breeding season. Since they nest in tree cavities, their nesting habitat will not be affected by invasive plant treatments – no native trees will be treated or removed. Because they rarely breed in Oregon, invasive plant treatments are unlikely to disturb any breeding bufflehead.

These ducks eat aquatic invertebrates and fish, so risk from herbicide exposure is evaluated using a "fish-eating bird" scenario. A quantitative estimate of dose was calculated for a bird eating contaminated fish for one day (acute) and for a lifetime (chronic). The fish are from a pond (1000 m^2 by 1 m deep) that has been contaminated by a spill of 200 gallons of herbicide. No herbicide or NPE-based surfactant exceeded a dose of concern for any exposure (acute or chronic) at any application rate (typical or highest). Based on available data, adverse effects to fish-eating birds from the herbicides in this analysis are not likely.

The differences between the alternatives do not result in a difference in potential effects because neither disturbance nor herbicide exposure from invasive plant treatments are likely to have any effects to bufflehead. Therefore, invasive plant treatment projects will have "no impact" on bufflehead regardless of alternative.

Harlequin Duck

Harlequin ducks nest along fast-flowing rivers and mountain streams in the Cascade Range. Invasive plant treatments along fast-flowing sections of river and mountain streams are likely to be rare for a variety of reasons. Infestations of invasive plants are less likely along swift sections and higher gradient streams than in slower river bottom habitat. It is more difficult for seeds and propagules of invasive plants to become established in swift water. If invasive plants become established along some swift water areas, they may not be treated because terrain and swift water limit access to the infestation. However, some invasive plant infestations will be treated in potential harlequin duck habitat with moderate flow (e.g. Metolius River).

Disturbance to nesting ducks could occur along the shore from people treating invasive plants either manually, with string trimmers (weed whackers), or with herbicides. Manual and mechanical treatments are likely to cause more disturbance and of longer duration than treatments with herbicide. However, most herbicide treatment projects involve a component of manual or mechanical treatment, so there would be some disturbance regardless of the technique used. Duration of disturbance from any method is expected to be a maximum of three to four hours in a single day and only occurring once during the nesting season.

Risk from herbicide exposure would be the same as that discussed above for bufflehead. While harlequin ducks only rarely eat fish, there is not sufficient data to quantitatively estimate dose from consuming contaminated insects. Because harlequin ducks are found along swift water, any herbicide that inadvertently entered the water would be rapidly diluted and moved downstream. This would greatly reduce exposure of this duck and its prey to herbicide. The fish-eating bird scenario seems an appropriate "worst case scenario" to use as a surrogate for analysis. Results from this scenario indicate that no herbicide or NPE-base surfactant poses a risk of adverse effects to harlequin ducks.

Differences in potential effects between the alternatives would be minor and based on the degree and duration of disturbance from increased manual and mechanical treatment activities presumed for Alternative 3. However, because some disturbance will still occur with herbicide treatment and herbicide treatments often include manual or mechanical treatments as well, potential differences in effects are not substantial enough to differentiate between alternatives.

The magnitude and duration of any disturbance or herbicide exposure is low level and short term. Therefore, treatments proposed "may impact, but are not likely to lead to a trend toward federal listing" for harlequin ducks.

Yellow Rail

There is a breeding population of yellow rails at Big Marsh and there are about three acres of invasive plants that are proposed for treatment with manual, mechanical (string trimmer), and herbicide methods. The target species for treatment is reed canarygrass that will be treated primarily in ditches that are part of a hydrologic restoration program.

The reed canarygrass that will be treated is not in the main part of the marsh used by the rails. Yellow rails also do not utilize the non-native reed canarygrass so they are unlikely to be directly harmed by its treatment or removal. Future treatments of the main reed canarygrass infestation near yellow rail habitat are unlikely because the infestation is so large it is not currently feasible or cost effective to treat. Breeding yellow rails could be disturbed by treatment activity nearby. This potential effect could occur regardless of alternative chosen. Data is insufficient to distinguish between alternatives the likelihood or magnitude of this potential effect. Because yellow rail locations vary annually with surface water availability, a PDF for all alternatives requires a local biologist to review the site prior to implementation to determine the location of the yellow rails relative to planned treatments.

Risk of effects from herbicide exposure is evaluated using the insectivorous bird scenario. A quantitative estimate of dose was calculated for a small bird feeding on insects (or any other small item) contaminated by direct spray of herbicide. The bird is assumed to feed exclusively on contaminated insects for the entire day's diet. There is no chronic dose estimate because there is no data on long-term herbicide residue on insects. The herbicide triclopyr cannot be broadcast sprayed and it is unlikely that an entire day's diet of insects could be contaminated by spot spray or hand/selective applications, so quantitative estimates are not made for triclopyr.

At typical application rates, no herbicide exceeded a dose of concern for insectivorous birds. At highest application rates, glyphosate did exceed a dose of concern. Because glyphosate is one of the few herbicides that can be used in a wetland situation, it is likely to be used on the reed canarygrass in Big Marsh. However, glyphosate is not applied in a foliar spray at the highest rate analyzed because excessively high rate burns the vegetation and interferes with translocation, making the treatment ineffective, and it is a waste of treatment funds. Contamination of an entire day's diet of invertebrates seems unlikely for the following reasons: 1) yellow rails are not known to forage within areas dominated by invasive reed canarygrass, 2) the presence and movement of applicators is likely to scare off some invertebrates, making them less likely to be sprayed; and, 3) the infestation proposed for treatment is not immediately adjacent to the habitat used by the yellow rails.

NPE-based surfactants exceeded the dose of concern for insectivorous birds at both typical and highest application rates. However, PDFs for all alternatives restrict the application rate of NPE to 0.5 lb a.i./acre and prohibit spraying of NPE within habitat for the yellow rails. These PDFs eliminate plausible exposures of concern so no doses of concern to yellow rails will occur.

Invasive plant treatment projects "may impact, but are not likely to lead to a trend toward federal listing" for the yellow rail, regardless of alternative, for the following reasons:

- Yellow rails are unlikely to be immediately adjacent to the portion of Big Marsh scheduled for treatment
- PDFs require biologist verification of yellow rail locations relative to treatment location
- PDFs restrict broadcast spraying and application rate of glyphosate and NPE in yellow rail habitat.

Upland Sandpiper

Upland sandpipers nest in open, short-grass habitat and are extremely rare breeders in Oregon. The Ochoco National Forest has some suitable habitat. The cryptic nests of upland sandpipers are susceptible to crushing or trampling by people or vehicles. If upland sandpipers were nesting in areas where invasive plant treatments occurred, eggs or nestlings could be trampled, regardless of the treatment technique used. Data is not sufficient to distinguish in a meaningful way the magnitude or duration of disturbance or trampling between alternatives. Invasive plant infestations do not provide suitable habitat for nesting upland sandpipers. Due to the low likelihood of this sandpiper being present in the treatment sites, actual risk to the birds is very low.

Upland sandpipers eat insects so the risk from herbicide and NPE-based surfactants is as discussed above for sage grouse. Glyphosate is not broadcast sprayed at high application rates and NPE is limited to typical application rate by a PDF. Ingesting insects contaminated with NPE-based surfactant applied at typical rates could exceed a level of concern. However, the sandpiper's would have to eat contaminated insects exclusively and it is unlikely that this would happen. Due to the low likelihood of this sandpiper being present in the treatment sites, actual risk of herbicide exposure to the birds is very low.

Upland sandpipers are not known to nest or forage in stands of invasive plants that are likely to be treated. Due to their very low likelihood of being present within treatment areas, the proposed treatments will have "no impact" on upland sandpipers regardless of alternative.

American Peregrine Falcon

Peregrine falcons are not dependant upon riparian areas and do not forage exclusively within them, so the differences in alternatives will not produce any differences in potential effects to the peregrine falcon. There are no known peregrine falcon nests in the action area, but some individuals have been seen.

There is no quantitative scenario for a predatory bird that eats primarily other birds, such as the peregrine falcon, so the “fish-eating bird” scenario and the “mammal-eating bird” were used as surrogate scenarios. The fish eating bird scenario likely overestimates the dose to the peregrine falcon because the hypothetical fish consumed are from a pond contaminated by a large spill of herbicide. These hypothetical fish likely have higher concentrations of herbicide in their bodies (and thus a higher dose to the predatory bird) than would a small bird that incidentally ingested herbicide before it was preyed upon. Also, the small mammal in the “mammal-eating bird scenario” is directly sprayed. It would be practically impossible to directly spray a bird that a peregrine falcon would then immediately prey upon. Herbicide analysis indicates that no herbicide dose exceeded the toxicity indices for fish-eating or mammal-eating birds even at highest application rates in the “worst-case” scenarios.

The dose from NPE-based surfactant exceeded the level of concern, but only at the highest application rate. A PDF in all alternatives limits NPE to 0.5 lb a.i./acre or less only so this dose will not occur.

In reality, a peregrine falcon feeding on a bird would not receive a high dose from its prey (as estimated by the scenarios) because the herbicides proposed in this EIS are rapidly excreted from animals and do not bioaccumulate. In the fish scenario, the fish are still within the contaminated water and therefore have some herbicide in their tissues. In the mammal prey scenario the prey has been directly sprayed and is covered with herbicide. So, if birds were exposed to herbicides and then subsequently preyed upon and consumed by peregrine falcons, the amount of herbicide that the peregrine would be exposed to is likely less than that modeled in the “worst case” scenarios using contaminated fish or small mammals.

No current nest sites for peregrine falcon occur within 1.5 miles of any proposed treatment area, the mandatory PDFs 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 for all action alternatives.

Gray Flycatcher

Gray flycatchers are not associated with riparian areas, so the differences in alternatives will not produce any differences in potential effects to the gray flycatcher.

Gray flycatchers nest in trees and are not susceptible to the short-term disturbance created by invasive plant treatments. Gray flycatchers are insectivorous birds and could be exposed to herbicides by consuming contaminated insects. Most of the insects consumed by gray flycatchers are unlikely to become contaminated with herbicides because they inhabit tree canopies, are not necessarily associated with invasive plant species, and foliage would intercept most herbicide applied. Herbicide exposure to insectivorous birds was estimated as described above for sage grouse. Only glyphosate applied at a high application rate and NPE-based surfactant at high and typical rates resulted in a dose that exceeded the NOAEL. Glyphosate is not sprayed at high application rates as described above for sage grouse. A PDF in all alternatives limits NPE application 0.5 lb a.i./acre or less so doses of concern would not occur. Substantial numbers of insect prey are not likely to be sprayed during ground spraying treatments (no aerial treatment is proposed). Gray flycatchers are unlikely to forage exclusively on insects contaminated with NPE applied at typical rates, so doses of concern are unlikely.

The proposed prescribed burning of 14.3 acres on the Ochoco will have “no impact” on gray flycatchers because they do not nest or forage in houndstongue. The burn will not pose any risk to their nests. In addition, the small size of the burn, which will occur in four discreet patches, is insufficient to significantly alter their habitat in the project area. Therefore, invasive plant treatments will have “no impact” on gray flycatchers.

Tricolored Blackbird

Tricolored blackbirds nest in wetland areas, primarily in native emergent vegetation, but have also been reported to use blackberries in Oregon. Birds nesting in cattails or other native vegetation are unlikely to be disturbed by invasive plant treatments. If birds were nesting in blackberries that are the target of treatment with manual, mechanical, or herbicide methods, they would be vulnerable to disturbance that could destroy the nests.

The potential effects would be the same regardless of alternative chosen. This potential effect is unlikely within the project area as there are no known breeding sites on the Deschutes or Ochoco National Forests or the Grassland.

Risk of herbicide or NPE exposure is the same as discussed above for yellow rail. Blackbirds forage in areas beyond the 10-foot no-herbicide buffer around perennial lakes and ponds specified in Alternative 3, so there is little or no difference between alternatives in likelihood of exposure to, or effects from, herbicide. A PDF in all alternatives restricts spraying of NPE to 0.5 lb a.i./acre so doses of concern will not occur.

Invasive plant treatments are will have "no impact" on tricolored blackbirds because they are not present in treatment areas and the PDF restricting the application rate of NPE eliminates the potential for NPE exposures of concern.

Oregon and Columbia Spotted Frogs

The habitat and life histories of these two frogs are similar so their risk of effects from disturbance or herbicide is similar. Columbia spotted frog has a larger distribution within the project area so there is a larger overlap between proposed and future treatments and their habitat. Columbia spotted frogs utilize terrestrial habitat more than Oregon spotted frogs and so are somewhat more susceptible to disturbance or inadvertent trampling.

Disturbance

Adult frogs, eggs, and larvae are not likely to be disturbed by invasive plant treatments during the breeding season because they are restricted to aquatic habitat. After breeding however, adults, particularly Columbia spotted frogs, will disperse into adjacent wetland and riparian habitats. Adults and juveniles would be susceptible to trampling from invasive plant treatment activities in wetland and riparian habitat utilized by frogs. The probability that this would actually occur is low because the frogs are less likely to inhabit areas infested with invasive plants. This potential effect would occur in all alternatives, but might be slightly more likely in Alternative 3 due to increased use of manual and mechanical techniques.

Prescribed Fire

Both action alternatives propose burning 14.3 acres of houndstongue in four discreet spots in the Dry Paulina Creek watershed, treatment areas 72-37 and 72-15. Oregon spotted frogs are not present, but Columbia spotted frog habitat is present in the general area. The prescribed burning of houndstongue sites will take place in spring when the frogs are located in aquatic habitat. While Columbia spotted frogs have been reported to move between aquatic habitats, these movements have been documented to occur after the breeding season (Bull and Hayes 2001) so no effects to dispersing frogs will occur. Spotted frogs will move prior to breeding, to locate females and suitable breeding sites. However, the burn areas do not provide quality habitat so the Columbia spotted frogs are not likely to be affected by the burn, but harm to an isolated individual frog that happened to be in the small burn patches cannot be ruled out. The burn will not involve any aquatic habitat and will not burn any suitable breeding or feeding habitat. The prescribed burn has a low probability of harming individual frogs, but will not affect the local population level or degrade habitat.

Summary of Herbicide Effects to Amphibians

There are 41 project areas within 100 feet of spotted frog habitat that propose use of herbicides. Almost all of these project areas are roads in which small patches of invasive plants along the road shoulder would be sprayed. The spatial distribution of the invasive plants along roads is widely scattered and infestations are not dense. Small patches over very large areas would be treated, resulting in a very low probability of exposure to individual frogs or contamination of breeding ponds or streams.

Data on herbicide effects to amphibians is limited. Appendix B of the Invasive Plant BA (USFS 2005d) summarized available data on the effects of herbicides to amphibians and this discussion is incorporated by reference. As stated previously ("Introduction and Methods"), where data was lacking, toxicity data on fish was used as a surrogate for toxicity to amphibians, based on studies comparing data available for both groups of species (Berrill et al. 1994; Berrill et al. 1997; Perkins et al. 2000). For glyphosate and sulfometuron methyl there was sufficient data to do a quantitative evaluation of exposure and risk.

Results of the analysis indicate that the following herbicides pose a low risk of mortality to amphibians: chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron methyl, and picloram. Data is insufficient to evaluate risk of sub-lethal effects. The Poast® formulation of sethoxydim is much more toxic to aquatic species than is technical grade sethoxydim. However, use of Poast® is unlikely to result in concentrations in the water that would result in toxic effects to aquatic species (SERA 2001). There is a substantial limitation to this risk characterization because there are no chronic toxicity studies on aquatic animals available for either sethoxydim or Poast®. However, for the types of herbicide applications proposed in this analysis, the R6 Invasive Plant BA (USFS 2005d) demonstrated that chronic exposures of concern to aquatic species are not possible.

Formulations of glyphosate that contain POEA surfactant are much more toxic to aquatic organisms than aquatic-labeled formulations, which do not contain POEA. The concentration in water for a "worst case scenario" (see fisheries effects analysis) was compared to toxicity data on both versions of glyphosate. At typical application rate, concentrations in the water for acute and chronic exposures were well below any reported LC_{50} for either version of glyphosate, with the exception of one study by Smith (2001). The Smith study is not consistent with other reported studies on glyphosate and so was not used to establish the threshold of concern for aquatic species in the Glyphosate Risk Assessment (SERA 2003 Glyphosate).

Relyea (2005) reported a synergistic effect with predatory cues and glyphosate with POEA for one of six amphibian species tested. The effect occurred in wood frogs (*Rana sylvatica*) but not leopard frogs (*R. pipiens*), green frogs (*R. clamitans*), bullfrogs (*R.catesbeiana*), American toads (*Bufo americanus*) or gray tree frogs (*Hyla versicolor*). The stress from the presence of predatory cues caused glyphosate with POEA to be twice as lethal to wood frogs. Relyea did not report, or did not study, this effect for glyphosate without POEA and states that the POEA surfactant is the likely cause for the high toxicity. The lack of comparison with glyphosate without POEA hampers the usefulness of the study in terms of facilitating conclusions about herbicides and potential synergistic effects from environmental stressors. It cannot be demonstrated that the effect noted by Relyea was due to the herbicide at all.

At the high application rate, concentrations of glyphosate with POEA surfactant exceeded lethal levels and mortality to amphibians could occur. The version of glyphosate without POEA (i.e. the aquatic-labeled formulations) did not exceed 0.1 of the lethal dose (SERA 2003 Glyphosate). Based on available data, this dose does not appear to pose a risk of adverse effects to amphibians.

Sufficient data are available on the toxicity of sulfometuron methyl to allow quantitative estimates of exposure and risk. Data is limited to that generated by studies on *Xenopus* (African clawed frogs), but other studies have indicated that *Xenopus* are a sensitive indicator for effects to amphibians (Mann and

Bidwell 2000, Perkins et al. 2000). Results from the "worst case scenario" for aquatic species indication that all estimated exposures were far below acute and chronic "no-observable-effect-concentration" (NOEC) values. Sulfometuron methyl has been reported to cause malformations in amphibians, but only at doses that far exceeded those estimated from the worst case scenario.

Triclopyr comes in two forms; triclopyr BEE and triclopyr TEA. Triclopyr BEE is much more toxic to aquatic organisms than is triclopyr TEA. Triclopyr cannot be broadcast sprayed, regardless of alternative, because of a standard added to the LRMP by the R6 2005 ROD. At typical application rates, neither version is likely to result in adverse effects to amphibians, using a sub-lethal effect for tadpole responsiveness as a threshold of concern. At the highest application rate analyzed, tadpole responsiveness could be reduced. However, the highest application rate analyzed exceeds that which is legally permitted on the herbicide label, so this rate could not be applied. Also, the concentrations of concern are not likely to occur from applications in the proposed action due to the restriction on broadcast spraying.

Triclopyr also has an environmental metabolite known as TCP (3,5,6-trichloro-2-pyridinol). TCP is about as acutely toxic to aquatic species as triclopyr BEE (SERA 2003 Triclopyr). Adverse effects to aquatic species (based on data from fish) from TCP are likely only if triclopyr is applied at the highest application rates. These rates are highly unlikely to be realized given the prohibition on broadcast spraying of triclopyr.

NPE-based surfactants are known to cause adverse effects, including estrogenic effects, to aquatic organisms. A quantitative risk assessment for NPE was conducted by Bakke (2003), which included risks to aquatic organisms. Estimated concentrations from the operational scenario analyzed (10 acres of broadcast spray immediately adjacent to water) produced exposures 15-30 times lower than the level of concern from all NPE related compounds. Bakke also analyzed a scenario in which a small pond or stagnant stream reach is oversprayed directly, with no foliar interception. In this case, levels of NPE related compounds could reach those that pose a risk of toxic effect.

In summary, adverse effects to amphibians are only likely from glyphosate with POEA and triclopyr applied at high rates, or NPE sprayed directly on stagnant water. As discussed, the high application rates of triclopyr and glyphosate will not be used and triclopyr cannot be broadcast sprayed at all, so concentrations in water that pose risks to amphibians are highly unlikely. The spotted frog PDF prohibits spraying of NPE-based surfactants within 100 feet of occupied or suitable spotted frog habitat, so an inadvertent overspray of standing water is not possible.

In addition, other PDFs required in all alternatives minimize the amount and type of herbicide to which spotted frogs could be exposed by restricting application methods and buffer distances. Minimum buffer widths for each alternative (Tables 15 and 16) are listed for each herbicide. These buffer widths restrict the use of herbicides along streams, ponds, and lakes and in wetlands. Glyphosate with POEA cannot be broadcast sprayed within 300 feet, or spot sprayed within 100 feet, of lake/wetland habitat in Alternative 2, and cannot be used at all within 300 feet of lake/wetland habitat in Alternative 3. Both of these options make it highly unlikely that this version of glyphosate would reach the water bodies and create concentrations of concern. It is not possible to differentiate potential effects between alternatives because adverse effects in either alternative are unlikely.

Triclopyr TEA cannot be used within 15 feet of water and triclopyr BEE cannot be used within 50 feet of water in Alternative 2. Triclopyr BEE cannot be used at all and triclopyr TEA cannot be spot-sprayed within 15 feet of water in Alternative 3. These restrictions also make it highly unlikely that concentrations of triclopyr in water would reach levels of concern. It is not possible to differentiate potential effects between alternatives because adverse effects in either alternative are unlikely.

Adult spotted frogs could also be dermally exposed to herbicides as they move through treated vegetation or soil, although this would be unlikely because spotted frogs are highly aquatic. There is insufficient data to quantify dose received from dermal exposure to contaminated vegetation or soil, but it is likely to be much less than if the frog was in contaminated water and could easily absorb the solution through its skin. Our assumption for analysis is that risk from exposure to contaminated water adequately encompasses risk from all types of herbicide exposure for amphibians.

Relation to Programmatic BA Project Design Criteria

The Programmatic BA (USDA Forest Service 2006) contains a project design criteria (equivalent to a PDF) that prohibits the use of herbicides in and adjacent to spotted frog habitat. The project design criteria for the Programmatic BA set implementation requirements that, if followed, would result in no impact, or no adverse impact, on the these species. The proposed action and alternatives discussed in this document do have the potential for adversely impacting spotted frogs, so communication with the U.S. Fish and Wildlife Service has been initiated and new project design features for invasive plant treatment projects have been developed. This process was anticipated to occur and is mentioned in the Letter of Concurrence received from the USFWS, dated August 24, 2006.

Summary of potential effects to spotted frogs

There is a low likelihood of disturbance to spotted frog eggs, larvae or adults during invasive plant treatments, although some disturbance could occur to adults moving overland. Some individuals Columbia spotted frogs could possibly be harmed during the prescribed burn, but the probability of this actually occurring is very low because the burn sites are not suitable spotted frog habitat. Due to the relatively low toxicity of most herbicides proposed, the low concentrations in water that would occur under normal operations (i.e. low exposures), and the Forest Plan standards and PDFs that restrict herbicide and NPE use in or near spotted frog habitat, adverse effects from herbicide exposure are unlikely. Treatment of reed canarygrass in spotted frog habitat would provide beneficial effects to frog breeding and habitat maintenance. Therefore, invasive plant treatments “may impact, but are not likely to lead to a trend toward federal listing” for Oregon and Columbia spotted frogs.

Crater Lake tightcoil snail

This snail likely occurs in project area units located within riparian or wetland habitat on the Sisters RD. Manual and herbicide treatments are proposed within suitable habitat (e.g. Metolius River ribbongrass control). These snails are among wetland vegetation and under rocks and woody debris. At least some individuals may be subject to trampling during treatment of ribbongrass or reed canarygrass infestations. They have not been specifically reported from this vegetation, but it is assumed they could use it. Trampling could occur for any treatment method under any alternative. The impact of trampling would be limited to a few individuals immediately on or in the vegetation to be removed. Other snails in the population would be under cover of rocks and woody debris, and in adjacent native riparian and wetland habitat, and would not be subject to trampling or disturbance from invasive plant treatments.

There is limited data on herbicide effects to terrestrial snails. Relyea (2005) found no effect to three species of aquatic snails from the glyphosate formulation Roundup. Data on terrestrial snails are limited to studies with glyphosate and picloram on the brown garden snail (*Helix aspersa*) (SERA 2003 Glyphosate, SERA 2003 Picloram). No studies showed adverse effects to the snails. It appears unlikely that herbicides are likely to pose serious toxic risk to terrestrial snails, but this conclusion of risk is made with the reservation that data is extremely limited.

Invasive plant treatments “may impact, but are not likely to lead to a trend toward federal listing” for the Crater Lake tightcoil because potential impacts are limited to a few individuals that may be on or in riparian or wetland invasive plants targeted for treatment.

Summary of Effect to Forest Service Sensitive Species

The determinations and reasons for them for Forest Service sensitive species are listed in Table 97.

Table 97. Summary of Effects to Forest Service Sensitive Species for both Action Alternatives. The determination for all species is "no impact" for the No Action alternative.

Species	Determination	Reason
Bald eagle	no impact	PDFs minimize potential for disturbance; herbicide effects highly unlikely
California wolverine	no impact	not present in treatment areas
Pacific fisher	no impact	not present in treatment areas
Pygmy rabbit	MINL*	may not be present in treatment area, PDFs minimize potential effects, treatments improve habitat
Greater sage grouse	MINL	PDFs minimize potential effects, invasive plant treatments important for habitat improvement
Horned and red-necked grebes	no impact	not likely present during treatment, herbicide effects or disturbance unlikely
Bufflehead	no impact	not likely present in treatment areas; herbicide effects or disturbance unlikely
Harlequin duck	MINL	may be present in only a few treatment areas, potential disturbance is short term and low magnitude, herbicide effect unlikely
Yellow rail	MINL	PDFs minimize potential for effects; herbicide effect unlikely
Upland sandpiper	no impact	not present in treatment areas
American peregrine falcon	no impact	PDFs eliminate disturbance or NPE exposure; no known nests in treatment areas
Gray flycatcher	no impact	prey unlikely to contaminated, not susceptible to disturbance from short-duration, low magnitude invasive plant treatments
Tricolored blackbird	no impact	not present in treatment areas
Oregon spotted frog	MINL	low likelihood of disturbance, adverse effects from herbicide unlikely, PDFs minimize potential for effects
Columbia spotted frog	MINL	low likelihood of disturbance, adverse effects from herbicide unlikely, PDFs minimize potential for effects
Crater Lake tightcoil	MINL	some individuals may be trampled, suitable habitat will be maintained, herbicide effects unlikely

*MINL = may impact, but not likely to lead to a trend toward federal listing.

Direct and Indirect Effects to Management Indicator Species

Effects to bald eagle, northern spotted owl, peregrine falcon, and wolverine were previously discussed. Effects to MIS from herbicide exposure were evaluated by placing the species into groups based on taxa type, body size, and diet. Exposure scenarios for various groupings were used to quantitatively estimate dose and characterize risk. Scenarios are discussed in detail in Appendix P of the R6 2005 FEIS and this information is incorporated by reference. The following scenarios were used for the following species:

- *Predatory bird consuming a contaminated small mammal*: golden eagle, northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tail hawk, great gray owl.

- *Predatory bird consuming contaminated fish*: osprey, great blue heron, waterfowl.
- *Bird consuming insects*: pileated woodpecker, primary cavity excavators
- *Herbivorous bird consuming contaminated vegetation*: waterfowl
- *Large mammal consuming contaminated vegetation*: deer and elk
- *Carnivore consuming contaminated small mammal*: American (pine) marten
- *Insectivorous mammal*: Townsend's big-eared bat

Effects to pileated woodpeckers, northern flicker, and primary cavity excavators are included below.

Pileated Woodpeckers, Primary Cavity Excavators

Species that forage and nest in trees are not likely to be exposed to herbicides because no trees will be treated and no aerial application, which could create drift over large trees, is proposed. Lewis' woodpecker and northern flicker are the only cavity excavators that may feed on the ground or low shrubs for a substantial portion of their diet. They may encounter contaminated insects. No herbicides except triclopyr (which cannot be broadcast sprayed) are a concern at typical application rates. NPE may exceed toxicity index at typical and highest application rates given the worst case scenario of feeding exclusively on contaminated insects. Given the varied diet and movement of these birds, they are unlikely to forage exclusively within one patch of treated invasive plants and actual doses exceeding levels of concern are unlikely. None of these species are susceptible to the low magnitude, extent, and duration of disturbance caused by treating patches of invasive plants, which occur mostly along roadsides. Invasive plant treatments will not cause adverse effects to these species. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to MIS Raptors

Effects from herbicide exposure are the same as those previously discussed for the northern spotted owl. The estimated dose from an NPE-based surfactant applied at the highest rate did exceed the NOAEL. Project design feature number 12 limits use of NPE-based surfactants to the typical application rate, so exposures exceeding the NOAEL will not occur. Also, the probability is very low that any raptors would consume a prey item directly sprayed with NPE and no herbicide posed a risk of adverse effects to predatory birds. Only sites treated with heavy equipment or other mechanical methods are likely to cause enough noise to disturb these nesting raptors, and mechanical treatments are proposed only for 23 project area units. Of these sites, 21 propose use of string trimmers and 2 propose use of a disc. Eighteen of the sites are located along roads or recreational areas where existing ambient disturbance occurs regularly. For treatment sites where noise from the treatments would exceed ambient levels of disturbance, effects from disturbance would be avoided by adhering to the PDF for nesting raptors and herons that lists seasonal restrictions for nesting raptors. Invasive plant treatments will not cause adverse effects to these species. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to Great Gray Owl

No herbicides or NPE-based surfactants applied at typical application rates pose a risk to predatory birds consuming small mammals that may have been directly sprayed. At the highest application rates, only NPE-based surfactants exceeded a level of concern. A PDF for all alternatives restricts NPE to application rates of 0.5 a.i/acre (less than the "typical rate" analyzed) or less, so doses of concern will not occur. For treatment sites where noise from the treatments would exceed ambient levels of disturbance, effects from disturbance would be avoided by adhering to the PDF that lists seasonal restrictions for nesting raptors. In addition, great gray owl is a Survey and Manage species for which pre-disturbance surveys are required. Conducting the pre-disturbance surveys to document presence and the PDF which restricts seasons for disturbance causing activities will eliminate potential effects from disturbance. Invasive plant treatments will not cause adverse effects to this species. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to Osprey and Great Blue Heron

Effects from herbicide exposure are the same as those previously discussed for the bald eagle. Potential for disturbance is the same as discussed for MIS raptors. Effects from disturbance would be avoided by adhering to the PDF that lists seasonal restrictions for nesting raptors and the great blue heron. Invasive plant treatments will not cause adverse effects to these species. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to MIS Waterfowl

For acute exposures, no herbicide resulted in a dose that exceeded a level of concern for birds consuming contaminated vegetation. NPE exceeded the level of concern only at the highest application rate, but a PDF restricts the use of NPE to 0.5 lb a.i./acre (less than the ‘typical rate analyzed), so exposures of concern will not occur. For chronic exposures, glyphosate, sethoxydim, and sulfometuron methyl exceed the level of concern, but only at the highest application rates. Waterfowl would have to feed exclusively on treated vegetation for 90 days to receive the chronic dose of concern. Given foraging movements of the birds and the nature of invasive plant treatments proposed (small patches scattered over larger areas), this scenario is highly unlikely. The R6 Invasive Plant BA (USFS 2005d) demonstrated that chronic exposure in water are not possible with the types of applications proposed. Waterfowl are highly unlikely to receive a dose of triclopyr that would exceed a level of concern due to restrictions on use of triclopyr. High application rates of glyphosate are not sprayed because it reduces effectiveness and wastes money. Tables 16 and 17 list the buffers for all herbicides. Sethoxydim cannot be broadcast sprayed within 100 feet of water in Alternative 2 and not at all in Alternative 3. Sulfometuron methyl cannot be broadcast sprayed within 50 feet of water in Alternative 2 and not at all in Alternative 3. These buffers and restrictions make it highly unlikely that waterfowl could feed exclusively on treated vegetation over a 90 day period, which is what would have to occur in order to receive the chronic dose of concern. In addition, these waterfowl species do not feed extensively, if at all, on invasive plants, so the likelihood of any exposure is very low.

Disturbance to nesting waterfowl could occur for treatments with any method, but will be short term, low intensity, and limited in extent (usually less than one acre). No adverse effects from this low level of disturbance will occur.

Invasive plant treatments will not cause adverse effects to MIS waterfowl. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to Deer and Elk

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. No broadcast spraying is proposed over large areas in which deer or elk would forage. Spot spraying and roadside boom spraying of invasive plants are not likely to expose deer or elk to harmful levels of herbicide or NPE because they are unlikely to forage exclusively on treated invasive plants, which are not their preferred forage. Also, the patchy nature of the applications makes it unlikely that the deer or elk would forage exclusively on the scattered treated patches.

Invasive plant treatments can create some disturbance, but the level of disturbance would be short term, low intensity, and limited extent. The level of disturbance will not create negative effects for these very mobile and wide-ranging species. Invasive plant treatments will have no negative effect on deer or elk. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Treatment of invasive plants in meadows and along roadsides in meadow habitat could beneficially affect deer and elk by preserving native forage species and maintaining the long-term suitability of the habitat. Invasive plants can reduce the ability of an area to support deer and elk (Rice et al. 1997).

Effects to American Marten

No herbicide or NPE exceeded a level of concern for carnivores eating contaminated small mammals. Invasive plant infestations are unlikely to occur in marten habitat except along disturbed roadsides, so disturbance to martens from treatment is not likely to occur. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to Townsend's Big-eared Bat

Currently known sites are not near invasive plant treatment areas and are in mining shacks, caves, or rock crevices in canyon rims. This bat may 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.

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. It is highly unlikely that bats would be exposed chronically to contaminated insects 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.

Invasive plant treatments will not cause adverse effects to Townsend's big-eared bat. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Effects to Birds of Conservation Concern

The short-term (one day or less), low magnitude, and limited extent (usually 1 acre or less scattered over larger areas) of disturbance that will occur with invasive plant treatments will not cause negative effects to populations of birds in this category. In addition, several of the raptors in this category are further protected from disturbance by the PDF for nesting raptors and great blue heron.

Effects to golden eagle, peregrine falcon, sage grouse, yellow rail, Lewis's woodpecker, Williamson's sapsucker, white-headed woodpecker, tricolored blackbird, and pygmy nuthatch have been discussed previously. Similar to the discussion for MIS, risk of herbicide exposure to these species was evaluated by placing them into groups based on diet.

Predatory bird consuming small mammal: Swainson's hawk, flammulated owl, burrowing owl, and prairie falcon. Risks are the same as those discussed for MIS raptors.

Insectivorous bird: American avocet, solitary sandpiper, long-billed curlew, marbled godwit, Wilson's phalarope, and loggerhead shrike. Risks are the same as those previously discussed for the gray flycatcher and upland sandpiper.

Brewer's Sparrow and Sage Sparrow

There is no quantitative exposure scenario for birds that eat primarily seeds, but the scenario for birds that eat contaminated vegetation can be used as a reasonable surrogate. Herbicide residue rates on grass are high compared to other vegetation and the caloric content of grass is low compared to seeds (Kenaga 1973; EPA 1993, p. 3-5). This means that birds would ingest more vegetation and receive a higher dose of herbicide than expected for seed eaters. Therefore, the risks to sparrows from herbicide exposure are the same as those discussed previously for MIS waterfowl.

Invasive plant treatments will have no negative effect on Birds of Conservation Concern. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives. Control of invasive plants will protect and improve important habitat for many of the birds included in this category.

Effects to Landbirds or their Habitat

The Forest Service has prepared a Landbird Strategic Plan (January 2000) to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations to achieve biological objectives. The conservation strategies that cover the project area all mention the adverse impacts of exotic plants to landbird habitat. Therefore, invasive plant treatments are consistent with management direction provided in the conservation strategies.

Some of the conservation strategies for priority habitats and focal species mention pesticides, including herbicides. One concern listed is the effect of insecticides on insect prey base. Insecticide use is not part of this action and is not likely to occur within invasive plant treatment areas. The herbicides in this proposal are not toxic to insects, although data is limited (USFS 2005d, SERA 2001, 2003, 2004). However, herbicides target physiological systems found primarily or exclusively in plants and have a low potential for effects to insects.

For herbicide use or noxious weeds, conservation strategies recommend that herbicides be applied by hand if practical. Most herbicide applications considered will be done by hand (selective methods, back pack, or hose and wand attached to a vehicle-mounted tank). No aerial application is proposed. Some broadcast applications will be applied under Alternative 2, but those would be roadside patches and other patches in relatively flat terrain. There would be less spraying in riparian habitat in Alternative 3, but treatments in both alternatives avoid native vegetation and any difference in effect between the two alternatives is so small it cannot be meaningfully measured. The use of herbicides to target invasive plants will not reduce cover needed by focal species because the invasive plants are not extensively used by native birds. One exception may be Himalayan blackberry.

The conservation strategy for riparian habitat states that herbicide use should be limited to invasive non-native species (e.g. reed canarygrass) to enhance habitat. This is consistent with the herbicide uses proposed in the alternatives.

Recommendations for yellow warbler and yellow-breasted chat include elimination of willow cutting and herbicide spraying in riparian zones, and Taylor and Littlefield (1986) is cited for this recommendation. However, Taylor and Littlefield (1986) discuss the purposeful treatment of native willows to increase cattle forage. The proposed invasive plant treatments in both action alternatives contain buffers that restrict spraying of herbicides in riparian zones, and willows are not the target of invasive plant treatments, so no habitat for these species will be removed or degraded.

In conclusion, none of the proposed invasive plant treatments will negatively affect the habitat features provided by native vegetation and may serve to improve the quality of these habitat features for the focal species identified; none of the herbicides proposed for use will substantially affect any insect prey populations; and none of the herbicides or surfactants proposed for use pose a toxic risk to focal species of birds. The treatment of invasive plants is consistent with management recommendation contained in the various conservation strategies that cover the project area.

Invasive plant treatments will not have negative effects on focal species or priority habitats included in the Landbird Strategy. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives.

Colony Collapse Disorder

Herbicides have a low likelihood of being implicated in CCD. Other pesticides, like miticides, may contribute to conditions that favor CCD. None of the herbicides included in the proposed action or alternatives exceeded toxicity values for honey bees at typical application rates. At highest application rates, only glyphosate caused any mortality, and this necessitated a direct spray at the highest rate. Herbicides are not typically used directly on the agricultural crops that honey bees pollinate because they would have a high likelihood of adversely affecting the agricultural crop (unlike on grass crops where selective herbicides are used on the crop directly). Herbicides are used near these crops to control weed however.

Herbicides used in the proposed action or alternatives have a very low probability to cause any affect to honey bees or contribute to CCD because: 1) treatments on the forest are often in remote locations far from commercial bee hives; 2) treatments in the vicinity of bee hives would only entail treatment of patches of invasive plants and not a widespread application likely to expose honey bees; 3) these herbicides have a low toxicity to honey bees; 4) affects to bees from these herbicides only occurred for one herbicide at the highest application rate, which is not applied in a spray application (in practice, highest application rates of glyphosate are used in wicking, wiping, or injection applications which are unlikely to expose bees).

Currently, the pathogen Israeli acute paralysis virus and the parasite *Nosema ceranae* are the leading candidates for cause of CCD.

In conclusion, neither the proposed action nor any alternatives are likely to have adverse effects on honey bees or contribute to the potential cause(s) of CCD.

Cumulative Effects

The overall impact of this project is beneficial to wildlife. Negative impacts to wildlife, including species of local interest, are far more likely with invasive plants that with the treatments proposed.

The basis for cumulative effects is discussed in section 3.1.3. Current and proposed invasive plant treatments are generally very small (less than 1 acre and often less than 0.1 acre) with patches widely scattered across the landscape. The current infestations amount to approximately 0.5% of the National Forest System lands in Central Oregon. The planning area for this EIS is nearly 3 million acres in Central Oregon, while treatments are limited to no more than 16,000 acres per year total, no more that 1.0 acre per year in the stream channel per 6th field watershed, and no more that 10 acres of riparian area treatments for every 1.5 miles of stream. These caps, along with realistic budget constraints, further limit the size of treatments in any one location in sensitive wildlife habitats.

Infestations, and therefore treatments, are primarily along roadsides and other disturbed sites, which do not provide quality habitat for most wildlife. While some infestations do occur in important wildlife habitat like early seral stage vegetation or wetlands, PDC and buffers minimize the potential for adverse exposure so much that there is virtually no potential for exposures to accumulate and cause harm to any habitat or species.

The herbicides proposed for use would have no potential to bioaccumulate in any individual animal, and the potential for acute exposure is very small. The potential for an animal to be exposed to herbicide is limited to the area immediately adjacent to the application site (15 – 150 feet) and a short window of time (24 hours or less). Mobility, persistence, and toxicity are all managed through PDC.

A discussion of cumulative effects to specific species or species groups follows.

Northern Spotted Owl

Northern spotted owls are also exposed to disturbance from vehicle traffic, recreation, timber harvest activities, development, and other potential sources of disturbance and habitat loss.

It is unlikely that there would be negative cumulative effects to northern spotted owls from the No Action or action alternatives when added to past, present or reasonably foreseeable actions because invasive plant treatments create only discountable or no effects from disturbance or herbicide exposure and do not remove or degrade spotted owl habitat. Invasive plant treatments involve sites that are small patches, occur primarily along roads, create noise that is primarily within ambient noise levels, that would be treated in a matter of minutes, and likely repeated only once or twice, if at all, during the treatment season. The probability of an effect from the No Action or action alternatives is so low that it could not be added to other activities in a meaningful way. Therefore, the no alternatives will create any cumulative effects to northern spotted owls.

Bald Eagle

Similar to spotted owls, bald eagles are also exposed to disturbance from vehicle traffic, recreation, timber harvest activities, development, and other potential sources of disturbance and habitat loss.

It is unlikely that there would be negative cumulative effects to bald eagles from the proposed action when added to past, present or reasonably foreseeable actions because the No Action or action alternatives create no effects from disturbance or herbicide exposure and do not remove or degrade bald eagle habitat. Invasive plant treatments involve sites that are small patches, occur primarily along roads, create noise that is primarily within ambient noise levels, that would be treated in a matter of minutes, and likely repeated only once or twice, if at all, during the treatment season. The probability of an effect from the No Action or action alternatives is so low that it could not be added to other activities in a meaningful way. Therefore, the No Action and action alternatives will not create any cumulative effects to bald eagles.

Forest Service Sensitive Species

There will be no cumulative effects to the following sensitive species because the proposed invasive plant treatments, including alternatives, do not create any effects that would cumulate with current effects: California wolverine, Pacific fisher, horned and red-necked grebes, bufflehead, upland sandpiper, American peregrine falcon, gray flycatcher, and tricolored blackbird.

Invasive plant treatments involve relatively small, well-defined spatial areas. Most treatments are confined to patches infested with invasive plants while leaving interspersed native vegetation intact. Native wildlife habitat is not removed, modified, or degraded, nor are any hydrologic regimes affected. Treatments occur one to three times during a season, generally from late spring to mid-fall. Treatments are low intensity and of small magnitude and generally short duration (one day or less). Given the spatial and temporal scale of invasive plant treatments, potential for cumulative effects is low.

Cumulative effects to pygmy rabbits are unlikely because there are no known populations within the project area and most potential population sites are protected by exclosures. There is a very low potential for disturbance from invasive plant treatments to add to disturbance caused by grazing or other land management activities. But, the disturbance level from invasive plant treatments is very low and unlikely to add significantly to current disturbance levels. There is no potential for cumulative effects from herbicide exposure because pygmy rabbits on National Forest system land would not be exposed to additional herbicide use other than invasive plant treatments, and the herbicides proposed for use do not bioaccumulate or biomagnify. There are no significant cumulative effects to pygmy rabbits.

For sage grouse, there is limited potential for disturbance from invasive plant treatments to add to disturbance from other land management activities. The potential for disturbance is greatly limited by the PDF for sage grouse. As such, there will be no significant cumulative effect from disturbance. Cumulative exposure of sage grouse to herbicides could only occur for birds that move between National Forest System lands and other ownerships (invasive plant treatments are the only herbicide use proposed within the project area). Because the herbicides proposed for use in this project are rapidly excreted, do not bioaccumulate or biomagnify, and pose low risk to the grouse, even if exposures occurred from multiple ownerships, they are unlikely to result in any cumulative toxic effect to the sage grouse. There are no significant cumulative effects to sage grouse.

Harlequin ducks and yellow rails could be disturbed by recreational activity as well as other activities occurring in riparian areas. Invasive plant treatments could add to the disturbance, but are such low magnitude, short duration, and low intensity that no significant cumulative effect is likely to occur. In addition, the PDF for yellow rails also limits the amount of disturbance that could occur from invasive plant treatments. Cumulative exposure of harlequin ducks and yellow rails to herbicides could only occur for birds that move between National Forest System lands and other ownerships. Because the herbicides proposed for use in this project are rapidly excreted, do not bioaccumulate or biomagnify, and pose low risk to the birds, even if exposures occurred from multiple ownerships, they are unlikely to result in any cumulative toxic effect to these birds. There are no significant cumulative effects to harlequin ducks or yellow rails.

Oregon and Columbia spotted frogs might be disturbed or harmed if they were within or traveling through invasive plants targeted for treatment. Likelihood of this occurring is low because they are very aquatic and not likely to be within patches of upland invasive plants. Other activities, such as grazing, road maintenance, or recreation could also create some disturbance. Invasive plant treatments could add to the disturbance, but are such low magnitude, short duration, and low intensity that no significant cumulative effect is likely to occur. Herbicides proposed for use have a low likelihood of causing effects to spotted frogs due to their low toxicity and PDFs limiting exposure. Spotted frogs that may be exposed to very low levels of herbicide within the project area are not likely to be exposed to herbicide use from some other source because the frogs are somewhat limited in their movements. Because the herbicides proposed for use in this project are rapidly excreted (even by aquatic organisms), do not bioaccumulate or biomagnify, and pose low risk to spotted frogs, significant cumulative effects from herbicide exposure are unlikely. Spotted frogs are at risk from exposure to more toxic compounds like insecticides, but these compounds are not proposed for use on the National Forest System lands where invasive plant treatments would occur. There are no significant cumulative effects to Oregon or Columbia spotted frogs.

Some individuals of Crater Lake tightcoil snail could be trampled during invasive plant treatments. Trampling could also occur from recreational use or similar activities in riparian areas. The magnitude and extent of trampling from invasive plant treatments is very low and restricted to a few individuals present within or immediately adjacent to invasive plant species. In addition, because Crater Lake tightcoil is a Survey and Manage Species, pre-disturbance surveys are required. As such, trampling from invasive plant treatments are unlikely to add significantly to trampling or disturbance from other activities. There is currently no evidence that the herbicides proposed for use will have adverse effects on terrestrial snails, so there are no herbicide effects to add to other past, present, or future effects. There are no significant cumulative effects to Crater Lake tightcoil snail.

MIS

None of the MIS are significantly affected by invasive plant treatments. Even effects to individuals have a very low probability of occurring. In many cases, there will be no effect at all to MIS. Therefore, the effects from invasive plant treatments will not add to past, present, or future effects to create significant cumulative effects.

Landbirds and Birds of Conservation Concern

Landbirds and Birds of Conservation Concern are negatively impacted primarily by habitat loss and fragmentation. Invasive plant treatments do not alter native habitat. Some birds can be harmed by insecticide applications, but the current and proposed herbicides have very low toxicities and are not expected to add to or accumulate with other herbicide exposures because they are not retained or stored in the body. None of the birds or their habitats are significantly affected by invasive plant treatments. Even effects to individuals have a very low probability of occurring. In many cases, there will be no effect at all to the birds or their native habitats. Therefore, the effects from invasive plant treatments will not add to past, present, or future effects to create significant cumulative effects.

Colony Collapse Disorder

There is no evidence to suggest that herbicide applications contribute to CCD, honeybees have a low likelihood of being exposed to herbicides from the No Action or action alternatives, and the toxicities of the herbicides used, or proposed for use, are very low for honeybees. Due to a lack of significant effect to individual honeybees, or honeybee hives, there are no cumulative effects relative to CCD.

3.10 Economic Analysis

3.10.1 Introduction

Concerns about project cost, financial efficiency, and jobs were expressed during scoping. The Forest Service in Oregon and Washington is spending about 4.8 million dollars annually to treat approximately 25,000 acres of invasive plants in the Pacific Northwest Region. From 2003 to 2005 the Deschutes and Ochoco National Forests and Crooked River National Grassland have had an average annual combined budget for invasive plant management of about $224,500 (Cheney, pers. comm. 2006). 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.

Costs used in the analysis were the best available information at the time the analysis was conducted. Refer to the R6 Invasive Plant Program FEIS for more information on unit costs (page 4-94).

Economic Impact of Invasive Plants

Invasive plants (noxious weeds) have an enormous impact on Oregon's economy and natural resources. In 1999, Oregon Department of Agriculture (ODA) partnered with Oregon State University (OSU) to study the economic impacts of 21 of the 99 invasive plants listed in Oregon as noxious. Existing populations of these 21 species presently reduce Oregon's total personal income by about 83 million dollars, the equivalent of 3,329 jobs lost to Oregon's economy from the production foregone by the presence of these invasive plants. The continued expansion of these species could further reduce Oregon's personal income by another 54 million dollars. The value of Oregon's resources is reduced by approximately one billion dollars because of these weeds (The Research Group 2000). Of the 21 invasive plants highlighted for economic evaluation by ODA and OSU, several are present in the Forests and Grassland and are targets of this proposal: yellow starthistle, spotted knapweed, diffuse knapweed, Russian knapweed, leafy spurge, Scotch thistle, orange hawkweed, tansy ragwort, Scotch broom, gorse, purple loosestrife, and whitetop.

A recent Oregon State University publication describes the importance of integrating economics into decisions about invasive species prevention, eradication, and control (Oregon State University 2009). The report calls for a wider role for economics that includes "measures of the impact of invasive species on total economic value ad the consequences of the loss or impair of ecosystem services for the economic well-being of Oregon." It also states that prevention and early detection are the most cost-effective methods of controlling and preventing invasive species.

3.10.2 Treatment and Project Costs

Non-herbicide methods can be more costly than herbicide applications (USFS 2005a, p. 4-94), and treatment costs are a factor in the amount of acreage that can be completed. Most of the cost associated with invasive plant treatment is in labor. Hand pulling and hand application of herbicides have the highest labor costs. It is the combination of different methods, however, that is often most effective. The availability of volunteer labor could offset the costs associated with manual treatment as long as the commitment and availability of volunteers matched the treatment requirements. Cultural and biological methods are not included in this assessment because they account for such a small portion of the treatments proposed.[19]

[19] Biological control is about $70 per acre and cultural methods average around $50 per acre according to the R6 Invasive Plant FEIS, page 4-94.

Table 98. Cost of Treatment by Method

Method	Cost Per Acre	Wage cost as Percent of Total
Manual	$340	100
Herbicide - Broadcast	$100	24
Herbicide - Spot, hand	$250	85
Mechanical	$100	40
Active Restoration	$500	50

Variables that affect the actual cost of treating an invasive plant site include such things as whether or not return visits are required and for how long, the amount of acres that requires re-treating, whether the objective is to control/eradicate or to contain (containment objective will likely have fewer net acres treated)[20], and the reduced amount of herbicides used in subsequent treatments. When figuring project costs, it was assumed that:

- All acres are previously untreated.
- Where the treatment involves herbicides, the herbicides application will occur in the first year and will be 100% herbicide, even though prescriptions may include some manual or mechanical treatment during or before herbicide application.
- Broadcast will be the application method on roads and spot or hand application will be the method employed everywhere else that broadcast is allowed.
- Non-herbicide treatments that are combined with herbicide treatments are assumed to start occurring in the second year of treatment (as populations become more manageable, more of the treatment becomes manual).
- Acres are of the mapped invasive plant sites in GIS (and therefore larger than actual infested acres varying by the density of the infestation).

Based on Table 5, Page 29, about 95% of the first year's treatment would be herbicide application, and 5% manual. Sites that are classified as a road site type were used to estimate the proportion of broadcast treatment vs. spot or hand application (although roadsides sites are not necessarily treated by broadcast spraying).

Table 99. Estimated Cost of Treating all Acres in First Year.

	Proposed Action	Alternative 3
Cost for First Year's Treatments (all acres)	manual - $240,040 herb (spot/hand) - $968,750 herb (broadcast) - $996,500 ------------------------------------ $2,205,290	manual - $255,340 herb (spot/hand) - $1,472,750 herb (broadcast) - $790,400 ------------------------------------ $2,518,490

The difference in cost for the action alternatives is small and is based on the area within 10 feet of water switching from hand application of herbicide to manual pulling as well as the areas within 300 feet of water switching from broadcast application of herbicides to hand/spot application. Alternative 3 also restricts certain herbicides within 300 feet of streams, which could also affect cost, particularly if no effective herbicide were allowed and the treatment became manual. The cost of Alternative 2 would be less than Alternative 3. The costs associated with Alternative 1 would be based on the remaining work to be done on the sites approved for treatment in earlier NEPA documents. Because

[20] For example, medusahead sites on the Grassland are very large, but the containment strategy involves treating the perimeter and along roadways.

herbicide use on these sites has declined as treatment has been effective, costs will become more associated with manual work (see, for example, Table 23).

Costs of active restoration will vary by site. It is estimated that active restoration will cost on average $500 per acre. Of the known sites, 9 are currently expected to require active restoration (Appendix A, Table A-3). If the currently infested acres of these project area units were actively restored, the cost could reach $131,000. Additional active restoration may be deemed necessary, based on post-treatment monitoring.

Table 100. Pattern of herbicide to non-herbicide over time alternatives 2 and 3, if all 1,892 sites were treated beginning in 2007. Based on analysis done by the Olympic National Forest (USFS 2006).

Year	Percent Herbicide Use	Percent Non-Herbicide Use
2007	95%	4%
2008	75%	25%
2009	50%	50%
2010	0%	100%

For the Proposed Action, assuming a constant budget of $250,000 per year[21], about 10% of the infested sites could be effectively treated in the first year. As prioritization takes place across the Forests and Grassland to make the best use of the budget, high priority sites would be most likely to be effectively treated, but other infestations would continue to spread until they could be effectively treated. Cost of treating existing infestations would continue to increase.

Early Detection / Rapid Response

The intent of the EDRR strategy is to treat new invasive plant sites while they are small and more easily controlled. Smaller populations can be treated manually (depending on the species), so the costs associated with EDRR may be more related to the labor involved in inventory, processing, and implementing manual treatments. If new invasive plant populations are detected, the costs for treatment would generally be the same as for the inventoried sites. However, because early detection means that new sites can be treated while small, the quick treatment of newly discovered could mean less are treated and fewer return visits.

The EDRR strategy described in Appendix F, coupled with the ongoing prevention strategies employed by the Forests and Grassland (Appendix G) could yield cost-benefit ratio of as much as 34:1 (ODA 2000).

Cumulative Effects

There are costs associated with implementing the prevention standards of the 2005 Record of Decision (USFS 2005a, pp 4-98 to 4-103). Local prevention guidelines will also have some cost associated with them. Use of funds for these purposes and for invasive plant treatment can impact the amount of money available to other programs.

With the implementation of prevention standards and guidelines, invasive plant spread is anticipated to slow (USFS 2005b, p. 9). The cost, therefore, incurred with detecting and responding to new invasive plant sites is expected to go down over time. Implementing effective treatments on existing invasive plant sites will also reduce the sources of spread and therefore the cost associated with treating new sites.

[21] The figure of $250,000 was used as an annual budget, which is based on a slight increase over the average received by the Forests and Grassland for invasive plant treatments for years 2003, 2004, and 2005.

3.10.3 Jobs Associated with Invasive Plant Treatment

Some members of the public felt 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 an invasive plant program with a greater proportion of this treatment method compared to other methods would require more manpower and therefore more money.

The R6 FEIS compared alternatives that involved more or less manual treatments and found that the larger the percentage of treatments done by manual methods, the fewer acres that could be treated for a given amount of money (USFS 2005a, p. 4-97). The Regional Forester's selected alternative for invasive plant management in the Region provided a balance between cost-effectiveness and risk of adverse effects (USFS 2005b, p. 9).

The Forests have been employing Youth Conservation Corps (YCC), youth-at-risk programs (e.g. COSTEP), and county corrections crews for manual work on invasive plants. Additional work that would be beyond the capacity of these resources would result in short-term employment opportunities. Also, assuming full funding, the most ambitious treatment scenarios in either alternative would result in short-term employment opportunities (for all treatment methods). Employment opportunities would diminish over time as the invasive plants are eradicated, controlled, contained, or suppressed and treated sites are restored.

It is estimated that a hand crew of 10 people can complete work on one acre in one day on a heavily infested knapweed site (USFS 1998a).

Wages are estimated as 80 percent of labor cost (assuming the other 20 percent applies to taxes and benefits). Wages are assumed to average $160 per worker day; actual wages range widely for machine operators, herbicide applicators, and hand laborers (USFS 2006c).

Table 101. Assumptions for Worker Days per Treatment Area.

Treatment Method	Total Cost per Acre	Wage Cost as % of Total	Worker Day per Treatment Acre
Herbicide-Broadcast	100	24	.23
Herbicide-Spot/Hand	250	85	1.6
Mechanical	100	40	.3
Manual	340	100	3
Restoration	500	50	1.18

Table 102. Number of Jobs for First Year of Most Ambitious Treatment Scenario (all acres treated in first year).

Alternative	Total Acres	Total Worker Days	Number of Jobs Assuming 6 Month Season
No Action	1,595*	3,858	32
Alt. 2	14,546	10,610	88
Alt. 3	14,546	13,497	112

*Average annual treatment under current NEPA, from Table 3, page 25.

Future years' job numbers would decline rapidly after the first year of the most ambitious scenario, because less treatment would be needed in following years. However, restoration work would remain.

Jobs associated with restoration in these subsequent years amount to about 6 additional jobs per 6-month year.

Alternative 3 would involve more labor because of a heavier reliance on manual treatment and/or hand application of herbicide near water, which are more labor-intensive methods, but the difference would be slight considering the entire project area.

Cumulative Effects

This job level is not significant to the economy of the counties surrounding the Deschutes or Ochoco National Forest, although the most ambitious treatment scenario may require the help of workers from outside the local area.

Government officials estimate that invasive plant control occurs on over 1,250,000 acres in Oregon and Washington, and more than 90 percent of this control is through the use of herbicides (based on informal discussions with state and county agriculture and weed personnel). These data suggest that the broader regional treatment program resembles the Proposed Action. If this is true, then invasive plant control in the region creates roughly 8,038 jobs annually (applying the average of one $20,000 job equivalent for every 138.3 acres treated). (USFS 2005a).

3.11 Rangeland Resources

3.11.1 Affected Environment

Introduction

The Crooked River National Grassland and the Deschutes and Ochoco National Forests (Forests) combined administer 109 grazing allotments, of which 73 are active, 23 are vacant, and 13 are closed to permitted livestock grazing. There are currently invasive plant populations mapped on 78 of these allotments including on 16 of the vacant allotments, and on 7 of the closed allotments. These invasive plant populations range in size from less than 1 acre to more tan 2,000 acres. Tables 118, 119, and 120 shown below list invasive plant species and acres by allotment and administrative unit.

The Crooked River National Grassland administers 25 grazing allotments, of which 19 are active, 1 is vacant, and 5 allotments are closed to permitted livestock grazing. There are currently weed populations mapped on 17 of these, 2 of which are closed allotments with the remainder being active. The Deschutes National Forest administers 34 grazing allotments, of which 7 are active, 20 are vacant, and 7 are closed to permitted livestock grazing. There are currently weed populations mapped on 28 allotments, including 16 vacant allotments, and 6 closed allotments. The Ochoco National Forest administers 50 grazing allotments, of which 47 are active, 2 are vacant, and one is closed to permitted livestock grazing. There are currently weed populations mapped on 36 allotments, including 2 vacant allotments, and 1 closed allotment.

Invasive species are not present on all allotments, nor are they present on only active allotments. On the Deschutes National Forest in particular, many allotments have been vacant for several decades or more and yet invasive species are present on many of these. Invasive species are not confined uniquely to grazing allotments, as these plants are commonly present where no allotments exist. This is especially evident when considering the Deschutes National Forest where invasive plants are common on the Bend, Crescent, and Sisters Ranger Districts where grazing is not occurring.

Historical grazing either by domestic or wild grazing animals likely occurred over much of the project area, but recent livestock grazing activities are much more defined and concentrated on managed allotments. There is likely a connection between unmanaged, historic livestock grazing to the increase of some invasive plants. However, in more recent times there is still a connection and problems associated with spread of invasive plants into well managed allotments as well as allotments that have been vacant for decades. For example, on the Sisters Ranger District, spotted knapweed appears to be able to spread into disturbed sites along roads and commonly infests native upland Ponderosa pine/ Antelope bitterbrush/Idaho fescue plant communities that are not subject to any grazing.

Invasive Plant Species of Concern within Grazing Allotments

Healthy plant communities appear to be fairly resistant to most of the current invasive species that are present on the project area. There are exceptions to the susceptibility of native plant communities to invasive plant infestations; however, it is generally recognized that more arid ecosystems tend to be more fragile and less resilient to invasion compared to more moist environments. Parks et al. 2005 reported that in drier climates, such as that of the Middle Rocky Mountain Ecoregion and the eastern portion of the Cascade Sierra Steppe ecoregions are at greater risk to invasive than more mesic western portions of the Cascade Ecoregion. And in Oregon, xeric grasslands comprised mostly of perennial bunchgrass communities, upland shrub communities, and riparian areas are susceptible to the most non-native plant species, while subalpine meadows and moist spruce forests are susceptible to the fewest invasive plant species (Parks et al. 2005). An Exception to this general rule is the xeric salt desert shrub communities of the eastern portion of the Cascade and Great Basin Ecoregions that show less susceptibility to invasive plant invasion.

Annual invasive plants such as Medusahead *(Taeniatherum caput-medusae)* and cheatgrass *(Bromus tectorum)* are very aggressive and are more common in drier shrubland communities as compared to forested communities on the project area. These two plant species readily occupy areas of soil disturbance, particularly on drier sites, and have been know to invade native plant communities. Where these species become dominant, the wildfire cycle or return interval is usually shortened and adjacent native plant communities are very susceptible to further invasion. In these situations the remaining native vegetation may cross an ecological "threshold" and become purely dominated by the aggressive annuals. Once these species cross the "threshold" and dominate these types of arid environments it is difficult to control and tends to dominate the site for decades or longer, or until extensive efforts are made to treat and reestablish desirable vegetation on the site. Once native species are lost and non-native invasive species occupy a site, the process of recovery can entail eradication of the invasive species or reducing their presence, reestablishing native or desirable non-native species with appropriate follow-up livestock management to ensure long term success. Depending on the size of the site, the process of recovery can be cost prohibitive and can require a large commitment of resources. Because control costs are often cost prohibitive to obtain the desired level of control over large acreages, it is rarely treated on a large scale except in agricultural situations or unless special resources are threatened such as T&E plant and animal habitats. However, treating small infestations using EDRR tactics is an effective strategy to prevent small, isolated cheatgrass infestations from increasing in size and threatening areas of native rangeland or where re-seeding restoration efforts may be planned.

Ventenata (*Ventenata dubia)* is a relatively new invasive annual plant that also occupies the Central Oregon area and shares many common traits with cheatgrass. This species may be as invasive as cheatgrass and Medusahead. Some managers who have worked with this species suggest that it may out-compete cheatgrass. Early detection and rapid response for small, threatening infestations will be the most desirable management action for this plant.

In addition, certain invasive plants are known to be toxic to various classes of permitted livestock. Canada thistle has the potential to concentrate nitrates and cause nitrate poisoning in ruminants. Field bindweed contains tropane alkaloids and may also accumulate toxic levels of nitrate. It is most likely to cause poisoning in animals when it becomes the only predominant plant available for livestock to consume. Russian knapweed and yellow starthistle both produce a unique poisoning of horses that is generally fatal. Black henbane is a member of the nightshade family (Solanaceae) and has the potential to cause poisoning, but because it is unpalatable, it is rarely eaten. Poison hemlock is toxic to a wide variety of animals including man, birds, wildlife, cattle, sheep, goats, and horses. The poison can be transmitted through the milk of animals that have eaten poison hemlock. Leafy spurge can cause excessive salivation and diarrhea in cattle, however it does not appear to affect sheep and goats (Knight & Walter 2001).

Table 103. Grazing Allotments with Known Invasive Plant Populations on the Crooked River National Grassland.

Allotment Name Status: active	Invasive Plant Species	Total gross acres*
Blanchard	whitetop, medusahead, diffuse knapweed	5.2
Boyce	whitetop, spotted knapweed, diffuse knapweed, bull thistle, field bindweed	1.6
Cyrus	whitetop, spotted knapweed, bull thistle, field bindweed, spotted knapweed, Dalmation toadflax	16.1
East Winter	medusahead	468.1

Fox	medusahead	3.1
Grizzly	whitetop, spotted knapweed, diffuse knapweed, Canada thistle, bull thistle, field bindweed, St. Johnswort, medusahead	2,113.4
Haystack	Russian knapweed, spotted knapweed, diffuse knapweed, bull thistle, Scotch thistle	237.1
Holmes-Williams	spotted knapweed, diffuse knapweed	97.6
Juniper Butte	diffuse knapweed	26.0
Lone Pine	spotted knapweed, diffuse knapweed, St. Johnswort, medusahead, spotted knapweed, Canada thistle	1,714
Lower Desert	spotted knapweed, diffuse knapweed, medusahead	272.7
North	spotted knapweed, medusahead, Scotch thistle	355.2
Round Butte	medusahead	5.2
Rush	Russian knapweed, whitetop, spotted knapweed, diffuse knapweed, bull thistle, field bindweed, medusahead	103.1
Steer	whitetop, spotted knapweed, diffuse knapweed, bull thistle, field bindweed	0.9
	Total gross acres active allotments	**5,419.3**
Status: closed		
Clevenger	N/A	0
Goldmine/Falls	N/A	0
Peninsula	N/A	0
Whychus Creek	spotted knapweed, diffuse knapweed, medusahead, St. Johnswort	545.9
	Total gross acres closed allotments	**545.9**
Status: vacant		
Canadian Bench	N/A	0

*Gross invasive plant acres: reflects the number of acres with infestations as "mapped" in our corporate GIS system. Polygons reflect mapped infestations and the entire area within a polygon is part of the numeric result, but it may or may not contain invasive plants throughout the entire mapped area.

Table 104. Grazing Allotments with Known Invasive Plant Populations on the Deschutes National Forest

Allotment Name Status: active	Invasive Weed Species	Total gross acres
Cinder Hill {Cinder Cone}	spotted knapweed, bull thistle, Russian thistle, Dalmation toadflax	2.5
Holzman (Special use)	spotted knapweed, diffuse knapweed, Scotch broom, Dalmation toadflax	7.9
Indian Ford*	spotted knapweed, diffuse knapweed	3.8
Pine Mountain	spotted knapweed, Canada thistle, bull thistle, Dalmation toadflax, Russian thistle,	188.5
Quartz Mountain	spotted knapweed, diffuse knapweed, Canada thistle	4.3
Sand Springs	spotted knapweed, Canada thistle, bull thistle	9.4
	Total gross acres active allotments	**216.4**
Status: closed		
Abbot	spotted knapweed, Canada thistle, bull thistle, leafy spurge	17.0
Big Marsh	spotted knapweed, diffuse knapweed, reed canarygrass	827.3
Glaze Meadow	spotted knapweed, diffuse knapweed, St. Johnswort, bull thistle, Dalmation toadflax	115.7

Little Deschutes		0
Ryan Ranch	spotted knapweed, bull thistle, reed canarygrass, Dalmation toadflax	10.7
Tethrow Meadow	quackgrass, Scotch thistle	17.6
Crater Buttes	Scotch broom	1.0
	Total gross acres closed allotments	**988.3**
Status: vacant		
Big Hole	spotted knapweed	100.2
Cache Mountain	spotted knapweed, diffuse knapweed, Canada thistle, St. Johnswort, bull thistle, knapweed, Dalmation toadflax, tansy ragwort, Russian thistle	473.1
Coyote {Bessie}	spotted knapweed, diffuse knapweed, bull thistle, Dalmation toadflax, Russian thistle	126.6
Crescent Butte	spotted knapweed, diffuse knapweed, Canada thistle, St. Johnswort, bull thistle	26.9
Crescent Creek	spotted knapweed, diffuse knapweed, Canada thistle, pepper weed, St. Johnswort, bull thistle, reed canarygrass, Dalmation toadflax, tansy ragwort, butter and eggs, Russian thistle	253.3
Davis Lake	spotted knapweed, diffuse knapweed, St. Johnswort, bull thistle, Canada thistle, Scotch broom, butter and eggs, reed canarygrass	1,325.0
Fremont Siding	spotted knapweed, diffuse knapweed, bull thistle, St. Johnswort	58.9
Fuelbreaks	spotted knapweed, diffuse knapweed, Canada thistle, knapweed, St. Johnswort, bull thistle, Scotch broom, Dalmation toadflax, tansy ragwort, medusahead	1,521.7
Garrison Butte	spotted knapweed, diffuse knapweed, bull thistle, St. Johnswort	104.3
Gilchrist	N/A	0
Hole-in-the-ground	spotted knapweed	225.7
Mowich	spotted knapweed, diffuse knapweed, bull thistle, St. Johnswort, field bindweed, kochia, butter and eggs, Canada thistle	114.6
Sand Flat	diffuse knapweed, bull thistle, yellow sweet clover	5.4
Spring Butte	spotted knapweed, bull thistle	123.1
Whychus Creek	diffuse knapweed, spotted knapweed, knapweed	138.1
	Total gross acres vacant allotments	**4,597.9**

* Weed population is currently outside allotment between the fence and the adjacent roads.

Table 105. Grazing Allotments with Known Invasive Plant Populations on the Ochoco National Forest.

Allotment Name Status: active	Invasive Weed Species	Total gross acres
Badger	musk thistle, spotted knapweed, medusahead	23
Bear Creek	spotted knapweed, diffuse knapweed, Canada thistle, houndstongue, St. Johnswort, sulphur cinquefoil, medusahead	2.8
Big Summit	spotted knapweed, diffuse knapweed, Canada thistle, bull thistle, Scotch thistle, Mediterranean sage, butter	1.2

	and eggs	
Burn	spotted knapweed, diffuse knapweed, Canada thistle, houndstongue, teasel, St. Johnswort, medusahead	1.2
Canyon Creek	whitetop, spotted knapweed, diffuse knapweed, Canada thistle teasel, butter and eggs	2.5
Crystal Springs	Russian knapweed, spotted knapweed, diffuse knapweed, Canada thistle, houndstongue, Mediterranean sage, medusahead	13.5
Deep Creek	Russian knapweed, spotted knapweed, diffuse knapweed, Canada thistle, field bindweed, houndstongue, Scotch broom, St. Johnswort, Dalmation toadflax, sulphur cinquefoil	59.4
Double Cabin	whitetop, spotted knapweed, diffuse knapweed, Canada thistle, St. Johnswort, sulphur cinquefoil	3.0
Dry Corner	sulphur cinquefoil	0.1
East Maury	whitetop, spotted knapweed, diffuse knapweed, Canada thistle, Dalmation toadflax, Scotch thistle	4.0
Elkhorn	spotted knapweed, Sonoma ceanothis, Canada thistle, houndstongue, medusahead	33.6
Fox Canyon	spotted knapweed, diffuse knapweed, bull thistle	1.3
Gray Prairie	whitetop, St. Johnswort	2.3
Happy	spotted knapweed, diffuse knapweed, Canada thistle, houndstongue, teasel	25.5
Heisler	medusahead	0.9
Klootchman	Russian knapweed, whitetop, spotted knapweed, diffuse knapweed, Canada thistle, Scotch thistle, sulphur cinquefoil, medusahead	3.3
Little Summit	spotted knapweed, diffuse knapweed, Canada thistle, St. Johnswort	1.1
Lost Horse	spotted knapweed, whitetop, medusahead	0.3
Marks Creek	spotted knapweed, Canada thistle, houndstongue, teasel, leafy spurge, Scotch thistle, medusahead	3.5
Mill Creek	whitetop, spotted knapweed, diffuse knapweed, field bindweed, Canada thistle, houndstongue, Scotch broom, St. Johnswort, Scotch thistle, sulphur cinquefoil, medusahead, teasel	15.6
Pisgah	houndstongue	0.1
Pringle	whitetop, St. Johnswort	42.2
Reservoir	spotted knapweed, Canada thistle, houndstongue, St. Johnswort, Scotch thistle	3.3
Roba	whitetop, diffuse knapweed, Canada thistle, houndstongue, teasel, sulphur cinquefoil, medusahead	869.2
Sherwood	whitetop, Canada thistle	0.4
Shotgun	whitetop, diffuse knapweed, Canada thistle, bull thistle, teasel	37.1
Snowshoe	spotted knapweed, diffuse knapweed, houndstongue, field bindweed, medusahead	16.0
Sunflower	Russian knapweed, whitetop, spotted knapweed, diffuse knapweed, Canada thistle, leafy spurge, St. Johnswort, sulphur cinquefoil	12.9
Trout Creek	spotted knapweed, diffuse knapweed, Canada thistle, field bindweed, Scotch broom, teasel, St. Johnswort, sulphur cinquefoil, medusahead	11.8
West Maury	spotted knapweed, Canada thistle, Mediterranean sage	20.9

Wildcat	spotted knapweed, diffuse knapweed, houndstongue, Scotch broom, St. Johnswort, medusahead	4.8
Wind Creek	whitetop, spotted knapweed, Canada thistle, teasel, sulphur cinquefoil, medusahead	23.3
Wolf Creek	whitetop, diffuse knapweed, spotted knapweed, Canada thistle, houndstongue, St. Johnswort, Dalmation toadflax, reed canarygrass, sulphur cinquefoil, Mediterranean sage, medusahead	36.7
	Total gross acres active allotments	**1,276.8**
Status: closed		
Allen Creek	whitetop, spotted knapweed	0.4
	Total gross acres closed allotments	**0.4**
Bearskull/Cotton	yellow star-thistle, diffuse knapweed, spotted knapweed, Canada thistle, bull thistle, houndstongue, teasel, St. Johnswort, Scotch thistle, Himalayan blackberry	19.6
Rock Creek	diffuse knapweed, Canada thistle	2.1
	Total gross acres vacant allotments	**21.7**

In reviewing the tables above, the Grizzly, Whychus Creek, Lone Pine, East Winter and the Lower Desert allotments of the Crooked River Grassland (Grassland), the Big Marsh, Cache Mountain, Davis Lake, and the Fuelbreaks Allotments of the Deschutes NF and the Roba allotment of the Ochoco NF have relatively large infestations (500 acres or more). These are moderate to large allotments, some of which have permitted livestock grazing and others that do not. Three of the five Grassland allotments are active and two are closed, while all of the Deschutes Allotments are vacant or in the case of Big Marsh, closed. The Roba allotment on the Ochoco NF is active.

The Ochoco National Forest also administers the Big Summit Wild Horse Management Area. Wild horses currently occupy the designated horse area. The wild horse area in its entirety is comprised of the Canyon Creek and Reservoir Sheep allotments and its exterior boundary is shared where these two allotments do not share a common boundary. There are currently weed populations mapped on the occupied area, see Table 106 below. There are 3.5 acres of infestation within the Reservoir allotment and 1.7 acres of infestation within the Canyon Creek allotment. As mentioned previously, certain weed species, such as Russian knapweed and yellow star-thistle, are known to be toxic to horses, which could be a concern if they were to become widespread within the area.

Table 106. Occupied Wild Horse Territories with Known Invasive Plant Populations on the Ochoco National Forest

Wild Horse Area Name	Invasive Weed Species	Total Gross acres
Big Summit	spotted knapweed, Canada thistle, houndstongue, teasel, St. Johnswort, Scotch thistle	5.2

3.11.2 Environmental Consequences

ALTERNATIVE 1 – NO ACTION

Direct and Indirect Effects

The direct and indirect effects are evaluated based upon the physical boundaries of the 109 allotments within the project area over the period of time which implementation of the decision occurs and until such time as the decision is modified or superseded by another decision.

Current management of invasive plants within the project area has had some success with existing invasive sites and in treating new starts that are found. Under current management, the ability to treat invasive plants is limited by existing environmental documents completed in 1998. Management of existing sites is currently limited by treatment method and often excludes the use of herbicides. In addition, under existing treatment options, the choice of herbicides that can be used is much more restrictive than that which would be allowed under Alternative 2. New sites can not be treated with herbicides.

Species such as Canada thistle and field bindweed can be toxic to livestock and to wild horses. Under current management these plants will continue to increase in distribution and numbers and could have an increasing affect on wild horses and livestock.

An example where the ability to use more effective herbicides to control an invasive plant is in the Quartz Mountain Allotment on the Bend/Fort Rock Ranger District, where the main species of concern is Spotted knapweed. Small areas are infested, approximately 4.3 acres with one large site at a mining claim managed under a special use permit and several isolated starts along road corridors. Management is mainly concerned with containment and control of the one large site and smaller sites, and with discovery and prevention of new infestations. Current management is mostly hand treatment which seems to be keeping the situation under control but not eradicating the problem. Livestock are not currently linked as a major vector of concern under current grazing management activities with this species. The no action alternative will limit our ability to eradicate the existing populations by restricting the use of more effective herbicides and selecting less cost effective treatment methods.

The desired future condition of the project area is to "retain healthy native plant communities that are diverse and resilient, restore ecosystems that are being damaged, provide high quality habitat for native organisms throughout the Forests and Grassland, and assure that invasive plants do not jeopardize the ability of these administrative units to provide the goods and services communities expect." This alternative will not meet the desired future condition as previously stated because as invasive plants spread more allotments/pastures will be impacted, grazing operations could be reduced, goods and services will be reduced, native ecosystems are reduced and/or replaced by invasives, restoration of ecosystems is outpaced by the continual expansion of invasive plants, and high quality habitat for managed species is reduced or lost (hunting opportunities)and potentially restricting public use.

ALTERNATIVE 2 – PROPOSED ACTION

Direct and Indirect Effects

The expected effect of invasive plant treatments on the 77 affected grazing allotments and the one wild horse territory will be the retention and in some cases increases in density and vigor of native and desired vegetation within project area units.

Some herbicides have use restrictions in regards to livestock grazing and/or slaughtering (see Appendix D). A key element to the implementation of herbicides where livestock may be present will be proper coordination and notification of permittees and rangeland managers. Timely notification and coordination should occur during annual operating instruction/plan meetings and by posting/signing areas to be treated prior to and after treatment.

Local producers who were contacted in regards to growing “chemical free beef” have raised no concerns in using herbicides to treat invasive plants. Their interest is more in growing beef free of growth hormones as they have stated that they are not concerned with herbicides (Personal communication with Byron Cheney and contact with Doc Hatfield {Oregon Natural Beef Cooperative}, 2005).

If label directions are followed and handling methods are implemented (see PDF section 2.4), the use of herbicides is expected to be of no concern to livestock and livestock managers (also see Human Health, Section 3.8).

The Proposed Action Alternative will allow invasive plant treatments across approximately 52,000 acres within the Deschutes and Ochoco National Forests and Crooked River National Grassland. Under this Proposed Action, approximately 14,500 weed site acres would be treated. Control of invasive plants and eradication at some locations, will allow grazing activities to remain much as they are under current conditions and would meet the desired future condition within the project area.

EDRR

A key part of this effort will be early detection and response (EDRR) for any new infestations. An upper limit of 16,000 acres for EDRR is sufficient to address any expected situations that arise. The increase in invasive plants will be greatly reduced or virtually stopped. As invasive plant sites are controlled, eradicated, suppressed, and contained, and as new starts are located and managed under EDRR, the positive cumulative effects will be to improve rangeland conditions and overall ecosystem health.

Project Design Features

1. Permittees will be made aware of annual treatment actions at the permittee annual operating plan meetings and/or if requested, notified in advance of spray dates (treatment standard #23).
2. Use wick, wipe, or similar low applications methods when herbicides are applied within 100 feet of permanent water sources used for livestock watering such as water troughs associated with spring developments, reservoirs, trick tanks and other sources developed for range use and listed as a range improvement(s). If herbicides are not to be applied, invasive plants will be treated using other methods. Temporary watering developments such as watersets, will have no restrictions except when in use and as needed to follow guidelines established in Grazing Restriction Table, Appendix D.

ALTERNATIVE 3

This alternative proposes to meet the same objectives as stated in the Proposed Action, but intends a more cautious approach with herbicides in riparian areas. Specific herbicides would not be allowed for use, and treatment methods to apply herbicides would be limited. Mechanical treatment methods that may cause significantly increased sediment would not be allowed in this alternative.

The potential for herbicide exposure to livestock and permittees will be slightly decreased as fewer herbicides will be used within the treatment area. It is expected that invasive plants will continue to increase over time in riparian areas and this will reduce available forage due to displacement of native vegetation and reduced ecosystem health.

The implementation of EDRR will be limited in riparian areas by the amount of herbicide, type of herbicide and the application method that could be applied within this zone. The concern will be effectiveness of treatment within the riparian areas and is correlated to overall success in meeting management goals. An estimate of impacts to permittees within the project area will be a reduction of

2 to 10 percent available grazing area over the next decade based on an expectation that invasive plants will increase in riparian areas as much as 8 percent. Livestock frequent riparian areas to obtain water and to acquire what is often preferred forage depending on the season of use and the surrounding rangeland conditions. Preferred forage competition with invasives may be reduced.

Implementing Alternative 3 will result in beneficial impacts on 77 grazing allotments (active, vacant, and closed) and one wild horse territory by providing additional methods of treatment (for example: additional herbicides and application techniques) and by increasing the size and number of sites treated (more cost effective herbicide methods vs. hand pulling allow for more acres to be treated). Inclusion of the EDRR strategy will allow managers to treat new sites as they are discovered with available tools. In general public lands in the project area are not currently at a level of infestation where invasive plants are displacing grazing opportunities except in very small localized situations.

Of concern with Alternative 3 are the riparian reserves project area units (PAU) and the potential new infestations that may occurs within these riparian reserves where treatment with herbicides will be restricted. Alternative 3 is expected to reduce invasive plants in PAUs but it will not be as effective as Alternative 2 and some invasive riparian species will persist. Any impacts to grazing management under this alternative will be dependent on the effectives of the herbicides available for use.

Cumulative Effects – All Alternatives

Cumulative effects to grazing and rangeland management of this project area expected to be positive for Alternatives 2 and 3 because more aggressive treatments combined with EDRR will reduce the potential for additional spread and loss of available forage. Positive cumulative effects could occur as Forest Service efforts are combined with other federal, state, county and private landowner efforts, reducing the rate of spread on a regional level. Actions proposed in all alternatives will complement the efforts of state control programs and community volunteer efforts. For example, the inclusion of English ivy on the state of Oregon invasive species list has helped to reduce sale of this species in nurseries and prioritized funding for control of this species by the state. Local volunteer efforts to remove the species has not only decreased the extent of the species, but also educated the public on the problems associated with it, which in turn elicits control on the individual level in private backyards (Preventing and Managing Invasive Plants Final Environmental Impact Statement April 2005).

The authorized number of AUMs has been decreasing for the past decade as some allotments become vacant for a variety of environmental and socio-economic reasons. Thus, factors other than invasive plant management will continue to influence grazing levels regardless of the alternative selected in this EIS. Invasive Plant management and other land management practices may positively influence forage quantity or quality and potentially result in beneficial impacts to grazing with renewed interest in some vacant allotments. Also see Section 3.3 Treatment Effectiveness for beneficial effects for native vegetation, including forage.

3.12 Cultural Resources

This section of the EIS provides desired condition, existing condition, evaluates the effects of the alternatives, and describes the mitigation or monitoring that is recommended.

Management Direction

Management direction for cultural resources is found in the Deschutes National Forest Land and Resource Management Plan (LRMP), the Ochoco National Forest LRMP, the Crooked River Grassland LRMP, in the Forest Service Manual section 2360, in federal regulations 36 CFR 64 and 36 CFR 800, and in various federal laws including the National Historic Preservation Act of 1966 (as amended), the National Environmental Policy Act, and the National Forest Management Act (NHPA). In general, the existing management direction asks the Forest to consider the effects on cultural resources when considering projects that fall within the Forest's jurisdiction. Further direction indicates that the Forest will determine what cultural resources are present on the forest, evaluate each resource for eligibility to the National Register of Historic Places (Register) and protect or mitigate effects to resources that are eligible.

Relevant Deschutes National Forest Management Plan Standards and guides include:

CR-2 which states that cultural resource properties located during inventory will be evaluated for eligibility to the Register.

CR-3 states that in concert with inventories and evaluations the Forest will develop thematic Register nominations and management plans for various classes of cultural resources.

CR-4 indicates that project level inventories or the intent to conduct such shall be documented through environmental analysis for the project.

Ochoco National Forest and Crooked River National Grassland Management Plan standards and guides are not separated the same way but are consistent with those on the Deschutes and include conducting inventories prior to ground disturbing projects, evaluating resources located for eligibility to the National Register, and determining effects of projects in consultation with the Oregon State Historic Preservation Office (SHPO).

Desired Condition

The desired condition is not clearly stated in the Deschutes Forest Plan but can be derived from the implied goals of the Standards and Guides and the Monitoring Plans. It would be desired to know the location and extent of all cultural resources, have evaluated each one for eligibility to the Register, and have developed management plans for eligible properties that would provide protection or mitigate effects that will occur to the resource.

The desired condition in the Ochoco LRMP is more clearly stated. The plan calls for obtaining extensive knowledge about the historic and prehistoric resources on the Forest and tribal use resources to include site types, distribution, and management plans for heritage resources. This would facilitate efficient and precise resource management. Emphasis of management would be less on additional inventory and more on thematic evaluations and increased interpretation and management of facilities to enhance heritage resources.

The Crooked River National Grassland has a desired condition that includes a greater emphasis on enhancement and interpretation of heritage resources and greater use by Native American groups for native food gathering and religious practices. Native Americans would be more involved in the management of heritage resources and the Grassland in general.

3.12.1 Affected Environment

Numerous previous projects have been inventoried for cultural resources within the current project analysis area. Some of them were conducted and documented sufficiently to be used as adequate survey. As this decision will include treatment of locations not yet identified (EDRR), no complete numbers of past projects or acres surveyed can be determined.

Through these past and present surveys, many heritage sites have been located and recorded. Sites are defined by having 10 or more artifacts or the presence of features such as a cave, rock art, fire pit remains, structure, etc. Isolates are defined as not having any features and locating less than 10 artifacts.

Various tribal use plants are known in the project area (see Table 87). The Warm Springs, Paiute, and Wasco Tribes from The Confederated Tribes of the Warm Springs Reservation of Oregon, The Klamath Tribes, and the Burns Paiute are the known tribes with historic associations to this area. The project area is within lands ceded to the Federal Government by treaty. Only the tribes of the Warm Springs Reservation retain land use rights on the ceded lands under the Treaty with the Tribes of Middle Oregon of 1855.

3.12.2 Environmental Consequences

Direct, Indirect, and Cumulative Effects – Action Alternatives

Under this project, only burning and disking or subsoiling are proposed treatments with a potential to affect historic properties and potential historic properties. Other types of treatments proposed of applying herbicides, hand pulling, and reduction of stalks by using a weed whacker or mower have little or no potential to affect historic properties or potential historic properties. Herbicides sprayed directly on features or artifacts would cause no loss of data or disturbance. Only two identified units have the potential to affect historic properties because the treatment methods involve burning and disking. Potential locations under the early detection/rapid response program that would require the same treatment methods would also have the potential to affect historic properties. Any added treatment locations or changes in treatment methods will require Section 106 (NHPA) compliance measures including consultation with the State Historic Preservation Office (SHPO). Effects to humans related to the cultural use of plants are discussed in Chapter 3.8.

Under this project, treatments with potential to affect historic properties or potential historic properties were inventoried and found to not contain any significant or unevaluated historic properties. The project will not impact any significant historic or prehistoric sites or locations with undetermined significance resulting in no direct or indirect effects. Since there will be no direct or indirect effects, no cumulative effects will occur.

Project Design Features and Monitoring

Treatment areas 72-15 and 72-37 will include both burning and discing of the soils. Field surveys found no eligible or unevaluated sites of historic or prehistoric nature are present and no avoidance measures are needed. EDRR locations added over time will also need to avoid any disturbances in similar cases if they occur. Post treatment monitoring can verify that avoidance measures were followed and were effective. Annual review of any proposed treatment changes or proposed treatment of newly identified invasive plant locations can determine what avoidance measures, if any, are needed under this project each year.

As part of annual implementation planning and public notification, treatments in the vicinity of tribal use plants will require consultation with the relevant tribal government and resource specialists. Herbicide use or burning of locations at the same time of traditional gathering or use of that plant will be avoided. Otherwise, treatments that may reduce competing invasive plants and may enhance the tribal use plant will be coordinated with tribal government and resource specialists.

3.13 Recreation and Scenery

Central Oregon has a history of being uniquely situated to "preserve and provide interpretation of unique geological and cultural areas for education, scientific and public enjoyment purposes" (Deschutes National Forest, 1990 Forest Plan LRMP, 4-90). Recreation and scenic resources, including the tourism industry, are increasingly being touted as a mainstay of the local economy within Central Oregon. Winter and summer recreation expenditures have long added an element of stability to the otherwise volatile wood products-based economy of the past (Deschutes National Forest, 1990 Forest Plan LRMP, 2-2).

Management Direction & Desired Future Condition

The Deschutes and Ochoco National Forest Land and Resource Management Plans (LRMP) allocated numerous management areas, each with a different role in providing goods and services, as well as perpetuating forest ecosystems (Deschutes National Forest, 1990 Forest Plan, 4-1, M11-M14, M9; and Ochoco National Forest, 1989 Forest Plan, 4-22, 4-26, MA-F26). Similarly, the Crooked River National Grassland also established management areas to provide similar goods and services benefiting the general public.

Desired future condition statement: In Central Oregon, healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is providing for native organisms throughout the area. Invasive plants do not jeopardize the ability of the Forests to provide goods and services to communities.

The Landscape Character goal for the analysis area is to achieve a natural appearing landscape, such as open park-like stands, where management directions, the desired future conditions, and social and ecological framework are met (Forest Plan, Deschutes LRMP MA-9, MA-19 - MA-28, and Ochoco NF MA-F26).

The Recreation Objective is to provide a wide variety of quality outdoor recreation opportunities and experience within a forest environment where the localized settings may be modified to accommodate large numbers of visitors. The recreation setting and opportunities provided include the Recreation Opportunity Spectrum (ROS) categories of Rural and Roaded Natural (Deschutes National Forest LRMP, MA-11). Provide safe, healthful, and aesthetic facilities for people to utilize while they are pursuing a wide variety of recreational experiences within a relatively natural outdoor setting (Ochoco National Forest LRMP, MA-F13).

The Scenic Quality Objective states that scenic quality within the analysis area would have a natural-appearing character where various line, form, color, and texture elements are found within the landscape. Human alterations, in general, would be subordinate and conform to natural appearing landscape characteristics. Character trees, snags and small openings, to highlight special features within the landscape, are desirable and encouraged. Where biologically feasible, diversity in vegetation species, age, and size classes is encouraged (Deschutes NF LRMP MA-9, Ochoco NF LRMP MA-F26).

Scenic Resources

The outstanding and remarkable scenery of Central Oregon is well known. The existing Forest Plan direction on recreation management and scenic quality is the basis for this analysis. Further direction regarding scenery management is in Forest Service Manual 2380 (Landscape Management) and Landscape Aesthetics: A Handbook for Scenery Management. (USFS 1995d)

The Forest Service implementing regulations also establish a variety of Scenic Quality Standards for scenic views allocation areas (Management Area 9). These include:

- Natural-appearing landscape with high scenic integrity level (Retention);
- Slightly altered landscape with medium scenic integrity level (Partial Retention);
- Altered landscape with low scenic integrity level (Modification).

Primary and secondary access and travel routes, along with trails and waterway corridors, are within the scenic allocation area under the Deschutes and Ochoco National Forests and the Crooked River Grassland management plans. Two primary distance zones fall within the analysis area as viewed from the scenic corridor; including: Foreground (0-0.5 mile) and Middleground beyond the Foreground up to 5.0 miles.

Along travel routes and waterways within Central Oregon, natural disturbances such as past wildfires, insect and disease infestation, wind damage, and invasive plant infestation are evident. As a result, the Central Oregon landscape is characterized by a mosaic of disturbed conditions caused by these natural and human-caused processes.

The scenic quality within the project area is based generally on people's perception, including emotional and/or physical attachment to the landscape from a sensory perspective (such as sight, sound, feel, taste, and touch) and cultural value (such as attitudes and beliefs).

Recreational Experience

The end product of recreation management is the experience people have. The key to provide most experience opportunities is the setting and how it is managed. Many desired experiences, by way of such proper and effective recreation management, are translated into "setting indicators" as access, remoteness, naturalness, facilities/site management, social encounters, visitor impacts, and visitor management (USDA Forest Service ROS Users Guide, USFS 1990b).

Central Oregon has numerous recreation sites, including dispersed and developed campgrounds, trails and trailheads, fish and wildlife viewing platform, viewpoints and vista points, boating facilities, and others. These allocations also include Intensive Recreation and Special Interest Areas.

In general, the recreation sites on the Forests have been designated as either Rural or Roaded Natural (ROS Classes), specifically along access and travel route, such as road, trail, and river corridors. Further direction regarding ROS classes can be found in the USDA Forest Service ROS Users Guide.

3.13.1 Affected Environment

Deviations from the valued landscape character and recreation experience are often caused by human or management activities. These may include changes from construction of facilities, increase in human interaction that socially affect quiet places or private areas, and naturally caused disturbance events, such as wildfire, insect and disease, invasive plant infestations, and flooding or erosion.

The recreation and scenic condition within the analysis area may not meet the expectations and preferences of many visitors or users in its current condition. An overall decline in forest health in addition to recent wildfires, invasive plant infestation, and other disturbances, affects recreation experience and scenic characteristics of the area the most.

In Central Oregon, natural and man-made forest disturbance processes are especially visible and accessible to the forest visitor along major travel corridors, including roads, trails, and waterways. Access roads, utility corridors, recreation facilities development, timber harvest activities, insects and diseases infestation, wildfires, and the spread of invasive plants have all contributed to the alteration of natural landscape character and recreational experience.

With relative ease of access by vehicles, including OHVs, mountain bikes, horses, and hikers, the spread of invasive plants have been slowly taking a foothold, particularly along the majority of Central Oregon's road, trail, and river corridors. Slowly and surely, this "quiet invasion" is altering natural landscapes and affecting recreational experience level on the Deschutes and Ochoco National Forests and the Crooked River National Grassland.

Invasive Plant Infestations

In general, invasive plants do not affect scenic corridors and developed recreation sites within low use or low impact settings. Results of a spot field survey of low to moderate use developed sites and scenic corridors in higher elevation, show that areas above 5,000 feet have little to no infestation of invasive plants. On the other hand, invasive plants are greatly affecting developed recreation sites and scenic corridors in high-use areas and at lower elevations (generally below 5,000 feet above sea level).

Infestation levels for developed recreation sites, visually sensitive access and travel routes, including waterways, are classified as low, moderate, and high. Since dispersed sites are so numerous and within the low use/low intensity area, the infestation level of invasive plants, if any, is expected to be low, especially in traditional higher-elevation sites. The following three tables list scenic corridors on the Forests and Grassland that currently have invasive plant infestations.

Table 107. Deschutes National Forest. Based on GIS inventory invasive plant data and limited field checking. The invasive plant affected areas includes proximity to developed recreation sites along travel routes, allocated scenic and waterway corridors.

Scenic Corridors
Skyliner (Road 4601)
Highway 46 (Cascade Lakes National Scenic Byway)
Upper Deschutes River Wild and Scenic River
Little Deschutes River
Road 40
Road 41
Road 42
Road 43
Road 44
Road 45
Highway 97
Highway 58
Road 61
Road 18 (China Hat Road)
Road 18 (China Hat Road)
Road 9720 (Lava Cast Forest)
Road 21 (Paulina Creek)
Road 22
Highway 31
Road 14 (Metolius Wild and Scenic River)
Highway 20 (Santiam Pass Highway)
Highway 242 (Mckenzie National Scenic Byway)
Road 11
Road 12 (Metolius Basin)
Road 15

Road 16

Table 108. Ochoco National Forest (Lookout Mountain Ranger District and Paulina Ranger District).

Scenic Corridor
Road 12
Road 16
Road 17
Road 22
Highway 26
Road 2630
Road 27
Road 33
Road 38
Road 42
Road 58
North Fork Crooked River National Wild and Scenic River

Table 109. Crooked River National Grassland

Scenic Corridor
Highway 97
Highway 26
Road 64
Lake Billy Chinook
Lower Deschutes Wild and Scenic River
Lower Crooked Wild and Scenic River

3.13.2 Environmental Consequences

Direct and Indirect Effects of Alternatives on Recreation and Scenic Resources

The effect on recreation and scenic resources resulting from implementation of the alternatives is described for the short-term and long-term (generally within the life span of the proposed treatment). It is assumed the effects described would be most prominent to the visiting public within the immediate area of recreation sites, administrative facilities, and travel corridors where invasive plant treatment activities are being proposed.

Alternative 1- No Action

Only those invasive plant sites already approved for treatment under existing NEPA would continue to be treated under Alternative 1. Some sites along scenic corridors such as the Cascade Lakes Scenic Byway will continue to be treated.

Under this alternative, the area's landscape character, scenic quality, scenic integrity level would remain essentially unchanged during the short-term period. There would be no direct effect on recreation opportunity spectrum classes (experience levels) or users/visitors. Indirectly, however, the effect from this alternative would likely result in the continued expansion of invasive plants all over areas of concern, specifically along access, travel, and river corridors where new sites have become established since the noxious weed EAs were written in 1998. Invasive plants are expected to be dispersed by both human and natural vectors. Such vectors include: vehicles, people, and animals traveling along roads, trails, and waterways that can spread invasive plants to high value areas. Similarly, wind and flowing water can quickly carry seeds considerable distances along all access, travel, and river corridors.

The long-term effect on scenic quality, scenic integrity level, landscape character, and recreation experience levels would be altered as the rate of spread of invasive plant species follows successional pathways, which is currently estimated to be approximately 8% per year. Under this alternative, the desired future condition for recreation and scenic resources may not meet public expectations, goals, or objectives under the Forest Plan.

Alternative 2

Effect on Scenic Resources

Aesthetic considerations expressed in the current Handbook for Scenery Management (pages 23, 24- Purpose and Scope) suggest ecological process, function, structure and composition of the landscape that is consistent with the elimination of invasive plants for the promotion of long-term ecological health.

Under this alternative, the treatment of invasive plants, primarily low lying forb and shrub species, along access and travel corridors (including within immediate foreground of the landscape) would likely only create minimal short-term negative effects on scenic resources for about one to two growing seasons. Long-term benefits of restoring ecological balance to the landscape and promoting positive and natural landscape character is expected to out weigh the short-term negative effects on scenic resources.

This alternative is expected to fully meet desired future scenic condition, specifically for travel routes and scenic corridors proposed to be treated.

Effect on Recreation Resources

Under this alternative, the effect(s) on recreation resources generally means the effects to the recreating public and human health, brought on by the proposed treatment activities. The effect on recreation resources, including human health and the conflict of the proposed treatment activities with recreation users, could occur at certain developed and dispersed recreation sites, administrative sites, special uses sites, and at cultural and special forest product collection areas. Effects to human health are analyzed in Section 3.8 Human Health.

The project area units overlap the following recreation areas/sites, and there may be a potential for visitor/forest worker interaction:

Deschutes National Forest

- Skyliner (Road 4601): Tumalo Falls Trailhead and Day Use, Skyliner Lodge, and Skyliner Snopark.
- Highway 46 (Cascade Lakes National Scenic Byway): Arlie’s Rock Photo Point (North Portal), Virginia Meissner Snow Park, Wanoga Snow Park, Vista Butte Snow Park, and Dutchman Flat Snow Park,

- Upper Deschutes River Wild and Scenic River (Road 41): Meadow Day Use, Lava Island Falls Trailhead, Lava Island Day Use, Dillon Trailhead, Dillon Falls Day Use, Slough Camp Trailhead, Slough Camp Day Use, Benham Falls Day Use, and Benham Falls Trailhead.
- Road 42: Fall River Campground, South Twin Lake Campground, Brown Mountain campground, and Brown Crossing Campground.
- Highway 97: Lava Lands Visitor Information Center and Lava River Cave Trailhead.
- Highway 58: Crescent Lake Snow Park, Simax Beach Day Use, Simax Beach Campground, and Simax Beach Group Site.
- Road 21 (Paulina Creek): Road 21/Hwy 97 Information Station, Ogden Trailhead, Ogden Group Campground, Ten Mile Snow Park, Road 21 Overlook, Paulina Lake Campground, and Paulina Lake Visitor Center.
- Road 14 (Metolius Wild and Scenic River): Camp Sherman Fish Viewing Station and Candle Creek Campground.
- Highway 20 (Santiam Pass Highway): East Portal Information Station, Camp Sherman/Metolius Information Station, Suttle Lake Information Station, Indian Ford Campground, Black Butte Trailhead, Shuttle Lake Water Ski Area, Blue Bay Campground, Mt. Washington Viewpoint, and Corbett Snopark.
- Highway 242 (McKenzie National Scenic Byway): Windy Point Viewpoint and Dee Wrights Observatory.
- Road 11: Perry South Campground.
- Road 12 (Metolius Basin): Jack Lake Campground and Jack Lake Trailhead.
- Road 16: Tam McArthur Rim Trailhead and Three Creek Lake Campground.

Ochoco National Forest

- Road 12: Wildwood Campground.
- Highway 26: Bandit Spring Trailhead.
- Road 27: North Potlid Trailhead and Scotty Creek Trailhead.
- Road 33: Steins Pillar Trailhead, Stein Pillar Information Station, and Wildcat Campground.
- Road 42: Lookout Mtn. Trailhead.
- Road 2630: Keeton trailhead and Fry Trailhead.
- Road 38: South Apple Trailhead, West Black Canyon Trailhead, and North Payten Trailhead.

Crooked River National Grassland

- Highway 97: Haystack Campground
- Highway 26: Rimrock Springs Trailhead, Rimrock Springs Wildlife Management Area, and Gray Butte Trailhead.

Under this alternative, the recreating public would have more potential for temporary contact with contaminated vegetation within the above listed recreation areas/sites than the general public traveling along road and river corridors. When inventoried invasive plant sites within these Project Area Units are treated--with implementation of the recommended Project Design Features (such as public notification, PDF 26, 31)--the overall effect on recreation resources is expected to be minimal, limited, short-term, and localized only to the project area units. If recreation sites need to be closed for implementation (PDF 31, 34), there would be an impact to visitors who would be displaced for a short period of time, but closures would prevent people from being exposed to herbicides.

Manual treatments would require more people and time to accomplish than herbicide treatments, and therefore manual treatments have the potential to impact the recreating public more. PDFs 32 and 35 require limiting the number of entries into recreation areas and avoiding peak user periods when possible. Solarization by tarping will be an unnatural intrusion on the landscape; however, they will be small in scale and would take place in areas not frequented by recreationists. Although the herbicides being used as part of the treatment process have a short life span and are considered relatively safe to use, there is still a perception of risk, so people encountering forest workers may have a negative experience. Public notification will serve to educate as well as notify the public of what to expect if treatments will occur in recreation sites.

The long-term effect on scenic quality, scenic integrity level, landscape character, and recreation experience levels would improve as the rate of spread of invasive plant species is either reduced or eliminated from the current level, which follows successional pathways and is currently estimated to be approximately 8% to 10% per year, nationally.

Treating infestations under the EDRR strategy will follow all steps outlined in Appendix F, ensuring that Project Design Features related to recreation sites and notification of the public are adhered to.

Alternative 3

This alternative proposes to meet the same objectives as stated for the proposed action, but intends to reduce the potential impact from herbicides in riparian areas. Specific herbicides would not be allowed for use, and treatment methods to apply herbicides would be limited within a 300 foot buffer. See Section 2.3.3 for restrictions of herbicide use and application methods in riparian areas.

Under this alternative, similarly to Alternative 2, the effect on scenic and recreation resources is expected be minimal, limited, localized, and short-term. Where visual degradation from control measures is a concern, revegetation with native plants should occur within six months following treatment. Along the Metolius, fishing and recreating public would be exposed to herbicides in areas of ribbongrass treatment. This alternative would reduce the amount of exposure because there would be no use of herbicide within 10 feet of the water.

The long-term effect on scenic quality, scenic integrity level, landscape character, and recreation experience levels would improve as the rate of spread of invasive plant species is either reduced or eliminated from the current level.

Cumulative Effect all Alternatives

Because the effect(s) of the proposed invasive plant treatments on recreation and scenic resources, are considered to be minimal, limited, localized, and short-term, there is very low chance the effects would accumulate with effects brought on by past treatment activities (see Chapter 3.1).

3.14 Congressionally-Designated Areas and Other Areas of Special Interest

3.14.1 Wilderness

Affected Environment

The 1964 Wilderness Act established the National Wilderness Preservation System to ensure that parts of the United States would be preserved and protected in their natural condition. A wilderness area is defined, 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. The Wilderness Act places responsibility upon the administering agency for preserving the wilderness character of the area.

The Regional Forester is responsible for vegetation manipulation in wilderness. In the ROD for the Region 6 2005 Invasive Plant FEIS, the Regional Forester approved invasive plant control (including pesticide use) according to certain standards in all National Forest land allocations, including designated wilderness (FSM 2323.04c), wilderness study areas, and designated or candidate research areas. In Wilderness, motorized travel is prohibited and the ground disturbances and vectors of invasive plant spread associated with motorized vehicle use are greatly diminished. However, both natural and human caused ground disturbances and vectors of invasive plant seed spread still exist. Invasive plants adversely affect wilderness values because they disrupt natural processes.

According to the R6 Invasive Plant Program FEIS, invasive plant inventories show that Wilderness areas in Region Six have not yet been highly infiltrated by invasive plants, but that invasive plants are gradually finding their way into Wilderness, and have been identified mostly along trails and more heavily used zones (USFS 2005a, page 3-70). This holds true for the Ochoco National Forests as well, where there are currently only three project area units – both at trail or trailhead. Eight Wilderness areas occur on the two Forests: Mt. Jefferson, Mt. Washington, Three Sisters, Diamond Peak, Mt. Thielsen, Mill Creek, Bridge Creek, and Black Canyon. Current inventories show few occurrences of invasive plants in Wilderness (Table 110).

Table 110. Project Area Units Located within Wilderness, Deschutes & Ochoco National Forests

Wilderness Area	Project Area Units overlapping Wilderness	Species	Treatment Methods
Mill Creek Wilderness, Ochoco NF	71-57 (trail)	Spotted knapweed, diffuse knapweed	Manual
Black Canyon Wilderness, Ochoco NF	72-52 (trail)	Canada thistle, bull thistle	Manual
Black Canyon Wilderness, Ochoco NF	72-53 (trail & trailhead)	Canada thistle, houndstongue, teasel, scotch thistle	Manual (chemical at trailhead outside Wilderness)

Unit 71-57 contains five small patches of diffuse and spotted knapweed that occupy approximately ½ acre in total along a hiking trail. The 72-52 site in the Black Canyon Wilderness is comprised of 8 small patches of bull thistle totaling less than one acre, is also located along a trail. Site 72-53 is located at the east Black Canyon Trailhead; the site crosses into the wilderness for a short distance. This trailhead is one of the few access points into the wilderness, and consequently there is a high risk for spread of these infestations further into the wilderness.

Project area units are also located adjacent to Wilderness, primarily along roads. For example, the Cascade Lakes Highway (Hwy 46, unit 11-07) parallels the Three Sisters Wilderness for several miles on the west side of the Deschutes NF; a railroad right-of-way and Road 60 (a recreation access road) border the Diamond Peak Wilderness. These routes involve large mapped sites of several invasive species (units 12-06, 12-16) where proposed treatment would involve herbicide and manual methods. Project Area Unit #15-06 runs along State Highway 242 between the Three Sisters Wilderness and Mt. Jefferson Wilderness Areas. Most of the area included in these sites are already being treated with herbicides under the 1998 Deschutes NF Noxious Weed Control EA.

Environmental Consequences

Consequences of No Action

Invasive plants have adverse effects to Wilderness values because they disrupt natural processes. The no action alternative would not allow for any treatment within the Wilderness as listed in Table 110 above; and it would not allow for control of most of the sites near Wilderness (except those identified in early NEPA documents such as along Cascade Lakes Hwy), where there is a possibility of spread. Without the ability to quickly respond to new infestations in and near Wilderness the invasive plants could continue to spread and impact Wilderness values. Visitors' experience may be diminished if they are aware of the invasive plants. Where herbicide treatments have been on-going near the Wilderness, such as along Cascade Lakes Highway, and it has not affected Wilderness values. Invasive weed species can have substantial negative impacts on the quantity and quality of outdoor recreational activities such as fishing, hunting, hiking, and wildlife viewing. They negatively affect a wide array of environmental attributes that are important to support recreation, including but not limited to soil quality, water quality and quantity, plant diversity, availability of forage and cover, and animal diversity and abundance (Eiswerth et al, 2005). Visitors' experience may be diminished if they are aware of the invasive plants. Uncontrolled infestations of invasive plants in and adjacent to Wilderness can be expected to spread, affecting native plant communities, and ultimately Wilderness values.

The eastern end of Black Canyon Wilderness near site 72-53 is dominated by plant communities and soils vulnerable to medusahead invasion. Medusahead aggressively out-competes perennial grasses. Where it gains a foothold, it tends to form exclusive stands which show increases in soil erosion, increases fire return intervals and are not used by wildlife species (Sheley 1999). The Wilderness environment in the vicinity of the medusahead site is shallow, rocky, residual soil (clay) and sparse vegetation. Available plant moisture is limiting due to shallow soils and low precipitation. As a result of soil type and low moisture the vegetation is dominated by sagebrush and bunchgrasses, including, Sandberg's bluegrass, Idaho fescue, bluebunch wheatgrass and squirreltail. The Interior Columbia Basin Ecosystem Management Project considers this vegetation type as a cool shrub zone (Hann et al 1997). Spread vectors of medusahead include wind, wildlife and human activities. Human and horse transport of seedheads is of particular concern because new infestations can be started far from the original infestation, and may go undetected until they are quite large.

Effects of Both Action Alternatives

Controlling invasive plants will benefit Wilderness by keeping existing populations from spreading further into the Wilderness areas and by eradicating existing infestations. Natural conditions will be preserved.

Treatments may affect Wilderness values because human intervention will be necessary. Manual treatment is proposed on those species inside the Wilderness (see Table 110); manual treatment is consistent with policy to use only non-mechanical, non-motorized equipment in wilderness areas. It will be short-term (during the time that manual treatments are occurring). Wilderness visitors may notice the effects of invasive plant treatments, but only manual control is proposed, so it would be very minimal. Two species (houndstongue and scotch thistle) located outside the Black Canyon Wilderness at the trailhead, are proposed for spot spraying with herbicide. A visitor's sense of solitude may be affected if they came upon an invasive plant worker. However, following the implementation plan (Appendix F) and project design features 31-35 would limit interaction between invasive plant control efforts and forest visitors. These design features include avoiding treatment during high use periods, posting treatment dates in advance at trailheads, and minimizing the number of workers. Invasive plant surveys take place each year in Wilderness areas. The EDRR strategy would provide a means to control infestations by manual treatment soon after detection. Under EDRR, any newly detected sites within Wilderness that would require more than manual treatment for effective control would need to be further analysis for effects to wilderness values.

Cumulative Effects

The amount of treatment that will occur in Wilderness is very minute compared to the size of the Wilderness. If the manual treatments were to occur along the trail at the same time as any trail work, there may be an additive effect to a person's wilderness experience because they could encounter more people than ordinary. No management activities take place within wilderness areas. Livestock grazing occurs within the Mill Creek and Bridge Creek Wilderness Areas on the Ochoco NF. Mill Creek is grazed by 385 cow/calf pairs for 30 days, and the Bridge Creek Wilderness is grazed by 290 cow/calf pairs for 40 days. Cattle can be a vector of weed introduction and spread, and may exacerbate the spread of the knapweed within Project Area Unit 71-57 in the Mill Creek Wilderness. The proposed manual treatment would prevent the spread of knapweed by cattle.

Since January 2007, pelletized feed or certified weed-free feed is required in all Wilderness areas and Wilderness trailheads. This Forest Plan standard will benefit Wilderness as the introduction of new sites can be checked through this prevention effort. Combined with the eradication efforts on existing sites, and early detection/rapid response to new sites, there will be a beneficial cumulative effect of keeping Wilderness free of invasive plants.

3.14.2 Oregon Cascades Recreation Area

Affected Environment

The goals of the Oregon Cascades Recreation Area (OCRA) is "To conserve, protect, and manage in a substantially undeveloped condition the unique values associated with the Oregon Cascade Recreation Area. To feature dispersed recreation opportunities and wildlife, fish, and scenic resources…including nesting habitat for spotted owls." (USFS 1990, p 4-146). Project activities are in a portion of the OCRA that is also a Wild and Scenic River corridor (Big Marsh Creek).

Invasive species sites occur in the OCRA, in project area unit 12-05. Reed canary grass has been established in Big Marsh since the area was used for grazing in the 1940s. This grass is spread throughout the marsh, however, spotted and diffuse knapweeds, Canada thistle, and bull thistle also occur within this project unit at this time. Reed canarygrass forms dense, highly productive monocultures that spread radially. It inhibits the growth of short perennial grasses, eventually eliminating them.

Environmental Consequences

Consequences of No Action

Because of the tenacity and rapid growth of reed canarygrass, this species poses a major threat to wetland ecosystems. Study data shows declines of wetland and wet prairie species after several years of canarygrass growth (Apfelbaum and Sams 1987). Reed canarygrass is expected to continue to expand throughout the marsh, dominating the site and replacing native species. The other weed species in Big Marsh are also expected to spread, and in large numbers, can affect the recreation experience.

Effects of Both Alternatives

Treatment for the invasive plants in this area includes focusing on controlling reed canarygrass in the disturbed ditches along the edges of the marsh where hydrologic restoration activities have been occurring. Treatments will consist of solarization of patches of the invasive plant by covering with black plastic; then revegetating with local native plants. Manual treatment is proposed for knapweed, Canada thistle and bull thistle. Treatment is the same under both alternatives. Short term (<5 years) effects to the recreation experience in Big Marsh will be visual impact of plastic covering on patches of reed canarygrass. After solarization is complete, there will be areas devoid of vegetation; however the areas would be planted with native species to restore the site. In the long-term effects to the OCRA will be beneficial by favoring native vegetation and will further the objectives of the management area. Water quality, botanical and wildlife resources are discussed in other sections of this chapter. The EDRR strategy would provide a means to control new invasive plant infestations soon after detection, while they are small and more easily controlled.

Cumulative Effects

Invasive plant treatment will positively affect ongoing efforts to restore the natural hydrology and enhance habitat for TES plants and wildlife in the area. Reed canarygrass in other areas of the marsh may be controlled by rising water through the restoration activities that are ongoing; treating the ditches through this project will complement those effects. Revegetation with native plants in areas of bare soil (caused through the hydrologic restoration activities) will also have a positive additive effect to the efforts to suppress reed canarygrass and prevent introduction of invasive plants.

3.14.3 Wild and Scenic Rivers

Affected Environment

Several rivers on the Forests and Grasslands are partially or completely within the National Wild and Scenic River System, as designated by Congress, or have been identified as eligible to be included. The intent of the 1968 Wild and Scenic Rivers Act is to maintain the free-flowing character of the designated rivers and to protect their "outstandingly remarkable values." Outstandingly remarkable values (ORV) 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. The ORVs for the wild and scenic rivers on the Forests and Grassland are identified in Table 112. Table 111 lists the river where project area units are overlapping the corridor or adjacent to the corridor as well as the types of treatments that would occur.

Table 111. Project Area Units within or Partially within Designated and Eligible Wild and Scenic River Corridors.

River Segment	Project Area Units	Species	Treatment Methods	Site Types
Upper Deschutes River*	11-38, 11-23, 11-80, 11-57, 11-11, 11-10, 11-50, 11-62, 11-67,	CIVU, CEDI3, CEBI2, CIAR4, PHAR3, HYPE, LIDA, ELRE4, EUES	Chemical/manual Manual/mechanical Manual Mechanical/manual/cultural	Dispersed camping Trail and day use Meadow Road-stream Road-forest

	11-68, 11-69, 11-70, 11-71			
Crooked River	75-10	CEBI2, CEDI3, TACA8, ONAC	Chemical Chemical/manual	Quarry
North Fork Crooked River	71-01, 71-08, 71-25, 72-03, 72-67, 72-68	CIVU, CEBI2, CEDI3, CYOF, LIDA, ONAC	Chemical/manual Manual chemical Biological	Quarry Road Stream
Metolius River*	15-12, 15-17, 15-18, 15-19, 15-21, 15-32,	TACA8, HYPE, CYSC4, CIVU, CEDI3,CEBI2, LIDA, SEJA, CIAR4, PHARP	Chemical/manual/cultural Chemical/manual/biological Chemical/manual Manual mechanical	Road Stream
Whychus Creek	15-03	CEBI2, CEDI3	manual	Road
Little Deschutes River*	N/A	None	N/A	N/A
Crescent Creek	12-03, 12-04, 12-07	CEBI2, CEDI3, CIVU, CYSC4, LIDA, HYPE, CAPU6, CESO3, COAR4, KOSC, MEOF, SAKA	Chemical/manual manual	Road
Big Marsh Creek*	12-05	CIVU, CIAR4, PHAR3	Manual/chemical Cultural/chemical manual	Wetland
Jack Creek (Eligible)	15-10, 15-16, 15-21,	HYPE, CYSC4, CIVU, CEDI3,CEBI2, LIDA, SEJA, CIAR4, PHARP	Manual Chemical/manual Chemical/manual/biological mechanical	Road
Deschutes River (Eligible)	11-07, 11-09, 11-35,	CEBI2, CEDI3, HYPE, LIDA, PHAR3	Chemical/manual Mechanical/manual/cultural	Road Lake
Fall River (Eligible)	11-10	CEBI2, CIAR4, CIVU, CYSC4, HYPE, LIDA, PHAR3	Chemical/manual Manual Mechanical/manual/cultural	Road
Browns Creek (Eligible)	11-10	CEBI2, CIAR4, CIVU, CYSC4, HYPE, LIDA, PHAR3	Chemical/manual Manual Mechanical/manual/cultural	Road-forest
Paulina Creek (Eligible)	11-03, 11-33	CEBI2, CIAR4, HYPE, LIDA	Chemical/manual Manual Mechanical/manual/cultural	Road-forest Lake

*Management Plans have been completed for these rivers. See http://www.fs.fed.us/r6/centraloregon/projects/planning/major-plans/index.shtml

Table 112. Outstandingly Remarkable Values for the Wild and Scenic Rivers on the Deschutes & Ochoco NFs and CRNG.

ORV	Upper Deschutes	Crooked	N. Fork Crooked	Metolius	Whychus Cr.*	Little Deschutes	Crescent Cr.	Big Marsh Cr.
Vegetation or Ecology	X		X	X		X	X	X
Scenery	X	X	X	X	X	X	X	X
Geology/Hydrology	X			X	X	X		X
Fisheries/Fish Habitat	X			X	X			
Wildlife	X			X				X
Recreation	X	X		X				
Cultural	X			X**	X			

* Resource Assessment is in Draft
** Historic and prehistoric values, and traditional uses

Environmental Consequences

Direct, Indirect, and Cumulative Effects

Consequences of No Action

Many of the invasive plant sites within the Wild and Scenic corridors occur along roads that serve as major access routes to recreation areas. Previous NEPA documents determined there would be no significant impact to the ORVs of the Wild and Scenic Rivers from the treatments authorized in 1998. Unless identified in the previous NEPA documents listed on page 24, these sites would not receive adequate treatment, leaving them to spread, which could impact Wild and Scenic River values by degrading scenery and vegetation, affecting fish and wildlife habitat, and impacting recreationists.

Native species diversity would be reduced by uncontrolled spread of invasive plants. In susceptible areas monocultures can develop, reducing biological diversity by displacing the macro and microfauna that depend on native plants for habitat and food. Severe infestations such as this reduce community productivity, species diversity, and species richness (Sheley and Petroff 1999). This would have a direct effect on vegetation and ecology ORVs of the Upper Deschutes, North Fork Crooked, Metolius, Little Deschutes, Crescent and Big Marsh Creeks. These creeks were designated for their vegetation and ecology outstanding values, which is based on native plant communities, not invaded by exotic introduced species. The consequences of changes in native vegetation affect other values as well, including wildlife presence within the wild and scenic river corridors, as they are dependant on native vegetation.

The Upper Deschutes and Metolius Rivers have fisheries and fish habitat as outstanding remarkable values. Infestations of reed canarygrass and quackgrass occur along the Upper Deschutes River, and ribbongrass occurs along the Metolius River. These are particularly aggressive monoculture-forming invasive grasses that would not be controlled under Alternative 1. Although these species have several beneficial traits including high root density for bank stabilization and erosion control, and robust vegetation providing some shade, these traits ultimately have negative impacts on water quality and fisheries habitat. Dense mats of these grasses out-compete and prevent native deciduous shrub establishment. Deciduous vegetative material, such as falling catkins and bud scales from willow, black cottonwood and red alder provide a major source of nutrients to aquatic bacteria which feed aquatic macroinvertebrates that are a critical to juvenile salmon diets (Miller et al, 2008).

Water quality and the free-flowing nature of the Forests and Grassland wild and scenic rivers may be at risk from several invasive plant species listed in Table 111, including ribbongrass, reed canarygrass and quackgrass. For example, unchecked spread of the invasive ribbongrass on the banks and islands of the Metolius River may eventually lead to channel changes that could negatively affect the character of the stream. The dense growth of ribbongrass and reed canarygrass slows water flow and increases siltation (Miller et al, 2008).

Effects of Alternatives 2 and 3

With the implementation of both action alternatives, control would be accomplished within 31 project area units overlapping Wild and Scenic corridors and in nine units overlapping the eligible rivers. These project area units can each include several invasive plant sites, and the majority of the infestations are small, consisting of less than a acre each, ad occur along roadways and rock pits, treatment of which would not affect ORVs within the wild and scenic rivers. The exception is the invasive grass infestations described above, affecting the Upper Deschutes (2 acres), Metolius (scattered within 119 ac.) corridors. Reed canarygrass also occurs within Big Marsh Creek (2 acres), and the eligible Deschutes River (2 acres), and Paulina Creek (5 acres).

A common outstandingly-remarkable value (ORV) for the rivers is scenery. Invasive plant treatments can temporarily affect scenery if large numbers of target plants are clumped together and are seen when dead or dying and turning brown, in particular this will be the case for the invasive grass sites listed above. Also, manual treatments could cause visible ground disturbance. Concentrations of dead and dying plants may be evident and unattractive to some people; there would be slight alterations in landscape color and texture. However; these effects are small in scale and would not be noticed the following growing season when the residual live, green native vegetation dominates the view. These treatments would contribute to maintaining native plant communities which in many instances have been identified as an ORV.

Controlling invasive plants in these corridors would be beneficial to vegetation, but would have negligible effects to other outstandingly remarkable values (see 3.4 Native Vegetation, 3.6 Water Quality; 3.7 Fisheries. Project design features (PDFs) are incorporated to ensure protection of water quality, fisheries, and non-target plants and wildlife. Alternative 3 provides more restrictions on chemicals that can be used and by what method within proximity to water. Neither alternative would impact the free-flow character of the streams. Following the implementation plan (Appendix F) and project design features 31-34 would limit interaction between invasive plant control efforts and forest visitors at areas such as scenic overlooks. These design features include avoiding treatment during high use periods, posting treatment dates in advance at trailheads, and minimizing the number of workers.

Alternative 3 provides more restrictions on chemicals that can be used and by what method within proximity to water. Picloram, triclopyr and sethoxydim would not be used within aquatic stream buffers (see Chapter 2, Tables 15 & 16 for a list of buffer widths). Picloram would be the most effective control on five species that occur within wild and scenic river corridors, including Dalmatian toadflax, scotch thistle, leafy spurge, Russian knapweed and field bindweed. More frequent treatments may be necessary as a result of using a less effective herbicide, which is anticipated to impact the scenery more often. However, as stated above, most of these infestations are small and are along roadsides, and would be subordinate to the overall landscape.

Implementing the early detection/rapid response strategy would have the same minor short-term effects, but on an even smaller scale, as infestations would be found and treated quickly. The implementation plan described in Chapter 2 and Appendix F would ensure a site-specific prescription and monitoring plan for each new infestation proposed for control. The visual absorption capacity of the wild and scenic river corridors is great enough to tolerate herbicide, manual and mechanical treatments.

Cumulative Effects

Throughout the timeframe of this project, approximately 0-15 years, other actions may occur in the Wild and Scenic corridors. Scenic integrity of the corridors will not be further reduced by invasive plant treatments. Treatments, even if they were to occur simultaneously with other activities, would not affect the free-lowing nature of the rivers, most ORVs, and would have a minor short-term effect on scenery.

3.14.4 Research Natural Areas

Affected Environment

Research Natural Areas are part of a national network of ecological areas designated in perpetuity for research and education and/or to maintain biological diversity on National Forest System lands. Natural processes are to be allowed to continue in Research Natural Areas (RNAs) for research purposes and education. The Forest Supervisor and District Rangers have the responsibility to approve all management plans and to administer, manage and protect all Research Natural Areas (FSM 4063.04b). Forest Service Manual 4063.3 further directs control measures be taken on exotic plants introduced into RNAs using techniques that specifically target exotics with minimal impact to other components of the ecosystem.

Table 113. Research Natural Areas with Project Area Units Overlapping or Adjacent.

Research Natural Area	Project Area Units	Site Type	Species	Treatment Methods	Native Plant Communities Potentially at Risk
Headwaters Cultus River RNA (proposed)	11-07 (adjacent)	Road	CEBI2, CIAR4, HYPE, LIDA	Chemical/manual	Engelmann spruce bottomlands Lodgepole/blueberry/forb wetlands Lodgepole/bitterbrush/sedge Ponderosa/bitterbrush/needlegr ass
Katsuck Butte RNA (proposed)	11-07 (adjacent)	Road	CEBI2, CIAR4, HYPE, LIDA	Chemical/manual	Mtn. hemlock/grouse huckleberry lodgepole pine/grouse huckleberry
Cache Mtn. RNA (established)	15-30 (adjacent)	Road	CEBI2, CIAR4, HYPE, SEJA, CEDI3	Chemical/manual Manual Mechanical Chemical/manual/ biological	6 plants communities ranging from moist meadows through mixed conifer
Metolius RNA (established)	15-19 (adjacent)	Road	CEBI2, CIAR4, HYPE, CYSC4 SEJA, CEDI3	Chemical/manual Manual Manual/biological	Ponderosa pine/bitterbrush and ponderosa pine-Douglas fir/green manzanita
Ochoco Divide RNA (established)	71-16, 71-32	Road/ General Forest	ARMI2, CEBI2, CYOF, TACA8, COAR4	Chemical/manual	Grand fir Ponderosa pine
Grassland Island RNA (established)	75-47	General Forest	TACA8	Manual	Sagebrush/steppe

Environmental Consequences

Consequences of No Action

Invasive plant species are degrading the natural conditions of RNAs where they have been invaded. The No Action Alternative does not provide an effective means of controlling these infestations and would allow three project area units within the Ochoco Divide and Grassland Island RNAs to go untreated (see Table 113). In addition, there is multiple project area units listed in Table 126 with noxious weed infestations adjacent to RNAs. These sites would continue to spread from the roadside and may invade RNAs that currently have no known invasive plant sites. Unit 15-19 involves a heavily-infested major access road into the Metolius River area. Without treatment, the six species that are currently known along the road could continue to expand throughout the area, and potentially into the Metolius RNA which currently has no known invasive plant sites within the RNA. Table 113 also shows the native plant communities at risk to invasion by invasive species.

Effects of Alternatives 2 and 3

Control of invasive plants is proposed in the Ochoco Divide and Grassland Island RNAs. All other RNAs listed in Table 113 are not currently infested with weeds, but have weeds along road systems adjacent to RNA boundaries. Treatment of invasive plants is consistent with the direction for RNAs: it is necessary for maintaining the natural conditions of the area. Invasive plant control measures, including the use of herbicide, are under the authority of the District Ranger (FSM 4063.04b). Use of herbicides within the established Ochoco Divide RNA (site 72-32) would allow successful treatment within a shorter timeframe than hand-pulling, and would prevent hard to control species like knapweed, houndstongue and medusahead from spreading throughout the RNA. In addition, herbicide is proposed along the 2210 Road (area 71-16) which traverses the Ochoco Divide RNA to control houndstongue, spotted knapweed and lesser burdock. Control of these infestations is proposed as spot treatment, targeting individual invasive plants, with little affect on native species. The Island RNA on the Crooked River National Grassland, which is a peninsula of Forest Service land overlooking Lake Billy Chinook, has a scattered but extensive medusahead infestation. Medusahead is a high-priority species for control. Partnerships with Bureau of Land Management and the Native Plant Society have worked together on hand-pulling which is currently considered effective at controlling this site; continuation of this treatment is proposed in both action alternatives. Three project area units (11-07, 15-19, and 15-30) are roads located adjacent to RNAs; these RNAs do not currently have known invasive plant sites. Effective control measures along roadsides would reduce the likelihood that invasive plants could become established in the RNAs.

EDRR

There would be no difference between the effects of the two action alternatives within the RNAs. Early detection rapid response would provide a means to effectively control invasive plants while infestations are small, preventing long-term effects to native plant communities.

Cumulative Effects

There are no effects to RNAs on the Deschutes NF, and therefore no cumulative effects. There are no management activities that take place either in the Island or Ochoco Divide RNAs. These areas are set aside for education and research. Aside from the benefit of controlling invasives, there would be no cumulative effects from the treatments to the RNA values.

3.14.5 Newberry National Volcanic Monument

Designated by Congress in 1990, the Newberry National Volcanic Monument covers approximately 50,000 acres of the Deschutes National Forest. It was established "in order to preserve and protect for present and future generations Newberry's remarkable geologic landforms – and to provide for the conservation, protection, interpretation, and enhancement of its ecological, botanical, scientific, scenic, recreational, cultural, and fish and wildlife resources. (Public Law 101-522)." (USFS 1994b, p 1).

Affected Environment

Table 114. Project Area Units within or Partially within Newberry National Volcanic Monument

Project Area Units	Site Type	Species	Treatment Methods
11-01	Road-forest; major transportation vector bisecting monument	CEBI2, CEDI3, HYPE, LIDA, ONAC, SAKA	Chemical/manual
11-03	Road and sno-park	CEBI2, CIAR4, HYPE, LIDA	Chemical/manual
11-33	Lake; high-use recreation	CIVU, PHAR3	Mechanical/manual/cultural
11-38	General Forest	CIVU	manual

Highway 97 bisects the Monument; vehicles are a major vector of weed introduction and spread. Knapweed populations have been greatly reduced as part of the treatment authorized by the 1998 Noxious Weed Control EA, Russian thistle is not authorized for treatment and populations have increased. Project Unit 11-03 is within the Monument and includes Road 21, the access road to the Paulina Lakes, and 10-Mile Snopark. There are fourteen small sites scattered along the road and snopark. The west shore of Paulina Lake (11-33) is a high use recreation site including resort and boat launch. Reed canarygrass grows along the shoreline. Project Unit 11-38 consists of numerous small bull thistle infestations scattered throughout disturbed areas.

Environmental Consequences

Effects of No Action

Because current inventory shows invasive plant sites along roads and in high-use recreation areas, there is a strong probability that the sites will spread within the project area units along the roads and also be spread from the high-use sites to other areas of the Forest. Invasive plant sites approved for treatment under the earlier NEPA documents (Highway 97) do not adequately address all of the existing infestations, species, and effective chemicals. Spread of existing infestations and new invasive plant introductions are expected to increase if no control action is taken. The Monument is a popular area for sight-seeing and recreation; and the vectors of invasive plant spread are many, including watercraft, vehicles, and humans. Unimpeded spread of invasive species would detract from the Monument's basis for establishment, stated above.

Effects of Alternatives 2 and 3

Invasive plant sites within the Monument that occur along the roadside and west shore of Paulina Lake (11-01 and 11-03) will be treated with herbicides. Bull thistle within the Project Area Units will receive manual and mechanical treatment methods, as this species is a biennial ad is easy to control. As with other designated areas, the values for which the Monument is established will benefit from the control and reduction of invasive plants. Resources that are to be protected within the boundaries, such as botanical resources, will benefit from the invasive plant treatments because native vegetation will be restored.

Based on the location of currently mapped infestations, it is likely that future control of invasive plants will be required along the roads in the Monument. New infestations would be analyzed using the EDRR strategy and implementation protocol outlined in Chapter 2 and Appendix F.

3.14.6 Inventoried Roadless Areas

Inventoried Roadless Areas (IRAs) occur across both Forests, are mapped in the Final Environmental Impact Statement for the Roadless Area Conservation Final Rule, and can be found at http://roadless.fs.fed.us/states/or/desc.pdf and http://roadless.fs.fed.us/states/or/ocho.pdf. Inventoried roadless areas are National Forest System lands typically exceeding 5,000 acres that meet the minimum criteria for wilderness consideration under the Wilderness Act of 1964.

Affected Environment

There are approximately 198,000 acres of IRA across the Deschutes and Ochoco NFs and Grassland. The majority of PAUs listed in the table below are along major access routes that bisect the roadless areas.

Table 115. Project Area Units that overlap Inventoried Roadless Areas

Inventoried Roadless Area	Project Area Units	Project Area Unit Description	Treatment Methods*
Bearwallows	15-03	Road plus adjacent disturbed area; spotted and diffuse knapweed spreading along road.	Manual
Bend Watershed	11-17	Knapweed, Canada thistle ad toadflax in the floodplain; Tumalo Creek stream restoration area. Mapped weed site does not currently enter IRA	Chemical/Manual
Maiden Peak	12-01	Plantation at edge of IRA	Manual w/ selective chemical as needed for expansion
West-South Bachelor	11-39	Reed canarygrass at Lava Lake.	Mechanical, manual, chemical, cultural
Mt. Jefferson	15-05, 15-02	Roads and adjacent disturbed areas; including Highway 20. Six inventoried species; knapweed expanding	Chemical, manual, biological
Metolius Breaks	15-12	Road plus adjacent; only known medusahead on Deschutes NF.	Chemical, manual, cultural, biological
South Paulina	11-38, 11-03	Road & forest; Newberry National Volcanic Monument. Five species.	Manual, Chemical
North Paulina	11-43	Canada thistle at pods created by geothermal test drilling.	Chemical, manual
Deschutes/Steelhead Canyon	75-43, 75-56, 75-42	Road, General Forest, Stream. Large knapweed & medusahead sites and adjacent private land.	Chemical, manual
Green Mountain	71-48	Eleven species on primary access route to the west end of the district.	Chemical, manual, biological
Lookout Mountain	71-11, 71-18	Whitetop and St. Johnswort on the 4215 Road.	Chemical, manual

Rock Creek	72-49, 72-70	Diffuse knapweed on major access road and within rock quarry.	Chemical, manual, biological
Cottonwood Creek	72-48	Himalayan blackberry near hiking trail. Only known site.	Chemical

*In combination or alone, depending on species, see Appendix A for specific treatment.

Environmental Consequences

Effects of No Action

Invasive plants are known to occur in several IRAs (see Table 115). Some sites were addressed in previous NEPA documents. These include small areas of herbicide application on major access roads adjacent to the Maiden Peak, Mt. Jefferson, Lookout Mountain, Green Mountain and Rock Creek roadless areas, which were included in the 1998 Noxious Weed EAs. Also included are two small diffuse knapweed sites within the Deschutes Canyon roadless area. These infestations are currently reduced to where manual treatments are effective for control. There are however, new infestations and new species that have become established since 1998 that are listed in Table 115. Where not already covered, or without effective treatment, these sites are likely to expand and provide for expansion to other areas (see Section 3.3 Treatment Effectiveness). The Cottonwood Creek IRA has the only known site of Himalayan blackberry. It is a high-priority site with an objective of eradication. The canes of the Himalayan blackberry can grow up to lengths of 7 meters in a single season (Mazzu 2005); where these canes root new daughter plants can develop. Without treatment it could spread rapidly.

Most of these roadless areas receive high recreation pressure from forest visitors, including horse use, and the number of invasive plant sites is expected to continue over time due to these vectors of introduction and spread. The No Action alternative provides no mechanism for responding quickly to newly discovered invasives. Areas that are currently uninfested but near invasive plant sites are at risk from them expanding.

Effects of Alternatives 2 and 3

Most project area units that are near or overlap the IRAs occur along road corridors that run parallel to the boundaries. Treatments along roads, trails, and adjacent disturbed areas make it less likely that the sites will expand into the IRAs. Controlling invasive plants improves habitat for TES species and native plants in general (see Native Vegetation, Chapter 3.4).

Alternative 2 would control Himalayan blackberry along Cottonwood Creek because it would allow the preferred herbicide to be used within 300 feet of the water (triclopyr, which is selective, spot or hand application only). Alternative 3 would allow the 2nd choice alternative to be used, but it is not selective (glyphosate), so would also affect grass species creating a larger impact to non-target vegetation.

The Early-Detection/Rapid Response (EDRR) strategy will allow early treatment of new infestations while they are small and will help prevent establishment and spread of invasive plants into uninfested areas.

Values associated with IRAs such as natural-appearing landscapes, good water and habitat, and protection of cultural resources will benefit from the control of invasive plants. Precautionary measures to protect fish, wildlife, and non-target plants are built into the alternatives (see Chapter 2.4).

Cumulative Effects

Invasive plant treatments will have no cumulative effect on IRAs, but may offset negative impacts of weed invasion. Inventoried Roadless Areas on the Deschutes NF do overlap with vacant or closed grazing allotments. Cattle and sheep grazing and invasive plant control is not a cumulative effect. On the Ochoco NF, grazing does occur in the Green Mountain and Lookout Mountain Roadless Areas. There are 385 cow/calf pairs that graze in Green Mountain for 50 days. There is a sheep allotment of 1100 pairs that graze the northwest end of Lookout Mountain for three months. There are also three small cattle pastures on the east and south edges of Lookout Mountain that are grazed for short duration (20-30 days). There are also approximately 60 wild horses that use the Lookout Mountain IRA. Cattle, sheep and horses are known vectors of invasive plant introduction and spread. Proposed invasive plant control measures along roads adjacent to IRAs would limit the spread potential due to livestock by reducing the amount of seed produced that would be carried into the roadless area. The EDRR strategy would also provide a way to quickly control infestations that may be caused by livestock and wild horse grazing.

3.14.7 Experimental Forest

No Action and Alternatives 2 and 3

Burgess Road (Hwy 43) crosses the Pringle Falls Experimental Forest on the Deschutes National Forest. The road accesses recreation sites along the Deschutes River, including a section of privately-owned land. Spotted knapweed and Dalmatian toadflax have been inventoried along this road. Project Area Unit 11-11 incorporates the known weed sites and the rest of the road to account for incomplete inventory and potential spread along the road corridor. Proposed chemical and manual treatments will have no effect on the values for which the Experimental Forest was designated (to conduct research activities for silvicultural practices on lodgepole and ponderosa pine). Recent road closures may have a beneficial effect of reducing invasive plant spread into the Experimental Forest; however, high recreation use still poses a risk of introduction of new species. It is expected that the No Action alternative would result in the spread of toadflax and spotted knapweed along the road and subsequently into the Experimental Forest. Further introduction of other invasive species is also expected due to the high vehicle traffic and recreation use in the area. The No Action Alternative also does not include the EDRR strategy to quickly stop the spread of new infestations.

Summary Designated Areas

A prevailing theme in the goals and objectives for these designated and special areas is the desire to maintain natural conditions. Invasive plant treatments are consistent with this. Many of these areas are at risk of losing habitat to invasives (see for example, Section 3.4 on sensitive plants that are currently threatened by invasive plant infestations). The short-term and minor impacts from treatment to the values of these areas are compared to the potential long-term and more negative impacts of the invasive plants. Both action alternatives will help to protect native plant communities in unique areas by aggressively treating invasive plant populations in those areas or along roads and trails leading to them. Alternative 2 treats has more herbicide options available and therefore would allow more areas to be treated faster and more effectively thereby protecting the native plant communities in unique management areas, because there are more tools and methods available to treat invasive plant populations. The two action alternatives provide a mechanism for treating new invasive plant sites that if left untreated could expand into specially designated areas. The response to and treatment of new or currently undetected invasive plant populations in Congressionally-designated or areas of special interest is expected to have the same minor short-term effects and the same long-term positive effects as described earlier for known sites.

3.15 Forest Plan Amendments

Alternatives 2 and 3 in this Draft EIS propose an amendment to the Ochoco National Forest Land and Resource Management Plan (Forest Plan). The proposed amendment is a minor change to two of the standards and guidelines in the Forest Plan.[22] The purpose of the amendments is to reconcile the Ochoco Forest Plan with recent standards and guidelines established in the 2005 Invasive Plant Program Record of Decision (USFS 2005b). The proposed changes are described in Table 14. These amendments if approved would be effective at the time of the decision and would apply to the respective management areas throughout the Forest and Crooked River National Grassland.

The regulations for forest planning under the National Forest Management Act (36 CFR Part 219, as of July 1999) provide procedures for the Responsible Officials to amend a Forest Plan.

The regulations state: "If the change resulting from the amendment is determined not to be significant for the purposes of the planning process, the Forest Supervisor may implement the amendment following appropriate public notification and satisfactory completion of NEPA procedures" (36 CFR 219.10(f)). Additional guidance on amending Forest Plans is provided in the Forest Service Manual 1900-Planning. Section 1926.51 describes non-significant amendments as:

1. Actions that do not significantly alter the multiple-use goals and objectives for long-term land and resource management;
2. Adjustments of management area boundaries or management prescriptions resulting from further on-site analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long –term land and resource management;
3. Minor changes in standards and guidelines; and/or
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescriptions.

The proposal to amend the Forest Plan was described in a notice mailed to the public in March of 2006. The proposed amendment does not propose changes in management area boundaries or prescriptions, but does represent minor changes in standards and guidelines and provides for additional management practices that could contribute to achieving management prescriptions.

The proposed minor changes to the standards and guidelines would not alter any of the multiple use goals or objectives outlined in the Forest Plan for the Ochoco NF or Crooked River NG. To the extent that invasive plants may adversely affect the multiple use goals of these management areas, however, allowing for the appropriate use of herbicides to treat invasive plant populations in these areas could contribute to achieving multiple use goals.

The minor change to forest and grassland-wide standards do not change the overall intent of the standards. The standards as written could mean that methods other than herbicides need to be tried first on a weed site before herbicides could be used. In other words, they would be used only as a last resort when other methods fail. That would contradict the Regional Forester's direction in the R6 2005 Record of Decision for the Invasive Plant Program (USFS 2005b). The Record of Decision established that only allowing herbicides to be used as a method of last resort is inconsistent with integrated weed management principles (ROD page 27). The amendment makes the Ochoco Forest Plan consistent with this most recent direction.

[22] The two standards were incorporated into the Ochoco Forest Plan through amendment in 1995 (Ochoco National Forest and Crooked River NG Weed Environmental Assessment and Decision Notice).

3.16 Other Disclosures

Smoke Management and Clean Air Act

Treatments within Project Area Units 72-15 and 72-37, totaling approximately 14 acres, will include the use of controlled burning prior to herbicide application (see Figure 8, p. 317). The use of fire is intended to clear away dense standing old houndstongue and seed beds in dense stands of houndstongue to facilitate herbicide application. The fuel on site is primarily herbaceous (houndstongue, mullein, bull thistle, grass, and bare ground). Very few planted trees occur in the locations to be burned. These areas would likely be burned in the spring when soil and fuel moisture are appropriate. Burning will occur once in a season, for no more than two seasons.

The Oregon Department of Environmental Quality (ODEQ) is responsible for assuring compliance with the Clean Air Act. In 1994, the Forest Service, in cooperation with the ODEQ, the Oregon Dept. of Forestry, and the Bureau of Land Management, signed a Memorandum of Understanding (MOU) to establish a framework for implementing an air quality program in Northeast Oregon. The MOU includes a prescribed fire emission limit of 15,000 tons of PM 10 per year for the national forests of the Blue Mountains (which includes the Ochoco). PM10 are particulate matter that measure ten microns in diameter or less, and are small enough to enter the human respiratory system.

Burning would be conducted under the State of Oregon Smoke Management System to track smoke produced and would be coordinated through Oregon Department of Forestry. Controlled burning would be conducted under favorable smoke dispersal conditions and would be avoided during inversion conditions, which would increase the potential for smoke pooling in valleys and drainages.

Smoke from the burning operations would not affect any Class I Wilderness or urban Special Protection Zones because of where Project Area Unit 72-15 and 72-27 are located. The nearest Class I wilderness is the Strawberry Mountain Wilderness, nearly 45 miles to the east. The nearest special protection zone is Bend, approximately 75 miles to the west, into the prevailing winds. Prescribed fire operations are not expected to contribute significantly to smoke pooling in the Paulina Valley. Impact from smoke could affect widely scattered individual dwellings in the Paulina Valley, and would be short-term.

Energy Requirements and Conservation Potential

There are no unusual energy requirements associated with this project. No unusual equipment would be used. Fossil fuels would be used in a prudent manner.

Environmental Justice and Civil Rights

This project would not result in disproportionate impacts to low income or minority groups. It is the policy of the Forest Service that the Responsible Forest Service Official (FSM 1704) review proposed actions for civil rights impacts and take either of the following actions in compliance with DR 4300-4 and 1010-1 (FSM 1730.1): prepare a civil rights impact analysis and statement of its findings for any proposed policy or organizational action which may have a major civil rights impact, or document the determination that a civil rights impact analysis and a statement of findings are not needed. In order to make the determination that a civil rights impact analysis and a statement of findings were not needed, we scoped with more tan 700 individuals, organizations, tribes, and other agencies as part of the NEPA process.

Irreversible or Irretrievable Use of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a powerline right-of-way or road.

No irreversible or irretrievable uses of resources are associated with this invasive plant treatment 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.

Effects on Long-term Productivity

Positive effects on site productivity would be expected as native vegetation is restored. None of the herbicides under consideration for use has been shown to have a notable effect on soil productivity.

Prime Farmlands, Rangelands, Forestlands

No prime farmland, rangeland, or forestlands exist in the project area; therefore, there would be no effects to these. Under the No Action alternative, continued spread and incidence of invasive plants on National Forest System lands could impact adjacent private lands which could be considered prime farmland or rangeland. Alternative 2 would be the most effective because of reduced costs and more herbicide options available and therefore it would better reduce the potential of invasive plants to spread to adjacent private lands from National Forest System lands (also see discussion in Chapter 3.3, Treatment Effectiveness).

Floodplains and Wetlands (Executive Orders 11988 & 11990)

Proposed invasive plant treatments within the riparian areas and wetlands are discussed in Chapter sections 3.6 and 3.7.

The proposed treatments would be implemented using the standards from the Invasive Plant ROD (USFS 2005b) and Project Design Features (Chapter section 2.4). The project does not involve any construction or improvements to occur in wetlands; no destruction or modification of wetlands will take place. No occupancy, development, or modification of floodplains is proposed. No adverse impacts associated with construction, developments, or improvements will occur from any alternative.

Consistency with Forest Service Policies and Plans

The action alternatives are consistent with all Forest Service policies and existing plans, except where Forest Plan Amendments are described in Chapter 2 (Table 14). Refer to Appendix C for applicable standards and guidelines from Forest Plans. Project implementation will comply with pesticide use reporting as required by Oregon State law and Forest Service manual direction.

Conflicts with Other Plans or Policies

NEPA directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with … other environmental review lands and executive orders.” 40 CFR 1502.25(a). Based on information received during scoping and informal consultation meetings, none of the alternatives would conflict with existing plans or policies of other jurisdictions. Refer to Chapter 2 for the description of a non-significant Forest Plan Amendment that will align two standards and guidelines of the Ochoco Forest Plan with the new direction provided with the R6 ROD (USFS 2005b).

A recent lawsuit, Washington Toxics Coalition et al. v. EPA, regarding the lack of Endangered Species Act consultation on allowable public use of certain herbicides, was resolved by requiring certain buffers near streams. Herbicide use on federal land was exempt from the buffer zone requirement because such use already "implements safeguards routinely required" by the regulatory agencies.

Adverse Effects that cannot be Avoided

Most issues have been resolved through development of and 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:

- Common non-target plants are likely to be killed by treatments in close proximity. This is most likely to occur with broadcast spraying of herbicides. The adverse effects of the invasive plants themselves outweigh the potential for adverse effects to non-target species. See Sections 3.4 for a discussion of expected effects (beneficial and negative) to non-target vegetation.
- Invasive plant treatment will incur a cost to the government. Ultimately the taxpayers will be responsible for most costs of treatment. Section 3.10 provides estimates of project cost.
- Herbicide toxicity exceeding thresholds of concern are unlikely but possible given an accidental herbicide spill or unpredictable weather event.
- Although effects of herbicide treatments on the soil resource are minimized (because of compliance with standards and guidelines and local project design features), and overall effects of herbicide application on the soil resource are not expected to be significant at the Forest scale, some adverse effects have been shown to be unavoidable. These include primarily localized effects on soil microorganisms and soil productivity as a result of the toxicity and persistence of herbicides, and changes to soil disturbance and/or cover levels as a result of manual and herbicide treatment methods. See Section 3.5 for information on effects to soils.

Incomplete or Unavailable Information

CEQ NEPA regulations require the Forest Service to disclose when information that is relevant to reasonably foreseeable significant adverse impacts is incomplete or unavailable (40 CFR 1502.22). There are no significant adverse impacts expected from either action alternative analyzed in this EIS.

As discussed in Chapter 3.1.3, there is no accurate accounting of all acres of invasive plant treatment within the watersheds where this project is proposed. The state's pesticide reporting program provides some information, but it is voluntary, applies only to certain landowners, and is therefore not a reliable source for the data. However, because a significant adverse effect is not foreseeable; the risk of an adverse effect from herbicide use on National Forest System lands accumulating in the waters downstream is shown to be nil), this information is not essential to a reasoned choice among the alternatives.

Studies are not available regarding the effects of herbicides on native, non-target species. The EPA performs studies predominantly on crop species rather than native species. The R6 FEIS disclosed that research by Boutin (2004) showed it was likely that species tested were not representative of the habitats found adjacent to agricultural treatment areas, thus risk to native species may be underestimated. The information would not be relevant to reasonably foreseeable significant adverse impacts essential to a reasoned choice among alternatives because herbicide effects to native species can be extrapolated from the risk assessment or herbicide labels. This project considers site-specific information, including potential impacts to non-target species when determining the prescription for invasive plants (see for example, Table 34, PDFs that protect non-target vegetation).

SERA Risk Assessments (see Chapter 3.2) identify and evaluate incomplete and unavailable information that is potentially relevant to human health effects resulting from herbicide use. Information is necessarily incomplete on potential toxic doses of most herbicides in humans, and on the variation in dose-response among individuals in the human population. Preparation of Environmental Documentation of Risk Assessments (SERA 2001a) discusses the generally-accepted scientific regulatory methodologies to encompass these uncertainties in predictions of risk.

Chapter 4

Consultation & Coordination

Chapter 4 Consultation and Coordination

Chapter 4 Changes Between Draft and Final

- Consultation information has been updated
- Information about the public comment period has been added.
- The Responsible Officials have been updated.

4.1 Consultation with other Agencies

4.1.2 Consultation with U.S. Fish and Wildlife Service and National Marine Fisheries Service (NOAA Fisheries)

Informal consultation was conducted with USFWS for northern spotted owl and Canada lynx. Based on the effects analysis prepared for the project, the project is not likely to adversely affect spotted owls and will have no effect on Canada lynx (see Chapter 3.9). Therefore, formal consultation is not required for these species.

Informal consultation was conducted with USFWS for bull trout. The Level I team was presented the proposed action and affected environment; conversations with the Level One Team has continued throughout the analysis stages. Informal consultation was conducted with NOAA fisheries on listed anadromous fish species and their habitat that occur within or near the proposed invasive plant treatment areas. For those watersheds where listed fish and their habitat occur, formal consultation with USFWS and NOAA began in April 2009. A Record of Decision for those areas will not be signed until a Biological Opinion is received.

4.1.3 Consultation with Oregon State Historic Preservation Office (SHPO)

The National Historic Preservation Act of 1966 requires consideration be given to the potential effect of federal undertakings on historic properties. This includes historic and prehistoric cultural resource sites, structures, and objects. The guidelines for assessing effects and for consultation are provided in 36 CFR 800. To implement these guidelines, the Pacific Northwest Region (Region 6) and the USDA Forest Service signed an agreement in 2004 with the Oregon SHPO and the Advisory Council on Historic Preservation. In accordance with the agreement, areas of potential effect were inventoried and project design features were developed to avoid impacts to any historic properties or potential historic properties. A no effect determination has been made for the proposed action (Alternative 2) and for Alternative 3 and documentation has been submitted to the Oregon SHPO for their review.

Any additional locations identified for treatment under the early detection/rapid response protocols will include review of potential effects to historic properties and compliance with the provisions of the National Historic Preservation Act as specified in the agreement with the Oregon SHPO and the Advisory Council on Historic Preservation.

4.1.4 Consultation with Tribal Governments

Potentially affected Tribes were first notified of the proposed action on September 23, 2005, by letters addressed to each of the following Tribes: Burns Paiute, Klamath, Confederated Tribes of the Warm Springs. The Tribes also received the January 2006 mailing of the alternative descriptions.

Several phone calls were made to Natural Resource Directors, and Cultural and Heritage Directors of the Tribes. The Tribes expressed concerns about the use of herbicides in areas of plant collecting and requested that notification and signing be used. These measures are incorporated into the action alternatives (PDFs and the implementation planning process (Appendix F)).

The Forest Service offered to provide electronic maps to the Burns Paiute, Klamath and Confederated Tribes of the Warm Springs (CTWS). The CTWS and Klamath Tribes accepted this offer; the Burns Paiute were provided paper maps.

A meeting was held with Confederated Tribes of the Warm Springs in May 2006. This meeting did not result in identification of any new significant issues related to the proposed action. The natural resource managers expressed support for treatment of invasive plants.

4.1.5 Consultation with State and County Noxious Weed Departments

Because the county weed departments and Oregon Department of Agriculture (ODA) conduct invasive plant treatments in and around the Forests and Grassland, they are experts in the selection and application of herbicides. Representatives of the ODA and Deschutes and Crook County noxious weed departments have been consulted on technical aspects of the project. These departments were invited to review the Project Design Features and the list of preferred herbicides for invasive species. They have also participated in field review of invasive plant sites, including discussions of herbicide application techniques and implementation of project design features.

4.2 Preparers and Contributors

This Draft EIS document was prepared by the USDA Forest Service, Deschutes and Ochoco National Forests, and Crooked River National Grassland. A Forest Service Interdisciplinary Team developed analysis, prepared the FEIS document, and provided technical review of analysis and documentation. This Chapter identifies the coordinators, resources specialists and others who participated in the overall preparation of the Draft and Final EIS for Invasive Plants Treatment, and includes the index for the document and the project glossary. A distribution list of agencies and people who requested a copy of the DEIS is also in this chapter.

RESPONSIBLE OFFICIALS

John Allen - Forest Supervisor, Deschutes National Forest

Jeff Walter – Forest Supervisor, Ochoco National Forest

ID TEAM MEMBERS

Beth Peer – USDA Forest Service, Deschutes/Ochoco National Forests
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Experience: Eighteen years experience with the Forest Service in planning, and GIS.

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Education: B.S., Wildlife Management, Humboldt State Univ. 1985; M.S. Zoology and Physiology, Univ. of Wyoming, 1988.
Experience: Eighteen years experience with the Forest Service in habitat and endangered species management, consultation, NEPA writing and reviewing, and exotic plant control in endangered species habitat.

Marcy Boehme, USDA Forest Service, Deschutes National Forest, Crescent Ranger District, Environmental Specialist
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Contribution: Alternative development, herbicide expert, human health effects analyst
Education: M.S., Humboldt State University, 1984
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Experience: Twenty-four combined years Forest Service and BLM in Recreation Management, Range Management, Fire Management, Special Uses, and Timber Management.

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Experience: Twenty-five years experience with the Forest Service in silviculture, recreation, public information and writing.

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Contribution: Soils Report; BAER Team Member
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Experience: Sixteen years experience with the Forest Service; Two years university instructor, trainer, and public facilitator on civil rights issues.

Donald Zettel - Archaeologist, USDA Forest Service, Deschutes NF, Sisters RD

Contribution: Heritage Resources Report, SHPO compliance report
Education: BA in Anthropology, UCLA, 1985, graduate work, University of Montana, 1986 and 87.
Experience: 19 years experience as archaeologist with Forest Service at Deschutes NF, Bighorn NF, and Black Hills NF, and two years as seasonal archaeology technician at Beaverhead NF.

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Kev Alexanian – Crook County Weed Management Specialist, Prineville, Oregon

Dave Langland –Oregon Department of Agriculture Weed Specialist, Redmond, Oregon

4.3 Distribution of the Environmental Impact Statement

The Draft Supplemental Environmental Impact Statement has been distributed in the form of a hard copy or compact disc to individuals who responded throughout the development of this project and is also available at the National Forests Website (http://www.fs.fed.us/r6/invasiveplant-eis/site-specific/DES/). In addition, copies have been sent to federal agencies, federally-recognized tribes, state and local governments. Where agencies or individuals requested only www access to the DSEIS, a letter informing them when and where the document is available has been sent. The comments received on the February 2007 Draft EIS and the Forest Service responses are available on the web site.

Received DSEIS or Notified of DSEIS Availability

Federal Agencies

U.S. Dept. of the Interior National Park Service
U.S. Dept. of the Interior Bureau of Land Management
U.S. Dept. of the Interior Fish and Wildlife Service
U.S. Dept. of the Interior Office of Environmental Policy and Compliance
U.S. Dept. of Agriculture Forest Service
  Pacific Northwest Region
  Mt. Hood National Forest
  Willamette National Forest
  Pacific Northwest Research Station, Blue Mountains Pest Mgmt. Service Center
U.S. Dept. of Agriculture APHIS PPD/EAD
U.S. Dept. of Agriculture, National Agricultural Library
U.S. Army Engr. Northwestern Division
U.S. Dept. of Energy, Office of NEPA Policy and Compliance
National Marine Fisheries Service
Environmental Protection Agency
Natural Resources Conservation Service
Advisory Council on Historic Preservation
Northwest Power Planning Council
U.S. Coast Guard, Marine Environmental and Protection Division
Federal Aviation Administration
Federal Highway Administration

American Indian Tribes

Burns Paiute Tribe
Confederated Tribes of the Warm Springs Reservation
The Klamath Tribe

Oregon State Government Agencies

Oregon Dept. of Agriculture
Oregon Dept. of Geology and Mineral Industries
Oregon Dept. of Forestry
Oregon Dept. of Environmental Quality

Oregon Dept. of Fish and Wildlife

County/Local Government Agencies
Crescent Water Association
Crook County
Crook County Natural Resources
Crook County Parks and Rec.
Grant County Soil and Water
Deschutes County CDD
Deschutes County Weed Board
Deschutes County Road Dept.
Klamath County Weed Control
Sisters-Camp Sherman Rural Fire District

Businesses
Bill Gowen, Mt. Bachelor Academy
Richard and Audrie Bedortha, Bedortha Ranches, Inc.
Tim McIsaac, Gutierrez Cattle Company
Robert Marheine , Portland General Electric
Ken Speakman, Grant Western Lumber Co.
John Morgan, Ochoco Lumber Company
Loy Helmly, Black Butte Ranch

Individuals
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Robert Ervin
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Tyler Groo
Charles and Helen McDonald
Allen Greendale
James Baird
Eunice and Dean Richardson
Greg Bedortha
Loy Helmly
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Bob and June Hill
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Jerry Asher

Organizations
Blue Mountain Biodiversity Project
Central Oregon Audubon Society

Deschutes Basin Land Trust
Sunriver Homeowners Assoc.
Sierra Club, Juniper Group
Oregon Wild
Northwest Coalition for Alternative to Pesticides
Crooked River Weed Management
Clean Air Committee
Friends of Metolius
Western Society of Weed Science
Rocky Mtn. Elk Foundation

Paper of Record: The Bulletin, Bend, Oregon

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PROJECT 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.

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 plants are physiologically suited for high survival, good growth, and resistance to pests and diseases in a particular environment" (Northern Region Native Plant Handbook, 1995).

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 (USDA, USDI 1994a).

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 - Areas removed from the suitable timber base through agency direction and land management plans.

Absorption – The assimilation of gas, vapor, or dissolved matter by the volume of a gas, liquid, or solid material.

Adsorption[23] - The tendency of one chemical to adhere to another material such as soil. The assimilation of gas, vapor, or dissolved mater by the surface of a soil colloid or organic matter through an ionic bond.

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.

[23] The following describes a general distinction between adsorption and absorption for herbicides: Adsorption refers to the tendency for the herbicide to be bound to soil colloids and held in place (affecting mobility and degradation rates), while absorption refers to the ability for plant roots to take up the herbicide on site.

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 13112, 2/3/99).

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.

Anastimozing – A channel that splits into several channels that rejoin irregularly.

Anions - Negatively charged ions in solution e.g., hydroxyl or OH– ion.

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. (Dayton, 1950)

Anoxia - Literally, "without oxygen". A deficiency of oxygen reaching the tissues of the body especially of such severity as to result in permanent damage.

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.

ATSDR - Agency for Toxic Substances and Disease Registry; federal agency within the Public Health Service charged with carrying out the health-related analyses under CERCLA and SARA.

Background level - In pollution, the level of pollutants commonly present in ambient media (air, water, soil).

Bacteria - Microscopic living organisms that can aid in pollution control by metabolizing 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 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 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.

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 aquatic organism to levels greater than in the surrounding water.

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" (USDA Forest Service. "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins", Vol. II, 1997).

Biological Control - The use of nonnative agents 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 - In pesticides, to spread a chemical over a broad area.

Bryophytes - Plants of the phylum *Bryophyta*, including mosses, liverworts, and hornworts; characterized by the lack of true roots, stems, and leaves (USDA, USDI 1994a).

Candidate Species - Those plant and animal species that, in the opinion of the Fish and Wildlife Service (FWS) or 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.

CAS Registration number - An assigned number used to identify a chemical. CAS stands for Chemical Abstracts Service, 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.

Cation - Positively charged ions in a solution.

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 2 years). Chronic exposure studies are used to evaluate the carcinogenic potential of chemicals and other long-term health effects.

Chronic RfD - An estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. Chronic RfDs (reference doses) are specifically developed to be protective for long-term exposure to a compound (7 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).

Colluvium - soil material or rock fragments moved downslope by gravitational forces.

Congressionally Reserved Areas - 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 (USDA, USDI 1994). 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 scalelike 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 13112, 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 - 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 exposures - Exposures resulting from one or more activities that are repeated over a period of time.

Detritus - Loose fragments, particles, or grains formed by the disintegration of rocks or organic matter.

Dicot – A plant with two seed leaves.

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" (USDA Forest Service. "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins", Vol. II, 1997).

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), sometimes 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 - That portion of a sprayed chemical that is moved by wind off a target site.

Emergent - For purposes of this project, the term "emergent" is used to better describe ground conditions relative to where invasive plants are growing alongside a stream or other waterbody. Emergent vegetation is defined as plants that grow from below the water line to above the water line. Free floating vegetation is not considered emergent and will not be treated with herbicides under this project.

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 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" (Allaby 1996). Compare to "Indigenous" and "Native".

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 - "Not native; introduced from elsewhere, but not completely naturalized" (Harris, 1994). See "Alien 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 wildlife or animals of a specified region or time.

Federally Listed Species - Formally listed as a threatened or endangered species under the ESA. Designations are made by the FWS or NMFS.

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.

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 as a tool for controlling invasive plants has been tested by the Nature Conservancy and used by the BLM effectively on puncture vine and slender false brome. Hot foam is a mechanical method. It is effective on seedlings and annuals and can be applied under 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. (Source: Carbon Dioxide Information Analysis Center, 1990)

Game Fish - Species like trout, salmon, or bass, caught for sport. Many of them show more sensitivity to environmental change than non-game fish.

Granitic – Coarse-grained, acidic, intrusive rock

Ground water - The supply of fresh water found beneath the Earth's surface, usually in aquifers, which is often supplies 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.

Hazard quotient (HQ) - The ratio of the estimated level of exposure to a substance from a specific pesticide application to the RfD (reference dose) 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.

Indian Rights and Interest - Indian treaty and other rights or interests recognized by treaties, statutes, laws, executive orders, or other government action, or federal court decisions. (McConnell, 2003)

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. (McConnell, 2003)

Inerts - Anything other than the active ingredient in a pesticide product; not having pesticide properties.

Infested Area - A contiguous area of land occupied by a single 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. (NRIS Standards).

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 (FSM 2080.5).

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 an action.

Introduced Species - An alien or exotic species that has been intentionally or unintentionally released into an area as a result of human activity. "Introduced (agricultural crops may fit the definition as well as 'native' or 'introduced' wildland species) or exotic species whose genetic material originally evolved and developed under different environmental conditions than those of the area in which it was introduced, often in geographically and ecologically distant locations" (Brown, 1997). See also "Noxious Weed" and "Exotic."

Introduction - "The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity" (Executive Order 13112, 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 13112, 2/3/99).

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.

LC50 (lethal concentration50) - 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.

LD50 (lethal dose50) - 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.

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, bark, or soil).

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, weed whacking, hot foam)

Microorganisms - A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, protozoans and some fungi.

Minimum tool - Use of a weed treatment alternative that would accomplish management objectives and have the least impact on resources.

Miocene – Geological epoch of warmer climate from 24 to 5 million years ago.

Mollusks - Invertebrate animals (such as slugs, snails, clams, or squids) that have a soft unsegmented 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 (USDA, USDI 1994a).

Morbidity - Rate of disease, injury or illness.

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 (USDA, USDI 1994a).

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 (USDA, USDI 1994a).

National Marine Fisheries Service (NMFS) - The federal agency that is the listing authority for marine mammals and anadromous fish under the ESA.

Native Species - With respect to a particular ecosystem, a species which, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (Executive Order 13112, 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" (Allaby 1996).

NLAA - See **Not Likely to Adversely Affect**

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. (Northern Region Native Plant Handbook, 1995).

Non-target - 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).

NPDES - See **National Pollutant Discharge Elimination System**

Paleosols – Soils that formed on a landscape of the past, usually buried by more recent parent materials.

Pathogen - A living organism, typically a bacteria or virus that causes adverse effects in another organism.

Percolation – A 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 2 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, etc., 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, and so forth. (W, modified).

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 (>7) is alkaline or basic and a low pH (<7) is acidic.

Pleistocene: Geologic epoch of glacial advance and retreat from 1.8 million to 11,000 BC.

Population - “A group of individuals of the same species in an area” (Wilson and Hipkins, 1999).

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.

Pre-disturbance surveys - See “Surveys Prior to Habitat-Disturbing Activities.”

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 – The term potential vegetation type (PVT) 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.

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 (W).

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" (Society of Ecological Restoration, 2000).

Revegetation - "The re-establishment of plants on a site (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)". (Northern Region Native Plant Handbook, 1995).

RfD - A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. Environmental Protection Agency.

Rhyolitic – Light colored, fine-grained, acidic, extrusive volcanic rock.

Riparian Area - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it (Northwest Forest Plan).

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 (USDA, USDI 1994a).

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.

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.

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 (FSM 2670).

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 13112, 2/3/99).

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 (USDA, USDI 1994a).

Subchronic 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 subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Subchronic 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. Subchronic toxicity only applies to relatively long-lived organisms such as mammals.

Submerged Aquatic Vegetation - Vegetation that lives at or below the water surface; an important habitat for young fish and other aquatic organisms.

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.

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 - To kill or capture a species covered by the ESA.

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 (USDA, USDI 1994a).

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. As defined by U.S. EPA, 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.

Treated 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. (NRIS Standards).

U.S. Fish and Wildlife Service (USDI FWS) - The federal agency that is the listing authority for species other than marine mammals and anadromous fish under the ESA.

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 (USDA, USDI 1994a).

Viable Population – A viable population consists of a population that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within a planning area.

Weed - "A plant growing where man does not want it to grow" (Daubenmire 1978).

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.

Wetlands - 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.

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.

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