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Invasive Plant Treatments

Final Supplemental Environmental Impact Statement

VOLUME 1 – CHAPTERS 1 through 4

Deschutes and Ochoco National Forests, Crooked River National Grassland

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

St. John's-wort (*Hypericum perforatum*) on the Sisters Ranger District

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Final Supplemental Environmental Impact Statement Deschutes and Ochoco National Forests and Crooked River National Grassland

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

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Abstract: This Final Supplemental Environmental Impact Statement (FSEIS) 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 strategy to allow quick detection and response to new and 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 (USDA Forest Service 2005a), as this document identified available herbicides for use in Region 6 and established programmatic direction for invasive species management, including prevention standards.

Three alternatives were analyzed in this FSEIS:

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 the continuation of 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 the emphasis on responding to public concerns about herbicide application near water.

The issues studied in this FSEIS 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 and spreading infestations, and monitoring.

Reader's Guide

This Final Supplemental Environmental Impact Statement (FSEIS) contains information about project proposals that will address the problems posed by invasive plants that compromise our ability to manage native ecosystems in a sustainable manner, 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 and Record of Decision (USDA Forest Service 2005a, 2005b).

The information in this FSEIS is organized to facilitate the disclosure of the environmental effects to the public. Forest Supervisors of the Deschutes and Ochoco National Forests are responsible for deciding whether or not to implement the Proposed Action or alternatives to this proposal will utilize the effects analysis and public comments to come to a reasoned and informed decision.

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 Final 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 are 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 in response to public comment, 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 and were also responsive to public comments. 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 and no 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 FSEIS. 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: Volume 2 Appendices provides more detailed information to support the analyses presented in the FSEIS, and includes the following.

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, Crooked River National Grassland Invasive Plant Species Prevention Practices

Appendix H – Fisheries Analysis by Watershed and Tabular Data

Appendix I – Watershed Information

Appendix J – Response to Comments

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.

Executive Summary

This section is a brief summary of the contents of the Final Supplemental Environmental Impact Statement (per 40 CFR §1502.12). The full FSEIS begins with Chapter 1.

Introduction

The Forest Service proposes to treat invasive plants on the Deschutes and Ochoco National Forests (Forests) and the Crooked River National Grassland (Grassland). Currently, about 14,500 acres within Deschutes, Jefferson, Crook, Klamath, Lake, Wheeler and Grant Counties in Oregon, are 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.

Background

Invasive plants are currently damaging the ecological integrity of National Forest system lands on the Deschutes and Ochoco National Forests and Crooked River National Grassland and the surrounding area. Invasive plants spread at a rate of 8-12 percent annually (USDA Forest Service 2005a) affecting all land ownerships, including National Forest System lands. The 2005 Record of Decision for the Pacific Northwest Region Invasive plant Program, Preventing and Managing Invasive Plants (R6 2005 ROD) amended all Forest Plans in Region Six. Herbicides made available for use in the R6 2005 FEIS would be are more effective, less expensive and potentially have fewer adverse impacts than the current program.

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 FSEIS is intended to address the problems posed by invasive plants across the 2.5 million acre planning area of the Deschutes and Ochoco National Forests and Crooked River National Grassland ("Forests"). This document follows management direction and proposes the use of tools made available for use in Region 6 by the R6 2005 ROD and now part of the Forest Plans.

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 soon after detection so they can be controlled while they are still small. 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 has been included in the *Schedule of Projects for the Deschutes and Ochoco National Forests and the Prineville District of the BLM* since winter 2004. On February 23, 2004 the original Notice of Intent (NOI) to prepare an Environmental Impact Statement appeared in the 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/. A draft EIS was released on February 2, 2007. 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 a 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).

Scoping comments received from the original and supplemental proposals were used to develop issues and build alternatives that form the basis for the DSEIS. The DSEIS included additional analysis, and sought to better explain the alternatives and analysis.

On June 10, 2009 a letter was sent to 89 individuals, organizations, tribes, and other agencies asking for comments on the DSEIS; Alternative 2 was indentified as the preferred alternative. On June 26, 2009 a Notice of Availability (NOA) to comment on the Draft Supplemental Environmental Impact Statement appeared in the Federal Register Volume 74, No. 122 on page 30570.

The Forest Service received 14 responses. The largest number of comments concerned treatment methods. A large number of comments expressed concern for effects on human health and non-target species from toxicity of herbicides. 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. Many comments focused on the types of herbicides and where to use them. Comments generated from this public comment period facilitated a number of changes in this Final SEIS, including additional restrictions on the use of particular herbicides on porous or shallow soils to better protect groundwater. The results of the 45-day public comment period are described in Appendix J of this Final SEIS.

General Changes between the DSEIS and the FSEIS

Some portions of the document were edited and updated since the release of the Draft Supplemental EIS to respond to internal and external comments and requests for clarification. Changes are listed at the beginning of each chapter. None of the changes resulted in substantive differences to the alternatives or the analysis. Minor editing of Chapter 1 includes re-writing the issue indicators for conciseness. Several alternatives were considered as a result of public comment, and are added to Chapter 2.5 Alternatives Not Considered in Detail. Changes to Chapter 3 include updating and analyzing the plants and wildlife sections to the 2008 Regional Forester's sensitive species list; additional Survey and Manage species were analyzed in the Non-Target Vegetation section and the Wildlife section; redesignation of bull trout critical habitat on Forest Service lands; greater sage grouse are now a federal candidate species; the drinking water analysis was moved from the Water Quality section to the Human Health section.

The maps included in the DSEIS have been removed. Detailed, large scale maps can be located at http://fs.usda.gov/goto/centraloregon/invasive-plants-projects.

The results of endangered and threatened species consultation resulted in changes to the findings and determinations related to fish.

The appendices have had minor editing, and the latest approved list of adjuvants and surfactants added. A new appendix, Appendix J, was added to capture the response to comments on the DSEIS.

Alternatives Considered

In addition to the No Action Alternative (Alternative 1), one alternative to the Proposed Action (Alternative 2) was studied in detail (Alternative 3). Several alternatives were considered but not developed for detailed study, mainly because they were outside the scope of the project, did not meet the purpose and need, or were very similar to one of the alternatives considered in detail:

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. Approximately 1,892 known invasive plant sites that span approximately 14,547 acres of the Forests and Grassland would be treated. 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 responds to the public's concerns about herbicide use near waterbodies and streams. 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.

Environmental Consequences

The following table summarizes the environmental consequences of each alternative. This project may occur throughout the Forests and Grassland and over an extended period of time, however the impacts at any one time and place, if any, are very small. The risk of direct and indirect adverse effects of invasive plant treatments have been minimized by Project Design Features (see Chapter 2.4). Herbicides are unlikely to drift, leach or run off into surface waters and harm aquatic organisms, given the buffers described in Table 15 and Table 16. The project is unlikely to adversely impact soil productivity, native plant communities, wildlife habitats, water quality, cultural resources, or special places. Human health impacts are unlikely due to label requirements and Project Design Features. Pesticides have likely run off or leached into streams and rivers within and adjacent to National Forest System lands from private and agriculture use. However, beneficial uses of surface waters within the project area are not adversely affected by pesticide use. Section 7 Endangered Species Act (ESA) consultation has occurred and the project complies with terms and conditions required by ESA regulatory agencies.

Factors that limit the potential effects the action alternatives include the following:

- The risk of adverse effects of invasive plant treatments in all action alternatives has been minimized by the project design features and buffers applicable to known sites and new detections. Predicted herbicide exposures are very small compared to likely background downstream conditions, and are not likely to trigger cumulative adverse effects to neither people nor the environment.
- In general, invasive plant sites are small and scattered.
- Herbicide residues from past treatments in most locations would 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 one year could lead to some accumulation in soils at the invasive plant treatment site.
- Assuming private landowners are using herbicides according to label, and based on the 2007 data(ODA 2008) that shows glyphosate would constitute the majority of off Forest use, potential for additive exposures to result in cumulative adverse effects is low. Glyphosate is rapidly absorbed by target plants and readily binds to organic matter. These factors reduce the potential for glyphosate to run off and accumulate in surface waters.
- Early detection rapid response is part of Alternatives 2 and 3, and is considered in the direct, indirect and cumulative effects analysis. Effects of treatments each year under early detection rapid response, by definition, would not exceed the annual and life of the project caps. Treatment caps further restrict the spatial and temporal extent of impacts from this project.
- Multiple herbicide exposures on National Forest System land are unlikely to occur in close enough proximity in time or space with other applications to trigger cumulative effects beyond those analyzed and disclosed in the risk assessments and impact statements. Infestations that cross ownership boundaries are often treated cooperatively so the effects are limited to the existing infestation and immediately surrounding areas.
- The R6 2005 FEIS (Appendix P, Appendix Q, Chapter 4) and SERA Risk Assessments discussed effects of chronic exposure to low levels of herbicides used to treat invasives on National Forest System land. Chronic exposures do not result in cumulative effects because the herbicides are more rapidly excreted from organisms (people, animals and fish) than would be absorbed from predicted levels of exposure. Thus, an animal could encounter herbicide in more than one location over time; however there would be no possibility for this project to result in exposures that could cause a cumulative effect.

Summary of Environmental Consequences

The following table compares the alternatives based on how each responds to the issues. This is a summary of information presented in detail in Chapter 3.

Table E-1. Issues compared by alternative

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Treatment Effectiveness			
Estimated Acres of Invasives in 2014	13,640	7,767	8,519
Number of Herbicide Formulations Available	3 in all areas ONF; 4 in all areas DNF	10 in upland areas; 10 in riparian areas	10 in upland areas; 7 in riparian areas
Herbicide Application Method and Adjacency to Water	DNF – Allows broadcast spraying within 100' of water; spot spraying emphasized off roads. ONF – Allows broadcast spraying; spot spraying within 50 feet of water; wipe within 10 feet of water.	Allows broadcast application of aquatic formulations to within 50 feet of perennial water; other formulations 100-300 feet Allows broadcast application within 15-100 feet of intermittent water, depending on formulation. Allows wicking/wiping of aquatic formulations within perennial water.	Does not allow broadcast spraying within 300 feet of perennial or intermittent water. Does not allow any herbicide application within 10 feet of perennial water.
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. New infestations within the scope of effects can be treated without new NEPA if effects and treatments are within the constraints of this FSEIS	Yes, incorporates an EDRR strategy. New infestations within the scope of effects can be treated without new NEPA if effects and treatments are within the constraints of this FSEIS
Non-Target Vegetation			
Percent of Infested Acres Remaining in 2014	Upland = 98% Riparian = 67%	Upland = 60% Riparian = 12%	Upland = 60% Riparian = 49%
Percent of Forest Service Land Treated with Herbicides	Upland = 0.03% Riparian = 0.001%	Upland = 0.62% Riparian = 0.02%	Upland = 0.62% Riparian = 0.01%

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Types and formulations of herbicides available for use	Deschutes NF – allows use of herbicides that have higher potential for harming non-target plants, including: dicamba, picloram, glyphosate and triclopyr. Ochoco NF – allows the use of herbicides that have higher potential for harming non-target plants including: dicamba, picloram and glyphosate. Limited choice of herbicides increases the risk of developing herbicide resistance in target species.	Would allow the use of more selective herbicides, with less persistence in the environment, such as clopyralid which targets only 4 plant families. Does not allow the use of dicamba, which has a higher potential to harm non-target species. Includes a wider choice of herbicides (10) that would help prevent shifts in plant community composition, thus maintaining plant diversity, and less risk of target species resistence.	Same as Alternative 2, but lowers the number of available herbicides to 7 within 300 feet of perennial water (drops glyphosate, picloram, sethoxydim).
Soils			
Toxicity Potential to Soil Microbes and Resulting Effects to Soil Productivity	Low - 2,204 acres currently approved for treatment (approximately 65% of which is picloram)	Low (14,547 maximum acres proposed to be treated). Picloram, sulfometuron methyl, triclopyr have the highest risk; 6,178 acres of these herbicides are proposed as a first choice of herbicide. PDFs developed to limit effects.	Low (260 acres less herbicide treatment than Alt 2). No picloram or triclopyr BEE is allowed within 300' of intermittent or perennial streams. Sulfometuron methyl and aquatic triclopyr would be allowed within 15' of intermittent streams by backpack method and up to 10' by wick method.
Potential for Soil Erosion from Treatment Methods	Moderate (emphasis on manual treatments)	Low (staggered herbicide and follow-up maintenance treatments, PDFs 43-50)	Moderate (increased manual treatments in riparian areas, especially in connection with emergent species)
Water Resources and Aquatic Species			
Acres of Herbicide Treatments in Aquatic Buffers	Deschutes NF – not allowed within 100 feet. Ochoco NF - some sites within 1,045 acres of Treatment Areas in '98 EA. Allows spot spray within 10' and wick application up to water.	1,518 invasive plant acres proposed for herbicide treatment within 300 feet of water. 724 acres proposed within 100 feet. 260 acres within 10 feet.	1,288 invasive plant 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.

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Water Quality Parameters: Sediment & Turbidity Temperature Water Chemistry	No measurable increase in any parameter. Does not promote healthy riparian areas free of invasive plants.	No measurable increase in any parameter; meets State water quality standards. Promotes healthy, invasive-free riparian areas yet has the highest potential for short-term (<6 months) water quality effects primarily from direct overspray of herbicide into water, small reduction in shade in localized areas, and exposed soils due to reduced ground cover. PDFs minimize these risks.	No measurable increase in shade and water chemistry parameters. Pulling/digging emergent invasive species have the potential to exceed State water quality standards for sedimentation and turbidity. Does not allow herbicide treatment within 10 feet of water (260 acres), which does less to promote healthy, invasive-free riparian areas, such as the Metolius River. Lower potential for short term effects to water chemistry and shade. PDFs, treatment caps and restricting certain chemicals lower the risk even more.
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 precludes shade from becoming established.	Major impacts prevented with PDFs. Potential risk for effects to bull trout and redband trout from herbicide treatments near water, however PDFs and aquatic formulations lower the risk. No measurable effects from manual, mechanical and cultural methods.	Major impacts prevented with PDFs. Reduced risk of herbicide residue washing into streams. Reduced risk of direct overspray to water. Effective control of emergent species such as ribbongrass not likely. Invasives would continue to degrade habitat; TES species would be affected long-term. No measurable effects from manual mechanical and cultural methods except in Metolius River where cover would be reduced and sedimentation increased due to manual/cultural treatments to ribbongrass.
Human Health			
Exposure analysis from Appendix Q of the R6 2005 FEIS	Exposure analysis determined exposure to two products is of concern - triclopyr and NPE surfactants. The use of triclopyr is allowed on the Deschutes NF. NPE surfactants are allowed for use on both Forests and Grassland. The use of triclopyr is currently not allowed on the Ochoco NF.	The risk reduction framework, including project design features, eliminate plausible harmful exposure scenarios, for example: broadcast spraying of triclopyr is not allowed, use of Garlon 3A is favored over Garlon 4, triclopyr BEE not permitted within 150 feet of streams, NPE surfactants are limited to the lowest rate and are not allowed within 100 feet of water or ditches.	The risk reduction framework, including project design features, eliminate plausible harmful exposure scenarios, for example: broadcast spraying of triclopyr is not allowed, use of Garlon 3A favored over Garlon 4, triclopyr BEE not permitted within 300 feet of streams, NPE surfactants are limited to the lowest rate and are not allowed within 100 feet of water or ditches.

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Wildlife			
Threatened/Candidate Species: Northern Spotted Owl, Pacific fisher, greater sage grouse, wolverine, Oregon spotted frog	No direct adverse effects from ongoing treatment.	Potential for disturbance from noise, but minimized with PDF; no effect/impact to habitat. No plausible effects from herbicide.	Potential for disturbance from noise, but minimized with PDF; no effect/impact to habitat. No plausible effect from herbicide.
Sensitive Species: Oregon & Columbia spotted frogs, pygmy rabbit, sage grouse, harlequin duck, yellow rail, Northern waterthrush, Crater Lake tightcoil snail, silver bordered fritillary	May impact individuals but is not likely to lead to a trend toward Federal listing	May impact individuals but is not likely to lead to a trend toward Federal listing	May impact individuals but is not likely to lead to a trend toward Federal listing
Sensitive Species: bald eagle, wolverine, Pacific fisher, Townsend big-eared bat, horned grebe, bufflehead, upland sandpiper, peregrine falcon, white-headed & Lewis woodpeckers, tricolored blackbird, Johnson's hairstreak	No Impacts	No Impacts	No Impacts
Survey and Manage Species: great gray owl, Crater Lake tightcoil snail	Not habitat-disturbing	Not habitat-disturbing.	Not habitat-disturbing
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. Activities will not contribute to a negative trend in viability.	Effects from disturbance are avoided with seasonal restrictions. No adverse effects from disturbance or herbicide exposure. Activities will not contribute to a negative trend in viability.
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.

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Social/Economic Aspects			
Total cost for all sites' first year of treatment (assumes for simplicity that all roadside sites are broadcast in Alternatives 2 and 3)	$572,350 Spot/hand herbicide: $261,250 Manual: $310,100	$2,205,290 Broadcast herbicide: $996,500 Spot/hand herbicide: $968,750 Manual: $240,040	$2,724,590 Broadcast herbicide: $996,500 Spot/hand herbicide: $1,472,750 Manual: $255,340
Jobs created based on treating all acres in the first year	32	88	112
Rangeland Resources			
Effects to Forage Vegetation and Livestock	Invasive plants would continue to spread, competing with native grasses and reducing the nutrituional value of forage. Label restrictions are followed; but there is no PDF restriction for applying herbicides near livestock watering places.	Control of invasive plants, including those in riparian areas, would increase the density and vigor of native forage. Expands the choices of herbicides that do not have grazing restrictions. Label restrictions would be followed for herbicide use; PDFs restrict applying herbicides near livestock watering places.	Same as Alternative 2, with the exception that less effective control measures (eg no broadcast spraying) would be used in riparian areas, allowing invasive plants to spread and degrade preferred forage for livestock.
Cultural Resources			
Effects to Historic or Prehistoric Resources from Mechanical Methods	Treatments under current NEPA do not affect historic or prehistoric resources.	14.3 acres of burning & mechanical treatments are proposed that may have the potential to expose unknown historic or prehistoric resources. PDFs are in place to protect known cultural resources.	Same as Alternative 2
Effects to Cultural Plants	Does not effectively control most infestations introduced since 1998. Provides the least protection to the long-term sustainability of cultural use plants.	Does the most to prevent spread of invasive plants into cultural plant gathering areas. Many PDFs in place to protect non-target vegetation. PDF 41 specifically addresses time of herbicide application in cultural plant areas.	Emergent invasive plants would continue to spread in riparian areas that also contain cultural use plants; manual methods would not be as effective in preventing spread.
Recreation and Scenery			
Effects to Recreation and Scenery	Continued short-term visual effects from herbicide treatments within recreation areas and scenic corridors. Has the most potential for long-term affects of invasive	Short term effects (1-2 growing seasons) of dead vegetation along access and transportation corridors. Short periods of interaction between recreationists and weed-control crews; possible temporary	Same as Alternative 2. Longer periods of interaction between recreationists and weed-control crews in riparian areas due to the time factor involved with manual control

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
	plants to alter the scenic pattern, form and texture of the landscape.	closures of recreation sites during herbicide application work.	efforts.
Congressionally-Designated Areas and Other Special Areas			
Wilderness	No current herbicide use on sites within wilderness. Greatest risk of introduction and spread of invasives into wilderness areas.	Herbicide use is not proposed within wilderness, only manual treatment. This alternative would control invasives at trailheads and surrounding areas using all treatment methods, providing the most effective means to avoid spread into wilderness.	Same as Alternative 2
Oregon Cascades Recreation Area	Reed canarygrass and other species would continue to spread within Big Marsh, and this Alternative poses the greatest threat to the goals established for the area, and its unique values.	Cultural and manual methods are prescribed to treat invasive plants, having short-term effects to the recreation experience from reed canarygrass solarization control techniques and resulting dead patches of vegetation.	Same as Alternative 2
Wild and Scenic Rivers	This alternative has the greatest long-term risk of affecting the Outstanding and Remarkable Values (ORV) for all Wild and Scenic Rivers in the project area, from continued spread of invasive plants.	Herbicide treatments would have short-term effects to the scenery ORV. The alternative has the most long-term benefit to native plant communities and associated wildlife and fishery ORVs.	This alternative has slightly less long-term benefit due to the restriction of less effective treatment methods within 10 feet of Wild and Scenic Rivers. Reed canarygrass and ribbongrass control on approx. 13 acres is unlikely to be effectively controlled.
Research Natural Areas	Invasive plants would continue to spread within the Ochoco Divide & The Island RNAs, despite on-going manual treatment efforts. Greatest risk of spread within 6 RNAs due to adjacent weed populations.	Herbicide use is proposed within the Ochoco Divide RNA (26 ac). There would be minor, short-term effects to native vegetation from herbicide use. Greatest long-term benefit to maintaining natural conditions within RNAs by controlling weeds on adjacent roads, and by implementing EDRR. Manual treatment proposed in the Island RNA (3.5 ac).	Same as Alternative 2.
Newberry National Volcanic Monument	Herbicide treatment along Highway 97 would continue. Other invasive plant sites, including ribbongrass on Paulina Lake, would continue to spread. Reed canarygrass on the west shore of Paulina Lake would continue to spread around the lake.	Herbicide use proposed along major access roads in the Monument, and 10-Mile Snopark, would have minor visual effects. Herbicide treatment proposed for reed canarygrass/bull thistle at Paulina Lake would create dying vegetation visible to the public in the short-term (1-2 years).	Roadside treatments would be the same as Alternative 2. Invasive plants within 10-feet of water on Paulina Lake, reed canarygrass and bull thistle, would be either dug out of the shoreline or covered with plastic for solarization. Solarization treatment would have a visual effect for a longer period of time (3-4 years).

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Inventoried Roadless Areas	Current herbicide treatment would continue on roads adjacent to 5 Roadless Areas. Continued spread of invasives adjacent to and within all 13 IRAs	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Highest protection to native plant habitats.	Control of reed canarygrass at Lava Lake would be less effective due to 10-foot no herbicide buffer. Somewhat less effective control of one Himalayan blackberry site due to second-choice herbicide.
Experimental Forest	Does not allow treatment of Road 43, so is the highest risk for spread of knapweed and toadflax into Pringle Falls Experimental Forest	Allows roadside herbicide treatment of Road 43 (121 acres of roadside with one acre infested) and EDRR to prevent spread.	Same as Alternative 2.

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List of Frequently Used Acronyms

AI	Active Ingredient
ACS	Aquatic Conservation Strategy
BCF	Bioconcentration Factor
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
DSEIS	Draft Supplemental 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
FSEIS	Final Supplemental Environmental Impact Statement
GIS	Geographic Information System
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

Chapter 1. Purpose and Need for Action

Changes between DSEIS and FSEIS

Minor editing occurred in Chapter 1. The Public Involvement section was updated and clarification was made to issue indicators.

1.1 Background – Existing Condition

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.

A 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.

The Responsible Officials of this FSEIS 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.Watershed assessments completed since 1994 have recognized that populations of invasive plants/noxious weeds are expanding and control is needed to protect habitat (see Watershed Assessment Summary, Lopez 2011, in the project file).

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 1988 *Managing Competing and Unwanted Vegetation* Record of Decision 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 R6 2005 ROD (USFS 2005b) replaced management which was guided by the 1988 ROD and 1989 Mediated Agreement (USFS 1988a). The R6 2005 ROD amended all Forest Plans in the Region, adding new direction for containing, controlling or eradicating invasive plant species using prevention practices, various mechanical and hand treatments, and chemical treatments. This decision allows the use of 10 chemicals from an updated list of herbicides for effectively responding to invasive plant threats.

Prevention standards have been in place since the R6 2005 ROD amended the Forest Plans; these standards were put in place to reduce the rate of spread and introduction of invasive plants while still maintaining the Forest Service's ability to provide for existing uses and management activities on National Forest System lands. In addition the Deschutes and Ochoco National Forests adopted specific local prevention measures (see Appendix G). Prevention measures target several vectors of invasive plant spread and introduction including: heavy equipment, mineral materials, infested straw and feed, and forest activities that cause disturbance.

The Forests and Grassland have been treating invasive plants under 1998 Environmental Assessments (USFS 1998a, 1998b). The decisions approved the use of dicamba, picloram, and glyphosate on the Ochoco NF and Grassland; triclopyr was added to this list on the Deschutes NF. The decisions did not provide the ability to respond quickly to new infestations because the process covered only those sites known at the time of the 1998 decision. Many infestations were treated only by manual methods, those and new infestations since 1998 require multiple treatments per year and still require treatment after 12 years of effort, and are still spreading.

Monitoring and treatment records show that the invasive plant sites controlled with herbicides have decreased in plant density, and have been eradicated in some areas. The sites only require maintenance; herbicide volume has been greatly reduced, and takes very little time to treat. In contrast, sites treated with manual methods have not sucdessfully reduced the impact and spread of invasive plant species (1998-2011 treatment records and monitoring reports located at the Ranger Districts). The reasons for this are:

- Only known sites were covered, so new infestation since 1998 cannot be treated;
- The delay in the use of herbicides has allowed some infestations to become well established and spread;
- Manual treatments require expensive multiple visits to sites each year, ande the budget is not always adequate;
- The herbicides that were approved for use are not effective on some invasive species found on the Forest

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 FSEIS 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. Specialists' Reports were completed for botany, water resources, fisheries, soils, wildlife, recreation and scenery, heritage resources, and range. Separate biological evaluations were completed for botanical species, aquatic species, and terrestrial wildlife species. Biological Assessments were completed for aquatic species and terrestrial wildlife species as part of the

consultation process with the National Marine Fisheries Service and the US Fish & Wildlife Service. The project record is located at the Ochoco National Forest headquarters in Prineville, Oregon.

1.2 Desired Future Condition

The desired future condition, derived from the R6 2005 ROD and the Deschutes, Ochoco and Crooked River National Grassland Land and Resource Management Plans, is for healthy native plant communities to remain diverse and resilient, and damaged ecosystems be restored. High quality habitat is provided for native organisms throughout the area. 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 (USDA Forest Service 2005b).

Although the current invasive plant treatment program, which emphasizes manual methods, has been effective on some sites, there is limited ability to respond to the rate and extent of new infestations. An additional desired future condition is that the Forests and Grassland are able to implement treatment actions to more effectively contain and reduce the extent of invasive plants at existing inventoried sites, and rapidly responds to new or expanded invasive plant sites as they may occur in the future. Applicable Forest Plan goals and objectives are listed in Chapter 1.5.1.

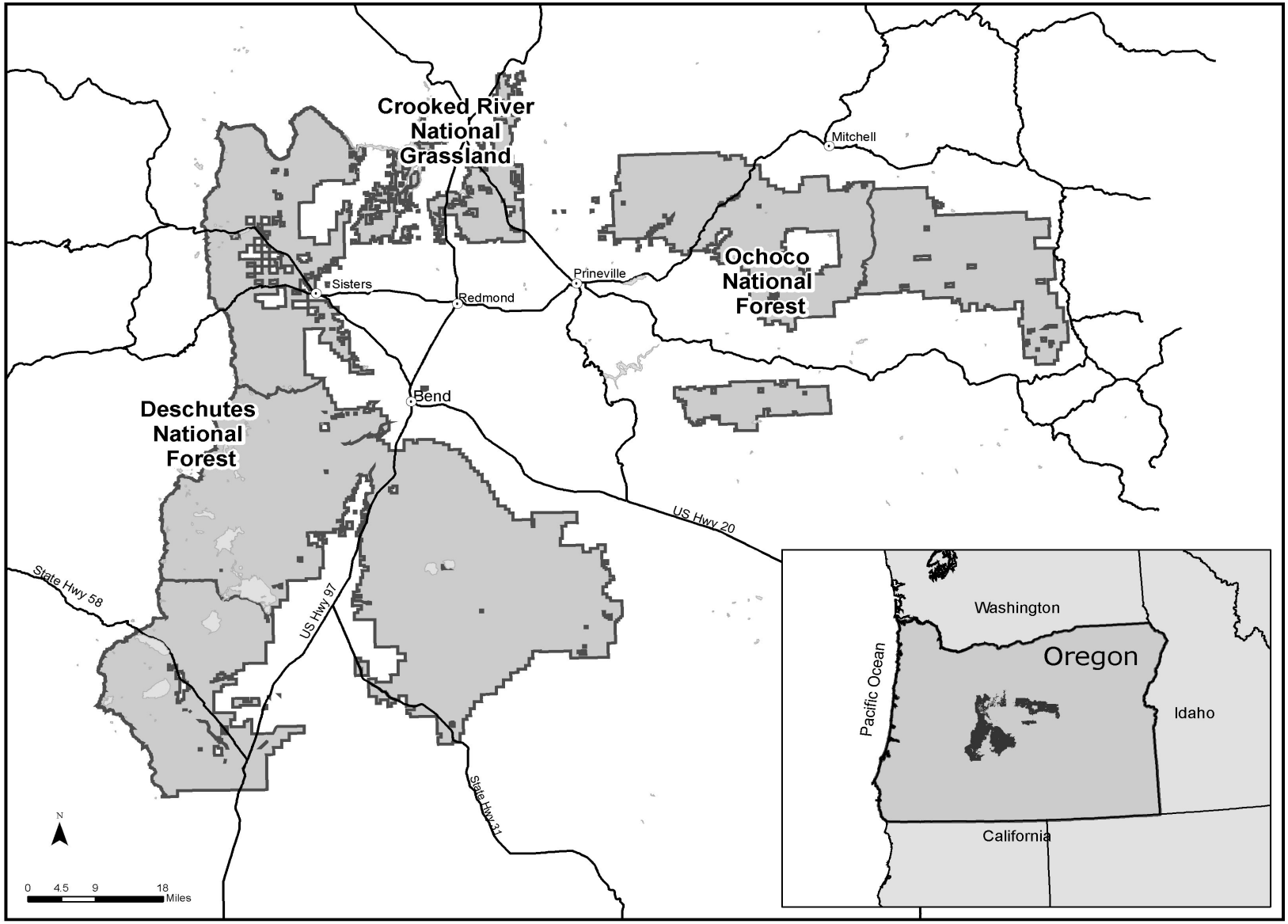

Figure 1. Project vicinity map

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 FSEIS 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 2.5-million acre planning area of the Deschutes and Ochoco National Forests and Crooked River National Grassland ("Forests"). This FSEIS 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 2005 Record of Decision (ROD). The ROD provided an updated approach to invasive plant management, including standards for the use of new herbicides. This FSEIS 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 that are being treated under the 1998 Noxious Weed Control EAs, (see, for example, Section 3.3.2), invasive plants continue to increase because they are introduced to areas not covered for control.

There is a need to eradicate, control, contain or suppress 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. See Section 3.3 for a characterization of the invasive plant sites across the Forests.

Table 1. Project area unit acres and invasive plant sites by administrative unit

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 are patchy.

Under the Proposed Action, invasive plants on National Forest System lands would be treated with a combination of manual, mechanical, biological, cultural 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 FSEIS, 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 (USDA Forest Service 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 non-native 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 (USDA Forest Service 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 FSEIS 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 FSEIS 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 PACFISH/INFISH (1995, 1995a) 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 (1995a) 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 was intended for the implementation of interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California.

Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales (Regional Forester's Forest Plan Amendment #2) applies to projects that include timber sales and does not pertain to this project.

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 FSEIS 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.[1] The R6 2005 ROD added 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.

Objective 1.3 Detect new infestations of invasive plants promptly by creating and maintaining complete, up-to-date inventories of infested areas, and proactively identifying and inspecting susceptible areas not infested with invasive plants.

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

Objective 1.5 Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.

Goal 3 - Protect the health of people who work, visit, or live in or near National Forests, while effectively treating invasive plants. Identify, avoid, or mitigate potential human health effects from invasive plants and treatments.

Objective 3.1 Avoid or minimize public exposure to herbicides, fertilizer, and smoke

Objective 3.2 Reduce reliance on herbicide use over time in Region Six

[1] *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.

Goal 4 – Implement invasive plant treatment strategies that protect sensitive ecosystem components, and maintain biological diversity and function within ecosystems. Reduce loss or degradation of native habitat from invasive plants while minimizing adverse effects from treatment projects.

Objective 4.1 Maintain water quality while implementing invasive plant treatments.

Objective 4.2 Protect non-target plants and animals from negative effects of both invasive plants and applied herbicides. Where herbicide treatment of invasive plants is necessary within the riparian zone, select treatment methods and chemicals so that herbicide application is consistent with riparian management direction, contained in PACFISH, INFISH, and the Aquatic Conservation Strategies of the Northwest Forest Plan.

Objective 4.3 Protect threatened, endangered, and sensitive species habitat threatened by invasive plants. Design treatment projects to protect threatened, endangered, and sensitive species and maintain species viability.

Invasive Plant Treatment Standards and Guidelines added to the LRMPs from the R6 2005 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 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, under the ACS section.

On December 17, 2009, the U.S. District Court for the Western District of Washington issued an order in *Conservation Northwest, et al. v. Sherman, et al*., No. 08-1067-JCC (W.D. Wash.), granting Plaintiffs' motion for partial summary judgment and finding NEPA violations in the *Final Supplemental to the 2004 Supplemental Environmental Impact* Statement *to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines* (USDA and USDI, June 2007). In response, parties entered into settlement negotiations in April 2010, and the Court filed approval of the resulting Settlement Agreement on July 6, 2011. Projects that are within the range of the northern spotted owl are subject to the survey and management standards and guidelines in the 2001 ROD, as modified by the 2011 Settlement Agreement.

This Invasive Plant Treatments Project is consistent with the Deschutes Land and Resource Management Plan as amended by the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD), as modified by the 2011 Settlement Agreement.

Prevention Guidelines

The Forests and Grassland have prepared a list of Invasive Plant Species Prevention Practices, included in this FSEIS 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 FSEIS. 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 winter 2004. On February 23, 2004 the original Notice of Intent (NOI) to prepare an Environmental Impact Statement appeared in the 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/. A draft EIS was released on February 2, 2007. 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 a 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).

Scoping comments received from the original and supplemental proposals were used to develop issues and build alternatives that form the basis for the DSEIS. The DSEIS included additional analysis, and sought to better explain the alternatives and analysis.

On June 10, 2009 a letter was sent to 89 individuals, organizations, tribes, and other agencies asking for comments on the Draft Supplemental EIS; it identified Alternative 2 as the preferred alternative and invited interested parties to submit written, facsimile, or electronic comments. On June 26, 2009 a Notice of Availability (NOA) to comment on the Draft Supplemental Environmental Impact Statement appeared in the Federal Register Volume 74, No. 122 on page 30570.

The Forest Service received 14 responses. The largest number of comments concerned treatment methods. A large number of comments expressed concern for effects on human health and non-target species from toxicity of herbicides. 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. Many comments focused on the types of herbicides and where to use them. Comments generated from this public input facilitated a number of changes in this Final SEIS, including additional restrictions on the use of particular herbicides on porous or shallow soils to better protect groundwater. The results of the 45-day public comment period are described in Appendix J of this FSEIS, and consultation activities are described in Chapter 4.

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 FSEIS analysis. Most issues are resolved through project design features, adherence to standards and guidelines and the appropriate laws and regulations, and by being consistent with decisions made in the *Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants* Record of Decision (2005b).

1.8.1 Significant Issues

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 more options available (e.g., number of herbicide formulations and different application methods) and the ability to respond quickly to

new infestations influence overall treatment effectiveness, which results in fewer acres of invasive plants in the future.

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;
- Herbicide application method and adjacency to water; and
- The ability to rapidly respond to new invasive plant populations (EDRR strategy).

Effects to Non-Target 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 Survey and Manage plant species have been and will continue to be displaced by invasive plant species. Invasive plant treatments, especially herbicides, also may harm non-target plants, including culturally significant, TES or Survey and Manage 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.

The indicator to measure the effects of invasive plants on non-target plants are:

- Percent of infested upland and riparian acres remaining in year 2014

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

- Percent of Deschutes and Ochoco NF upland and riparian acres treated with herbicides;
- Types and formulations of herbicides available for use to reduce effects to non-target plants.

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, and resulting effects to soil productivity;
- Potential for soil erosion from treatment methods

Water Quality & 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 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 canarygrass) 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 within aquatic buffers;
- Water quality parameters: sediment and turbidity, temperature, chemistry; 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, 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 a risk reduction framework (see Figure 5), which includes project design features and by complying with standards and guidelines. Alternatives do not vary on this issue. All include precautions to avoid a threshold of concern. A threshold of concern is the level of exposure below which the potential for adverse effects to a person is low. The indicator used to analyze this issue is:

- Worker and public exposure analysis documented in Appendix Q of the R6 2005 FEIS. This analysis includes direct contact with herbicide, eating contaminated fish, berries or mushrooms, and drinking contaminated water.

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); management indicator species (MIS), Survey and Manage species; and their habitat.

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 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. Alternatives 2 and3 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.

Rangeland Resources

Invasive plants can degrade rangelands and some species are toxic to livestock. Chapter 3.11 discusses the potential effects of invasive plants and their treatment, and is measured by:

- Effects to forage vegetation and livestock

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 scarification activities. Invasive plants can degrade traditional cultural plant gathering areas, and the treatment of invasive plants has the potential to affect traditional cultural plants, as measured by:

- Effects to historic or pre-historic resources from burning and mechanical treatment methods;
- Effects to cultural plants

Recreation and Scenic Values

Because much of the National Forest System lands in the project area have high scenic quality and provide areas for the recreating public, it is discussed in Chapter 3.13. The indicator used to measure this issue will be:

- Effects to recreation and scenery

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 assesses the amount and type of treatment within Wilderness, Oregon Cascades Recreation Area, Wild and Scenic River Corridors, Research Natural Areas, Newberry National Volcanic Monument, Inventoried Roadless Areas, and Experimental Forests, and the effect on the specific values of each.

- Extent of Treatment in Special Areas
- Qualitative Assessment of Impacts Relative to Special Area Management Direction

1.8.2 Non-significant Issues

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. The Forest Supervisors for the Deschutes/Ochoco National Forests determined that the following public issues would be eliminated from further analysis. Non-significant issues are part of the project record, and include:

- Invasive plant prevention measures applied to various land uses
- Findings/uncertainty/credibility of herbicide risk assessment
- Philosophical objections to or new requirements for herbicide use
- Labor source (volunteer, other), and avenues of funding

Chapter 2. Alternatives Including the Proposed Action

Chapter 2 Changes between DSEIS and FSEIS:

- A discussion of invasive plant prevention activities that are commonly used on the two Forests and Grassland has been added.
- Two alternatives (no broadcast spraying and prohibiting certain herbicides) have been added to Section 2.5 Alternatives Not Considered in Detail.
- Project Design Features were updated to comply with the Terms and Conditions in the Biological Opinions received from National Marine Fisheries Service and U.S. Fish and Wildlife Service.
- Project Design Features were updated to comply with the Survey and Manage Species 2011 Settlement Agreement.

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.

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 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 existing invasive plant species. Treatment priorities, methods and strategies are tiered to the R6 2005 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[2], 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.

2 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. The action alternatives do not drop any treatment areas from consideration; rather, they specify alternative means of controlling the invasive species, or require additional PDFs (sections 2.3.2 and 2.3.3).

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 approximately 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 on the Ochoco National Forest and Crooked River National Grassland 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 of manual methods of 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 using 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).
- Various Categorical Exclusions and Decision Memos authorizing manual methods of weed treatment across the two Forests and Grassland.

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 2005 to 2009 on the Deschutes and Ochoco National Forest (including the Grassland).

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

Method	Deschutes NF	Ochoco NF	Total Acres
Herbicide	671	555	**1,226**
Mechanical	0	0	**0**
Manual	2,138	1,179	**3,317**
Biocontrol	30	55	**85**
			4,628

Table 3 includes other invasive plant control activities that occur on the Forests: The Oregon Department of Transportation applies herbicides along the right-of-way of State Highways 20, 26, and 97 that pass through National Forest System land, and the Grassland. Bonneville Power Administration and TransCanada have treated their facilities on special use permit areas in the past.

Biocontrol[3] agents that have been released consist of the Canada thistle gall fly (*Urophora cardui*), Canada thistle stem boring weevil (*Ceutorhynchus litura*), Dalmatian toadflax stem boring weevil (*Mecinus janthinus*), Russian knapweed leaf stem gall nematode (*Subanguina picridis*), and others; see Appendix B for a complete list. 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 R6 2005 Invasive Plant ROD (USDA Forest Service 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 (USDA Forest Service 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.

[3] 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.

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 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 (EDRR) 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[4] 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 address the range of resource conditions within the PAUs. Effects analysis discussed in Chapter 3, and project design features displayed in section 2.4 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 FSEIS 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. Large-scale maps are available at the Deschutes or Ochoco National Forest headquarters offices in Bend and Prineville, or on the internet at http://fs.usda.gov/goto/centraloregon/invasive-plants-projects. 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.

[4] 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.

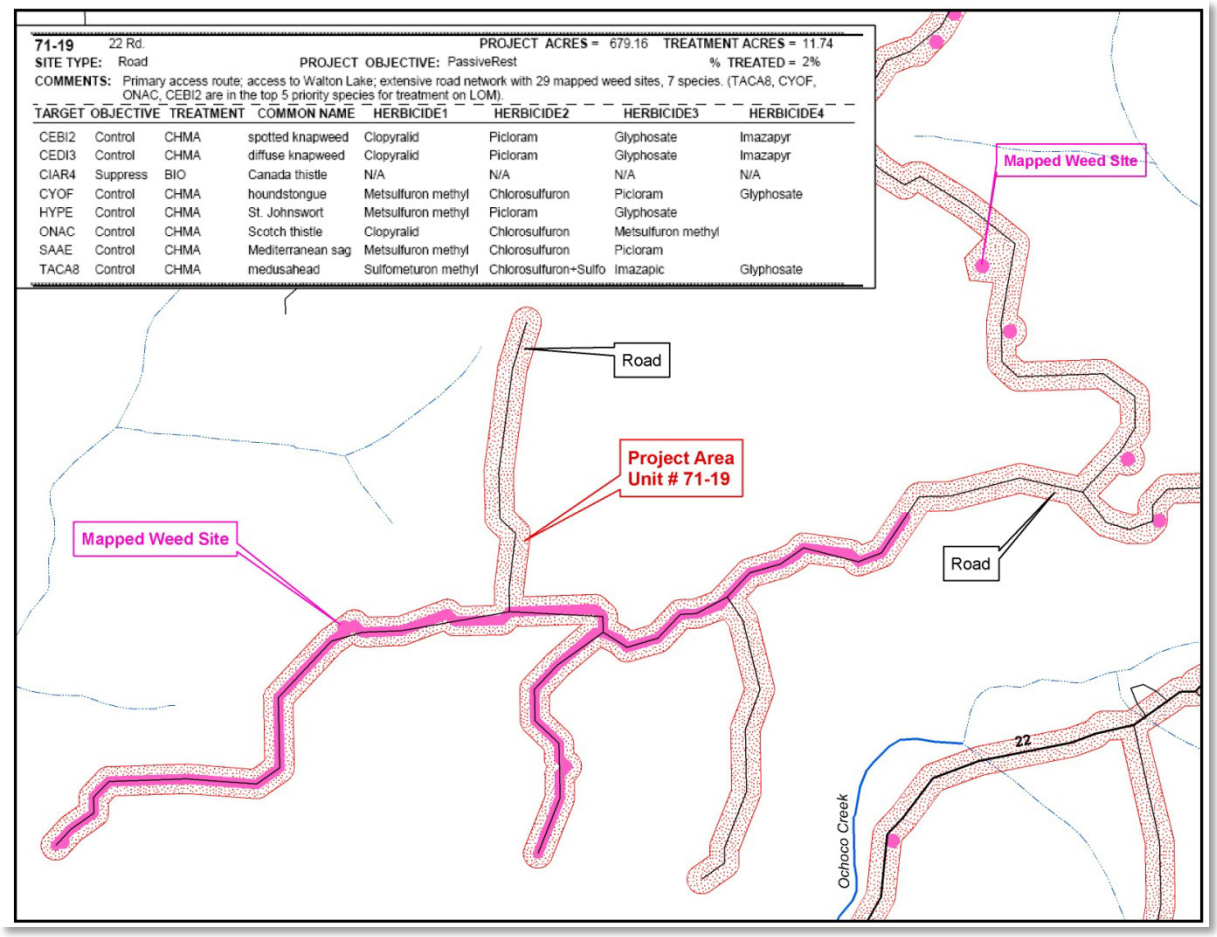

Figure 2. Representative project area unit and data from Project Area Summary Report, Appendix A of this FSEIS

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 and Ochoco NFs.

Table 4. Site type descriptions for project area units (PAUs)

Site Type	Project Area Unit Acres	Percent 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 %**
Total Acres	**52,015**	

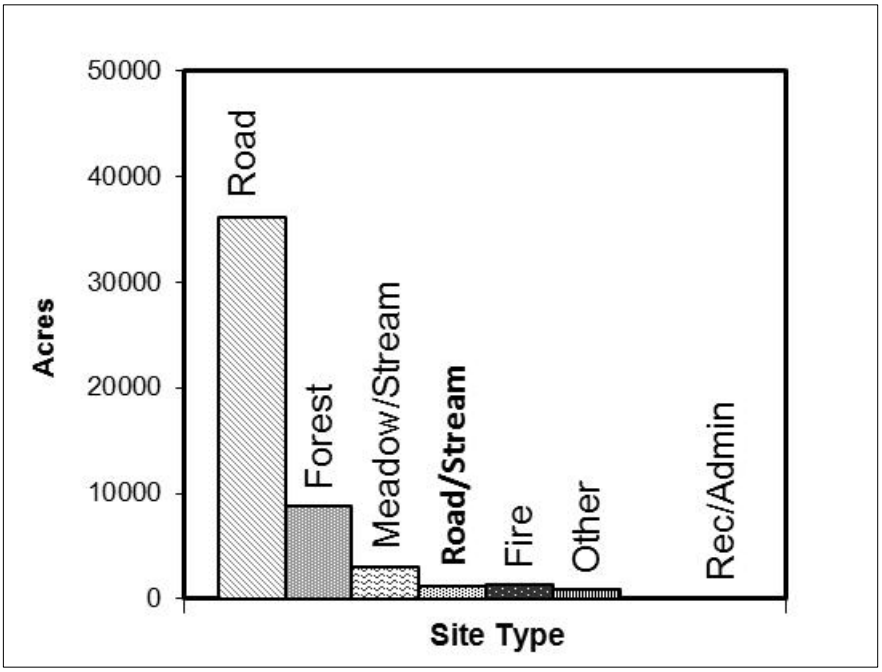

Figure 3. Acres of project area units by grouped site types. Disturbed areas, such as along roads, are the most common place to find invasive plants.

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 that follows summarizes information about 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.

Table 5. Treatment methods applied within project area units, Alternative 2

Treatment Method	Acres of Invasive Plant Sites	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 (section 2.4), which are intended to minimize or eliminate potential adverse impacts. 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).

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. An annual implementation plan is required (Appendix F) to determine the program of work each year.

Table 6. Summary of treatment method combinations that will occur across Project Area Units, sorted by site type, Alternative 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, Floodplain, Lakeside or Streamside	Biological Only	17.5
	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.

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 32-33), 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 BEE, picloram, non-aquatic glyphosate, or sethoxydim.
- Broadcast spraying would not be allowed within these buffers or along road segments that are within 300 feet of streams or lakes to reduce risk of drift into water.
- Ground disturbance by off-road machinery or mechanized equipment that could cause measurable 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, for a total of 260 acres.
- 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, therefore the treatment would revert to manual. Each site listed in Appendix A would be further characterized using the implementation procedures in Appendix F

Table 7. Width of aquatic buffers applied in Alternative 3

Stream and Waterbody Classification	Aquatic Buffers for Alt. 3 in feet
Class 1	300
Class 2	300
Class 3	300
Class 4	Bankfull
Wetlands	150
Lakes	300
Ponds	300
Reservoirs	300
Springs	300

The majority of Watershed Analyses identified riparian reserves at 300 feet in width for each side, however a few determined the width would be more than 300 feet (for example the Metolius River WA identified 320 feet). The increased widths were based on tree harvest and are not applicable to activities proposed in this project; therefore the typical riparian reserve width of 300 feet is used. 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 previously, 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
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
- 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 FSEIS, treatments will not be limited to the species in Table 9.

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

Species	District	No. of Sites	GIS polygon acres	First choice herbicide	Alternatives 2 & 3 Manual, biological & cultural treatments
Acroptilon repens (Russian Knapweed)	LOM	7	0.2	Clopyralid	Primary prescription is chemical for all
	PAUL	2	0.8	Clopyralid	Primary prescription is chemical for all
	CRNG	4	36.6	Clopyralid	Alt 2= 36.6 ac chemical Alt 3 = 0.75 ac manual
Arctium minus (Lesser burdock)	LOM	2	0.1	Metsulfuron methyl	Primary prescription is chemical for all
Cardaria draba (Whitetop)	LOM	20	1.6	Chlorsulfuron	Primary prescription is chemical for all
	PAUL	43	10.8	Chlorsulfuron	Primary prescription is chemical for all
	CRNG	12	1.9	Chlorsulfuron	Primary prescription is chemical for all
Cardaria pubescens (Hairy whitetop)	CRE	2	23.0	Chlorsulfuron	Primary prescription is chemical for all
Carduus nutans (Musk thistle)	LOM	1	0.6	Clopyralid	Primary prescription is chemical
Centaurea biebersteinii (Spotted knapweed)	BFR	214	1,281	Clopyralid	Primary prescription is chemical for all
	CRE	22	1,813	Clopyralid	Primary prescription is chemical for all
	SIS	101	2,836	Clopyralid	160 ac. manual both alts
	LOM	122	19	Clopyralid	0.7 ac. manual Alt 2 1.9 manual Alt 3
	PAUL	29	112	Clopyralid	Primary prescription is chemical for all
	CRNG	43	484	Clopyralid	Primary prescription is chemical for all
Centaurea debeauxii ssp. *Thuillieri* (Meadow knapweed)	LOM	1	< 0.1	Clopyralid	Primary prescription is chemical
Centaurea diffusa (Diffuse knapweed)	BFR	7	538	Clopyralid	Primary prescription is chemical for all
	CRE	9	1,437	Clopyralid	Primary prescription is chemical for all
	SIS	45	2,363	Clopyralid	311 ac. manual both alts
	LOM	64	12	Clopyralid	0.25 ac. manual both alts
	PAUL	15	8	Clopyralid	Primary prescription is chemical for all
	CRNG	39	831	Clopyralid	Primary prescription is chemical for all
Centaurea solstitialis (Yellow starthistle)	CRE	1	< 0.1	Clopyralid	Primary prescription is chemical for all
	LOM	2	0.1	Clopyralid	Primary prescription is chemical for all
	PAUL	1	1.1	Clopyralid	Primary prescription is chemical for all

Species	District	No. of Sites	GIS polygon acres	First choice herbicide	Alternatives 2 & 3 Manual, biological & cultural treatments
	CRNG	1	< 0.1	Clopyralid	Primary prescription is chemical for all
Cirsium arvense (Canada thistle)	BFR	27	182	Clopyralid	Primary prescription is chemical for all
	CRE	20	928	Clopyralid	0.5 ac. manual; 17 ac biological, both alts
	SIS	20	85	Clopyralid	Primary prescription is chemical for all
	LOM	293	61	Clopyralid	Biological both alts
	PAUL	96	13	Clopyralid	0.4 ac manual; 7.5 ac biological, both alts
	CRNG	3	0.2	Clopyralid	Biological both alts
Cirsium vulgare (Bull thistle)	BFR	69	346		Manual both alternatives
	CRE	25	1,159	Clopyralid	1,146 ac manual both alts
	SIS	12	195	Clopyralid	192.5 ac manual both alts
	LOM	8	0.5		Manual both alternatives
	PAUL	8	0.8	Clopyralid	0.5 ac manual both alts
	CRNG	19	16		Manual both alternatives
Convolvulus arvensis (Field bindweed)	CRE	3	28	Picloram	Primary prescription is chemical for all
	LOM	9	0.8	Picloram	Primary prescription is chemical for all
	PAUL	1	0.2	Picloram	Primary prescription is chemical for all
	CRNG	15	1.8	Picloram	Primary prescription is chemical for all
Cynoglossum officinale (Houndstongue)	CRE	2	88	Metsulfuron methyl	Primary prescription is chemical for all
	LOM	83	263	Metsulfuron methyl	Primary prescription is chemical for all
	PAUL	101	783	Metsulfuron methyl	14.3 mech; 14.3 fire both alts; rest is chemical. Alt 3 = 35.1 ac manual
Cytisus scoparius (Scotch broom)	BFR	2	0.09	Triclopyr	Primary prescription is chemical for all
	CRE	4	607		Manual both alternatives
	SIS	15	401	Triclopyr	392 ac manual both alts
	LOM	5	0.4	Triclopyr	Primary prescription is chemical for all
	PAUL	1	0.1	Triclopyr	Primary prescription is chemical for all
Dipsacus fullonum (Teasel)	LOM	17	1.2		Manual both alternatives
	PAUL	6	2.8		Manual both alternatives
Elymus repens (Quackgrass)	BFR	2	38	Glyphosate	Alternative 2 = chemical Alternative 3 = manual
Euphorbia esula (Leafy spurge)	BFR	1	1	Picloram	Alternative 2 = chemical Alternative 3 = manual
	CRE	1	1.3	Picloram	Alternative 2 = chemical

Species	District	No. of Sites	GIS polygon acres	First choice herbicide	Alternatives 2 & 3 Manual, biological & cultural treatments
					Alternative 3 = manual
	LOM	5	0.1	Picloram	Alternative 2 = chemical Alternative 3 = manual
	PAUL	1	0.08	Picloram	Alternative 2 = chemical Alternative 3 = manual
Hypericum perforatum (St. Johnswort)	BFR	12	28	Metsulfuron methyl	Primary prescription is chemical for all
	CRE	21	1,108	Metsulfuron methyl	Primary prescription is chemical for all
	SIS	78	1,755	Metsulfuron methyl	1,427 ac. manual both alts; rest is chemical
	LOM	26	4	Metsulfuron methyl	Primary prescription is chemical for all
	PAUL	9	5	Metsulfuron methyl	Primary prescription is chemical for all
	CRNG	3	0.2	Metsulfuron methyl	Primary prescription is chemical for all
Iris pseudacorus (Yellow flag iris)	SIS	1	0.5	Imazapyr	Alternative 2 = chemical Alternative 3 = manual
Kochia scoparia (Kochia)	CRE	2	0.20	Chlorsulfuron	Primary prescription is chemical for all
	CRNG	2	0.1	Chlorsulfuron	Primary prescription is chemical for all
Linaria dalmatica (Dalmatian toadflax)	BFR	68	132	Picloram	Primary prescription is chemical for all
	CRE	9	230	Picloram	Primary prescription is chemical for all
	SIS	7	111	Picloram	93 ac manual both alts
	LOM	3	0.1	Picloram	Primary prescription is chemical for all
	PAUL	4	1.2	Picloram	Primary prescription is chemical for all
	CRNG	3	0.1	Picloram	Primary prescription is chemical for all
Linaria vulgaris (Butter and eggs)	BFR	1	< 0.1	Picloram	Primary prescription is chemical for all
	CRE	8	439	Picloram	Primary prescription is chemical for all
	LOM	4	0.3	Picloram	Primary prescription is chemical for all
Melilotus officinale (Yellow sweet clover)	CRE	2	.01		Manual both alternatives
Onopordum acanthium (Scotch thistle)	BFR	2	1	Clopyralid	Primary prescription is chemical for all
	CRE	3	243	Clopyralid	12.5 ac manual both alts
	SIS	-	-	Clopyralid	Primary prescription is chemical for all
	LOM	8	0.8	Clopyralid	Primary prescription is chemical for all
	PAUL	3	11	Clopyralid	Primary prescription is

Species	District	No. of Sites	GIS polygon acres	First choice herbicide	Alternatives 2 & 3 Manual, biological & cultural treatments
					chemical for all
	CRNG	3	39	Clopyralid	Primary prescription is chemical for all
Phalaris arundinacea (Reed canarygrass)	BFR	14	110	Glyphosate	Alternative 2 = chemical Alternative 3 = manual
	CRE	7	16.6		All cultural, both alts
	SIS	1	89	Glyphosate	Alternative 2 = chemical Alternative 3 = manual
Phalaris arundinacea var. *picta* (Ribbongrass)	SIS	236 patches	1	Glyphosate	Alternative 2 = chemical Alternative 3 = manual
Potentilla recta (Sulphur cinquefoil)	LOM	26	3	Picloram	Primary prescription is chemical for all
	PAUL	20	5	Picloram	0.3 ac manual both alts
Rubus discolor (Himalayan blackberry)	PAUL	1	0.8	Triclopyr	Alternative 2 = chemical Alternative 3 = manual
Salvia aethiopis (Mediterranean sage)	LOM	5	16	Metsulfuron methyl	Primary prescription is chemical for all
	PAUL	2	5	Metsulfuron methyl	Primary prescription is chemical for all
Salsola kali (Russian thistle)	BFR	9	267	Chlorsulfuron	Primary prescription is chemical for all
	CRE	2	132	Chlorsulfuron	123 ac manual both alts
	SIS	2	9.3	Chlorsulfuron	Primary prescription is chemical for all
Senecio jacobaea (Tansy ragwort)	CRE	9	88	Clopyralid	Primary prescription is chemical for all
	LOM	1	< 0.1		Manual both alternatives
	SIS	11	126		Manual both alternatives
Taeniatherumcaput-medusae (Medusahead)	SIS	2	6	Sulfometuron methyl	Primary prescription is chemical for all
	LOM	33	14	Sulfometuron methyl	Primary prescription is chemical for all
	PAUL	13	6.7	Sulfometuron methyl	Primary prescription is chemical for all
	CRNG	25	4,756	Sulfometuron methyl	Primary prescription is chemical for all
Bromus tectorum[1] (Cheatgrass)		--	--	--	Primary prescription is chemical for all
Ventenata dubia[1] (North Africa grass)		--	--	--	Primary prescription is chemical for all

Note: A site may contain multiple species; therefore sites and acreages are not cumulative

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 due to extent of current infestations. 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 FSEIS

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 R6 2005 FEIS and considered in this FSEIS

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, chainsaws, 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 6 species: reed canarygrass and ribbongrass (weed whacking to reduce biomass in order to use less herbicide), Canada thistle, leafy spurge and St. John's-wort (either to reduce biomass to use less herbicide or to mow/weed whack plants to reduce vigor). Dense houndstongue sites would be scarified for revegetation after treatment. Scarification would not occur within riparian buffers in Alternative 3. 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. Anticipated redistribution of biocontrols in the future include: leafy spurge, bindweed, tansy ragwort, Mediterranean sage, Scotch broom & yellow starthistle. Redistribution of biological control agents already present on the Forests would occur naturally, and by moving them to new sites, regardless of this decision (for all alternatives) 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.

Type Treatment	Description	Comments
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. Herbicide is usually applied with a backpack sprayer. Spot spraying is also done 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.	None of the alternatives propose aerial herbicide application. R6 2005 FEIS 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 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 for broadleaves. Repeated treatments on the same site may be necessary for species with a long-lived seed bank; often up to 5 years. Multiple treatments may also be required in a single year, as monitoring may find areas that were missed during the first application, or germination from the seed bank occurring in the fall.
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 houndstongue seed germination before spraying the area with herbicides. Burning will help deplete the seed bank.

These treatments are frequently used in combination according to integrated invasive plant management and as described in Appendix B

Volume 2, Appendix B, Table B-3 displays the biological control agents currently released across the planning area. Additional releases and re-distribution of these agents would be expected to occur regardless of this decision and in compliance with Standard 14.

The following table displays an example of the most common biological control agents found in the planning area. See Table B-3 for a complete list.

Table 11. Common biological agents found in the Planning Area

Invasive Plant	Common Name Biocontrol Agent	Scientific Name Biocontrol Agent
Canada thistle	Canada thistle stem weevil	*Ceutorhynchus litura*
	Canada thistle stem gall fly	*Urophora cardui*
St. Johnswort	St. Johnswort moth	*Aplocera plagiata*
	Klamath weed beetle	*Chrysolina hyperici*
Dalmatian toadflax	Toadflax stem weevil	*Mecinus janthinus*
Diffuse and spotted knapweed	Knapweed flower weevil	*Larinus minutus*
	Blunt flower weevil	*Larinus obtusus*

Herbicides

The R6 2005 FEIS and Appendix D of this FSEIS lists 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 FSEIS (R6 2005 FEIS Appendix N). Table 12 displays the herbicide active ingredients (a.i) that may be used in both action alternatives as well as the lowest, typical, and highest application rates. 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 typical application rates listed below and used in the Risk Assessments are based on using the broadcast application method across 10 acres. Spot application methods may result in somewhat higher rates when treating individual or small groups of plants, however the overall rate would not exceed typical due to substantial areas left untreated. The "highest application rate" is the highest Forest Service application rate reported in 2001. Multiple entries may occur within one year to treat areas missed during the first application; however the overall rate would not be exceeded.

Table 12. Application rates analyzed in Forest Service Risk Assessments

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	0.350	0.50
Glyphosate	0.5	2.000	7.00
Imazapic	0.031	0.130	0.19
Imazapyr	0.03	0.450	1.25
Metsulfuron Methyl	0.013	0.030	0.15
Picloram	0.1	0.350	1.00
Sethoxydim	0.094	0.300	0.38
Sulfometuron Methyl	0.03	0.045	0.38
Triclopyr	0.1	1.000	10.00

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, 47, 56, 67, Table 14). Specific instances where these PDFs have been applied to existing invasive plant sites are listed in Table 14.

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 in Appendix A for each species at each site. Clopyralid is prescribed as first choice on the majority of sites in the project area. Also see Chapter 3.2 for more information on herbicides.

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 using herbicides on the Deschutes/Ochoco/Grassland 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 approximately a 10 percent increase to the proposed quantity of treatment of known sites. The overall cap applies to sites within PAUs and those treated under EDRR. Defining this acreage “cap” allows the analysis in the FSEIS to proceed within maximum, 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 budgets and what has been treated in recent years. Assuming a constant budget of $500,000 per year, about 30% of the infested sites could be effectively treated each year.

Herbicide treatment (for existing sites as well as future treatment under EDRR) is further subject to an annual limit for areas adjacent to water: 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. Treatments below bankfull would be restricted to 1.0 acre per year 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. These limits were determined based on the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model used to estimate the amount of herbicide that could potentially reach a perennial stream via runoff, drift and leaching using these parameters. GLEAMS overestimates the amount of herbicide concentrations that would plausibly enter streams from this project as it is based on broadcast spraying next to perennial streams, which is prohibited in this project (see Table 15and Table 16). See more detailed information on the GLEAMS model in Chapter 3 Sections 3.6.2, 3.7.2, and 3.9.2.

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 if necessary to stay within all the cap restrictions listed above.

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 (one to two growing seasons), 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 (USDA Forest Service 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*), a desireable native grass. It is hypothesized that the plant was present in very small quantities, and then expressed itself as a result of 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 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).

Active restoration 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.

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).**

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 FSEIS, and according to the Project Design Features listed later in this Chapter. The nature of invasive plants 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 invasive 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 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.

As of 2005, there were 14,547 acres of known invasive plant sites. Since that time, the Forests and Grassland have conducted annual surveys of varying intensities (dependent on annual budgets and priorities) and have identified 844 newly detected sites outside of project area units covering 4,453 acres. This represents an average increase of 742 acres per year and an overall increase of 30.6% in the six-year period; about 5% per year. This rate of increase is likely low for the Forests and Grassland as a whole because comprehensive surveys are not conducted across the 2.5 million acres in any given year. This rate of spread would be expected to continue through the life of the project; the R6 2005 FEIS found that invasive plants were spreading at a rate of 8 to 12% per year, and that an emphasis on prevention could slow, but would not stop their spread.

The distribution of new sites since 2005 closely corresponds to Table 1; most of the new sites on the Deschutes NF occur on Sisters Ranger District (many as a result of wildfires), and most of the new acreage on the Ochoco NF occurs on the Crooked River NG. Medusahead accounts for nearly half of the new site acreage introduced on the Ochoco NF, 896 ac on 320 sites, which occupies the site type "Forest" (see Table 4 for a description of site types). The other half of the new acreage on the Ochoco NF are the species houndstongue and knapweed, found along roadsides and within riparian buffer site types. The new sites on the Deschutes NF are found within roadside, riparian and forest sites types. On the Deschutes new sites have a wide diversity of invasive species closely correlated to the distribution found in Table 9, with knapweed species making up the highest percentage (14%).

Overall for the two Forests and Grassland, new sites occur on roadsides (34.5%), forest areas (36.5%), and within riparian areas (29%). Riparian site types include buffer widths found in Table 7 and there has been 113 acres of newly documented emergent species, namely reed canarygrass. New species of note since 2005 include puncturevine found in dry highly disturbed roadside areas, and orange hawkweed, an escaped ornamental plant that grows in riparian areas. The new sites fall within the parameters of the FSEIS analysis, and the effects of treatment of these sites would be similar to those disclosed in Chapter 3. Project design features and treatment caps would apply; new sites would go through the implementation process in Appendix F.

The EDRR approach allows the Forest Service to treat on the Forest where the need exists, based on, but not limited to, the current inventory and anticipated rates of spread. Methods may change, depending on adaptive management and monitoring results, but not beyond the scope of this FSEIS. The Implementation Planning process detailed below is intended to ensure that effects are within the scope of those disclosed in this FSEIS 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 FSEIS. 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 FSEIS 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 the most likely to be 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. Integrated treatment methods would be determined by such things as species and location of the site, based on priority detailed in Appendix F and 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. If, after an interdisciplinary review and consideration of new information within the context of the overall project, the responsible official determines that a correction, supplement, or revision to this FSEIS is not necessary, implementation would continue. An analysis according to Section 18 of the 1909.15 Forest Service NEPA Handbook would be warranted if the

treatment prescription was not similar to any analyzed in this FSEIS, or there were circumstances not considered in this FSEIS. 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 FSEIS and approved in the Record of Decision.
- The site does not have unique features and is similar in size, condition, and physical setting, as one of the treatment areas analyzed in this FSEIS.
- 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.

Invasive Plant Prevention Activities

Some members of the public commented on the Draft SEIS that they would like to see prevention measures as a connected action to this project. Although prevention is not a connected action to this proposal, it is however part of existing management direction that would continue under any alternative. Measures to prevent the introduction and spread of invasive plants are included in all site-specific projects, while this project proposal concentrates on control techniques as part of an integrated invasive plant program. See Appendix G for a complete list of Forest Plan Standards and local prevention practices. Prevention measures have been put into practice for a number of years:

- The Ochoco NF LRMP was amended in 1995/1998 to include an extensive set of practices at the project level. An example of these practices includes "consider excluding livestock from high priority noxious weed sites where the animals would likely cause spread of the weed" (the West Pasture of Roba Allotment was rested for three years, and control efforts concentrated there to control houndstongue).
- The USFS Washington Office published a "Guide to Noxious Weed Prevention Practices" in 2001. This was an extensive list of goals and practices, many of which matched what was currently being implemented locally. Some of the guidelines suggested went beyond local practices at the time, such as seeding areas after wildfire as part of the Burned Area Emergency Rehabilitation plans to compete with unwanted plants (one example where this was incorporated was seeding done on the Sisters Ranger District Eyerly Fire in 2002).
- In 2005 Region 6 released a Record of Decision and Final EIS on Preventing and Managing Invasive Plants, which amended the Deschutes, Ochoco and Crooked River Grassland LRMPs with standards of prevention (see Appendix G for a list of standards).
- In June 2007 the Forest Supervisors authorized additional prevention measures to be implemented locally that would meet the goals and standards from the R6 2005 ROD (see Appendix G for a list of measures).

Education is an important goal of prevention. The Forests and Grassland spend considerable time and effort sharing information to partners, forest visitors and employees. In 2009 approximately 1,410

public individuals participated and over 128 hours were spent on invasive plant identification, biology and vectors of spread, explaining the need for the weed-free forage program, and why preventing invasive plants from establishing is critical to an integrated program.

Another important goal of prevention is reducing the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions. Every project has design criteria that address disturbance, and program activities include prevention measures as well. A few examples include:

- The South Bend Hazardous Fuels Reduction Project on Bend/Ft. Rock Ranger District included measures that prevent equipment use within 30' of road shoulders infested with spotted knapweed; deleted areas of known weed populations from timber harvest units; and weed sites were treated before project implementation.
- The Snowshoe Project on Lookout Mountain Ranger District (non-commercial thinning and slash disposal) dropped proposed units from consideration due to houndstongue infestations within the units.
- The Deep Creek Grazing Allotment Management Plan on the Paulina Ranger District included a provision for a holding pasture to be constructed where cattle would spend time before moving into the allotment. Cattle graze the Roba Allotment, which is heavily infested with houndstongue, and then move to the Deep Allotment; the cattle would be kept in the holding pasture until houndstongue seed falls off their coats (approximately 2 weeks).
- Road maintenance, a part of the engineering program, is an annual activity consisting of blading, shoulder re-shaping, culvert cleaning, and the addition of gravel as necessary. Timing of this work is coordinated to avoid the flowering period to prevent seed spread, and some weed sites on road shoulders are avoided altogether. Gravel is taken from weed-free sources.

Although education is promoting public awareness to the effects of invasive plants on National Forest lands, and prevention measures are a standard way of conducting business for the two Forests, their effectiveness is not enough to prevent invasive plant introduction and spread. The R6 2005 FEIS found that the adopted invasive plant management direction had a "moderate to high potential to reduce rate of spread" and provided the assumption that prevention would reduce the rate of spread by 50%. Control techniques and early detection/rapid response is necessary for the success of an integrated weed program.

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 plan.

Implementation Monitoring

Implementation monitoring of invasive plant treatments is a two-step process. Each infestation is given a priority as required by Standard 11 (Forest Plans amended by the R6 2005 ROD). 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 would be determined and appropriate PDFs 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 Monitoring

Effectiveness monitoring is used to determine if objectives and desired conditions in the Forest LRMPs, R6 2005 ROD, and this Invasive Plant Treatments FSEIS 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 Non-target 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 FEIS, and if progress towards the desired future condition is occurring, including active or passive revegetation success. 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. For example, monitoring would occur in sample sites to ensure non-target vegetation is adequately protected. Non-target vegetation in selected areas would be evaluated before and immediately after treatment, and two to three months later. Treatment buffers would be expanded if damage were found as indicated by a decrease in the size of any non-target plant population, leaf discoloration or chlorophyll change, or mortality to individual species.

Forest Service policy requires annual reporting of treatment effectiveness in the Forest Activity Tracking System database (FACTS). FACTS protocols require at least 50% 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 PDFs, 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, and revegetation areas. 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 was developed by the Forest Service, Pacific Northwest Region, and reviewed by the National Marine Fisheries Service, and the US Fish and Wildlife Service, among others. 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 Region 6 Invasive Plant Monitoring Plan (USDA Forest Service 2011d).

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 Plans (Forest Plans) 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* (USDA Forest Service 2005b). This change will reconcile our Forest Plans 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 & Crooked River National Grassland Land and Resource Management Plans

Forest Plan	Scope	Current Standard and Guideline	Proposed Change
Och/CRNG 1995 Weed EA/DN	Forest-wide Direction	Use chemical treatments only when other methods have proven ineffective or impractical.	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).
Och/CRNG 1995 Weed EA/DN	Grassland-wide Direction	Use chemical treatments only when other methods would be ineffective or impractical.	

2.4 Project Design Features for all Action Alternatives

2.4.1 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 Syracuse Environmental Research Associates, Inc. Risk Assessments (2001, 2003a, 2003b, 2003c, 2003d, 2004a, 2004b, 2004c, 2004d, 2004e, 2004f, 2004h, 2011a, 2011b) disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label).

The R6 2005 ROD included an additional margin of safety by (lower threatened and endangered species thresholds were applied to all wildlife, fish and other aquatic organisms, see discussion in R6 2005 ROD pg 23-26). Finally, the Project Design Features (called project design criteria in Figure 5) further reduce the risks associated with herbicide treatments by eliminating or minimizing as much as possible the impacts to the environment.

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). All PDFs are

required in both Action Alternatives as follows: Alternative 2 requires PDFs 1-56, 63-97 and Alternative 3 requires PDFs 1-55, 57-97. Many of the PDFs also apply to implementation of the current invasive plant treatment program (No Action). 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, best management practices (BMPs), field experience, consultation with regulatory agencies, and scientific reasoning (Desser 2008). Buffers used in the PDFs and Tables 15 and 16 were determined by consulting published and agency literature (Berg 2004, Norris et al. 1991, SERA 2003, SERA 2005) and using professional judgement of the interdisciplinary team, with knowledge of local conditions and weed treatment methods. For treatments in or near riparian areas, wetlands, and other areas bordering water, use restrictions included equipment and application type, permitted herbicides or formulations, and distance from surface water. Herbicides that have an aquatic label and can legally be applied in or adjacent to water were given a smaller buffer distance (10 feet) than other herbicide that were low risk to aquatics but do not have an aquatic label (15 feet). It is anticipated that both buffers will keep herbicide out of surface waters due to PDFs and application methods.

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.

This project is consistent with the Council of Environmental Quality's January 2011 memorandum (CEQ 2011) which states: "Many Federal agencies rely on mitigation to reduce adverse environmental impacts as part of the planning process for a project, incorporating mitigation as integral components of a proposed project design before making a determination about the significance of the project's environmental impacts. Such mitigation can lead to an environmentally preferred outcome and in some cases reduce the projected impacts of agency actions to below a threshold of significance."

Mitigation measures are agency best management practices, they are called project design features in this FSEIS. They are included in the project design, are integral components of the proposed action, and are implemented with the proposed action. Those PDFs that would be monitored are noted as such. 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.

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. (Appendix G)
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. Irrigation ditches will be treated like intermittent streams, buffer widths in Tables 15 and 16 will apply. 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. Current agreements are in the project file.

Purpose	Project Design Feature	Source/Comments
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.	R6 2005 ROD Standards 15, 16, and 18. 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 a.i./ac. **Broadcast** application would not exceed application rates for the following herbicides: • Picloram at any rate higher than 0.5 lb. a.i./acre. • 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.	Limiting the application rate for these active ingredients will ensure their use stays below levels of concern for workers, the public, fish, wildlife, and other aquatic organisms; these rates are based on results of the SERA Risk Assessments.
	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 (Garlon 3A) over the ester formulation of triclopyr (Garlon 4) 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.

Purpose	Project Design Feature	Source/Comments
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 size is modeled to eliminate adverse effects to non-target vegetation 100 feet further from broadcast 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 herbicide 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 licensed 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. ▪ Require that 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. ▪ Require safe disposal of herbicide containers, following label instructions and State and local laws.	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 large spills.
22.	Spray equipment would be calibrated prior to seasonal start-up and	To ensure proper application of herbicide.

Purpose	Project Design Feature	Source/Comments
	periodically throughout the season to assure accuracy in applications.	
23.	Minimize traffic in riparian reserves/RHCAs where appropriate.	To minimize trampling, protect riparian habitat, and prevent potential invasive plant spread in riparian areas. RR/RHCA widths incorporates the 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. The 150' width incorporates the 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, wicking or wiping. 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.	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.
29.2	Invasive plant treatments would not occur adjacent to waterbodies during Public Health Advisory periods for blue-green algae.	To respond to public concern. Based on advisories and other state

Purpose	Project Design Feature	Source/Comments
		water regulations.
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 USFS 2003 Risk Assessment.
37.	In areas of known special forest products 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.	Peak seasons would be avoided when possible (PDF 41), and known cultural plant gathering sites, popular berry and mushroom picking areas would be posted or otherwise marked where treatment with herbicides is occurring during harvest season.	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.	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.	Do not use herbicides where cultural use plants are present during their season of collection, where possible (mostly spring and early summer for	To ensure no inadvertent public contact with herbicide occurs and

Purpose	Project Design Feature	Source/Comments
	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 Native 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.	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 are designed to protect spawning fish or eggs incubating in the stream.
43.	Use only aquatic formulations or low aquatic risk herbicides on saturated soils, or those 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. 43.1 No broadcast spraying of picloram, non-aquatic triclopyr, non-aquatic glyphosate or sethoxydim on roads that have a high risk of delivery to water (generally roads within RHCAs).	Source: SERA Risk Assessments; R6 2005 FEIS (Chapter 4.72 & 4.73) and Fisheries Biological Assessment & Biological Opinion. To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. Compliance with 2011 Biological Opinion Terms & Conditions.
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 picloram, clopyralid or metsulfuron methyl on high porosity soils (texture class 3 or 4) particularly where the water table is shallow. Exceptions include heavily compacted sites located on artificially constructed road and dam structures. See PDF 43 for further restrictions.	Label advisory. To avoid excessive percolation to groundwater or spring sources.
46.	No more than one application of sulfometuron methyl would occur on a given area in a calendar year, except to treat areas missed during the initial application. No more than one application of picloram would occur on a given area every two years, except to treat areas missed during the initial application.	To reduce potential for accumulation in soil. Based on label restriction.
47.	Do not use chlorsulfuron, picloram, and/or sulfometuron methyl on shallow (<12" depth), scabland, or high clay content (texture class 1 – fine texture, refer to Table 41 in Soil Section) soils with low infiltration rates where runoff from storm events could reach surface waters.	Label advisory. To avoid excessive herbicide runoff to reduce potential for entering surface or groundwater.
48.	Deleted due to redundancy with PDF 47.	Deleted.
49.	Ester formulation of triclopyr is not allowed within 150 feet of any perennial water body for Alternative 2, and 300 feet for Alternative 3. Outside of the 150 foot distance, the salt (aquatic) form of triclopyr is preferred over the ester form of triclopyr where it is effective.	Width based on aquatic influence zone. Lower risk herbicides are preferred where effective to protect aquatic organisms, fish, wildlife and human health.
50.	Apply erosion control measures (*e.g.* silt fences or shut down periods) and native revegetation (*e.g.*, mulching, native grass seeding, planting) for manual treatment where detrimental soil disturbance or de-vegetation may result in the delivery of measurable levels of fine sediment to federally listed fish species' critical habitat.	Common measures to minimize sedimentation.

Purpose	Project Design Feature	Source/Comments
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 (Standard 16) 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 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 (see Table 12 and associated text). Minimum distance to water is 10 feet for spot spraying herbicide. Within 10 feet, only hand application (e.g. wicking/wiping) is allowed in Alternative 2. See Table 14 for fisheries-specific Project Design Features concerning specific herbicides and use rates within certain watersheds.	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 Tables 14 and 15 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.	Based on label advisories and SERA risk assessments. Buffers correspond to herbicide characteristics. Complies with Standards 19 and 20 from the R6 2005 ROD.
	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.	To reduce likelihood that herbicides will enter surface waters in concentrations of concern.
Alternative 3 Only		
57.	Use selected buffers and application methods from Tables 14 and 16 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.	Based on label advisories, SERA risk assessments. Complies with Standards 19 and 20 of the R6 2005 ROD.
	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.	To reduce likelihood that herbicides will enter surface waters at levels of concern.
58.	Do not use NPE or POEA surfactants within 300 ft of streams, lakes, and wetlands.	Alt. 3 only allows lower risk surfactant near surface water.
59.	No application of any herbicides within the high water mark of intermittent streams, or seasonal lakes, ponds, wetlands, and reservoirs.	Further protection of aquatic organisms by reducing potential

Purpose	Project Design Feature	Source/Comments
	The high water mark is defined as bankfull or an area above the water surface where non aquatic vegetation is established.	for herbicides to enter surface waters at levels of concern.
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 streams, rivers, lakes, ponds, wetlands, or reservoirs.	Further protection of aquatic organisms by reducing potential for herbicides to enter surface water at levels of concern.
62.	No mechanical treatment that disturbs the soil allowed within 300 feet of perennial 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 Survey and Manage Plants		
63.	Surveys will be conducted for Threatened, Endangered, Sensitive 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.).	Forest Service Manual 2670; 35 foot distance more conservative than Marrs et al. (1989). To ensure sensitive species are protected and surveys are conducted when appropriate. 2001 Survey & Manage ROD as modified by 2011 Settlement Agreement.
64.	Within TES and Survey and Manage 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 these plants. This may involve avoiding these plant populations or individuals (i.e., identify/map areas around TES plant populations that must be avoided, or flag individual 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 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 Survey and Manage plants.	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.
65.	For manual treatments within TES and Survey and Manage 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 if buffers are needed to protect TES and Survey and Manage 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 Survey and Manage plants.

Purpose	Project Design Feature	Source/Comments
67.	Protection buffer widths for TES and Survey and Manage 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 utilized if plant is not susceptible to these selective herbicides. Spot spray of glyphosate may be used if conducted when a 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 Survey and Manage plants. Buffer distances based on Thistle (2006) and Marrs et al. (1989).
68.	In order to protect TES and Survey and Manage 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 of sulfonylurea herbicides (chlorsulfuron, sulfometuron methyl, metsulfuron methyl) will require soils, adjacent vegetation, and site conditions to be evaluated prior to treatment. Use spot spray or wick method for 1-2 years after a severe disturbance (eg wildfire) or until the area is revegetated. Do not use herbicides when exposed soils are powdery and dry and rainfall is likely to be of high intensity.	To reduce potential for wind and water 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 plans. Label caution states “for the previous year”. 18 months provides higher level of protection.
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, Survey and Manage 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.	Do not use harrowing or discing methods in eligible or unevaluated archaeological sites. Refer to implementation plan for avoidance measures in specific Project Area Units.	To protect cultural resources.
73.	Do not use prescribed 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 the R6 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.	The measure will also protect wildlife that may use stock watering sources.

Purpose	Project Design Feature	Source/Comments
	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 areas. **Less than 10 feet:** Use selective hand application methods such as wiping and wicking.	
	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 0.25 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 (USFS 2010); distance is known to reduce sound levels and therefore disturbance. Source: Livezey 2003, USFS 2010.

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 0.25 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 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.	To minimize or eliminate disturbance as required by Programmatic BA (USDA Forest Service 2006f) and National Bald Eagle Guidelines (USFWS 2007).
	79. Project activities that have potential to disturb bald eagle winter roosts, shall be restricted within 1200 ft of the roosting area from November 1 to April 30th.	To minimize or eliminate disturbance. Source: Programmatic BA (USDA Forest Service 2006f).

Purpose	Project Design Feature	Source/Comments
Greater Sage Grouse		
80.	Do not use glyphosate or NPE-based surfactants in areas where sage grouse may forage (consult with District wildlife biologist). Limit the application rate of glyphosate to the typical rate of 2 lbs a.i./acre	To eliminate risk of exposure. Biologist consult is to determine areas where grouse forage. Source: BE for Des/Och Invasive Plant FSEIS
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: USDA Forest Service 2003, Connelly et al. 2000.
82.	Do not 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.	Do not broadcast spray POEA or 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 Deschutes/Ochoco Invasive Plant FSEIS.
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 which indicates that late nesting and fledging would occur.	Source: J. Pagel, unpublished data.
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.

Purpose	Project Design Feature	Source/Comments
Wetland Habitat (yellow rail, tricolored blackbird, and waterfowl)		
89.	Do not broadcast or spot spray NPE-based surfactants in or adjacent to suitable habitat. Do not exceed typical application rates of glyphosate (2 lbs a.i./acre).	To eliminate risk of exposure. Source: BE for Des/Och Invasive Plant FSEIS.
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. comm.
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 FSEIS.
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. (Consult District Wildlife Biologist)	To eliminate risk of exposure. Source: BE for Des/Och Invasive Plant FSEIS.
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

To further protect aquatic organisms, PDF 54 requires the use of certain herbicides, formulations, rates, and acreage limits for certain watersheds displayed in Table 14.

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	71-50 71-55 71-56 71-59	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	71-02, 06, 10, 14-16, 23, 28, 32, 33, 50, 56, 75	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Mountain Creek 1707020113	71-42 & 67 72-06, 23, 36, 61	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Rock Creek 1707020114	72-07 to 09, 49, 70	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Upper Middle John Day 1707020113	72-07 72-48	Steelhead Redband Trout	Use of picloram restricted to treating sulphur cinquefoil and field bindweed species.
Lower SF John Day 1707020113	72-01, 07 to 10, 52, 53	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.

Table 15. Minimum buffers (ft) for herbicide applications near streams, lakes, wetlands, used in Alternative 2

Herbicide	Perennial stream or river			Seasonal intermittent stream			Perennial lake/wetland			Seasonal lake/pond/wetland		
	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand
Clopyralid	100	15	bankfull	50	15	bankfull*	100	15	bankfull	50	15	bankfull*
Chlorsulfuron	100	50	bankfull	50	50	bankfull	100	50	bankfull	50	50	bankfull
Aquatic Glyphosate	50	10	0	15*	10*	0	50	10	0	15*	10*	0
Glyphosate	300	100	50	100	50	50	300	100	50	100	50	50
Imazapic	100	15	bankfull	15	15	bankfull*	100	15	bankfull	15	15	bankfull*
Aquatic Imazapyr	50	10	0	50*	10*	0	50	10	0	50*	10*	0
Imazapyr	100	50	15	100	50	bankfull	100	50	bankfull	100	50	bankfull
Metsulfuron Methyl	100	15	bankfull	15	15*	bankfull*	100	15	bankfull	15	15*	bankfull*
Picloram	300	100	50	100	50	50	300	100	50	100	50	50
Sethoxydim	300	100	50	100	50	50	300	100	50	100	50	50
Sulfometuron Methyl	100	15	bankfull	50	15	bankfull	100	50	bankfull	50	15	bankfull
Aquatic TriclopyrTEA	X	15	0	X	15*	0	X	15	0	X	15*	0
TriclopyrBEE	X	150	150	X	50	50	X	150	150	X	50	50
Tank Mix	Use greatest buffer identified above.											

*If channel/wetland is dry there is no buffer. X – no broadcast spraying is allowed. Bankfull - the point where water begins to overflow onto the floodplain.

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		
	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand	Broad-cast	Spot spray	Hand
Clopyralid	300	15	10	300	15	bankfull	300	15	10	300	15	bankfull
Chlorsulfuron	300	50	10	300	50	bankfull	300	50	10	300	50	bankfull
Aquatic Glyphosate	300	10	10	300	bankfull	bankfull	300	10	10	300	bankfull	bankfull
Glyphosate	300	300	300	300	300	300	300	300	300	300	300	300
Imazapic	300	15	10	300	15	bankfull	300	15	10	300	15	bankfull
Aquatic Imazapyr	300	10	10	300	bankfull	bankfull	300	10	10	300	bankfull	bankfull
Imazapyr	300	50	15	300	50	bankfull	300	50	10	300	50	bankfull
Metsulfuron Methyl	300	15	10	300	15	bankfull	300	15	10	300	15	bankfull
Picloram	300	300	300	300	300	300	300	300	300	300	300	300
Sethoxydim	300	300	300	300	300	300	300	300	300	300	300	300
Sulfometuron Methyl	300	15	10	300	15	bankfull	300	50	10	300	15	bankfull
Aquatic TriclopyrTEA	X	15	10	X	15	bankfull	X	15	10	X	15	bankfull
TriclopyrBEE	X	300	300	X	300	300	X	300	300	X	300	300
Tank Mix	Use greatest buffer identified above.											

Bankfull - the point where water begins to overflow onto the floodplain. X – no broadcast spraying allowed

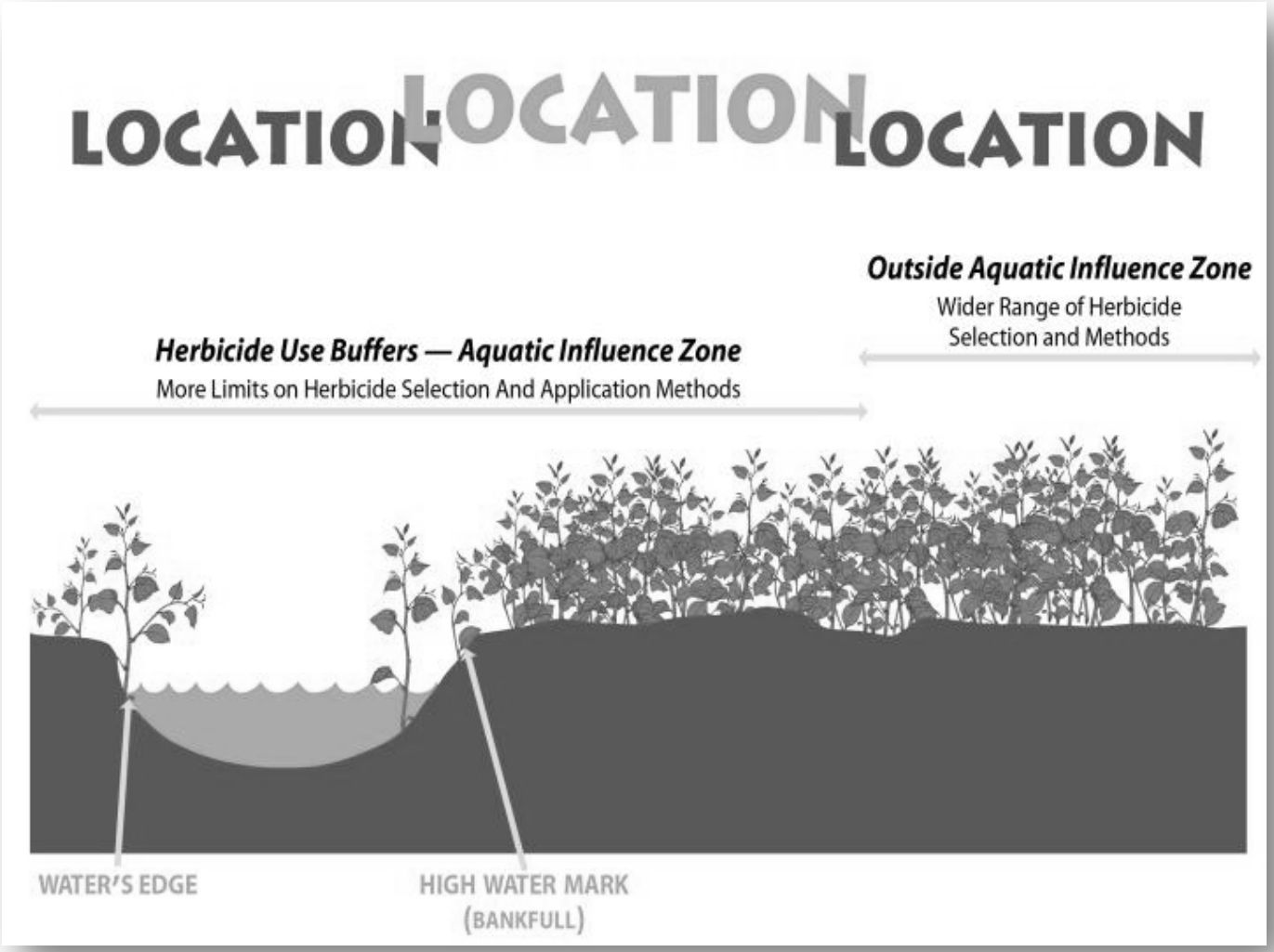

Figure 4. This picture shows where "water's edge", "high water mark" and "bankfull" lie for use in herbicide selection and application methods.

2.5 Alternatives Not Considered in Detail

The Forest Service considered the alternatives suggested by the public during the various scoping and comment periods and in some cases, used the alternative suggestions to refine elements of the Proposed Aciton and action alternative. This section describes all of the alternatives the Forest Service considered during the planning of this project and the reasons the Forest Supervisors chose to eliminate them from detailed analysis.

Emphasize Methods Other Than Herbicides

Members of the public who are concerned about or opposed to herbicide use on national forest suggested that we emphasize other methods besides herbicide use. Some people proposed the alternative that the Forest Service use herbicides only where all other methods have been found inadequate, regardless of timeliness and cost. Some people would prefer no herbicide use at all, or only in rare cases. Some people suggested eliminating herbicide use specifically within lower priority sites, riparian reserves, riparian habitat conservation areas, and/or municipal watersheds. Alternatives that eliminate or essentially eliminate herbicide use for this project were not developed for detailed study because herbicides are necessary to cost-effectively treat invasive plants, especially where the size of the population or phenology of the target species make non-herbicide treatments counter-productive or cost-prohibitive. Alternatives eliminating or essentially eliminating herbicide use would not meet the need for timely treatment of invasive plants. The Common Control Measures described in Appendix B are a compendium of research on the most effective treatments for each target species. Herbicides are a necessary part of the integrated weed management toolbox; avoidance of use of herbicides has contributed to the current inventory of invasive plants and their ongoing spread.

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.[5] Herbicides can effectively eradicate, control and/or contain this invasive plant. Another example is ribbongrass, for which 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).

By the time all of the suggested herbicide restrictions were applied, the result would be very similar to No Action. Under No Action, about 6 percent of the total number of currently mapped sites (1,892) may be treated with herbicides. Under No Action, up to 2,000 acres per year would be approved for treatment compared to 16,000 acres (treatment cap per year) in the action alternatives. 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.

[5] 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).

The following paragraphs address specific public suggestions that would emphasize other methods over herbicide use:

No herbicide use on lower priority sites

This approach was not fully developed because some sites/target species may currently be lower priority, but timely, cost-effective treatment would still require herbicides. If not effectively treated, over time, lower priority sites may become higher priority, but be harder or impossible to treat due to increased size of established population and seed bank. At that point, more herbicide would be necessary to effectively treat the site, thus this approach would ultimately prove counter-productive. In addition, funding may be available to treat an area that would otherwise be lower priority.

No herbicide use within riparian reserves or riparian habitat conservation areas

Concerns about herbicide use in riparian areas are addressed in the action alternatives by buffers and PDFs that minimize potential for herbicide to reach water. Alternative 3 is specifically designed to address concerns about the riparian and aquatic environment by providing a greater degree of caution (buffers) while still allowing some effective treatment in riparian areas. 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 and spread throughout the forest. This is contrary to the purpose and need of controlling known sites and preventing them from spreading further. Refer to sections 3.6 and 3.7 for expected impacts to the riparian areas and aquatic organisms.

No herbicide use 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. Coordination and agreement with departments managing municipal water systems, restriction on broadcast application, and buffers around water intakes would adequately address concerns about herbicide toxicity, drinking water safety, and public health. As discussed in Chapter 3.7, drinking water standards will be met in the action alternatives. An alternative that eliminates herbicide use in municipal watersheds would not have measurably different impacts than the proposed action. Thus, this alternative was not developed for detailed study.

No herbicide use in other areas

The following areas were suggested as no herbicide use areas: within essential or critical fish habitat; cultural plant areas; on biological soil crusts; special forest product areas; trailheads and other recreation areas; Oregon Cascades Recreation Area; roadless areas; wild and scenic rivers; Newberry Monument; Research Natural Areas;along the Metolius River; within spotted owl, wildhorse, horned grebe, red neck grebe, amphibian, pygmy rabbit, bufflehead, harlequin duck, yellow rail, sage grouse, prairie falcon, tricolored blackbird, tightcoil snail habitat; or along roadside ditches leading to streams. By the time these and all other areas in the above bulleted list are removed from herbicide use, very little of the Forests and Grassland remain. Thus, this alternative is

very similar to no herbicide use, which is even more restrictive than the no action alternative and would not meet the need for invasive plant control. Invasive plants would continue to spread and degrade wildlife habitat in the long-term.

Tool of Last Resort

Herbicide use as a "tool of last resort" has been suggested to limit or eliminate herbicide use. The idea is that other methods would be tried first, then herbicides used only in the event of failure. The R6 2005 FEIS analyzed an alternative that would have made herbicides a tool of last resort (see page 9 and page 2-25). In the R6 2005 ROD (page 27), the Regional Forester chose not to make herbicides a tool of last resort because this approach would deviate from integrated weed management principles that are part of Forest Service manual direction (FSM 2080.5). This FSEIS tiers to the R6 2005 FEIS and thus an alternative using herbicides as a tool of last resort was not analyzed in this project FSEIS (40 CFR 1502.20). This alternative is similar to No Action because manual and mechanical treatments would generally be categorically excluded from NEPA documentation, and individual herbicide projects that are proven necessary (last resort) could be analyzed in future environmental assessments. The end result of this approach would be similar to No Action and would not meet the purpose and need for action.

No Broadcast Spraying of Herbicides

Some people suggested an alternative eliminating broadcast spraying of herbicides everywhere across the project area. Broadcast spraying is proposed where the density and extent of infested plants is great enough to warrant continuous coverage. Most of the infestations are small and scattered and spot spraying would be prescribed, even in upland areas where broadcast would be allowed. However, in areas that are dense or larger, broadcast spraying is the most cost-effective method.

Under the Proposed Action (Alternative 2), PDFs and buffers were developed to restrict broadcasting where there is a potential risk of herbicide delivery to surface water bodies, based on models that assume a worst-case scenario with continuous broadcast spray (see discussions about GLEAMS and other models in Chapter 3). PDF 9 and 12 eliminate all broadcast with triclopyr, and limits the application rates that sulfometuron methyl, picloram, and/or NPE may be broadcast, to avoid exposures of concern to human health. PDF 27 states that broadcast will not occur in municipal watersheds without specific consultation with water managers. Selective applications are required in administrative areas (PDF 33). PDF 67 eliminates broadcast spraying within 100 feet of Survey and Manage, sensitive, threatened, and/or endangered botanical species. PDF 75 eliminates broadcast spraying within 100 feet of range watering resources. No broadcasting would occur within 50 feet of perennial streams (see Table 15), and non-aquatic labeled herbicides would not be broadcast within 100 feet of perennial streams (about 724 acres of invasives are currently mapped within 100 feet of streams). Together, these PDFs serve to minimize the risks associated with broadcast spraying in Alternative 2. Alternative 3, analyzed in detail, provides additional restrictions on broadcast spraying within 300 feet of perennial waterbodies (approximately 1,518 acres or 11 percent of the total known infested acres) are within 300 feet of streams).

An additional alternative is not necessary to understand or resolve issues related to broadcast spray. Further restrictions would be arbitrary and are not necessary to mitigate for specific effects. Further restrictions would reduce cost-effectiveness, but not add substantial benefit. Therefore, an alternative that does not allow any broadcast applications was not developed in detail.

Prohibit Certain Herbicides and Add Others

The Forest Service considered alternatives that eliminate use of some of the chemicals listed in Standard 16 of the R6 2005 ROD, which includes herbicide formulations containing 10 active ingredients. Some members of the public were in particular against the use of glyphosate and triclopyr. See Appendix J for specific response and discussion about these herbicides. Appendices B and D show options for herbicide use for each target species. The more options available, the more likely that treatments will be cost effective and restrictions on herbicide use tends to reduce cost effectiveness (USDA 2005a). For example, here are requested suggestions for chemical restrictions received during the comment period:

- Do not use NPE or NP surfactants, picloram, sulfonylurea herbicides, triclopyr, sethoxydim with naphthalene, or glyphosate with POEA surfactant.
- Do not use glyphosate, glyphosate with POEA, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, triclopyr acid, triclopyr BEE, NPE surfactant, or cholorsulfuron near fish.
- Do not use sulfometuron methyl, imazapic, metsulfuron methyl, or chlorsulfuron near aquatic plants.

In the case of treating emergent vegetation growing in or on the edge of water (reed canarygrass, ribbongrass), eliminating the above herbicides from the list of 10 formulations proposed, there would be two choices left for treating next to a stream with fish present: clopyralid and imazapyr. Clopyralid does not kill grass and is not labeled for use in water; imazapyr does kill grass but again, is not labeled for use in water. The result is no effective option and equates to not treating invasive vegetation growing in water with herbicides, which is analyzed in Alternative 3.

The Alternatives include herbicide use according to standards and design features and buffers. Project design features and buffers are based on specific risks associated with herbicide ingredients. The PDFs minimize risks to low levels, however where possible, having more herbicide choices increases flexibility and improves effectiveness.

Alternative 3 includes some herbicide ingredient (and application method) restrictions within riparian areas to address specific risks. However, throughout this document, the analysis finds that the small degree of increased protection from the restrictions is outweighed by the potential loss of treatment effectiveness.

It was suggested that aminopyralid be added to the list of active ingredients included in this action. Aminopyralid is recognized as an herbicide that has a favorable risk profile and could be effective on some of the broadleaf target species in the project area. The R6 2005 Record of Decision Standard 16 requires that herbicides must have appropriate risk analysis before use. Aminopyralid was not included in the 2005 ROD as an herbicide available for use because the risk analysis was not completed at that time; therefore is not included in this Invasive Plant Treatments FSEIS. The risk assessment for aminopyralid was not complete until June of 2007, after consultation with US Fish and Wildlife Service and National Marine Fisheries Service for this project had begun. Including aminopyralid would have required re-initiating consultation and therefore would have delayed completion of the FSEIS. Aminopyralid could be added later following a supplemental or separate NEPA document.

Prohibit Biological Control

Some members of the public expressed concern over the use of biological control agents proposed in our invasive plant treatment project. The concerns centered on risks to non-target species. 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. A Technical Advisory Group assists the Animal Plant Health Inspection Service (APHIS) officials in the testing and approval process. See the R6 2005 FEIS pp 3-83 to 85, and its Appendix J for more detail on the APHIS testing procedure. Once the control agent is approved and established, re-distribution of the agent is done by ODA. 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 – maintained within the invasive plant toolbox available at http://www.fs.fed.us/r6/invasiveplant-eis.htm).

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.

Release of biological control agents on adjacent lands by the Oregon Department of Agriculture, as analyzed by APHIS, will continue under all alternatives, and contributes to reducing the spread of invasive plants. It is recognized that biocontrol agents have, and will likely continue to cross land ownership boundaries. Thus, an alternative eliminating biological control would likely be impossible to actually implement.

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 “Emphasize 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 2005 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” (USDA Forest Service 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 FSEIS. The R6 2005 FEIS, tiered to in full, analyzed an alternative that especially emphasized prevention (see R6 2005 FEIS page 2-25 and its Appendix B). 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 FSEIS 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.* The R6 2005 ROD selected an alternative that includes standards and guidelines for invasive plant prevention that became part of the Deschutes and Ochoco NF Land and Resource Management Plans, and remains our current direction.

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 FSEIS. 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 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 FSEIS 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 2005 FEIS, Ch. 3.3.2). 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

Alternative Component	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
Allows mechanical scarification within 300 feet of waterbodies for revegetation	Not addressed	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 summary of the alternatives based on how each responds to the issues (details in Chapter 3)

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Treatment Effectiveness			
Estimated Acres of Invasives in 2014	13,640	7,767	8,519
Number of Herbicide Formulations Available	3 in all areas ONF; 4 in all areas DNF	10 in upland areas; 10 in riparian areas	10 in upland areas; 7 in riparian areas
Herbicide Application Method and Adjacency to Water	DNF – Allows broadcast spraying within 100' of water; spot spraying emphasized off roads. ONF – Allows broadcast spraying; spot spraying within 50' of water; wipe within 10' of water.	Allows broadcast application of aquatic formulations to within 50' of perennial water; other formulations 100-300 ft. Allows broadcast application within 15-100 ft of intermittent water, depending on formulation. Allows wicking/wiping of aquatic formulations within perennial water	Does not allow broadcast spraying within 300 feet of perennial or intermittent water. Does not allow any herbicide application within 10' of perennial water.
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. New infestations within the scope of effects can be treated without new NEPA if effects and treatments are within the constraints of this FSEIS.	Yes, incorporates an EDRR strategy. New infestations within the scope of effects can be treated without new NEPA if effects and treatments are within the constraints of this FSEIS.
Non-Target Vegetation			
Percent of Infested Acres Remaining in 2014	Upland = 98% Riparian = 67%	Upland = 60% Riparian = 12%	Upland = 60% Riparian = 49%
Percent of Forest Service Land Treated with Herbicides	Upland = 0.03% Riparian = 0.001%	Upland = 0.62% Riparian = 0.02%	Upland = 0.62% Riparian = 0.01%
Types and formulations of herbicides available for use	Deschutes NF – allows use of herbicides that have higher potential for harming non-target plants, including: dicamba, picloram, glyphosate and triclopyr. Ochoco NF – allows the use of herbicides that have higher potential for harming non-target	Would allow the use of more selective herbicides, with less persistence in the environment, such as clopyralid which targets only 4 plant families. Does not allow the use of dicamba, which has a higher potential to harm non-target species. Includes a wider choice of herbicides (10) that would help prevent shifts in plant	Same as Alternative 2, but lowers the number of available herbicides to 7 within 300 feet of perennial water (drops glyphosate, picloram, sethoxydim).

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
	plants including: dicamba, picloram and glyphosate. Limited choice of herbicides increases the risk of developing herbicide resistance in target species.	community composition, thus maintaining plant diversity, and less risk of target species resistence.	
Soils			
Toxicity Potential to Soil Microbes and Resulting Effects to Soil Productivity	Low - 2,204 acres currently approved for treatment (approximately 65% of which is picloram)	Low (14,547 maximum acres proposed to be treated). Picloram, sulfometuron methyl, triclopyr have the highest risk; 6,178 acres of these herbicides are proposed as a first choice of herbicide. PDFs developed to limit effects.	Low (260 acres less herbicide treatment than Alt 2). No picloram or triclopyr BEE is allowed within 300' of intermittent or perennial streams. Sulfometuron methyl and aquatic triclopyr would be allowed within 15' of intermittent streams by backpack method and up to 10' by wick method.
Potential for Soil Erosion from Treatment Methods	Moderate (emphasis on manual treatments)	Low (staggered herbicide and follow-up maintenance treatments, PDFs 43-50)	Moderate (increased manual treatments in riparian areas especially in connection with emergent species)
Water Resources and Aquatic Species			
Acres of Herbicide Treatments in Aquatic Buffers	Deschutes NF – not allowed within 100 feet. Ochoco NF - some sites within 1,045 acres of Treatment Areas in '98 EA. Allows spot spray within 10' and wick application up to water.	1,518 invasive plant acres proposed for herbicide treatment within 300 feet of water. 724 acres proposed within 100 feet. 260 acres within 10 feet.	1,288 invasive plant 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.
Water Quality Parameters: Sediment & Turbidity Temperature Chemistry	No measurable increase in any parameter. Does not promote healthy riparian areas free of invasive plants.	No measurable increase in any parameter; meets State water quality standards. Promotes healthy, invasive-free riparian areas yet has the highest potential for short-term (<6 months) water quality effects primarily from direct overspray of herbicide into water, small reduction in shade in localized areas, and exposed soils due to reduced ground cover. PDFs minimize these risks.	No measurable increase in shade and water chemistry parameters. Pulling/digging emergent invasive species have the potential to exceed State water quality standards for sedimentation and turbidity. Does not allow herbicide treatment within 10 feet of water (260 acres), which does less to promote healthy, invasive-free riparian areas, such as the Metolius River. Lower potential for short term effects to water chemistry and shade. PDFs, treatment caps and restricting certain chemicals lower the risk even more.

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
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 precludes shade from becoming established.	Major impacts prevented with PDFs. Potential risk for effects to bull trout and redband trout from herbicide treatments near water, however PDFs and aquatic formulations lower the risk. No measurable effects from manual, mechanical and cultural methods.	Major impacts prevented with PDFs. Reduced risk of herbicide residue washing into streams. Reduced risk of direct overspray to water. Effective control of emergent species such as ribbongrass is not likely. Invasives would continue to degrade habitat; TES species would be affected long-term. No measurable effects from manual mechanical and cultural methods except in Metolius River where cover would be reduced and sedimentation increased due to manual and cultural treatment of ribbongrass.
Human Health			
Exposure analysis from Appendix Q of the R6 2005 FEIS	Exposure analysis determined exposure to two products is of concern - triclopyr and NPE surfactants. The use of triclopyr is allowed on the Deschutes NF. NPE surfactants are allowed for use on both Forests and Grassland. The use of triclopyr is currently not allowed on the Ochoco NF.	The risk reduction framework, including project design features, eliminate plausible harmful exposure scenarios, for example: broadcast spraying of triclopyr is not allowed, use of Garlon 3A is favored over Garlon 4, triclopyr BEE not permitted within 150 feet of streams, NPE surfactants are limited to the lowest rate and are not allowed within 100 feet of water or ditches.	The risk reduction framework, including project design features, eliminate plausible harmful exposure scenarios, for example: broadcast spraying of triclopyr is not allowed, use of Garlon 3A favored over Garlon 4, triclopyr BEE not permitted within 300 feet of streams, NPE surfactants are limited to the lowest rate and are not allowed within 100 feet of water or ditches.
Wildlife			
Threatened/Candidate Species: Northern Spotted Owl, Pacific fisher, greater sage grouse, wolverine, Oregon spotted frog	No direct adverse effects from ongoing treatment.	Potential for disturbance from noise, but minimized with PDF; no effect/impact to habitat. No plausible effects from herbicide.	Potential for disturbance from noise, but minimized with PDF; no effect/impact to habitat. No plausible effect from herbicide.
Sensitive Species: Oregon & Columbia spotted frogs, pygmy rabbit, sage grouse, harlequin	May impact individuals but is not likely to lead to a trend toward Federal listing	May impact individuals but is not likely to lead to a trend toward Federal listing	May impact individuals but is not likely to lead to a trend toward Federal listing

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
duck, yellow rail, Northern waterthrush, Crater Lake tightcoil snail, silver bordered fritillary			
Sensitive Species: bald eagle, wolverine, Pacific fisher, Townsend big-eared bat, horned grebe, bufflehead, upland sandpiper, peregrine falcon, white-headed & Lewis woodpeckers, tricolored blackbird, Johnson's hairstreak	No Impacts	No Impacts	No Impacts
Survey and Manage Species: great gray owl, Crater Lake tightcoil snail	Not Habitat-disturbing	Not Habitat-disturbing	Not Habitat-disturbing
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. Activities will not contribute to a negative trend in viability.	Effects from disturbance are avoided with seasonal restrictions. No adverse effects from disturbance or herbicide exposure. Activities will not contribute to a negative trend in viability.
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.
Social/Economic Aspects			
Total cost for all sites' first year of treatment (assumes for simplicity that all roadside sites are broadcast in Alternatives 2 and 3)	$572,350 Spot/hand herbicide: $261,250 Manual: $310,100	$2,205,290 Broadcast herbicide: $996,500 Spot/hand herbicide: $968,750 Manual: $240,040	$2,724,590 Broadcast herbicide: $996,500 Spot/hand herbicide: $1,472,750 Manual: $255,340
Jobs created based on treating all acres in the first year	32	88	112
Rangeland Resources			
Effects to Forage Vegetation	Invasive plants would continue to spread, competing with	Control of invasive plants, including those in riparian areas, would increase the	Same as Alternative 2, with the exception that less effective control measures (eg no

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
and Livestock	native grasses and reducing the nutrituional value of forage. Label restrictions are followed; but there is no PDF restriction for applying herbicides near livestock watering places.	density and vigor of native forage. Expands the choices of herbicides that do not have grazing restrictions. Label restrictions would be followed for herbicide use; PDFs restrict applying herbicides near livestock watering places.	broadcast spraying) would be used in riparian areas, allowing invasive plants to spread and degrade preferred forage for livestock.
Cultural Resources			
Effects to Historic or Prehistoric Resources from Mechanical Methods	Treatments under current NEPA do not affect historic or prehistoric resources.	14.3 acres of burning & mechanical treatments are proposed that may have the potential to expose unknown historic or prehistoric resources. PDFs are in place to protect known cultural resources.	Same as Alternative 2
Effects to Cultural Plants	Does not effectively control most infestations introduced since 1998. Provides the least protection to the long-term sustainability of cultural use plants.	Does the most to prevent spread of invasive plants into cultural plant gathering areas. Many PDFs in place to protect non-target vegetation. PDF 41 specifically addresses time of herbicide application in cultural plant areas.	Emergent invasive plants would continue to spread in riparian areas that also contain cultural use plants; manual methods would not be as effective in preventing spread.
Recreation and Scenery			
Effects to Recreation and Scenery	Continued short-term visual effects from herbicide treatments within recreation areas and scenic corridors. Has the most potential for long-term affects of invasive plants to alter the scenic pattern, form and texture of the landscape.	Short term effects (1-2 growing seasons) of dead vegetation along access and transportation corridors. Short periods of interaction between recreationists and weed-control crews; possible temporary closures of recreation sites during herbicide application work.	Same as Alternative 2. Longer periods of interaction between recreationists and weed-control crews in riparian areas due to the time factor involved with manual control efforts.

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Congressionally-Designated Areas and Other Special Areas			
Wilderness	No current herbicide use on known sites in wilderness. Greatest risk of introduction and spread of invasives into wilderness areas.	Herbicide use is not proposed within wilderness, only manual methods. This alternative would control invasives at trailheads and surrounding areas using all treatment methods, providing the most effective means to avoid spread into wilderness.	Same as Alternative 2
Oregon Cascades Recreation Area	Reed canarygrass and other species would continue to spread within Big Marsh, and this Alternative poses the greatest threat to the goals established for the area, and its unique values.	Cultural and manual methods are prescribed to treat invasive plants, having short-term effects to the recreation experience from reed canarygrass solarization control techniques and resulting dead patches of vegetation.	Same as Alternative 2
Wild and Scenic Rivers	This alternative has the greatest long-term risk of affecting the Outstanding and Remarkable Values (ORV) for all Wild and Scenic Rivers in the project area, from continued spread of invasive plants.	Herbicide treatments would have short-term effects to the scenery ORV. The alternative has the most long-term benefit to native plant communities and associated wildlife and fishery ORVs.	This alternative has slightly less long-term benefit due to the restriction of less effective treatment methods within 10 feet of Wild and Scenic Rivers. Reed canarygrass and ribbongrass control on approx. 13 acres is unlikely to be effectively controlled.
Research Natural Areas	Invasive plants would continue to spread within the Ochoco Divide & The Island RNAs, despite on-going manual treatment efforts. Greatest risk of spread within 6 RNAs due to adjacent weed populations.	Herbicide use is proposed within the Ochoco Divide RNA (26 ac). There would be minor, short-term effects to native vegetation from herbicide use. Greatest long-term benefit to maintaining natural conditions within RNAs by controlling weeds on adjacent roads, and by implementing EDRR. Manual treatment proposed in the Island RNA (3.5 ac).	Same as Alternative 2.
Newberry National Volcanic Monument	Herbicide treatment along Highway 97 would continue. Invasive plant sites along the 21 Road and 10-Mile Snopark would continue to spread. Reed canarygrass on the west shore of Paulina Lake would continue to spread around the lake.	Herbicide use proposed along major access roads in the Monument, and 10-Mile Snopark, would have minor visual effects. Herbicide treatment proposed for reed canarygrass/bull thistle at Paulina Lake would create dying vegetation visible to the public in the short-term (1-2 years).	Roadside treatments would be the same as Alternative 2. Invasive plants within 10-feet of water on Paulina Lake, reed canarygrass and bull thistle, would be either dug out of the shoreline or covered with plastic for solarization. Solarization treatment would have a visual effect for a longer period of time (3-4 years).

Issue and Indicator	Alternative 1	Alternative 2	Alternative 3
Inventoried Roadless Areas	Current herbicide treatment would continue on roads adjacent to 5 Roadless Areas. Continued spread of invasives adjacent to and within all 13 IRAs	PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Highest protection to native plant habitats.	Control of reed canarygrass at Lava Lake would be less effective due to 10-foot no herbicide buffer. Somewhat less effective control of one Himalayan blackberry site due to second-choice herbicide.
Experimental Forest	Does not allow treatment of Road 43, so is the highest risk for spread of knapweed and toadflax into Pringle Falls Experimental Forest	Allows roadside herbicide treatment of Road 43 (121 acres of roadside with one acre infested) and EDRR to prevent spread.	Same as Alternative 2.

2.7 Maps

Detailed maps of all known existing invasive plant infestations and proposed treatment areas are available on the Ochoco and Deschutes National Forest website located at: http://fs.usda.gov/goto/centraloregon/invasive-plants-projects.

There are 12 maps covering the Ochoco and Deschutes National Forests, and the Crooked River National Grassland. Printouts of these maps are included in the project record. Hard copies of the maps are also available by contacting the U.S. Forest Service at 541-416-6500.

Maps were included in the *Invasive Plant Treatments Draft Supplemental Environmental Impact Statement* published June 2009. Maps such as those found on the website, along with other Geospatial Information System tools, were used in the analysis documented in Chapter 3.

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Chapter 3. Affected Environment and Environmental Consequences

Changes between DSEIS and FSEIS:

- This final 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. Redundancies were removed and general and minor edits are made throughout for clarification.
- More emphasis was given to effects on cultural use plants by inclusion in Section 3.12 Cultural Resources, rather than being addressed in Section 3.4 Non-target Vegetation.
- Additional Survey and Manage plants were analyzed in Section 3.4 Non-target Vegetation. Sensitive plant species were updated to the 2008 Regional Forester's Sensitive Species list so that botany, wildlife and aquatic organism lists are consistent. Effects tables were summarized for easier comparison.
- Section 3.6 Water Resoureces, was updated to reflect the new 2010 303(d) list, which was approved on March 15, 2012.
- Section 3.7, Fisheries and Aquatic Organisms, was updated, and Alternative 3 changed from Not Likely to Adversely Affect; to Likely to Adversely Affect determinations for bull trout and steelhead. Change from No Adverse Effect; to Adverse Effect for Chinook and coho salmon essential fish habitat. Change from No Effect; to Not Likely to Adversely Affect for Middle Columbia River steelhead critical habitat. These changes are due to additional emphasis on manual treatments of emergent vegetation, as a result of comments received on the DSEIS.
- Section 3.7 was updated to reflect changes in bull trout critical habitat. On October 18th 2010 critical habitat for bull trout was re-designated in the coterminous United States. The previous designation (2005) did not designated critical habitat on Forest Service owned waters, while the re-designation of critical habitat does encompass streams, rivers, and lake habitats on the Deschutes and Ochoco National Forests and Crooked River National Grassland.
- Greater sage grouse now have federal candidate species status on the Ochoco and Deschutes National Forests, and the Crooked River National Grassland. It remains a Forest Service Sensitive Species. Effects to sage grouse from this project are included in Section 3.9; effects determinations remain unchanged.
- Sensitive wildlife species in Section 3.9 were updated to the 2008 Regional Forester's Sensitive Species list so that botany, wildlife and aquatic organism lists are consistent. Additional Survey and Manage wildlife species were analyzed.
- The potable water analysis was moved from Section 3.6 Water Quality, to Section 3.8 Human Health, and was summarized. The original detailed information can be found in the Hydrology Specialist's Report in the analysis file, and is incorporated by reference.

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).

Scientific Citations Submitted during Public Comment Period

During the 45-day public comment period (see Appendix J) the Forest Service received website citations and scanned documents that some felt showed scientific opposition to elements of the purpose and need, proposed action, and effects analysis. These documents were reviewed by the interdisciplinary team and experts at the Pacific Northwest Regional Office for their applicability to the analysis in the FSEIS. The final assessment is included in Appendix J Response to Comments. *Scientific Controversy* occurs when there are differing opinions within a body of science. Commenters provided no peer-reviewed scientific literature that disputes the evidence of herbicide risk assessments completed by SERA.

The effects of treatment are assessed for the entire project area 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 (16,000 acres is the maximum annual cap); however, the actual amount would likely be less, and would be based on priorities and limited by budget. EDRR sites, those new sites on the current inventory, would go through the Implementation Planning process documented in Appendix F before treatment could begin.

3.1.1 The Planning Area

The entire planning area involves nearly 2.5 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 and Scenarios

The analysis in this chapter of the FSEIS 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 to 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.

- Eighty percent 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 projected to recur for five years. Even though a site may be cleared of invasive plants before five years, the scenario used for analysis assumes a 5-year period.
- 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 the choice of herbicide is usually species-specific and timing specific, further lowering the amount of herbicide applied on the same place at the same time.

This project would be implemented over the next 15 years approximately, as funding allows, or until conditions have changed sufficiently to warrant this FSEIS 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, based on current budgets. 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[6]
- Number of Sites Treated: 1,892
- Acres Treated with Herbicide: 13,814
- Acres Treated with Non-Herbicide Methods: 732
- Percentage of Treatments that are Non-Herbicide: 5%
- Active Restoration- approximately 263 acres

Relationship to Early Detection-Rapid Response Strategy

All action alternatives include the ability for Forest Service Line Officers to approve treatments on currently unknown invasive plant sites while incorporating Project Design Features (see also page 61 and Appendix F). A changed condition analysis would be completed to determine the effects are within the constraints of this FSEIS. 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 58 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 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

Introduction

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). As is discussed throughout Chapter 3, the risks of direct and indirect adverse impacts from this project are relatively small in any one location or time. The project covers a large geographical area and will occur over approximately 15 years. A variety of activities will occur within and adjacent to the project area through this time, however the specific location of invasive plant treatment and other activities are uncertain at any given time.

This section is provided as a basis for cumulative effects analysis found in each individual resource section of Chapter 3. The potential for treatment effectiveness to affect other land ownerships is discussed. What is known about herbicide use off of Forest System land is discussed along with the

[6] 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.

results of studies focusing on the accumulation of herbicides and other pesticides in rivers and streams. Other reasonably foreseeable actions proposed on the Forests and Grassland are described. The potential for lingering effects from past and ongoing herbicide use on the Deschutes/Ochoco National Forests and Crooked River National Grassland (Deschutes/Ochoco/Grassland) is also discussed.

Despite the uncertainty inherent in multiple forests with multiple year projects, the cumulative effects of the project can be predicted because the PDFs limit the extent and intensity of impact from this project at any one location, and the duration of adverse impacts would be relatively short. CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making (40 CFR 1508.7).

This FSEIS tiers to the Region 6 Invasive Plant Program Final EIS (USDA Forest Service 2005a). The vectors and mechanisms of invasive plant spread are discussed in the FEIS at length, along with cumulative effects analysis. The baseline for cumulative effects analysis is the current condition as described in the affected environment sections throughout Chapter 3.

All invasive plant treatment methods have the potential to damage individual non-target plants, including sensitive, Survey and Manage species. Noise and worker activity can disturb wildlife and removal of vegetation can affect their habitat. If manual, mechanical or herbicide treatments create bare soil, erosion can be accelerated. Small amounts of herbicide or sediment could reach surface water and impact water quality/aquatic organisms. All treatments have the potential to injure a worker or result in other accidents; and all treatments would create jobs and cost money. There is little disagreement that the potential adverse impacts of non-herbicide invasive plant treatments are minor, small scale, and of short duration. The potential for non-herbicide treatments to result in effects of concern to the public is very low. The potential for cumulative effects from such treatments were discussed in the R6 2005 FEIS (Chapter 4-39, 4-50, 4-61 to 62, 4-89 to 4-90, and 4-122 to 123) and are incorporated by reference.

Aside from the cost-effectiveness of non-herbicide treatments, public issues focus on the effects of herbicide use in the alternatives. Some people have expressed concern that herbicide use from this project could combine with herbicide use elsewhere and have an additive, synergistic, or other cumulative effect; specifically the effects on wildlife, fish or people exposed to repeated doses of herbicides.

The focus of the following section is on the cumulative effects from proposed herbicide use combined with herbicide use elsewhere, however cumulative effects of relevant vegetation management, grazing, off-road vehicles, and other activities are addressed in the resource cumulative effects sections. The impacts predicted from invasive plant treatments with herbicide in the alternatives would occur on small acreages scattered across the 2.5 million-acre project area; the average infestation size is less than 8 acres. Up to 0.6 percent of the total project area may be treated with herbicides annually, 16,000 acres, in the action alternatives, as a result of a treatment cap (See Chapter 2, Section 2.3.4). The treatment cap is the **maximum** acres that could be treated, and is used in the analysis as a conservative approach to determine effects. The actual amount of herbicide that would be applied would be less than predicted because invasives are rarely continuously distributed across a given acre. The Invasive Plant Program budget on the Deschutes/Ochoco National Forests and Grassland allows, on average, treatment of approximately 2,900 acres with herbicide each year, which would also serve to limit the extent of herbicide treatments within the project area. Thus, the likelihood that this project would contribute to

measurable, detectable herbicide concentrations in downstream waters from any of the alternatives is very low and would not contribute to cumulative adverse effects. Multiple herbicide exposures on the Deschutes/Ochoco/Grassland are unlikely to occur in close enough proximity in time or space with other applications to trigger cumulative effects beyond those analyzed and disclosed in the risk assessments and impact statements. Infestations that cross ownership boundaries are often treated cooperatively so the effects are limited to the existing infestation and immediately surrounding areas.

Herbicide Use in Oregon

Herbicides are commonly applied for a variety of agricultural, landscaping and invasive plant management purposes. Herbicide use occurs on tribal lands, state and county lands, private forestry lands, rangelands, utility corridors, road rights-of-way, and private property. Studies (see sections below) have shown that pesticides are commonly found in surface waters. However, no studies have shown that the herbicide use similar to the type proposed in this project would result in harmful concentrations of herbicide in water. The R6 2005 FEIS (pg 4-10) estimated 3 percent of the herbicide use within Oregon and Washington is on Forest System land.

The following section discusses herbicide use in the state of Oregon. Beginning in 2007, the State of Oregon required Pesticide Use Reporting to a centralized database (http://www.oregon.gov/ODA/PEST/purs_index.shtml). Reporting requirements applied to those who use pesticides in the course of business or any other for-profit enterprise, to government entities, and for use in a locations intended for public access. Herbicide use was reported at the large river basin scale. The reporting system has since been discontinued due to budget, and the data inconsistencies were reported (ibid). However, the report does provide a way to contrast the potential for herbicide use under the alternatives to total use at the river basin scale. For 2007, approximately 5,732 reporters filed 284,984 reports of pesticide use into the Oregon system. Approximately 551 active ingredients were used in the state. The top five active ingredients, by pounds, for the entire state were:

- Metam-sodium (42%) [soil fumigant],
- Glyphosate (9%) [herbicide],
- Copper naphthenate (7%) [wood preservative],
- 1, 3-dichloropropene (5%) [soil fumigant], and
- Aliphatic petroleum hydrocarbons (4%) [insecticide].

Of these, glyphosate is the only herbicide. It was the second most used active ingredient and accounted for nine percent of all pesticide use reported statewide. The vast majority was agricultural use. Statewide reported glyphosate use was over 3.5 million pounds.

Herbicide Use within the Deschutes and John Day River Basins

The Oregon Department of Agriculture 2007 Pesticide Use Report showed that pesticide use (by pound) in the Deschutes and John Day Basins combined amounted to two percent of the reported use in Oregon with over 900,000 pounds of active ingredients applied. Of the top five ingredients used in these water basins, glyphosate is the only herbicide that is also proposed for use in this project. About 95,500 pounds of glyphosate was reportedly used in the Deschutes Basins. In the John Day Basins, there were nearly 153,000 pounds of glyphosate applied (ibid.).

By contrast, the Forest Service applied 38 pounds of glyphosate within the project area in 2007 (FACTS Pesticide Use Report 2007). This level of use would continue under No Action (Alternative 1). For Alternatives 2 and 3, glyphosate is the first choice of herbicide on about 149 acres under this project (Table 9), which would amount to approximately 1,043 pounds based on highest application rates (see

Table 12). A portion of this total would contribute to the total amount used in each water basin, but this additional glyphosate use is very unlikely to contribute to any cumulative effects. Glyphosate is quickly taken up by plants or bound up with soils so that it is not mobile in the environment soon after application. Effects of glyphosate from invasive plant treatments are very limited in time and space to the immediate area of the treatment. If vegetation adjacent to or emergent from flowing water is treated, glyphosate may be detected downstream from the treatment. However, it is very likely bound to organic matter and not biologically active and very unlikely to cause any effect. Therefore, glyphosate use as proposed in the action alternatives would not create cumulative effects with glyphosate use from other lands in the water basins.

Similarly, the effects from use of other herbicides in the action alternatives, if any, are very unlikely to accumulate with potential effects from herbicide use in other areas because of the limited spatial and temporal scale at which use would occur. Many of the proposed herbicides have limited mobility in the environment so effects would be limited to areas immediately adjacent to the treatment sites; others, though mobile to some extent, have properties that bind them to soil particles or ensure rapid degradation, so do not pose a level of concern. The PDFs and buffers reduce the potential for harmful levels of herbicide to enter surface waters or harm species of local interest. Effects of most of the herbicides proposed for use would not persist in the environment for more than a few weeks or months, and those that remain longer have PDFs limiting the frequency of use so that effects do not accumulate at the treatment site.

Three other herbicides proposed for use in the action alternatives (just triclopyr in No-Action) are within the top 100 reported statewide in 2007: imazapyr, sulfometuron methyl, and triclopyr. In both action alternatives, imazapyr is the first choice on one site that is smaller than an acre (Table 9), amounting to 1.25 pounds of active ingredient at the highest rate (Table 12), compared to the 2007 statewide use of over 43,000 pounds. Sulfometuron methyl is the first choice herbicide for about 5,086 acres of known medusahead sites within the project area (Table 9), amounting to about 229 pounds of herbicide active ingredient total at the highest rate (Table 12), as compared to 2007 statewide use of more than 21,000 pounds. This is a “worst-case” scenario, as much of the 5,068 acres of medusahead would be treated as a containment strategy, with only the borders of infestations treated. Triclopyr is the first choice herbicide on about 11 acres of known sites (Table 9), amounting to about 108 pounds of herbicide active ingredient total at the highest rate (Table 12), as compared to 2007 statewide use of nearly 216,000 pounds.

These data demonstrate the low amount of herbicide use compared to river basin or statewide use. The Forest Service contribution to this amount would remain low in all alternatives. No water quality issues related to pesticides have been identified in the waters in the project area (none of the streams in the area are 303(d) listed for chemical contamination). Any herbicide reaching the stream would be quickly diluted and as the herbicide moved downstream it would become less and less likely to cause impacts. Research by Evans and Duseja (1973) found picloram concentrations diluted 85 to 98 percent within 100 meters (328 feet) below treatment areas. Glyphosate, an herbicide prescribed for streamside treatments in this project and most widely used across Oregon, would become biologically inactive upon contact with organic matter in the stream or stream bank. However, detectable levels of pesticides are likely to currently exist within rivers within the project area, based on the studies described below.

NWQAP Pesticide Study

Since 1991, the National Water Quality Assessment Program (NWQAP) has implemented interdisciplinary assessments in 51 of the Nation’s most important river basins and aquifers, referred to as Study Units, and the High Plains Regional Ground Water Study. The USGS published a report: “Pesticides in the Nation’s Streams and Ground Water, 1992–2001” (Gillom and others 2006) that

presented evaluations of pesticides in streams and ground water based on findings for the first decadal cycle of NAWQA. The study found that undeveloped streams had one or more detectable pesticides or degradates 65 percent of the time. The study stated that presence of pesticide compounds in predominantly undeveloped watersheds[7] may result from past or present uses within the watershed for purposes such as forest management or maintenance of rights-of-way, uses associated with small areas of urban or agricultural land, or atmospheric transport from other areas. None of the herbicides proposed for use in this project were detected in the national samples (however it is acknowledged that glyphosate is widely used but was omitted from the study).

The report discusses the many delivery mechanisms of pesticides to surface and ground water:

> *Pesticides are transported to streams and ground water primarily by runoff and recharge. Nonpoint sources of pesticides originating from areas where they were applied—rather than point sources such as wastewater discharges—are the most widespread causes of pesticide occurrence in streams and ground water (Modified from Majewski and Capel, 1995.) The atmosphere is often overlooked as a source of pesticides, which return to earth with precipitation and dry deposition and can reach streams and ground water. Streams are particularly vulnerable to pesticide contamination because runoff from agricultural and urban areas flows directly into streams along with both dissolved and particle-associated pesticides. Ground water is most susceptible to contamination in areas where soils and the underlying unsaturated zone are most permeable and drainage practices do not divert recharge to surface waters.*

The study also stated:

> *Pesticide occurrence in streams and ground water does not necessarily cause adverse effects on aquatic ecosystems or humans. The potential for effects can be assessed by comparing measured pesticide concentrations with water-quality benchmarks, which are based on the concentrations at which effects may occur. No streams draining undeveloped land, and only one stream in a watershed with mixed land uses, had an annual mean concentration greater than a human-health benchmark.*

This study supports the conclusion that this project, combined with other herbicide use off Forest, would not result in herbicide delivery to streams over a threshold of concern for people and/or the environment. The State of California also 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 stream flow between application and monitoring sites may have contributed to the lack of positive detections (Jones et. al. 2000).

Clackamas River Pesticide Study

Closer to home, a study about the background levels of pesticides in surface waters was done on the Clackamas River, part of the Willamette River Basin in western Oregon. The Pesticide occurrence and distribution in the lower Clackamas River basin, Oregon, 2000–2005 (Carpenter, K.D and others 2008) was done as part of the NWQAP.

The Clackamas study took place from 2000–2005. Within 119 water samples from the Clackamas and its tributaries, 63 pesticide compounds: 33 herbicides, 15 insecticides, 6 fungicides, and 9 pesticides degradates were detected. Fifty-seven pesticides or degradates were detected in the tributaries (mostly

[7] Refers to urban and rural developments; roads and forest management activities may be occuring in these areas.

during storms), whereas fewer compounds (26) were detected in samples of source water from the lower mainstem Clackamas River, with fewest (15) occurring in drinking water.

The study stated that the two most commonly detected pesticides were the triazine herbicides simazine and atrazine, which occurred in about one-half of samples. It also said that the active ingredients in the "common household herbicides" RoundUP™ (glyphosate) and Crossbow™ (triclopyr and 2,4-D) also were frequently detected together. These three herbicides often made up most of the total pesticide concentration in tributaries throughout the study area.

The study stated that pesticides were most prevalent in the Clackamas River during storms, and were present in all storm-runoff samples — averaging 10 individual pesticides per sample from these streams. Two tributaries contained 17–18 different pesticides each during a storm in May 2005. These medium-sized streams drain a mix of agricultural land (row crops and nurseries), pastureland, and rural residential areas. Two small streams that drain the highly urban and industrial northwestern part of the lower basin had the greatest pesticide loads. Streams draining predominantly forested basins contained fewer pesticide detections (2–5 pesticides). The study stated that pesticide use on the Mount Hood National Forest, which comprises most of the Federal land in the upper Clackamas River Basin, was a relatively insignificant contribution. Similar to the Mt. Hood National Forest, the Ochoco and Deschutes National Forests lie in the headwaters of the Ochoco Mountains and Cascade Mountains.

None of the detections related to any of the herbicides proposed for use on the Deschutes/Ochoco/Grassland were above a threshold of concern in the Clackamas study. However the study noted that the thresholds do not account for simultaneous exposure to multiple pesticides and degradates and that it is difficult to determine the cumulative effect of such a mixture. 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 (R6 2005 FEIS pages 4-1 to 4-3). Based on the Clackamas example, information in the R6 2005 FEIS, and the PDFs and buffers associated with this project, herbicide exposures would not combine with other chemical uses and cause cumulative adverse effects to people or the environment.

The Clackamas River has a different mix of land uses and is in a different biological region than rivers within the project area. However, similar to the Clackamas situation, the Deschutes/Ochoco/Grassland invasive species treatments are likely insignificant to the overall presence of pesticides in surface waters, and the type of herbicides proposed for use are those that have not been found to accumulate downstream in concentrations over a threshold of concern. The effects analysis acknowledges that storm runoff is a delivery mechanism from herbicides to surface waters; however the amount of herbicide predicted to reach streams is below a threshold of concern and water quality standards will be met (see Water Resources Section 3.6).

Herbicide Use Adjacent to the Project Area

The following sections discuss what is known about herbicide use on other land ownerships adjacent to the project area, including BLM, tribal, state, and private lands. Past and ongoing herbicide use by the Forest Service is also discussed.

Counties are responsible for controlling noxious weeds along county roads and other county property outside of and within the Deschutes/Ochoco/Grasslands. They also work with conservation districts, weed management areas, and watershed councils to control noxious weeds on private property. Additive herbicide exposures are possible if herbicide is used on neighboring lands during the same day as planned on the Deschutes/Ochoco/Grasslands. PDF 6 addresses the coordination so that treatments are coordinated with other landowners. Crook, Deschutes, Jefferson and Klamath Counties, along with

Oregon Department of Agriculture help implement the Forest Service herbicide program, and therefore provide an important coordination link for treatments on and adjacent to national forest, in addition to those throughout the Counties.

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.

BLM Herbicide Use

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.

The Bureau of Land Management has also proposed vegetation treatments using herbicides on BLM lands in Oregon. Five alternatives, including continuation of current use and no herbicide use, are being considered in a Draft EIS published in 2009. The BLM currently uses herbicides to treat noxious weeds on approximately 9,700 acres east of the Cascade Mountains in Oregon. They propose to increase this use to up to 39,800 acres under the action alternatives (including use for invasive and native plant control). The herbicide use proposals are not specific enough to model cumulative effects at the watershed scale; the BLM Draft EIS notes that their contribution to cumulative effects would also be relatively low compared to other statewide use.

The Prineville District of the BLM, encompassing 1.7 million acres in northcentral Oregon, developed a proposed action for a site-specific Environmental Assessment for vegetation treatments using herbicides. The proposal identifies up to 50,000 acres of herbicide treatments that could occur each year. The acreage that will be treated with herbicides on BLM lands within watersheds in the project area is not available. The BLM and Forest Service will coordinate projects in shared watersheds (PDF 6).

Tribes

The Confederated Tribes of the Warm Springs and Bureau of Indian Affairs released a Vegetation Management Noxious Weed Control Plan and Assessment in 2005. Manual, mechanical, biological, prescribed burning, as well as herbicide treatments will be implemented over the next five years. The amount of herbicide to be used on tribal lands is not available. The Tribes and Forest Service will coordinate projects in shared watersheds (PDF 6).

State and Private

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 boundaries, and in the case of the Crooked River National Grassland, adjacent to federal land. Nonpoint sources of herbicides in streams and groundwater result from agricultural use (USGS 2006). More information on agricultural herbicide use is contained in the analysis files, and in Section 3.1.3.

Past and Ongoing Invasive Plant Treatments

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). Various other environmental analyses have been done to approve hand-pulling and digging of invasive plants across the two Forests.

The use of herbicides for treating unwanted vegetation (other than invasive plants) is also approved on Deschutes National Forests under the 18 Fire Competing Vegetation Project. This project includes 20 units treated with spot application of granular hexazinone, beginning in 2007). This project does not overlap the invasive plant sites proposed for treatment in this FSEIS. The effects of the hexazinone applications would not extend beyond the immediate treatment areas (see 18 Fire Competing Vegetation Project EA, USDA Forest Service 2006c). 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. In addition, the 1998 Noxious Weed EAs have resulted in ongoing herbicide treatments. Herbicides from past treatments are unlikely to be detectable after one year because herbicide residues from past treatments in most locations would be broken down or adhered to organic matter or soil particles within one year of application. The small amount of herbicide residue that may have entered waterbodies via runoff or percolation will have been degraded and diluted during the first runoff event and subsequent runoff events within the year before any herbicide applications occur under this FSEIS.

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. Additive 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 at the lowest effective application rate for a given location; with some herbicide application rates further restricted (PDF 12). 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. The potential for reduction in overhead and instream cover will only occur where reed canary, ribbongrass and yellow iris treatments are proposed. Other invasive plants targeted under this FSEIS are not riparian dependant and treatments would not alter streamside habitat cover. Proposed riparian treatments do not overlap with other projects that decrease instream habitat and cover. Current instream projects on the forests and grassland are working toward increasing cover with additions of woody debris. Water temperatures would not be affected by removal of reed canary/ribbongrass (See FSEIS Water Resources Section 3.6).

Reasonably Foreseeable Projects in the Planning Area

The Forest Service is proposing a variety of activities throughout the planning area, below is a listing of projects that foreseeably could overlap in time and space with invasive plant treatments.

Table 19. Location and category of foreseeable projects in the planning area

Project	Location	Category
Travel Management Project (implementation)	Deschutes/Ochoco NFs and Crooked River NG	Trails and Roads
Ochoco Summit OHV Trail (planning)	Ochoco NF, Lookout Mtn. & Paulina RDs	
Lava Rock OHV Trail (on hold)	Deschutes, Bend/Ft Rock RD	
Three Trails OHV Trail (implementation)	Deschutes, Crescent RD	
Upper Beaver Vegetation Management (implementation)	Ochoco NF, Paulina RD	Vegetation and Habitat Management and Restoration
Jackson Vegetation Management (planning)	Ochoco NF, Paulina RD	
Canyon Fuels and Vegetation Mgt (implementation)	Ochoco NF , Lookout Mtn. RD	
Howard- Elliot- Johnson Vegetation Management (implementation)	Ochoco NF, Lookout Mtn. RD	Vegetation and Habitat Management and Restoration
McKay Creek Vegetation Management (planning)	Ochoco NF, Lookout Mtn. RD	
Grassland Firewood Units Project (planning)	Crooked River National Grassland	
Lookout Mountain and Gray Prairie Prescribed Burn Projects (planning)	Ochoco NF, Lookout Mtn. RD	Fuel Reduction and Habitat Improvement
Southside,Marks Cr and Mill Cr Allotment Management Plans (implementation)	Ochoco NF, Paulina RD, Lookout Mtn. RD	Grazing Management
Flank and EFX Vegetation and Fuels Mgt Projects (implementation)	Deschutes NF, Bend/Ft. Rock RD	Vegetation and Habitat Management and Restoration
West Bend, Ogden Landscape, and Junction Vegetation and Fuels Mgt Projects (planning)	Deschutes NF, Bend/Ft. Rock RD	
Ryan Ranch Wetland Restoration (planning)	Deschutes NF, Bend/Ft. Rock RD	Habitat Management and Restoration
Kapka Butte Snopark and Trail Construction (planning)	Deschutes NF, Bend/Ft. Rock RD	Recreation Development
Phil's Trailhead Project (planning)	Deschutes NF, Bend/Ft. Rock RD	
Crescent Lake Resort Development (implementation)	Deschutes NF, Crescent RD	Resort Development
Rim Paunina Vegetation Project (planning)	Deschutes NF, Crescent RD	Vegetation and Habitat Management and Restoration
Popper Vegetation Management Project (planning)	Deschutes NF, Sisters RD	
Metolius River Log Collection Project	Deschutes NF, Sisters RD	Habitat Restoration

New projects are continuously being added, others move to the implementation phase, and others are completed. Surveys are conducted and projects avoid known invasive plant sites. All projects are designed and implemented consistent with invasive plant prevention strategies.

Additional ongoing projects may overlap with invasive plant treatment (for instance road, trail and administrative site maintenance; and vegetation and habitat management and restoration, etc). The

effects of ongoing or forseeable future projects are unlikely to combine with the effects of this project, because the impacts from the invasive plant treatments are small and are dispersed in time and space. The relationship between OHV trail use, travel management, and the introduction, establishment and spread of invasive plants was discussed in the R6 2005 FEIS, and recognized that OHV use can influence the spread of invasive plants by disturbing soil and carrying seed several orders of magnitude greater than 'conventional' dispersal methods (R6 2005 FEIS p. 3-15). The Deschutes/Ochoco NF Travel Management EIS closed Forest System Lands to vehicle travel off designated routes. The effects of this proposal will aid in the prevention of the spread and introduction of invasive plants. The other three OHV projects listed in the table above propose designating and constructing miles of trail to provide OHV-users an opportunity for this form of recreation. The trail and access management plans are required to address prevention of invasive plants (R6 2005 ROD Standard 1) and all alternatives utilize prevention standards as described in the R6 2005 FEIS. As discussed in Chapter 3.3, Treatment Effectiveness, the R6 2005 FEIS predicted a reduction in rate of invasive plant spread due to implementation of prevention standards.

Vegetation and fuels projects can create an environment that elevates the risk of invasive plant introduction and spread by reducing canopy closure and creating bare ground, which can stimulate spread of existing plant populations and also provide a seedbed for new starts. Timber harvest is an area where prevention measures are routine, enforceable and have proven to be effective (see Appendix G for prevention measures). Cleaning equipment, protecting weed sites from disturbance, and reseeding skid trails and landings have reduced the amount of aggressive invasive plant species seen on the two Forests. There are some species such as bull thistle and common mullein that always seem to invade disturbed sites like landings, but they generally do not spread and are ephemeral in nature. The incidences of more aggressive species, knapweed and medusahead for example, seen as a result of harvest have declined through the years (Mafera 2008 monitoring reports, pers. comm.), resulting in reduced need for treatment.

On the Deschutes/Ochoco/Grassland, cattle are the major type of livestock that graze forest service land (sheep are a minor component). The amount of weed infestations within grazed areas on the Deschutes NF are minor, 216 acres overall (see Section 3.11). Most of these infestations occur along roads and the cattle impacts are negligible. Approximately 75% of weed sites occur along roads throughout the planning area. However the weed/cattle interaction is more pronounced on the Crooked River Grassland, as invasive annual grasses occupy rangeland. The following is an excerpt from the R6 2005 FEIS Appendix D, describing cattle cause-effect relationship with invasive plants:

> *Herbivory by cattle can strongly influence vegetation composition and productivity in forest and range ecosystems. However, the role of cattle as contributors to the establishment and spread of non-native invasive plants is not well known. Ungulates spread seeds through endozoochory (passing through an animal's digestive tract) or epizoochory (attached to an animal's body); hence, animal-mediated spread of invasive plants is a common phenomenon. Manipulative experiments of ungulate grazing effects on non-native plant introduction, establishment, and spread are limited. Herbivory can alter successional patterns and rates when selective foraging favors survival, growth, and reproduction of plants with low palatability, although the impact can differ greatly among ecosystems. Descriptive studies in various habitats have shown that non-native species invade sites with or without livestock grazing, however other studies have shown that native bunchgrasses have a lowered ability to compete with invasive plants if grazed repeatedly.*

As with other forest activities, grazing can cumulatively increase the spread and introduction of invasive plants, which results in increased need for treatment. Prevention measures such as prohibiting grazing from invasive plant areas (see Appendix G) will help reduce the need for control of invasive

species using herbicide. The early detection-rapid response strategy would improve the ability to control infestations while small, to reduce the overall use of herbicide.

Invasive plant introduction and spread from OHV, timber harvest, prescribed burning, grazing, and other actions would continue, along with the primary vector – vehicle traffic. Prevention measures described in Section 2.3.4 and Appendix G, along with treatment efforts is expected to reduce invasive plants populations but will never eliminate them. Treatment of future populations would be within the scope of this project but are not likely to result in a greater level of herbicide use than predicted herein under the alternatives because of the annual treatment cap, budget constraints, and the EDRR strategy. The treatment cap of 16,000 acres is a maximum figure, however at this point in time about 2,900 acres of herbicide treatment occurs on the two Forests and Grassland. Prevention measures would slow the rate of spread; however the amount and location of future invasive plant treatments could be influenced by these up-coming projects. Treatment of invasive plant sites are prioritized by species and location, as outlined in Table F-1 of Appendix F, which would guide the future location of treatments. The EDRR strategy would play a critical role in keeping future infestations as a result of future actions small. The predictions in Chapter 3.3 regarding invasive plant spread over the life of the project incorporate assumptions about introductions of invasive plants from forest use and other human activities on and off the Deschutes/Ochoco/Grassland.

Summary

While this project may occur throughout the Forest and over an extended period of time, the impacts at any one time and place, if any, are very small. This limits the potential for this project to combine with another project and cause cumulative adverse effects on people, animals, or the environment.

The cumulative effects analysis assumes that legal use of herbicides is occurring on the other ownerships described above. The acreage proposed for treatment is relatively small and the invasives to be treated are widely scattered. This dilutes the potential for the impacts of this project to overlap with impacts of other projects. The effects of herbicide use are mainly limited to the site of application. Drift from broadcast treatments is unlikely to harm non-target vegetation more than 20 feet away from treated areas. Spot and selective treatments are far less likely to move off site (7 feet for lethal effects to native vegetation – see discussion on page 164).

In addition, the risk of direct and indirect adverse effects of invasive plant treatments have been minimized by the Project Design Features described in Chapter 2.4, thus there is little potential for the *effects* of this project to overlap in time and space with effects of other projects. Herbicides are unlikely to drift, leach or run off into surface waters and harm aquatic organisms, given the buffers described in Table 15and Table 16. The project is unlikely to adversely impact soil productivity, native plant communities, wildlife habitats, water quality, cultural resources, or special places. No human health impacts would occur.

The previous discussions make clear that pesticides occur at some level in streams and rivers within and adjacent to National Forest System lands. At the current time, beneficial uses of surface waters within the project area are not adversely affected by pesticide use. The baseline for cumulative effects analysis is the current condition.

The cumulative effects analysis assumes that invasive plants will be treated off the Deschutes/Ochoco/Grassland using integrated methods, including herbicide. Herbicide applicators would likely be repeatedly exposed to herbicides. People and animals could be exposed to repeated doses of herbicides. However, risk assessments and the R6 2005 FEIS (pages 4-1 to 4-3) found that repeated exposures would not result in cumulative effects because the herbicides proposed for use are

rapidly eliminated from the bodies of people and animals. For effects of repeated exposures to be additive, the repeated exposure would have to be simultaneous, such as a person contacting herbicide directly, while eating sprayed vegetation and drinking contaminated water.

In summary, factors that limit the potential for cumulative effects from herbicide use proposed in the action alternatives include the following:

- The risk of adverse effects of invasive plant treatments in all action alternatives has been minimized by the project design features and buffers applicable to known sites and new detections. Predicted herbicide exposures are very small compared to likely background downstream conditions, and are not likely to trigger cumulative adverse effects to neither people nor the environment.
- In general, invasive plant sites are small and scattered.
- Herbicide residues from past treatments in most locations would 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 one year could lead to some accumulation in soils at the invasive plant treatment site.
- • Assuming private landowners are using herbicides according to label, and based on the 2007 data that shows glyphosate would constitute the majority of off Forest use, potential for additive exposures to result in cumulative adverse effects is low. Glyphosate is rapidly absorbed by target plants and readily binds to organic matter. These factors reduce the potential for glyphosate to run off and accumulate in surface waters.
- Early detection rapid response is part of Alternatives 2 and 3, and is considered in the direct, indirect and cumulative effects analysis. Effects of treatments each year under early detection rapid response, by definition, would not exceed the annual and life of the project caps. Treatment caps (16,000 acres total; 10 acres within a 6th-field subwatershed per 1.5 miles of stream; maximum one acre per year below bankfull per 6th-field subwatershed) further restrict the spatial and temporal extent of impacts from this project.
- Multiple herbicide exposures on National Forest System land are unlikely to occur in close enough proximity in time or space with other applications to trigger cumulative effects beyond those analyzed and disclosed in the risk assessments and impact statements. Infestations that cross ownership boundaries are often treated cooperatively so the effects are limited to the existing infestation and immediately surrounding areas.
- The R6 2005 FEIS (pages 4-1 to 4-3) and Risk Assessments discussed effects of chronic exposure to low levels of herbicides used to treat invasives on National Forest System land. Chronic exposures do not result in cumulative effects because the herbicides are more rapidly excreted from organisms (people, animals and fish) than would be absorbed from predicted levels of exposure. Thus, an animal could encounter herbicide in more than one location over time; however there would be no possibility for this project to result in exposures that could cause a cumulative effec

3.2 Herbicides, Adjuvants, Surfactants and Inert Ingredients

3.2.1 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. Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available.

Table 20 displays the risk assessments that may be accessed via the Pacific Northwest Region website at http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm. The glyphosate risk assessment was updated in 2011, after the DSEIS was prepared and circulated for public comment. The findings in the updated risk assessment were reviewed and were found to be consistent with the findings in the FSEIS (Desser 2012 pers. comm.).

Table 20. Risk Assessments for herbicides and surfactants considered in this FSEIS

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 March 25, 2011	SERA TR 02-43-09-04a SERA TR-052-22-03b
Imazapic	December 23, 2004	SERA TR 04-43-17-04b
Imazapyr	December 18, 2004 December 16, 2011	SERA TR 04-43-17-05b SERA TR 052-29-03a
Metsulfuron methyl	December 9, 2004	SERA TR 04-43-17-01c
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 the 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), *Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications* (Bakke 2003, Bakke 2007) and the *Summary of Aquatic Acute Toxicity Data for Spray Adjuvants Allowed for Use on Aquatic Sites in Washington* (WSDA 2009).

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 2003) 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 (USDA Forest Service 2005a). The typical application rate of NPE for USDA Forest Service, Pacific Northwest Region is 1.67 pounds per acre (USDA Forest Service 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 (USDA Forest Service 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 is no statistically or biologically significant differences in the frequency or severity of any adverse effect in the exposed or control populations.[8] 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. Lower threatened and endangered species thresholds were applied to all wildlife, fish and other aquatic organisms.

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 is 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

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

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, 2011a, 2011b) disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label).

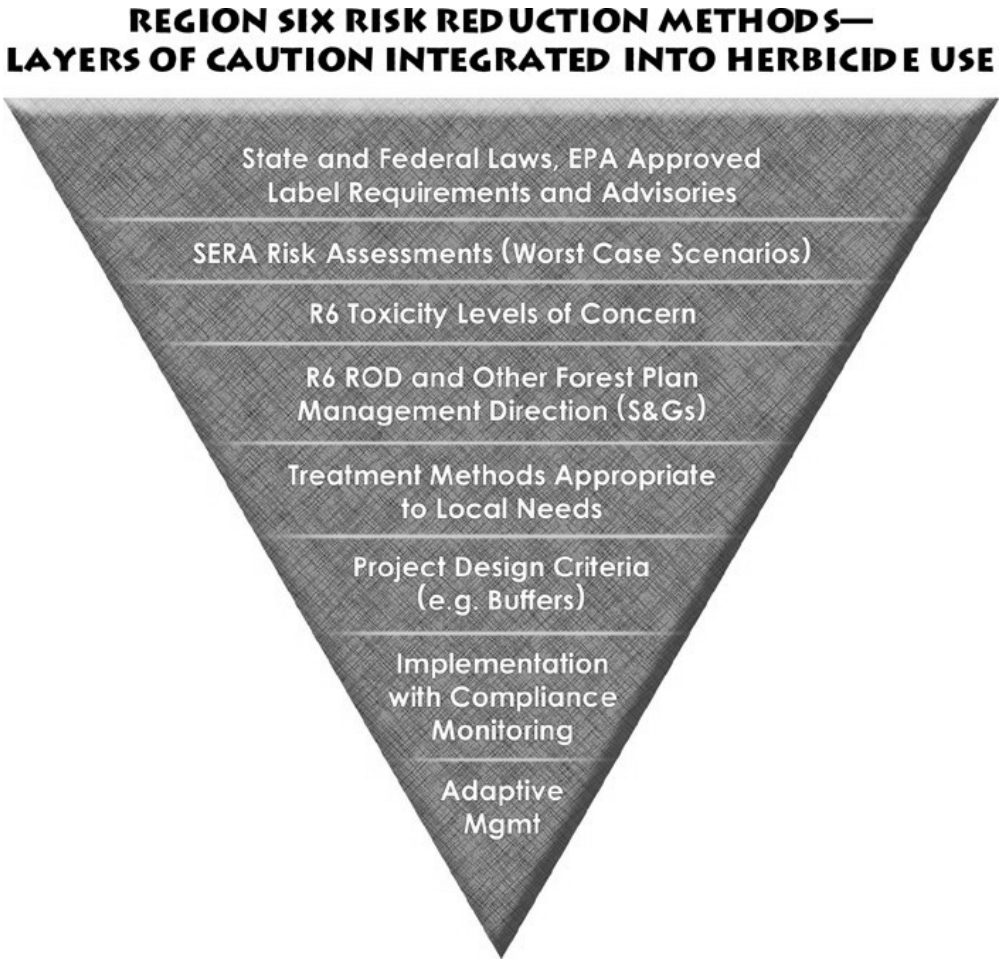

Figure 5. Layers of caution integrated into herbicide use

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 (lower threatened and endangered species thresholds were applied to all wildlife, fish and other aquatic organisms).The R6 2005 ROD adopted standards to minimize or eliminate risks to people and the environment.

Finally, the Project Design Features (called project design criteria in Figure 5) further reduce the risks associated with herbicide treatments by eliminating or minimizing as much as possible the impacts to the environment (FSEIS, Chapter 2.4).

Figure 5 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 Plant 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 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 (Sheley and Petroff 1999). Invasive plants spread between National Forest system lands to neighboring areas, affecting all land ownerships. The problem is so great that in 2006, the Chief of the Forest Service 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). In the past 10 years, nearly 2,000 invasive plant sites have been mapped covering 14,547 gross acres[9] (approximately 0.5% of the 2.5 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*) are common and widespread across the two Forests that they are not a priority for treatment or inventory. Most infestations of these species occur in disturbed areas and along roadsides, and are not typically found in dense coverage in the general forest area. Cheatgrass and ventenata are common however, across the Crooked River National Grassland. Table 9 lists the 32 species that are currently priorities for treatment in this analysis. Naturalized species such as cheatgrass, North Africa grass, and Russian thistle may be included in the treatment plan for some areas such as wilderness, RNAs or other high-value areas. These and other species not listed in Table 9 would also 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 21). The majority of inventoried sites (1,440 sites; 76% of known sites) are smaller than one acre; 215 sites (11%

[9] 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 invasive plants.

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 22 summarizes the mapped number of sites of invasive plant infestations currently inventoried on the Ranger Districts and the Grassland.

Table 21. Range of invasive plant site sizes

Size of Infestation	Number of Invasive Plant Sites	Percent 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 22. Number of invasive plant sites and acres currently mapped and proposed for treatment within PAUs by Forest and District

Forest/Grassland	District	Number of Sites	Acres of Invasive Plant Sites	Project Area Unit Acres
Deschutes National Forest	Bend/Fort Rock	350	1,604	12,469
	Crescent	49	1,080	1,892
	Sisters	272	4,320	10,579
Forest Total		***671***	***7,004***	***24,940***
Ochoco National Forest	Lookout Mountain	713	487	8,680
	Paulina	355	995	6,873
Forest Total		***1,068***		
Crooked River National Grassland		***153***	***6,061***	***11,522***
	Total For Project Area	***1,892***	***14,547***	***52,015***

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 not 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 less than 0.25 acres through herbicide and manual treatments that were approved in a 1998 Environmental Assessment (USDA Forest Service 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. Crescent Ranger District has the largest infestation of reed canarygrass, but other than this species Crescent does not have the scale of invasive plant problems like the other units. However, Crescent District plays a vital role in early detection and rapid response of new invader species entering the Deschutes National Forest from the south via major highways (e.g., Highways 97

and 58). In the past few years, individual plants of yellow starthistle, kochia, Dyer's woad, and hairy whitetop have been found along Highway 97 and 58 and hand-pulled before flowering and setting seed. Three species that are new to to the Forests and Grassland, but not yet well-established are jointed goatgrass (*Aegilops cylindrica*), slender false brome (*Brachypodium sylvaticum*) and orange hawkweed (*Hieracium aurantiacum*). These species would be high priority for EDRR.

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 (R6 2005 FEIS). 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. The R6 2005 ROD predicted that prevention standards would reduce the rate of spread by about 50 percent. In addition, local prevention guidelines have been developed to help slow the rate of spread.) 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 (USDA Forest Service 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 yellow-flag iris and purple loosestrife). For instance, ribbongrass is believed to have been 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. For another example, in 2005, Oregon Department of Agriculture 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.

The mechanisms of spread for invasive plants include natural vectors such as birds, insects, or wildlife, and natural forces, such as water and wind. Section 3.1 of the R6 2005 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. Invasion and dominance by invasive plants is highly correlated with soil disturbance, but is not limited to disturbed areas (Cox 1999). Invasive plants can readily invade, occupy, and dominate conifer plantations, road prisms, trails and trailheads, mined sites and 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 (USDA Forest Service 2005a). Invasive plant inventories indicate most infestations on the Forests and Grassland begin on disturbed areas, such as road shoulders and log landings. Forest System roads 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.

Wildfires also contribute to introduction and spread of invasive plants. [10] 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, and vehicles involved in fire suppression can carry invasive plant seeds attached to undercarriages and wheels, spreading these seeds 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, USDA Forest Service 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 (USDA Forest Service 2003a).

Priority Species

Table 23 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 23 are currently the highest priority for treatment, this list can change any time that a new invasive plant species is discovered.

Table 23. Top five 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	Orange hawkweed	Medusahead	Spotted knapweed	Dalmatian toadflax	Canada thistle
	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		Jointed goatgrass	Medusahead*	Russian knapweed	Scotch thistle	Whitetop

*Medusahead is scattered throughout the Grassland; this is a high priority species only on high priority sites such as protecting the RNA, private land, and other values at risk.

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.

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

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. After these events, 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. In a simulation experiment, Kremer et al. (1996) found that a less productive, invasive grass community would tolerate climate change, whereas a native sagebrush community would not survive the increased temperatures. 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).

Climate change may affect invasive species differently. Bradley et al. (2009) found that rather than simply enhancing invasion risk, climate change may also reduce invasive plant competitiveness if conditions become climatically unsuitable. Climate change could result in both range expansion and contraction for some invasive plants in the western United States. Yellow starthistle (*Centaurea solstitialis*) may be likely to expand with climate change. Cheatgrass (*Bromus tectorum*) and spotted knapweed (*Centaurea biebersteinii*) are likely to shift in range, leading to expansion in Central Oregon. Leafy spurge (*Euphorbia esula*) is likely to contract. Many areas at risk already contain small but not yet dominant populations of these invaders, creating the potential for rapid expansion in the face of climate change. Continued invasion of *C. solstitialis* is likely in climatically suitable areas. Heightened monitoring and treatment of nascent populations increasingly will be necessary in areas where invasion risk expands with climate change. This conclusion by Bradley et al. would make the EDRR concept important for control of invasive species in the future.

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, Pyke 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 CO_2 may not be realized at a local area, particularly within the time frame of this analysis. Growth of invasive plants under elevated CO_2 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, Bradley et al. 2010). The Forest and Grassland landscapes will become more vulnerable to the establishment of invasive plant 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 action 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.

Treatment Effectiveness

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[11] (the total number of known sites on the Forest at that time) on 1,657 acres (USDA Forest Service 1994a).

Monitoring showed that 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 Forest had 235 known noxious weed sites. In 1998, the Forest analyzed treatments on 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 (USDA Forest Service 1998a). See the specific discussion of treatment effectiveness under Alternative 1, below.

Ochoco National Forest/Crooked River National Grassland

In 1995, the Ochoco National Forest and Crooked River National Grassland completed an Integrated Weed Management Environmental Assessment which approved treatments on 34 treatment areas, mostly along roads (USDA Forest Service 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 Forest and Grassland completed an Environmental Assessment that approved treatments on 72 sites covering 673 acres (USDA Forest Service 1998b). Most of these sites occur 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 are approved for use on sites that have more than 11 target plants. Sites that contain less than 10 target plants are hand-pulled. Again, there has been success in greatly reducing the number of invasive plants on sites where herbicides were used (herbicide application reports are on file at the Ochoco NF Headquarters).

[11] The term “noxious weeds” was used by the Forest Service in the past; “invasive plant” is now used to refer to all of the species we control, whether they are designated noxious or not.

3.3.2 Environmental Consequences

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 in time and space 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.

General Discussion

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.

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 since 1997, yet the population has not been reduced (Powers 2006, pers. comm.).

The biology of the target invasive plant species must also be considered. Rhizomatous-type plant species, such as Canada thistle, yellow-flag iris, 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, (the entire Botany Report is incorporated by reference), 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 U.S. Forest Service Pacific Northwest Region (Region 6). Mazzu's information was incorporated into Appendix B of the FSEIS, 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 Region 6 2005 Invasive Plant FEIS (pp. 3-80 to 3-92).

Objectives of Treatment Methods Proposed in the FSEIS

Biological Control – Within the analysis area, biological control is proposed in this FSEIS 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. Also 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 FSEIS mainly focus on solarization techniques. Soil solarization involves 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 may be an option for a small area, but is difficult to do on a large scale. Solarization coverings may have negative effects on soil microorganisms and do not selectively allow other plants to grow as would manual methods, or a selective hand application of an herbicide. Solarization is planned for small select infestations that are easily accessible and a high priority, such as reed canarygrass sites in Big Marsh (Deschutes NF), with the objective being to shade out and kill pieces of roots or rhizomes (underground stems that are able to sprout).

Manual Treatments – Manual treatments proposed in this FSEIS 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. 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. Examples of where manual treatment 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, and houndstongue plants growing within 50 feet of the sensitive Peck's mariposa lily would be hand-pulled.

Mechanical Treatments – Mechanical treatments proposed in this FSEIS are in combination with other treatment methods to increase overall treatment effectiveness. 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. 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 inches tall, then do a fall application of aquatic labeled glyphosate (Tu 2005, pers. comm..). This treatment should be repeated the next year and then follow-up planting of intermittent plugs of desirable species.

Prescribed Fire – In this FSEIS, 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 shallow disk/harrow 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 (FSEIS, 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.

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, a certain amount of effectiveness is assumed 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 current 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 of established sites by 50 percent, reflecting 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 established 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 (USDA Forest Service 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 still small, due to the ability to use an Early Detection/Rapid Response strategy, which would improve the effectiveness of treatment.
- Alternative 3 was assigned an 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 2009, pers. comm.).
- 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, density of infestation). The 80% estimate is based on professional judgments of County Weed Agents, and the Forest Service Weed Coordinators, and local efficacy monitoring (USDA Forest Service 2011b).
- 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 (R6 2005 FEIS page 3-2).

- Options which have the widest variety of herbicides and herbicide families available for use have the greatest potential to result in effective treatments (R6 2005FEIS, page 4-20). More herbicide choices can result in effective treatments with fewer effects to non-target plant species.

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
- Herbicide application method and adjacency to water
- 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 eliminate plants missed by herbicide spraying, or using a mechanical method, such as weed whacking or mowing, 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 eliminate 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. See Appendix A for a detailed list of integrated methods proposed for each treatment area and species.

Cultural methods proposed such as using plastic tarps (soil solarization) to cover reed canarygrass infestations would be the same for the alternatives. This method varies in effectiveness; trials done by Jefferson County Weed Control in the Metolius Basin have shown it can be effective on small populations (Sussmann 2008). All vegetation, seeds, and insects underneath the tarp are killed. Solarization is an option for controlling invasive plants without the use of chemicals and has been used effectively in horticulture (Tu et al. 2001).

Biocontrol agents previously released on private lands and established on the Forests will continue to spread to other nearby invasive sites providing a potential long-term (10 + years) control treatment. Current monitoring shows that Canada thistle biocontrol agents are well established and spreading on parts of the Crooked River National Grassland and Deschutes NF. Effectiveness depends on the size and density of the infestation. Some areas have seen complete reductions in plant numbers. One example is Canada thistle at Haystack Reservoir, which over the last 15 years has been reduced down to few plants that do not reproduce. Release of biological control agents on National Forest System lands and adjacent lands by the Oregon Department of Agriculture, as analyzed by Animal Plant Health Inspection Service (APHIS), will continue under all alternatives, and contributes to reducing the spread of invasive plants. Biocontrol agents have, and will likely continue to cross land ownership boundaries.

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, USDA Forest Service 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 (Appendix G). All three alternatives in this FSEIS will comply with the LRMP Standards and utilize the Forests and Grassland Prevention Guidelines. If appropriate prevention, 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 (USDA Forest Service 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 (USDA Forest Service 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. Monitoring has shown that herbicides have been effective at reducing invasive plant populations at individual sites 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 24) (Grenier 2002).

Table 24. 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). 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. However, manual treatments have not been effective at most sites, such as Besson Day Use Area on Bend/Ft. Rock District. This area has been pulled since 1997 and has not reduced the spotted knapweed population, largely due to the population size and compacted soil (Powers 2006, pers. comm.). 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, pers. comm.). 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 in the long term (more than 4 years). 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 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 (USDA Forest Service 1998a), 72 sites on the Ochoco National Forest and Crooked River National Grassland (USDA Forest Service 1998b), and one medusahead site on Paulina District, Ochoco National Forest (USDA Forest Service 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. 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.

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, many of which have gone beyond introduction, and have become established. The direction to use herbicides as a last resort (Ochoco NF LRMP 1998 Amendment) resulted in an emphasis on manual and biological control methods. Despite diligent efforts at both these methods of control, invasive plants have spread at a rate of 1,200 acres per year. Manual control methods have been used for many years on large, dense weed sites with little change in weed density or perimeter. For example houndstongue, a biennial species, in the Roba Creek area of the Paulina RD has been treated manually by Forest Service personnel, youth crews and volunteers for the past 9 years. For the Roba Creek area alone, more than 17,842 person hours have been expended on manual control, at an approximate cost of $322,860 and yet the houndstongue population continues to expand.

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.

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 (R6 2005 FEIS Chapter 4.2). 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. However, some level of manual treatment does occur on the Forests and Grassland by employees who come across small clumps of noxious weeds during their day-to-day activities.

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. Yellow-flag iris and ribbongrass, a variety of reed canarygrass have become a growing concern as recent surveys indicate these species have spread along the Metolius River. Alternative 1 would not allow effective treatment of either species.

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, invasive plant infestations would continue to expand under Alternative 1 (Table 25). In year 2014, it is estimated 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

Of the three alternatives, Alternative 1 is the least effective in controlling invasive plants:

Invasive plants continue to expand. By year 2014, the existing invasive plant infestations would occupy 13,640 acres after five years of control efforts (Tables 24 and 25), a roughly 6% reduction. This is due to reduced effectiveness of manual treatments, especially for perennial species and annual grasses.

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 invasive plant species. Limited use of herbicides would result in limited treatment effectiveness, resulting in greater expense and 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.

Treatment effectiveness has been adversely affected by the delay between the time that infestations have been established and the time that the NEPA analysis has been 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.

Alternative 2 – Proposed Action

Alternative 2 proposes to treat inventoried invasive plant populations within 289 Project Area Units totaling 52,015 acres. This includes 1,892 individual plant sites encompassing 14,547 infested acres. These sites areTreatment 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 (USDA Forest Service 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 allows 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 15);
- 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 for Treatment Effectiveness

Of the three alternatives, Alternative 2 provides the most options for what, how and where different control methods 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 (80% compared to 50% for manual), which would result in a reduction to 7,767 acres of invasive weeds in the year 2014, as shown in Tables 25 and 26.

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 thousands of acres. Of the ten herbicides approved in R6 2005 ROD Standard 16, 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 the 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, using a small tank on an OCH, 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.

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 NF. Of the three alternatives, Alternative 2 provides increased ability to treat houndstongue because it would allow broadcast spray (when needed) of metsulfuron methyl on houndstongue up to 100 feet from perennial streams, lakes and wetlands, and up to 15 feet of seasonal intermittent streams, therefore allowing more efficient treatment of more acres. Current information suggests that this herbicide would be the most effective option for treating houndstongue (Alexanian 2006, pers. comm.). As discussed in Alternative 1, manual control methods have been used for many years on large, densely populated houndstongue sites with little change in the houndstongue population. 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. For example spotted knapweed grows intermingled with bitterbrush within Peck's penstemon populations. Clopyralid could be broadcast sprayed over Peck's penstemon without harming bitterbrush either one, because neither species are members of a plant family targeted by this herbicide. 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 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 2006 a demonstration project was done on private land along the Metolius River comparing the different methods and techniques of ribbongrass control. Herbicide (both wicking and spot spray), hand removal using shovels and black plastic matting methods were used on a total of 16 different plots (Sussmann 2006). Monitoring done in 2007 showed that hand digging of ribbongrass clumps that were entirely within the water was effective and reasonably efficient in terms of time in one plot. Some rhizomes were cut and floated away downstream while plants were being dug out. Nets would be used to remove the rhizomes from the water to reduce the risk of spreading them downstream (PDF 50). Digging of clumps and individuals mixed with other species within the stream bank was markedly less efficient in terms of time. Herbicide treatment effectiveness varied by application method, and target plant density. Further monitoring through 2010 (Sussmann 2011) showed the overall average effectiveness of herbicide control was 74% ribbongrass reduction. Control was best when target plant density was high and spot spraying was used (nearly 100%). Wicking was less effective, but fewer non-target plants were affected. All plots showed signs of native vegetation returning to the treated areas. Monitoring of the solarization plots showed that plants along the edges extended their leaves beyond the plastic, and therefore were not killed by the solarization technique (Sussmann 2011). Herbicides would curtail the spread of ribbongrass in a shorter time frame and more cost-effective manner.

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 scattered across approximately one acre. Hand pulling/digging of ribbongrass took approximately 12 person hours to remove and dispose of 60 square feet 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).

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.

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 the 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 increasing 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 herbicide at specific sites due to treatment effectiveness (Table 25). 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 35) on an individual site basis.

Using the assumptions discussed above, Alternative 2 would control the most invasive plant infestations (Table 25 and Table 26). 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.

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 previously, 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 25), 238 acres in riparian areas (Table 26), 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. More herbicide choices can result in effective treatments with fewer effects to non-target plant species. The chance of herbicide

resistance is inversely proportional to the number of herbicide families that can be used in a given situation (R6 2005 FEIS page 3-93 to 3-94).

- ***Allows broadcast application methods within riparian areas.*** Broadcast spraying of some herbicides would be allowed within 300 feet of perennial streams to control dense infestations efficiently and economically. Stream buffers and PDFs would prevent overspray and drift into water.
- ***Allows herbicide use within 10 ft. of perennial water bodies.*** Herbicides could be used to control rhizomatous perennial invasive plants, such as reed canarygrass, ribbongrass, and yellow flag iris. This increases the effectiveness of treatment, which would curtail the spread along important waterbodies such as the Metolius River.
- ***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.

Table 25. 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

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:

- Herbicide treatment would not be allowed on approximately 230 acres of perennial streams, springs, or lakes and approximately 30 acres on intermittent streams. In this Alternative no herbicide application would be allowed within 10 feet of perennial or fish bearing streams, rivers, lakes, ponds or reservoirs and intermittent streams when flowing. Application method is also limited within buffers (see Table 16).
- The following herbicides would not be allowed within 300 feet of water: Triclopyr BEE, non-aquatic glyphosate, 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 mechanized equipment that could cause sedimentation would not be allowed within the buffers or along roads where they are within 300 feet of a perennial stream or lake.

Direct and Indirect Effects for Treatment Effectiveness

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

Alternative 3 does not allow 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; although, at many sites, would not be as efficient as broadcast spraying, likely resulting in annual chemical treatment of fewer acres. 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-foot buffer (approximately 105 acres) would be reduced to 40% effectiveness.

The predominant invasive species within 10 feet of water are reed canarygrass, and ribbongrass, which are rhizomatous plants with extensive root mass. These species spread by root fragments, therefore manual treatment methods are not effective at controlling populations unless all pieces of root fragments are removed. Manual removal of flowering heads can prevent seed production but only if all seed heads are removed. Along the streambank (the area within 10 ft. of water), the dense root growth and bank substrates (rocks) make it difficult to remove all rhizomes. Annual weed whacking to remove flowering seed heads would reduce the seed source for re-colonization of treated areas in the stream channel but would have limited control of populations because the rhizomes are not removed. In addition to being ineffective, removing these species by hand is labor-intensive and costly; the extent of removal each year would depend on budgets and/or the ability to get volunteers. Alternative 3 would reduce the infestation of reed canarygrass and ribbongrass to a lesser extent than Alternative 2 and would leave a substantial amount of acreage infested with rhizomes along the riverbanks that would need annual treatment into perpetuity to prevent rhizomatous spread and seed sourcing downstream.

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, and also houndstongue, 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-foot buffer. There are species, including sulfur cinquefoil, dalmatian toadflax, and Himalayan blackberry that are most effectively controlled with these 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 27.

Table 26. 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			
Year	**Riparian Acres Infested**	**Acres Treated at 80% Effective**	**Acres Remaining with 10% Spread**	**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

Alternative 3 offers less effective control measures for Himalayan blackberry than Alternative 2 because the most effective herbicide for this species could not be used within 10 ft. of water

The only mapped site of Himalayan blackberry occurs along Cottonwood Creek on Paulina District, growing approximately 50 feet or less from this perennial creek. However, this site is expanding and, if left unchecked, has the potential to become a very large infestation further expanding into the riparian area. 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). Another herbicide option would be glyphosate, which is a broad spectrum, non-selective herbicide. 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.

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 outside of riparian zones. 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 individual sites would decrease as invasive plants are controlled.

Using the assumptions discussed above, 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 to 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 populations within 10 ft. of water on the stream bank would be difficult to remove all the rhizomes due to dense root growth and bank substrates (rocks) without excavating the entire riverbank. Alternative 3 would reduce the ribbongrass infestation to a lesser extent than Alternative 2 because it would leave a substantial amount of acreage infested with rhizomes along the riverbanks that would need annual treatment into perpetuity to prevent rhizomatous spread and seed sourcing downstream. Soil solarization, proposed at Big Marsh, could be an option for small areas by placing 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). There are effects from soil solarization however, it can cause significant biological, physical, and chemical changes in the soil that can last up to two years, and may deter the growth of desirable native species (Tu et al. 2001). Other preliminary monitoring results of a demonstration project to compare ribbongrass control methods (done on private property along the Metolius River) show that solarization of ribbongrass may be effective on plants in the interior of the mat, but not near the edges of the mat (Sussmann 2011). Results showed that all vegetation in the interior, including native plants, is 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-foot no herbicide riparian zone can also be reduced for tap-rooted species, such as spotted knapweed. This is because 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 would result in less effective treatment of those riparian sites where these conditions occur.

Summary of Treatment Effectiveness for Alternative 3

Alternative 3 would move toward the desired future condition, but at a slower rate in riparian areas. In summary, Alternative 3:

- ***Effectively controls invasive plants.*** Following the assumptions outlined on page 124, by year 2014 the current inventory of 14,547 acres of invasive plants would be reduced to 7,529 acres in upland

areas, as shown in Table 25, and 990 acres shown in Table 26 for riparian areas (more acres remaining than Alternative 2) for a total of 8,519 acres.

- ***Ten herbicides would be available for use but two cannot be used closer than 300 ft. from water.*** Ttreatment effectiveness would be increased because of 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. There would be a minor reduction in effectiveness within 300 feet of water due to the inability to use picloram and sethoxydim.
- ***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 feet 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 and thus more costly, possibly resulting in treating fewer acres annually (depending on budgets).
- ***Restricts herbicide use within 10 feet of water.*** This would reduce treatment effectiveness of invasive plants that are difficult to control with manual methods, such as reed canarygrass, ribbongrass, and Canada thistle.
- ***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 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 (see section 3.1.3 for an overall discussion of cumulative effects). 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 for the projections for invasive plant spread extends 5 years. The analysis assumes that possible repeated treatments within the same season do not overlap in time, or result in a cumulative effect. If repeated treatments are necessary it is usually a result of missed plants during the first herbicide application or manual treatment effort. In the first instance a second herbicide application would not overlap spatially or in time, and in the second scenario, the duration of manual treatment and resulting effects are small.

Past and Present Actions

The relationship between OHV trail use, travel management, and the introduction, establishment and spread of invasive plants was discussed in the R6 2005 FEIS (Chapter 3.1.3, Mechanisms of Invasion), and recognized that OHV use can influence the spread of invasive plants by disturbing soil and carrying seed several orders of magnitude greater than ‘conventional’ dispersal methods (R6 2005 FEIS p. 3-15). The Deschutes/Ochoco NF Travel Management EIS recently closed Forest System Lands to vehicle travel off designated routes. The effects of this action will aid in the prevention of the spread and introduction of invasive plants, and thus the need for treatment. The Record of Decision (2011) prohibits motorized travel outside of existing designated routes (roads and trails) on 99% of the project area. In addition, most of the project area is now closed to dispersed camping (74% on the Deschutes and 83percent on the Ochoco/Grassland). Existing designated routes remain open for motorized use. This project is beneficial overall in reducing the risk of invasive plant introduction, by prohibiting off-road vehicle travel across most of the Forest. The designated routes and areas open to motorized use and dispersed camping would continue to introduce and spread invasive plants as is happening at present.

Vegetation and associated fuel reduction projects can create an environment that elevates the risk of invasive plant introduction and spread by reducing canopy closure and creating bare ground, which can stimulate spread of existing plant populations and also provide a seedbed for new starts. Timber harvest is an activity where prevention measures are routine, enforceable and have proven to be effective (see Appendix G for prevention measures). Cleaning equipment, protecting weed sites from disturbance, and reseeding skid trails and landings have reduced the amount of aggressive invasive plant species seen on the two Forests. Logging on snow and frozen ground, as is currently happening with Cup and Lunch timber sales (Howard-Eliot-Johnson EIS), and also Powell timber sale (Upper Beaver EIS), greately reduce the amount of disturbed ground, and are unlikely to result in invasive plants needing treatment. There are some species such as bull thistle and common mullein that always seem to invade disturbed sites like landings, but they generally do not spread and are ephemeral in nature. The incidences of more aggressive species, knapweed and medusahead for example, seen as a result of harvest have declined through the years (Mafera 2008, pers. comm.-timber sale surveys.), resulting in reduced need for treatment.

Cattle are the livestock that graze forest service land (sheep and horses are minor components). The amount of weed infestations within grazed areas on the Deschutes NF are minor, 216 acres overall (see Section 3.11). Most of these infestations occur along roads and the cattle impacts to these sites are negligible. Approximately 75% of weed sites occur along roads throughout the planning area, and these sites are usually not impacted by cattle. However the weed/cattle interaction is more pronounced on the Crooked River Grassland, as invasive annual grasses occupy rangeland. The R6 2005 FEIS Appendix D summarizes cattle cause-effect relationship with invasive plants in two ways: 1) spread of invasive plant seeds, and 2) altering plant succession by favoring palatable species, thus increasing susceptibility to invasion. However, invasive plants occur with or without grazing.

Grazing on Forest Service land will continue and is expected to increase the spread and introduction of invasive plants, especially on rangeland, which could result in longer duration of treatments compared to other site types, such as road shoulders. More years of treatment may be required. Prevention measures such as temporarily prohibiting grazing from invasive plant areas would help reduce the time for control of invasive species. This has been used on the Roba Allotment on the Ochoco NF (see Appendix G) which increased the effectiveness of manual contol of houndstongue. The early detection-rapid response strategy would also improve the ability to control infestations while small, which results in lowering the overall use of herbicide.

Foreseeable Future Actions

The analysis assumes that current land uses will continue in the future. On the Deschutes and Ochoco National Forests and Crooked River Grassland, invasive plant prevention measures will be applied to land uses and activities, which would help address specific vectors of invasive plant spread. Invasive plant prevention measures (see Appendix G) are predicted to reduce rates of, but not stop, invasive plant spread (R6 2005 FEIS Chapter 4.2).

Forest Service projections suggest recreation use of roads and trails, both motorized and non-motorized will continue to increase in the long-term, and will continue to be conduits for the distribution of invasive plants. Future foreseeable actions include site-specific OHV projects planned on the Deschutes and Ochoco Forests (Lava Rocks and Ochoco Summit). These two projects propose new trails designated for motorcycles, OHVs and jeeps, some of which are on or adjacent to areas infested with invasive plants. It is expected that despite prevention measures, invasive plants would be introduced through concentrated use. As a result, control of invasives would take place, with herbicide application (where allowed) and manual treatment being the likely methods of control. The EDRR strategy in Alternatives 2 and 3 would catch infestations while small, but is expected that herbicide use may

incrementally increase as a result of the trail projects in those designated areas. The R6 2005 FEIS predicted a reduction in rate of invasive plant spread due to implementation of prevention standards (Chapter 4.2). However, the rate of spread is not predicted to reach zero and OHV trails are likely to remain vectors of invasive plant spread.

Other land management and use activities such as grazing, vegetation management, fuels management, road maintenance, natural disturbances, and fire suppression will continue to cause ground disturbances that can contribute to the introduction, spread and establishment of invasive plants on National Forest System lands (R6 2005 FEIS Chapter 4.2). These actions would continue, along with the primary vector – vehicle traffic. Prevention measures described in Section 2.3.4 and Appendix G, along with treatment efforts is expected to reduce invasive plants populations but will never eliminate them. Treatment of future populations would be within the scope of this project but are not likely to result in a greater level of herbicide use than predicted under the alternatives because of successful treatment, the annual treatment cap, budget constraints, and the EDRR strategy. The treatment cap of 16,000 acres is a maximum figure, however at this point in time about 2,900 acres of herbicide treatment occurs on the two Forests and Grassland. This is expected to increase for several years as sites currently going untreated, or being controlled by less effective manual methods, would switch to herbicide treatment.

The cumulative effect of increased disturbance caused by 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 to provide commodities, recreation, and restoration 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 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 using herbicide is not a part of the alternative. Invasive plants from National Forest System land in some areas will continue to spread onto private land, as is currently happening on the Crooked River Grassland.

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 System land or Tribal lands of the Confederated Tribes of the Warm Springs, and private land to the east. The extent of invasive plants and/or treatment on private land and Tribal land is unknown; invasive plants are likely to be spreading at a rate at least as high as on federal lands (8–12% annually, see R6 2005 FEIS Chapter 3.1) and is increasing each year. This figure may actually be higher if adjacent landowners do not use prevention measures. With added sources and vectors of spread from adjacent land, in addition to that occurring on the National Forest, invasive plant control without the use of herbicide would not result in a reduction of acreage. This is shown in the effects of the No Action Alternative above.

Wildfires will occur in the future. Many invasive plant species germinate readily after wildfire and, because 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.

Placement of instream wood for improving fish habitat in the Metolius River is also 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. These actions could overlap in time with Forest Service control activities. Project design requires coordination between landowners to increase effectiveness at a large scale. A comprehensive strategy would prevent the need for repetitive treatment due to upstream re-introduction of invasive plants.

Prevention measures would slow the rate of spread; however the amount and location of future invasive plant treatments could be influenced by future projects. Treatment of invasive plant sites are prioritized by species and location, as outlined in Table 1 of Appendix F, which would guide the future location of treatments. The EDRR strategy would play a critical role in keeping future infestations as a result of future actions small.

Comparison of Alternatives for Treatment Effectiveness

In summary, Alternative 1, which treats the fewest acres of invasive plants, would have the least overall effectiveness, and thus, would not do as well to reduce the potential of invasive plant spread from vehicles, ground disturbance and other activities. Alternatives 2 and 3, which treat more acres, have a better chance of increasing the effectiveness against weed spread. Under Alternative 1, invasive plant spread is expected to exceed control efforts; due to less effective treatment methods such as hand-pulling (see Table 25 and Table 26) and far fewer acres covered by existing NEPA. Under Alternatives 2 and 3, control is more likely to exceed spread, thus current infestations would be decreased in size, and new infestations would be more effectively treated when first detected.

Table 27. 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.	Yes, incorporates an EDRR strategy	Yes, incorporates an EDRR strategy

3.4 Non-Target 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), Survey and Manage plants, and other native 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 Survey and Manage species, found adjacent to or within treatment sites. The Botany Report is incorporated by reference in its entirety.

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 (USDA Forest Service 2005a, p. 3-40, and 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 (USDA Forest Service 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 (USDA Forest Service 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 section will address only Forest Service “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 (USDA Forest Service 1995b). The biological evaluation process consists of a pre-field 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 (USDA Forest Service 2008).
- Oregon Natural Heritage Information Center's Rare, Threatened and Endangered Species List (Oregon Biodiversity Information Center 2010).
- Forest Service sensitive plant survey GIS layer and associated databases.
- Forest Service personnel (District Botanists and Ecologists).
- Literature.
- Forest Service Sensitive Plant GIS layer.

Sensitive Plant Species Considered in Analysis

The Regional Forester's sensitive species (RFSS) list was updated in 2011, however the cover letter attached to the new list stated: *"Projects initiated prior to the date of this letter may use the updated RFSS list transmitted in this letter or the RFSS list that was in effect when the project was initiated"* (USDA Forest Service 2008). The analysis included here is based on the 2008 RFSS list. However, the most current species list would be reviewed during annual implementation planning, habitat would be evaluated, and surveys conducted according to PDF 63 as needed.

Seventy-four sensitive plant species are either documented or suspected to occur on the Deschutes and Ochoco National Forests and Crooked River National Grassland (Table 28). Of these 74 plant species on the Forests/Grassland Sensitive Plant List, there are 54 forbs, 12 bryophytes (mosses and liverworts), three lichens, and five fungi.

Table 28. 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
Vascular Plants			
Achnatherum hendersonii	Henderson's needlegrass; Indian ricegrass		D
Achnatherum wallowaensis	Wallowa needlegrass; Indian ricegrass		D
Agoseris elata	tall agoseris	D	
Arabis suffrutescens var. horizontalis	horizontal woody rockcress	S	
Arnica viscosa	Mt. Shasta arnica	D	
Artemisia ludoviciana ssp. estesii	Estes' artemisia; white sagebrush	D	S
Aster gormanii	Gorman's aster	S	
Astragalus diaphanus var. diurnus	transparent milkvetch		S

Scientific Name and Code	Common Name	DES	OCH & CRNG
Astragalus peckii	Peck's milk-vetch	D	S
Astragalus tegetarioides	bastard milkvetch		D
Botrychium ascendens	trianglelobe moonwort		D
Botrychium crenulatum	scalloped moonwort		D
Botrychium minganense	Mingan moonwort		D
Botrychium montanum	mountain moonwort		D
Botrychium paradoxum	peculiar moonwort		D
Botrychium pumicola	pumice moonwort	D	
Calamagrostis breweri	Brewer's reedgrass	S	
Calochortus longebarbatus var. peckii	longbeard mariposa lily		D
Camissonia pygmaea	dwarf suncap		S
Carex abrupta	abrupt-beaked sedge	D	S
Carex capitata	capitate sedge	D	
Carex diandra	lesser panicled sedge	S	S
Carex lasiocarpa var. americana	slender sedge	D	S
Carex livida	livid sedge	S	
Carex retrorsa	retrorse sedge	S	S
Carex vernacula	native sedge	S	
Castilleja chlorotica	green-tinged paintbrush	D	
Cheilanthes feei	Fee's lip-fern	S	S
Collomia mazama	Mt. Mazama collomia	S	
Cyperus acuminatus	short-pointed cyperus	D	
Cyperus acuminatus	short-pointed cyperus	D	
Cyperus lupulinus ssp. lupulinus	Great Plains flatsedge	S	S
Elatine brachysperma	short-seeded waterwort	S	S
Eleocharis bolanderi	Bolander's spikerush		S
Eriogonum cusickii	Cusick's buckwheat		S
Eucephalus gormanii (formerly Aster gormanii)	Gorman's aster	S	
Gentiana newberryi var. newberryi	Newberry's gentian; alpine gentian	D	
Heliotropium curassavicum	salt heliotrope	S	S
Lipocarpha aristulata	aristulate lipocarpha	S	S
Lobelia dortmanna	Dortmann's cardinalflower	D	
Lomatium ochocense			D
Lycopodiella inundata	inundated clubmoss	D	
Lycopodium complanatum	ground cedar	S	
Mimulus evanescens	Disappearing monkeyflower		S
Muhlenbergia minutissima	annual dropseed	S	S
Ophioglossum pusillum	northern adderstongue	S	
Penstemon peckii	Peck's penstemon	D	D
Pilularia americana	American pillwort	S	

Scientific Name and Code	Common Name	DES	OCH & CRNG
Potamogeton diversifolius	Rafinesque's pondweed	S	S
Rorippa columbiae	Columbia yellowcress	D	S
Rotala ramosior	lowland toothcup	S	S
Salix wolfii	wolf's willow		S
Scheuchzeria palustris ssp. americana	rannoch-rush	D	
Scirpus subterminalis	swaying bulrush	D	
Talinum spinescens	spinescent fameflower		S
Thelypodium eucosmum	world thelypody		S
Utricularia minor	lesser bladderwort	D	S
Bryophytes			
Brachydontium olympicum	moss	S	
Conostomum tetragonum	moss	S	
Helodium blandowii	moss	D	D
Polytrichium sphaerothecium (= Polytrichastrum sexangulare var. vulcanicum)	moss	S	
Pseudocalliergon trifarium	moss	D	
Rhizomnium nudum	rhizomnium moss	D	
Schistostega pennata	luminous moss	D	
Splachnum ampullaceum	moss	S	
Tomentypnum nitens	moss	D	D
Tortula mucronifolia	moss		S
Trematodon asanoi (= T. boasii)	moss	S	
Tritomaria exsectiformis	liverwort	D	
Lichens			
Dermatocarpon luridum	silverskin lichen	S	S
Leptogium cyanescens	skin lichen	S	
Texosporium sancti-jacobi	lichen	S	D
Fungi			
Alpova alexsmithii	fungus	D	
Gastroboletus vividus	fungus	S	
Helvella crassitunicata	fungus	D	
Hygrophorus caeruleus	fungus	D	
Ramaria amyloidea	fungus	D	

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 (Geographical Information System) layer 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. Only 9% of the PAUs needed additional surveys, which were conducted during field season of 2006. When the Regional Forester Sensitive Species List was updated in 2008, new sensitive plant species were added to both the Deschutes and Ochoco NFs lists.

Prior to invasive plant treatments, potential habitat and survey needs for these species will be evaluated according to PDF 63. Incidental surveys have occurred and found populations of *Carex capitata, Cyperus acuminatus, Hygrophorus caeruleus, Texosporium sancti-jacobi, Tritomaria exsectiformi*s, and *Utricularia minor* in Invasive Plant Project Area Units (Table 29).

Sensitive Plants that Occur in Project Area Units

Of the 74 plant species on the Forest/Grassland Sensitive Plant List, 20 occur within Invasive Plant Project Area Units (Table 29). These 20 species will be carried forward in the analysis; all other species listed in Table 28 are not analyzed further. New invasive plant infestations that would be controlled under the EDRR strategy would be evaluated under the Implementation Plan (Appendix F), and appropriate PDFs to protect sensitive plant species.

Of the 289 PAUs, 70 have at least one documented sensitive plant site (35 PAUs on the Deschutes National Forest; 32 on the Ochoco NF, and three on the Crooked River NG). Table 30 summarizes which PAUs have known sensitive plant sites, the PAU Site Type, and which invasive plant species is closest to known sensitive plant populations.

Table 29. 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	9
	Botrychium pumicola	pumice moonwort	3
	Carex capitata	capitate sedge	1
	Castilleja chlorotica	green-tinged paintbrush	5
	Cyperus acuminatus	short-pointed cyperus	1
	Gentiana newberryi	Newberry's gentian	3
	Hygrophorus caeruleus	Fungus	2
	Penstemon peckii	Peck's penstemon	19
	Rorippa columbiae	Columbia yellowcress	1
	Scirpus subterminalis	swaying bulrush	1
	Tomentypnum nitens	moss	3
	Tritomaria exsectiformis	liverwort	1
	Utricularia minor	lesser bladderwort	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
	Calochortus longebarbatus var. *peckii*	Peck's mariposa lily	25
Crooked River National Grassland	*Penstemon peckii*	Peck's penstemon	1
	Texosporium sancti-jacobi	woven spore lichen	2

Table 30. 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 moonwort (*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 moonwort (*Botrychium pumicola*)	Y	0	Spotted knapweed within pumice moonwort site. Overall, very few invasive plant sites in this Project Area Unit (Powers 2006, pers. comm.).
11-07	Bend/Ft. Rock	Century Drive	Wetland	Moss (*Tomentypnum nitens*)	Y	0	*Tomentypnum nitens* occurs throughout Lava Lakes wetland, which is adjacent to PAU 11-07. The very western portion of the moss population overlaps into a Canada thistle site, which is within PAU 11-07.
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.
11-13	Bend/Ft. Rock	Rd. 22	Road	Pumice moonwort (Botrychium pumicola)	N	39,000 (~ 7.4 miles)	Pumice moonwort is not near mapped bull thistle, which would be treated manually. The majority of the pumice moonwort population is not along the road and not within the Project Area Unit.
11-17	Bend/Ft. Rock	Tumalo Creek	Meadow/ Wetland/ Floodplain	Newberry's gentian (*Gentiana newberryi*) Moss (*Tomentypnum nitens*) Liverwort (*Tritomaria exsectiformis*)	N	280	Spotted knapweed is closest to gentian. The moss and liverwort occur in a wet area that is not near the open, disturbed habitats where spotted knapweed grows

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
11-37	Bend/Ft. Rock	Rd. 25	Road	Green-tinged paintbrush (*Castilleja chlorotica*)	Y	0	Spotted knapweed within TES plant site.
12-04	Crescent	Hwy 58, west	Road	Columbia yellowcress (*Rorippa columbiae*)	Y	0	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.
12-12	Crescent	Davis Lake Shoreline	Lake shoreline	Short-pointed cyperus (*Cyperus acuminatus*)	Y	0	Cyperus occurs along shoreline where reed canarygrass and Canada thistle occur.
15-01	Sisters	Little Montana, 800 Rd	Forest	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*); Fungus (*Hygrophorus caeruleus*)	Y	0	Spotted & diffuse knapweeds and Canada thistle occur near TES plants.
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*); Capitate sedge (*Carex capitata*)	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. Capitate sedge occurs in gravel along road near meadow but not currently threatened by invasive plants.
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.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
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*); Fungus (*Hygrophorus caeruleus*)	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.
15-19	Sisters	Rd. 14	Road	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.
15-22	Sisters	Trout Creek Swamp	Meadow/ Wetland	Moss (*Tomentypnum nitens*); lesser bladderwort (*Utricularia minor*)	Y	0	Rreed canarygrass is scattered through wetland.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
15-24	Sisters	Brooks Scanlon Rd.	Road	Peck's penstemon (*Penstemon peckii*)	N	12,000+	Peck's penstemon is about 2.4 miles away from mapped diffuse and spotted knapweed site.
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	Tall agoseris (*Agoseris elata*); Peck's penstemon (*Penstemon peckii*)	Y	0	Spotted & diffuse knapweeds and St. Johnswort near sensitive plants.
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.
71-18	Lookout Mt.	Rd. 42	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	7,000+	Peck's mariposa lily is at least 1.5 miles from mapped spotted knapweed.
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
71-41	Lookout Mt.	Rds. 4230-500, 600	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*); Henderson's needlegrass (*Achnatherum hendersonii*)	N	~ 100	One small part of mapped Peck's mariposa lily population is about 100 ft. from mapped spotted knapweed site; another edge of population is ~ 500+ ft. from St. Johnswort. Henderson's needlegrass not currently near mapped invasive plants.
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.
71-48	Lookout. Mt.	27, 33 Rd. system, West	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	N	~ 100	Peck's mariposa lily populations mostly not within mapped PAU. In 2 locations, edges of lily population mapped close (~ 100 ft.) to Canada thistle and St. Johnswort sites.
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.
71-71	Lookout Mt.	Rd. 4230-924	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*)	Y	0	Very small part of Peck's mariposa lily population overlaps with bull thistle, which will not be treated.
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;

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
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	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*); Scalloped moonwort (*Botrychium crenulatum*)	Y	0	Canada thistle near Peck's mariposa lily. Most of Botrychium population is not within Project Area Unit.
72-13	Paulina	4270 road, part of 4274 road and 4254 road	Road	Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*); Scalloped moonwort (*Botrychium crenulatum*)	Y	0	Diffuse knapweed, Canada thistle and houndstongue near TES plants. Botrychium subpopulations within Project Area Unit are not near any mapped invasive populations.
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.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
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*); Henderson's needlegrass (*Achnatherum hendersonii*)	Y	0	Houndstongue is near Peck's mariposa lily and also a threat to Henderson's needlegrass.
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.
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.
72-59	Paulina	5820-011 road (closed) area	Forest	Henderson's needlegrass (*Achnatherum hendersonii*)	Y	0	Three medusahead plants were pulled in 2003 & not seen since.
75-20	Crooked River NG	Rimrock Springs Dam	Upland/ Meadow/ Wetland	Woven spore lichen (*Texosporium sancti-jacobi*)	N	740+	Closest mapped invasive plant infestation is Russian knapweed (*Acroptilon repens*).
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.

Project Area Unit (PAU)	Unit	Location	Site Type	Sensitive Plant Species	Invasive Plant within TES	Distance from closest Infestation (ft.)	Invasive Plant Threats
75-47	Crooked River NG	The Island	Upland shrub/ grassland	Woven spore lichen (*Texosporium sancti-jacobi*)	N	Not mapped but currently no overlap	Entire Island is a Project Area Unit due to scattered medusahead infestations. The 3 lichen sites occur in more open scabby areas where medusahead is not currently present but open habitats are vulnerable to weed invasion (C. Veverka 2012, pers. comm.).

Survey and Manage Plant Species

In 1994, the Bureau of Land Management and Forest Service adopted standards and guidelines for the management of habitat for late-successional and old-growth forest-related species within the range of the northern spotted owl, commonly known as the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994). Direction was provided for management of known sites and conducting surveys for rare species that are closely associated with late-successional or old growth forests, called Survey and Manage species. These are species that, either because of genuine rarity or because of lack of information about them, the Agencies did not know whether they would adequately be protected by other elements of the Northwest Forest Plan. For some Survey and Manage species, surveys are required to be done at the project level before habitat is disturbed (called pre-disturbance surveys and equivalent effort surveys); for other species, surveys are to be conducted at a landscape-scale, covering the range of the species (called strategic surveys).

The Northwest Forest Plan pertains to western portions of the Deschutes National Forest only and does not affect the Ochoco National Forest, Crooked River National Grassland and portions of the Deschutes National Forest outside of this area.

This FSEIS applies the Survey and Manage species list in the 2011 Settlement Agreement (Table, Settlement Agreement Attachment 1) and thus meets the provisions of the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines*, as modified by the 2011 Settlement Agreement. The 2001 amended direction reorganized Survey and Manage plants into six species categories (Categories A-F) based on rarity and survey practicality (USDA Forest Service and USDI Bureau of Land Management 2001). These 6 categories are shown below in Table 31.

Table 31. Survey and Manage species categories and survey practicality

Relative Rarity	Pre-Disturbance Surveys Practical	Pre-Disturbance Surveys Not Practical	Status Undetermined
Rare	**Category A** • Manage all known sites • Conduct pre-disturbance surveys • Conduct strategic surveys	**Category B** • Manage all known sites • Conduct strategic surveys • If strategic surveys not completed, then conduct equivalent effort surveys in old-growth habitat to be disturbed	**Category E** • Manage all known sites • Conduct strategic surveys
Uncommon	**Category C** • Manage high priority sites • Conduct pre-disturbance surveys • Conduct strategic surveys	**Category D** • Manage high priority sites • Conduct strategic surveys	**Category F** • Conduct strategic surveys

Surveys are to be conducted prior to signing NEPA decisions or decision documents for habitat-disturbing activities. Habitat-disturbing activities are defined as those disturbances likely to have a significant negative impact on the species' habitat, its life cycle, microclimate, or life support requirements (USDA FS and USDI BLM 2001, Standards & Guidelines, p. 22). The evaluation of the scale, scope, and intensity of the anticipated negative impact of the project on habitat-or-life requirements should include an assessment of the type, timing, and intensity of the disturbing activity. Habitat-disturbing is not necessarily the same as "ground-disturbing." For example, helicopter logging or logging over snow, may not disturb the ground but might clearly affect microclimate or life cycle

habitat factors. Conversely, an activity having soil disturbing effects might not have a large enough scope to trigger a need to survey.

The scale, scope and intensity of proposed invasive plant treatments within the Northwest Forest Plan area on the Deschutes National Forest would not have a significant negative impact on habitat, life cycle, microclimate, or life support requirements for Survey and Manage plant species; therefore pre-disturbance/equivalent effort surveys are not required. The reasons for this determination are:

Scale

- The Deschutes NF has 776,514 acres of land within the Northwest Forest Plan area. Herbicide treatments are proposed within 12,487 acres in Invasive Plant Project Area Units within the Northwest Forest Plan (invasive plants actually occupy 260 acres). Of these 12,487 acres, 10,714 acres are along roads and in rock quarries; these highly disturbed areas are not habitat for Survey & Manage lichens, bryophytes, fungi and vascular plants. The remaining 1,773 acres (0.2% of the Northwest Forest Plan area on the Deschutes) occur in general Forest or along streams, lakes and wetlands. A very small portion of Northwest Forest Plan area would be treated with herbicides.
- Of the 776, 514 acres of land within the Northwest Forest Plan area, biological control is proposed within 2,356 acres of PAUS (invasive plants actually occupy 77 acres). Of these 2,356 acres, the majority (1,968 acres) is road or rock quarry sites that are not habitat for Survey and Manage lichens, bryophytes, fungi and vascular plants. The remaining 388 acres are general forest; a very small portion of the NWFP area would be within PAUs proposed for biological control (0.05%). Because biological control targets the invasive plant species and a very small area would be treated, this would not constitute a significant habitat-disturbing activity.
- Manual treatments, such as hand-pulling are proposed at many sites as a follow-up to herbicide spraying to get individual plants missed by the herbicide treatment, or as the only treatment where the invasive plant populations are small and the species can be effectively controlled manually. Manual treatments are proposed within 14,106 acres of PAUs in the NWFP area (invasive plants actually occupy 294 acres). Of these 14,106 acres, 10,714 acres are along roads and in rock quarries, which are not habitat for Survey and Manage lichens, bryophytes, fungi and vascular plants. The remaining 3,392 acres of manual treatment would occur within a small portion of the NWFP area (0.4%).

Scope

- On the Forest, invasive plants generally occur in open, disturbed areas that are not habitat for Survey & Manage species. Survey & Manage species are closely associated with late-successional or old-growth forests (USDA and USDI 2001). Invasive plants on the Forest most often occur where soils are disturbed and often highly compacted, such as road shoulders; these areas are not typical habitats occupied by Survey & Manage plant species. There are 82,504 acres of old growth forests in the NWFP area on the Deschutes National Forest. Of these 82,504 acres, 1,899 acres of old growth are scattered across 48 Invasive Plant Project Area Units (invasive plants occupy 327 acres in these 48 PAUs). Invasive plant infestations within or adjacent to old-growth habitats are small, patchy and scattered and do not occur in large continuous blocks. Treatment of small patches is unlikely to disturb survey and manage species because of the low likelihood of overlap between small scattered patches of weeds and the presences of the SM species.
- Invasive plants do not provide the essential native habitat components that sustain Survey and Manage populations. Some invasive plants may harm or degrade habitat components needed by survey and manage species.
- Invasive plant treatments would not remove or degrade late-successional or old-growth forest habitats.

Intensity

- Herbicide treatment caps further limit the scope and scale of treatments. There is a 16,000 ac. yearly treatment cap for the entire project area (two Forests and the Grassland). Herbicide treatment (for existing sites as well as future treatment under EDRR) is further subject to an annual limit for areas adjacent to water: 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. Treatments below bankfull would be restricted to 1.0 acre per year 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.
- Herbicide treatments are limited to hand application within 50 ft. of water, which minimizes potential impacts to Survey and Manage species.
- Herbicide and manual treatments are often repeated in the same year to eradicate individual plants missed by earlier treatments. Herbicide treatments would likely be repeated several years in a row until the invasive plant population is controlled. The amount of herbicide used at each site each year would be reduced as the invasive plant population is controlled.

Additional Information

- Multiple layers of caution are integrated into herbicide use. Project design features and riparian buffers provide protection to non-target vegetation and Survey and Manage habitat, reducing the scale of potential effects to Survey and Manage lichens, bryophytes, fungi and vascular plant habitat. This reduces or eliminates potential effects to Survey and Manage plant species.
- Treating invasive plants is important for protecting native plant habitats. Invasive plants create a host of adverse environmental effects that are harmful to native ecosystem processes (Sheley and Petroff 1999). 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 and neighboring areas, affecting all land ownerships. The problem is so great that in 2006, the Chief of the Forest Service included invasive species as one of the "Four Threats to the Nation's Forests and Grasslands" (http://www.fs.fed.us/projects/four-threats/).

The Forest will manage all known sites of Survey and Manage plant species according to the most current direction available for each species.

Appendix I of the Botany Report summarizes, by category, the Survey and Manage plant species documented or suspected to occur on the Deschutes National Forest within the Northwest Forest Plan area (the Botany Report is incorporated by reference in its entirety).

Pre-Field Review

A review of available information was completed in order to identify Survey and Manage plant species known to occur in the project area. The following sources were consulted for the prefield review:

- Forest Service NRIS TESP-Invasives database and GIS layers
- Forest Service personnel (District Botanists)
- The following references: Castellano and O'Dell (1997), Castellano et al. (1999 and 2003), Cushman and Huff (2007)

Sixty-four Survey and Manage plant species were evaluated in the prefield review (the Botany Report provides information on their Forest status, documented or suspected to occur, and known habitat

descriptions). Lifeforms of species considered in the analysis that are documented or suspected are summarized in Table 32.

Table 32. Summary of lifeforms of Survey and Manage plant species considered in this analysis that are documented or suspected to occur on the Deschutes National Forest

Lifeform	Number species in Category A	Number species in Category B	Number species in Category C	Number species in Category D	Number species in Category E	Number species in Category F	Total Number of Species
Bryophytes	1	2	-	-	-	-	3
Lichens	1	-	1	--	2	-	4
Fungi	-	48	-	6	-	2	56
Vascular Plants	-	-	1		-	-	1
Total # of species	2	50	2	6	2	2	64

Some field surveys have been conducted by Forest Service Botanists in invasive plant project area units and regional strategic surveys were conducted for Category B fungi species in selected high probability habitats in years 2001-2003 and 2007-2009. Survey & Manage plant populations found on the Deschutes NF during these surveys are included in this analysis.

In the annual implementation process for Early Detection/Rapid Response, new information and species sites will be evaluated and any survey needs and/or known site management identified.

Survey and Manage 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 Plan Area. The prefield review and surveys determined that six Survey and Manage plant species occur in seven Project Area Units that occur within eight PAUs within the Northwest Forest Plan area (Table 33). These species will be carried forward in the analysis. All other species are not analyzed further. If any new Survey and Manage plant species are discovered, Project Design Features (PDFs) would apply (See Section 2.4 in Chapter 2).

Table 33. Known sites of Survey and Manage plant species within Invasive Plant Project Area Units on the Deschutes National Forest

Project Area	Location	Species	Life-form	Survey & Manage Category	Notes
11-07	Rd. 46 (Century Drive)	*Hydnotrya inordinata*	Fungus	B	Occurs near a high elevation lake along Century Drive. No invasive plant sites in vicinity of fungus. Does not occur in mapped old growth.
11-17	Tumalo Creek	*Tritomaria exsectiformis*	Liver-wort	B	One *Tritomaria exsectiformis* site occurred downstream from a spotted knapweed site near the intake facility, but is no longer there; the other site is at a seep near Skyliner Lodge. Spotted knapweed occurs in open areas along the road and on the banks of Tumalo Creek but not in old growth habitat where liverwort occurs.
12-02	Hwy 58, west	*Chaenotheca furfuracea*	Lichen	F	Occurs in a dense, lush mixed conifer forest, on north aspect of large rootwad (of fir or hemlock), near perennial creek, north side of Odell Lake.
15-01	Little Montana	*Hygrophorus caeruleus*	Fungus	B	Within mapped spotted knapweed site but does not occur within mapped old growth habitat.
15-05	Hwy 20	*Choiromyces alveolatus*	Fungus	B	Spotted knapweed occurs along Hwy 20; St. Johnswort has expanded in areas along Hwy 20 due to recent wildfires. This fungus site is not in mapped old growth habitat and is on edge of Project Area Unit 15-05 but not where weeds occur.
15-10	Rd. 1230; west B&B	*Hygrophorus caeruleus*	Fungus	B	Fungus site on edge of Project Area Unit, in vicinity of 1232/320 Rds junction. Is within mapped old growth habitat.
15-14	Eyerly/Four Corners; Gunsight Pass	*Cypripedium montanum*	Vascular plant	C	Six sites occur along roads. Diffuse knapweed occurs in the road very near *Cypripedium montanum* in the Gunsight Pass area. Bull thistle and cheatgrass occur along the same road. Medusahead was found in the upper part of a timber sale unit immediately below the road.

3.4.2 Environmental Consequences

This section addresses effects of invasive plants and herbicides on all non-target plants, including Sensitive and Survey and Manage 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 and would be limited in occurrence and short term (1 to 5 years). 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.

Comparison Measures to Evaluate Effects to Non-Target Vegetation

The effects analysis evaluates the effects of invasive plants on non-target vegetation, the effects of herbicide on non-target vegetation, and the effects to sensitive plants, including sensitive and Survey and Manage plants.

The indicator to measure the effects of invasive plants on non-target plants are:

- Percent of infested upland and riparian acres remaining in year 2014

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

- Percent of Deschutes and Ochoco NF upland and riparian acres treated with herbicides;
- Types and formulations of herbicides available for use.

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, are often avoided by large herbivores, and have a broad range of tolerances for environmental conditions. 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 Eurasian plants have adapted to, but that North American plants have not (Hierro and Callaway 2003). Weed infestation can therefore lead to a decrease in native plant species. In some riparian and wetland habitats on the Forests, Eurasian reed canarygrass now dominates areas formerly colonized by native plants. Factors that contribute to its success include high resource availability (moisture and nutrients), low levels of environmental stress, and altered disturbance regimes. 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; reduces water circulation in ponds and along shores, and increases sediment deposition. 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. For example, ribbongrass, a variety of reed canarygrass, now dominates islands and banks of the Metolius River.

Invasive plants, left untreated, shift species composition and affect pollinated plants by disrupting the structure and function of ecosystems (North American Pollinator Protection Campaign 2006). A reduction or shift in pollinator species could also lead to changes in plant species composition or diversity (USDA Forest Service 2005a, 4-27). 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 negative effects on pollinators.

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 (a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria). 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 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 Non-Target 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.

Type of Herbicide and Selectivity

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, 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). For example, members of the lily family (in a group called "monocots"), in general, tend to be more tolerant since many herbicides are

designed for broadleaf plants called "dicots" (e.g., penstemons). This is especially true with grasses which tend to be more tolerant, except for herbicides specifically developed to control grasses.

Herbicides have the potential to shift species composition and reduce diversity of native plant communities, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. If a reduction or shift in pollinator species occurs, changes to plant species composition or diversity could follow (USDA Forest Service 2005a, p. 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).

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 organic matter in soil, minimizing the likelihood of runoff or leaching into groundwater, and prevents it from being taken up from the soil by non-target plants. Glyphosate also degrades quickly, which reduces the opportunity for offsite movement (USDA Forest Service 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, the application method, and the proximity of sensitive or other native plants to the treatment site. 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, but is selective to only a few plant families. Metsulfuron methyl works by inhibiting the activity of an enzyme called acetolactate synthase, an enzyme necessary for plant growth.

The Herbicide Information Summary (Appendix D) discusses herbicide selectivity. Some herbicides are selective for particular kinds of plants, whereas a non-selective herbicide has the ability to damage a broad spectrum of plant species. 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 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 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 exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan shape spray under a nozzle), but virtually all of the particles fall within a short distance of the release point. The smallest, and therefore the lightest particles have the potential to travel the farthest. Limiting the droplet size forced out of the nozzle to larger particle sizes greatly reduces the potential for herbicide to drift beyond the target vegetation. Figure 6 demonstrates the relationship between droplet size and buffer distance. As droplet size increases, Volume Median Diameter (VMD; the distance herbicide may travel in concentrations sufficient to harm plants) decreases. 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.

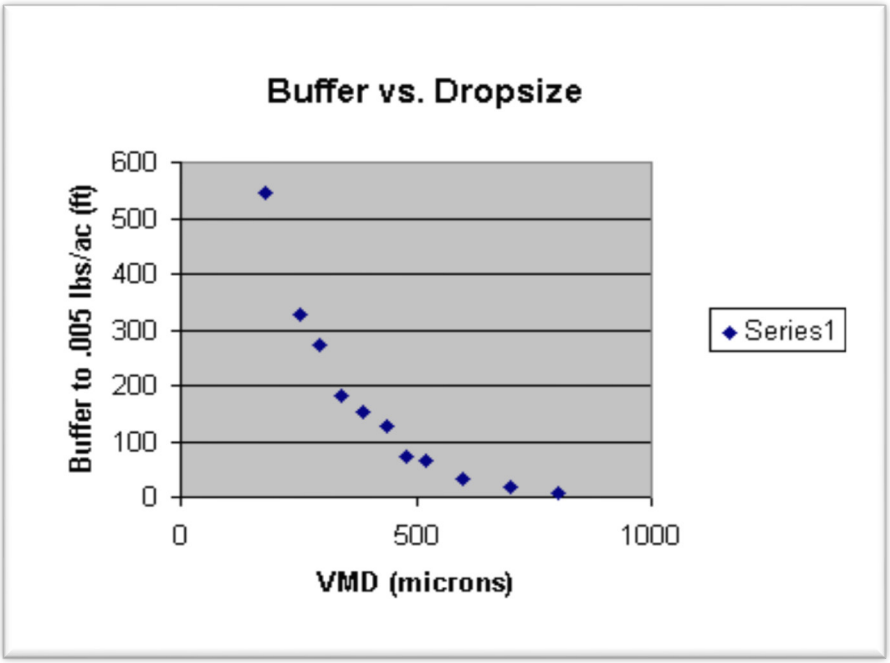

Figure 6. Illustration of how herbicide droplet size can reduce the distance that the herbicide can drift (USDA Forest Service 2006c). VMD = Volume Median Diameter.

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.

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 sulfometuron methyl, picloram, glyphosate, triclopyr which are known to affect soil mycorrhizae (i.e., mutualistic associations between specialized soil fungi and the roots of vascular plants), 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, pers. comm.); 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.

Mycorrhizal Fungi and Their Host Plants

Most vascular plants form relationships with specialized soil fungi (mycorrhizae) that 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.

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). Studies published after this publication similarly show various effects depending on the species, herbicide and dose.

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 (a type of mycorrhizal 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.

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 (i.e., terrestrial plants adapted to moderate water environments; neither too dry nor too wet). 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. Invasive plants often occur in highly disturbed areas (roads, quarries, etc.) unlike the upland undisturbed forests 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.

Newmaster and Bell (2002) evaluated aerial applications of triclopyr and glyphosate as part of a study of the effects of forest harvesting and silvicultural practices on cryptogam (spore producing plants) diversity. Of the five methods evaluated, they found herbicide treatments had the greatest initial effect on species richness, species abundance, and diversity indices. Cryptogam diversity showed signs of recovery 5 years after treatments. Missed strips (untreated areas) within a clearcut provided a refuge for remnant communities of forest cryptogams that could play a key role in the rehabilitation of forest diversity.

McMullin et al. (2012) found that herbicide applications affected lichen abundance with high mortality in some species but no effect for other species. One year post-treatment, triclopyr and glyphosate reduced the abundance, respectively in 40% and 56% of the boreal forest lichen species treated in this study. Lichen species can be classified based on their tolerance to herbicides (McMullin et al. 2012). Lichen traits (i.e., chemical and morphological differences) can explain some of the variation in the tolerance among various species' to herbicide applications. McMullin et al. (2012) found that the all but

one of the most herbicide sensitive lichen species have a richly branched growth form, whereas the more tolerant lichens were not distinctly branched.

Lichens and bryophytes would be especially sensitive to herbicides because they lack a waxy cuticle and so would easily absorb them (Geiser 2006, pers. comm.). 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.

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 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, Survey and Manage plants. In all alternatives, PDFs, implementation planning, and monitoring would be used to mitigate any effects to sensitive, Survey and Manage, and other plant species.

Biocontrol agents that currently are present within or adjacent to the forest could move onto other forest lands and provide a method of treatment, however, control may take a number of years and control is subject to target species and appropriate biocontrol agent presence. These less effective methods of control would likely lead to the continued displacement of native plant species and the increased spread potential of invasive plants currently infesting the forest. The analyses for effects of biocontrol agents have already been completed under documents developed by Agricultural Plant Health and Insect Service (APHIS) for approval of entry of such organisms and are hereby incorporated by reference. The effects of biological agents are described in Appendix J of the R6 2005 FEIS, and direct, indirect and cumulative effects are negligible; see examples of nontarget effects (page J-16).

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 Invasive Plant Standards (Forest Plans amended by 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 (e.g., Standards 19 and 20).

Effects to non-target plants from herbicide would be reduced by using alternate treatment 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.

Alternative 1 – No Action

Direct and Indirect Effects

Effects of Invasive Plants on Non-Target Vegetation

Alternative 1 is the least effective alternative in controlling invasive plants (see Summary ofTreatment Effectiveness, Table 27). Only 238 of the inventoried 1,892 invasive plant sites would be treated. Invasive plant populations would continue to expand. Alternative 1 would have the highest percent of infested acres remaining in year 2014 of the three alternatives. Ninety-eight percent (12,274 acres) of infested upland and 67% (1,366 acres) infested riparian acres would remain infested (see Table 25 and 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 previously, 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, pers. comm.). 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 than those available under Alternative 1 and would have a lower likelihood of 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 high abundance of reed canarygrass was strongly correlated with lower native plant composition and abundance. 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 prevention standards included in the Forest Plans amended by the R6 2005 ROD. The rate of spread of invasive plants is likely to slow from implementing the prevention standards; however, prevention alone is insufficient to reach desired future conditions because of the extent of existing infestation (R6 2005 FEIS Chapter 4.2). As a result, the infestations on the Forests and Grassland would continue to spread, and available control techniques would not exceed the expansion. 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).

Invasive plant spread was estimated as a way to compare the three alternatives for treatment effectiveness (see Summary of Treatment Effectiveness for Alternative 2 Table 27). Using these estimates, Alternative 1 would have the highest percent of infested acres remaining in year 2014 with 98% of upland acres and 67% of riparian acres still infested.

Effects of Herbicides on Non-Target Plants

To compare the alternatives for effects of herbicides on non-target plants, the percent of Forest Service land (acres) that could be treated with herbicides was evaluated. Under Alternative 1, 824 acres are treated with herbicides (based on the 3-year average of acres treated given current budgets and available resources). The Deschutes and Ochoco National Forests comprise approximately 2.5 million acres; therefore, under Alternative 1, 0.03% of upland acres and 0.001% of riparian acres of Forest lands could be sprayed with herbicides. Alternative 1 treats the least amount of Forest Service land with herbicides.

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.

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, currently dicamba and picloram are used to treat spotted knapweed. These herbicides are not as selective as clopyralid, which would be available under Alternatives 2 and 3.

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

Forest Service Manual requires botanists to evaluate each proposed project to determine if it would affect Threatened, Endangered or 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 Threatened or Endangered plants or their habitat on the Forests and Grassland; therefore there are no effects to Threatened or Endangered plants from any of the alternatives. Table 35 summarizes the biological evaluation -- for the majority of sensitive plants that occur in Project Area Units, Alternative 1 would result in a determination of MIIH due to continued invasive plant spread or being limited to less selective herbicides.

Under Alternative 1, sensitive plant populations in or adjacent to invasive plant populations have a greater risk of impacts as invasive plants expand. 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 29). 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 (Pajutee 2009). 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 moonwort (*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 for this species.

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 green-tinged paintbrush in Alternative 1.

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

- PAU 15-01 –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. There are 262 mapped infested acres in PAU 15-01.
- PAU 72-50 –, 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. There are 54 mapped infested acres in PAU 72-50.

In both PAUs, Alternative 1 results in longer time to control invasive plants because only manual treatment could be utilized. Given certain assumptions (see Section 3.3 Treatment Effectiveness and Appendix H of the Botany Report). Alternative 1 results in more acres of invasive plant infestation remaining in Year 2014 than Alternatives 2 and 3. For PAU 15-01 in Alternative 1 there are 132.1 acres remaining, compared to 0.1 and 1.0 acres remaining for Alternatives 2 and 3 respectively. In the year 2014 there are 6.5 acres remaing in PAU 72-50, compared to 0.03 and 2.7 acres for Alternatives 2 and respectively.

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 annual control efforts, largely by manual hand pulling, invasive plants are increasing across the range of Peck's penstemon, especially in wildfire areas (Pajutee 2009). Canada thistle will likely continue to spread along the Deschutes River, further impacting riparian plant species such as capitates sedge. 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.

Because 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 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 Survey and Manage Plants

The effects to Survey and Manage plant species would be similar to effects to sensitive plant species. The majority of invasive plant sites would be treated manually. The limited use of herbicides under Alternative 1 would result in a low potential risk of herbicide damage to individual fungi, bryophytes, and lichens, and not cause a decrease in species distribution (loss of sites or viability) 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 effectively manage invasive plants in Alternative 1 increases the potential for loss of species diversity and the loss of habitat for Survey and Manage fungi, bryophytes and lichens as compared to Alternatives 2 and 3.

Table 38 summarizes the effects evaluation for Survey and Manage plant species. For some species, a determination of No Impact is made because there is no spatial overlap between invasive plants and the rare species. However, for mountain lady's slipper and two fungal species, a determination of May Impact Individuals or Habitat was made due to the likely continued invasive plant spread under Alternative 1.

Summary of Herbicide Effects to Non-target 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.

- ***Poses risk to native vegetation from invasive plants.***
    - The majority of invasive plant sites would not be treated, resulting in the continued displacement of native plant species and habitats.
    - Highest percent of infested acres remaining in year 2014 of the three alternatives. 98% of upland and 67 % of riparian acres would still be infested.
    - Limited herbicides are available; this will reduce treatment effectiveness, resulting in continued loss of native plant biodiversity and higher risks to native plants, including fungi, bryophytes and lichens, 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 Survey and Manage 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.
- ***The effects of herbicide on non-target plants are minimal.***
    - Treats the least amount of Forest Service land with herbicides (0.03% of upland habitat and 0.001% of riparian habitat).
    - Fewer acres (2,204 of 14,547 inventoried acres of infestation) would be treated; therefore, less risk of inadvertent damage to individual non-target plants
    - The number and and types of herbicides are limited, and are not as species- selective as those allowed under Alternatives 2 and 3.

Action Alternatives 2 and 3

Botany Project Design Features Common to Action Alternatives 2 and 3

Project Design Features minimize or eliminate 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.

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 plants. PDFs are mandatory and are taken into consideration when comparing the alternatives. Of the 95 Project Design Features listed in Chapter 2, Table 34 gives examples of PDFs that would protect non-target plants from invasive plant treatments. A complete list was published in the Draft SEIS, and is shortened here for brevity (the complete list and further analysis of PDF protection can be found in the Botany Report).

Table 34. Examples of Project Design Features that protect non-target vegetation (for a complete list, see the Botany Report)

PDF No.	Focus of PDF	What PDF Requires	How the PDF would minimize* or eliminate effects to non-target 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.
47	Avoid excessive herbicide runoff	Do not use chlorsulfuron, picloram, and/or sulfometuron methyl on shallow (<12” depth), scabland, or high clay content (texture class 1 – fine texture, refer to Table 41 in Soil Section) soils with low infiltration rates where runoff from storm events could reach surface waters.	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.
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 No.	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 Survey and Manage 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 Survey and Manage plants are protected.	This PDF is to ensure that TES and Survey and Manage 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.
68	Protect rare plants from herbicides	In order to protect TES and Survey and Manage 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 Survey and Manage plants.

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

Alternative 2

The following 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 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 covered in the Region 6 Invasive Plant ROD 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 of Invasive Plants on Non-Target Vegetation

Alternative 2 is the most effective alternative in controlling invasive plants (Table 27). It allows treatment of all inventoried 1,892 invasive plant sites that have been mapped across 14,547 acres. Alternative 2 has the least percent of infested acres remaining in year 2014; 60% of upland acres and 12% of riparian acres (Table 25 and Table 26). Ten herbicides would be available for use, including more selective herbicides, and herbicides that are more effective on target weeds, than currently available. For example, Alternative 2 allows more broadcast spraying of herbicides which would increase the amount of infested acres able to treat in a given time and budget. An Early Detection/Rapid Response strategy allows quick control of new invasive plant sites.

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

Effects of Herbicide on Non-Target Plants

To compare the alternatives for effects of herbicides on non-target plants, the percent of Forest Service land (acres) that could be treated with herbicides was evaluated. For Alternatives 2 and 3, the maximum amount of acreage that could be treated annually was used to calculate the percent of Forest Service land that could be treated with herbicides. The annual treatment cap is 16,000 acres. Of these 16,000 acres, 15,440 acres are upland habitat and 560 acres are riparian. Alternatives 2 and 3 differ in the acres of riparian habitat that could be treated with herbicides: under Alternative 2, all 560 acres could be treated with herbicides, yet Alternative 3 could only treat 300 of the 560 acres (260 acres are within the

no-herbicide 10-foot buffer). The Deschutes and Ochoco National Forests and Crooked River National Grassland comprise 2.5 million acres, which was used in the calculation. Alternative 2 would result in less than one percent (0.62%) of upland acres and 0.02% of riparian acres that could be treated annually with herbicides (see Table s 25 and 26). The small amount of land that would be treated with herbicides minimizes effects of herbicides to non-target plants.

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 Forest 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 34 gives examples of PDFs that were 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 Forest Standards reduce the severity and extent of impacts associated with herbicide runoff and drift. For example, one Forest Standard restricts triclopyr to selective applications, which would reduce direct effects to non-target woody species, culturally important species, and ectomycorrhizal fungi. Another Forest Standard 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, and 69 are specifically developed to protect non-target plants from the sulfonylurea herbicides. 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, pers. comm.). Sulfometuron methyl is proposed for use on medusahead, with the majority of sites on the Grassland. Historically (in the late 1930s), 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, pers. comm.). PDFs 15, 16, and 67 are intended to minimize movement of herbicide molecules by wind.

Repeated use of herbicides could potentially shift native plant species composition, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. 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. Tables 35 and 36 show the decrease in herbicide use at selected sites on the Deschutes National Forest based on data from the Oregon Department of Agriculture, 2005. Monitoring has shown that herbicide use on the Deschutes National Forest at individual sites has declined since year 2000 when herbicide spraying began. 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 35. Acres treated with herbicides and total herbicide usage, 2000-2005, Deschutes NF

	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 36. Percent reduction in the amount of herbicide used at selected sites, 2000-2004, Deschutes NF

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 of biological crusts within the Deschutes, Ochoco and Crooked River National Grassland is variable, with little development on the younger ash soils derived from Mazama or Sand Mountain sources and variable presence on older residual soils located on the CRNG, scabland areas of the Ochoco and portions of the Deschutes. 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).

Many of the sites proposed for herbicide treatment contain little or no biological crusts as a result of mechanical disturbance or the soil type present. Biological 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. Since the project proposes to treat invasive plants in favor of native species, conditions more conducive to the development of biological crusts are likely to develop on treated sites.

Although the function and value of biological crusts in arid soil environments has been documented by research ecologists (Belnap et al. 2001), research on the direct effects of herbicides on biological crusts is limited. A study originally completed by The Nature Conservancy in cooperation with USGS, examining the effects of two glyphosate herbicides on microbiotic crust cover and species richness within a native bunchgrass community, found no negative effect on soil bryophyte cover or species richness from one year of glyphosate herbicide application (Youtie et al. 1999). Plots treated with herbicide in this experiment maintained existing cover of bryophytes and lichens compared to losses in the untreated plots, which were primarily attributed to an increase in litter cover of invasive annual grasses (medusahead) blocking the light needed for photosynthesis by the crust components. Other research cited by Youtie suggests the possibility of long-term physiological and ecological susceptibility of bryophytes and lichens to glyphosate and other herbicides (Youtie et al. 1999).

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 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 bunchgrass communities, as discussed earlier in this section ("Herbicide Effects Specific to Non-vascular Plants"). PDFs 46 and 47 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. PDFs would provide protection to biological soil crusts from the effects of herbicides and there would be no or minimal effects to biological soil crusts.

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 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), integrated layers of caution (Figure 5), 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.

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 27). 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 because it most effectively treats invasive plants, protecting sensitive plant habitats.
As discussed earlier under Alternative 1, two Project Area Units (PAUs 15-10 and 72-50) were selected for comparison purposes to represent how the alternatives differ in treating invasive plants that occur with sensitive plants (see Appendix H of the Botany Report). In both PAUs, Alternative 2 would control invasive plant infestations the quickest because more effective herbicides would be used and more acres could be treated. Alternative 2 results in the fewest acres of invasive plant infestation remaining in Year 2014 than Alternatives 1 and 3 (see Appendix H of the Botany Report) and therefore the risk to sensitive plants from invasive plants is reduced compared to Alternative 1.

Table 37 summarizes the effects evaluation. For the majority of sensitive plants, Alternative 2 would result in No Impact or 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 (MIIH). PDFs would minimize or eliminate effects of herbicides to sensitive plants but an effects determination of MIIH is given as a

conservative approach due to remaining uncertainty because the priority herbicide could cause some plant damage if it were to unintentionally contact a sensitive plant. Alternative 2 would not result in a loss of viability of sensitive plants nor cause a trend toward federal listing, but would protect sensitive plants and their habitat from invasive plants.

There are no Will Impact Individuals or Habitat (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 section 2.4, especially PDFs 63, 64, 65, 64, and 67). 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.

Effects to Sensitive Plants from Herbicides under Alternative 2

The 10 proposed herbicides were evaluated for potential effects on each of the documented sensitive plant species (see Appendix C, Botany Report for a complete list of all sensitive species determinations). 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 FSEIS 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.

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 the Forest Plans as amended by the 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 Survey and Manage) plant. In the long-term, sensitive plant habitats will benefit from invasive plant treatments. Forest Plan 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. A Forest Plan standard requires that we design treatments to minimize or eliminate adverse effects to non-target plants, so site-specific project design will be used (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 (Figure 5), 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 no substantial effects to populations are expected due to the controllable nature of applications. Any effects that do occur are expected to be short-term (1-5 years) and it is expected that there would be no loss of sensitive plant viability and no significant trend toward listing for any sensitive plant or fungi in either the short term or long term (5+ years) due to implementation planning and implementation of PDFs. 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 was not affected by the herbicide (Ahlenslager 2006, pers. comm.; 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 2009), and pumice moonwort (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 Survey and Manage 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. 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. The 35-foot buffer is based on Marrs et al. (1989) who state that a buffer from sensitive vegetation of about 5-10 meters (16-33 feet) 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 which is 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.

In Project Area Unit 72-59, Paulina District Botanist found and pulled three medusahead plants in 2003; 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. Sulfometuron methyl is a preferred option for treating medusahead, and this herbicide could affect Henderson's needlegrass (*Achnatherum hendersonii*) plants if the herbicide inadvertently came into contact with the needlegrass. PDF 71 requires a 50-foot buffer from sensitive plants. 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 through the annual implementation process, selecting the best herbicide 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, FSEIS). This herbicide has a potential to damage non-target plants by being carried with wind transport of treated soils. At this particular needlegrass site, there is not much risk of wind transport of soil due to the amount of gravel and red clay soils (Mafera 2006 and Bautista 2006, pers. comm.). If a site evaluation suggested that wind erosion potential was high, other herbicides, such as glyphosate, would be used. 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. 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 Sensitive and Survey and Manage plants. The 100 foot broadcast buffer in PDF 67 is based 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 results of the evaluation are shown in Appendix C of the Botany Report and the information was used to make the determinations listed inTable 37. 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). Projects are analyzed to determine if they 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; 2) the risk reduction framework, described at the beginning of Chapter 3, controls the use of herbicide and reduces risk of herbicide exposure; and 3) PDFs further provide protection to sensitive plants from invasive plant treatments (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 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 inadvertently come into contact with an individual plant. However, no substantial effects to sensitive plant populations are expected from herbicides. There are many sensitive plant populations that are not near invasive plants and no population is expected to decline from the use of herbicides. There could be damage to some individual plants if herbicide inadvertently came into contact with a plant, but this would be short-term (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.

Table 37. Evaluation of potential effects of proposed herbicides on currently known sensitive plant populations within Project Area Units for Alternatives 1, 2 and 3

Scientific Name	Common Name	Alt. 1	Alt. 2`	Alt. 3
Vascular Plants				
Achnatherum hendersonii	Henderson's needlegrass; Indian ricegrass	MIIH	NI	NI
Agoseris elata	Tall agoseris	MIIH	MIIH** NI where manual treatment	MIIH** NI where manual treatment
Astragalus tegetarioides	Bastard milkvetch	MIIH	NI	NI
Botrychium crenulatum	Scalloped moonwort	MIIH	NI	NI
Botrychium minganense	Mingan moonwort	MIIH	MIIH**	MIIH**
Botrychium montanum	Mountain moonwort	MIIH	MIIH**	MIIH**
Botrychium pumicola	Pumice moonwort	MIIH	NI	NI
Calochortus longebarbatus var. *peckii*	Longbeard mariposa lily	MIIH	NI if clopyralid used on Canada thistle; MIIH** if metsulfuron methyl used on houndstongue	NI if clopyralid used on Canada thistle; MIIH** if metsulfuron methyl used on houndstongue
Carex capitata	Capitates sedge	MIIH	MIIH**	MIIH**
Carex lasiocarpa var. *americana*	Slender sedge	NI	NI	NI
Castilleja chlorotica	Green-tinged paintbrush	MIIH	NI	NI
Cyperus acuminatus	Short-pointed cyperus	MIIH	MIIH**	MIIH**
Gentiana newberryi var. *newberryi*	Newberry's gentian; alpine gentian	MIIH	NI	NI
Penstemon peckii	Peck's penstemon	MIIH	NI if clopyralid used on Canada thistle; MIIH** if metsulfuron methyl used on St. Johnswort	NI if clopyralid used on Canada thistle; MIIH** if metsulfuron methyl used on St. Johnswort
Rorippa columbiae	Columbia yellowcress	MIIH	MIIH**	MIIH**
Scirpus subterminalis	Swaying bulrush	MIIH	NI	NI
Utricularia minor	Lesser bladderwort	MIIH	MIIH**	MIIH**
Bryophytes				
Tomentypnum nitens	Moss	MIIH		
Tritomaria exsectiformis	Liverwort	MIIH		
Lichens				
Texosporium sancti-jacobi	Woven spore lichen	MIIH	MIIH**	MIIH**
Fungi				
Hygrophorus caeruleus	fungus	MIIH	MIIH**	MIIH**

Effects codes for

Table 37:

NI = No Impact – This determination is made under one of the following three conditions: 1). The species occurs in Project Area Units (PAUs) but treatments would have no impact; 2). The species occurs on the Forests/Grassland but does not occur in PAUs, and therefore invasive plants would not be impacted by treatments; 3). The species has not been found but is suspected to occur on the Forest and would not be impacted by planned treatments.

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. MIIH = is given for several reasons such as: 1) likelihood of invasive plants to continue to spread, and/or 2) less selective herbicides available

MIIH = PDFs (**see** Table 18) would minimize or eliminate effects of herbicides to sensitive plants but an effects determination of MIIH is given as a conservative approach due to remaining uncertainty because the priority herbicide could cause some plant damage if it were to unintentionally come into contact with an individual plant. **However, treating invasive plants would be a beneficial effect on rare species and their habitat.**

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 FSEIS 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 quick response to treat new invasive plant populations that need herbicide to effectively control the new invader.

Alternative 2 is consistent with management direction in the Species Conservation Strategy for Peck's penstemon (Pajutee 2009), the Conservation Strategy for pumice moonwort (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.

Effects to Survey and Manage Plants

The prefield review identified known sites for Survey and Manage 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 six Survey and Manage plant species (Table 31): one vascular plant (*Cypripedium montanum*, lady's slipper), one bryophyte (*Tritomaria exsectiformis*), one lichen (*Chaenotheca furfuracea*), 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 Survey and Manage plant species.

In the short-term (1-5 years), herbicide treatments could inadvertently damage individual Survey and Manage plants and possibly their host plants, but this is not expected with the PDFs and other layers of caution built into Alternatives 2 and 3. The key to managing and protecting known sites of fungi, lichens and bryophytes is to maintain habitat diversity, host tree species, and microclimatic conditions. In the long term (5 + years), controlling or eradicating invasive plants would result in maintaining these conditions for native plants, with a beneficial effect to both the rare species and its host species. Use of herbicides would not result in a decrease in distribution (loss of sites) or loss of habitat.

The following summarizes potential effects for these six Survey and Manage species:

4. Mountain lady's slipper (*Cypripedium montanum*) occurs in the same habitat as invasive plants, along disturbed road shoulders. Six sites occur in PAU 15-14 on Sisters Ranger District. Botany PDFs 63-71 are designed to ensure protection of sensitive and Survey and Manage plant species. Forest Service Botanists would be involved in designing appropriate treatments (PDF 64) and would consider manual as well as herbicide treatments. If herbicide treatments were used, Forest Service Botanists would work closely with herbicide applicators to ensure PDFs are implemented (PDF 64). Mountain lady's slipper (*Cypripedium montanum*) plants are easily identified and can be avoided from invasive plant treatments by implementing PDFs. In addition, other layers of caution (e.g., Figure 5; the PDFs listed in Chapter 2) would reduce the

risk of potential damage to non-target plants. In the long-term (5+ years), eliminating invasive plants within mountain lady slipper sites will protect these orchid plants.

5. A fungus, *Choiromyces alveolatus*, occurs adjacent to Project Area Unit 15-05 (Highway 20) on Sisters District. This species forms fruiting bodies (i.e., truffles) 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*). Spotted knapweed occasionally occurs (in a very scattered distribution) on disturbed road shoulders on Highway 20, but the habitat for the fungus is not within the disturbed road shoulders. *Choiromyces alveolatus* has a dependent mycorrhizal association with old-growth stands containing high elevation hemlocks (*Tsuga heterophylla* and *T. mertensiana*), Douglas-fir (*Pseudotsuga menziesii*), true firs (*Abies* spp.), lodgepole pine (*Pinus contorta*) and ponderosa pine (*Pinus ponderosa*) (Castellano and O'Dell 1997). In addition to minimal spatial overlap between treatment sites and the *Choiromyces alveolatus* site, PDFs would minimize off-site drift (e.g., PDFs 9 and 16) reducing potential inadvertent effects to this fungus.
6. *Tritomaria exsectiformis* occurs in PAU 11-17 on Bend/Ft. Rock District. This species occurs in very wet habitats. Riparian invasive plant species, such as reed canarygrass and ribbongrass, could pose a threat to populations of this bryophyte, but surveys show there are currently no known invasive plant threats to these sites (Dewey 2006, pers. comm.). Currently, the known *Tritomaria exsectiformis* site in PAU 11-17 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 of herbicide buffers under Effects of Herbicide on Sensitive Plants).
7. There are two known sites of *Hygrophorus caeruleus* within Project Area Units 15-01 and 15-10 on Sisters District. The fungus grows in moist, closed-canopied forest areas, whereas the invasive plants are found in sunny disturbed areas along road shoulders (Pajutee 2008b).
8. The known *Hydnotrya inordinata* site is in PAU 11-07 on Bend/Ft. Rock District, but is not near any invasive plant plants.
9. The *Chaenotheca furfuracea* site occurs in PAU 12-02 on Crescent District, and grows in a lush, dense forest, not typical of the open, disturbed habitat where invasive plants occur. It is not currently threatened by invasive plants.

Table 38 summarizes the effects evaluation for Survey and Manage plant species (see Appendix K of the Botany Report). Alternative 2 would result in No Impact or "MIIH**" (see notes below Table 38). PDFs would minimize or eliminate effects of herbicides to Survey and Manage plants but an effects determination of MIIH is given as a conservative approach due to remaining uncertainty because the priority herbicide could cause some plant damage if it were to unintentionally contact a rare plant or the mycelium of a fungus. Alternative 2 would not result in a loss of viability of Survey and Manage plants, but would protect Survey and Manage plants and their habitat from invasive plants in the long-term (5+ years).

Alternative 2 is not likely to result in adverse impacts to these rare species or other fungi, bryophytes, and lichen populations or habitats because PDFs are tailored to protect non-target vegetation (Table 34). For example, PDF 5 is designed to protect non-target vegetation. PDFs 9 and 16 minimize off-site drift, reducing potential inadvertent contamination of fungi, bryophytes and lichens and their host trees. Additional PDFs, such as 12, 13, 15, and 16 protect non-target vegetation by reducing the potential for run-off or drift of herbicides. The Soils analysis determined that PDFs 9-17 and 45-47 minimize the effects of herbicides on the soil resources, which provides protection to fungal mycelium. PDFs 63-71 are designed to ensure protection of known populations of sensitive and Survey and Manage plant species. Other layers of caution, such as Forest Invasive Plant Standards and herbicide label restrictions,

would be incorporated into planning and implementing treatments and provide added layers of protection. Potential impacts to Survey and Manage plants are expected to be minimal (i.e., reduced the lowest extent possible) or eliminated. Changes in species distribution or loss of habitat for Survey and Manage plants (including fungi, bryophytes and lichens) are not expected. Controlling invasive plants would have a beneficial effect for these species by maintaining habitat diversity and microclimatic conditions.

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 Survey and Manage plants.

Table 38. Evaluation of potential effects of on known Survey and Manage plant populations within Invasive Plant Project Area Units

Sensitive Plant Species	Common Name	Alt. 1	Alt. 2	Alt. 3
Chaenotheca furfuracea	Lichen	NI	NI	NI
Choiromyces alveolatus	Fungus	MIIH	MIIH**	MIIH**
Cypripedium montanum	Vascular plant	MIIH	MIIH**	MIIH**
Hydnotrya inordinata	Fungus	NI	NI	NI
Hygrophorus caeruleus	Fungus	MIIH	MIIH**	MIIH**
Tritomaria exsectiformis	Liverwort	NI	NI	NI

Effects codes:

NI = No Impact – This determination is made because treatments would have 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. MIIH = is given for several reasons such as: 1) likelihood of invasive plants to continue to spread, and/or 2) less selective herbicides available

MIIH** = PDFs (**see Table 18**) would minimize or eliminate effects of herbicides to sensitive plants but an effects determination of MIIH is given as a conservative approach due to remaining uncertainty because the priority herbicide could cause some plant damage if it were to unintentionally come into contact with an individual plant or fungal mycelium. **However, treating invasive plants would be a beneficial effect on rare species and their habitat.**

Summary of Effects to Non-Target Vegetation for Alternative 2

Table 37 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.
  - Least percent of infested acres in year 2014
  - An Early Detection/Rapid Response Strategy allows quick response to treat new infestations.
  - Alternative 2 is the most effective in treating invasive plants, therefore preventing loss of habitat of sensitive and Survey and Manage plants including fungi, bryophytes and lichens.
- ***The effects of herbicides on non-target plants is minimized or eliminated***
  - Most currently mapped invasive plant infestations are proposed to be treated with herbicides; therefore herbicide use is maximized in this alternative. However, less than 1% of Forest Service land would be treated with herbicides.
  - Effects to non-target plants from herbicide applications are minimized or eliminated by incorporating layers of caution from the risk reduction framework, such as R6 2005 ROD standards and monitoring, and specific PDFs.

- More selective herbicides provide options to reduce the risk to non-target plants.
- Even with all these protective measures in place, there could be inadvertent damage to individual non-target plants from herbicides. However, there would be no changes in species distribution or loss of habitat for non-target plants, and sensitive and Survey and Manage plants (including fungi, bryophytes, and lichens) from the use of herbicides.

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 BEE (ester), picloram, sethoxydim, and the non-aquatic formulation of glyphosate.
- Broadcast spraying of permitted herbicides would not be allowed within 300 feet of water or along road segments that are within 300 feet of perennial streams or lakes.
- In addition, there would be no herbicide application within 10 ft of perennial streams, lakes, or wetlands.

Effects of Invasive Plants on Non-Target Vegetation

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 Survey and Manage plant species. Both Alternatives 2 and 3 would be more effective in treating invasive plants than Alternative 1 (Table 27), providing more protection to native plant habitats from invasive plants.

Alternative 3 is more effective in controlling invasive plants than Alternative 1 but not quite as effective as Alternative 2 in the amount of infested acres remaining in year 2014. The same amount of upland acres is predicted to be remaining in year 2014 for both Alternatives 2 and 3 (7,529 upland acres). Yet, 990 riparian acres would still remain infested by year 2014 for Alternative 3, while Alternative 2 would have 238 riparian infested acres. Alternative 3 would result in 60% of upland acres and 49% of riparian acres infested in year 2014 (see Table 27).

Effects of Herbicides on Non-Target Vegetation

As with Alternative 2, Alternative 3 would treat a small percentage of Forest Service land with herbicides. To compare the alternatives for effects of herbicides on non-target plants, the percent of Forest Service land (acres) that could be treated with herbicides was evaluated. For Alternatives 2 and 3, the maximum amount of acreage that could be treated annually was used to calculate the percent of Forest Service land that could be treated with herbicides. The annual treatment cap is 16,000 acres. Of the 16,000 acres, 15,440 acres are upland habitat and 560 acres are riparian. Alternatives 2 and 3 differ in the acres of riparian habitat that could be treated with herbicides: under Alternative 2, all 560 acres could be treated with herbicides, yet Alternative 3 could only treat 300 of the 560 acres (260 acres are within the no-herbicide 10-foot buffer). The Deschutes and Ochoco National Forests and Crooked River National Grassland comprise 2.5 million acres, which was used in the calculation. Alternative 3 results in less than 1 percent (0.62%) of upland acres, and 0.01% of all riparian acres that could be treated

annually with herbicides. The small amount of land that would be treated with herbicides minimizes potential effects of herbicides to non-target 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, such as buffers described above for Alternative 2, also apply to Alternative 3. Combined with other layers of caution (e.g., Forest Standards, and herbicide laws and regulations), Alternative 3 would protect 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 feet of water (cannot use triclopyr, sethoxydim, and picloram), and no herbicides can be used within 10 feet of water. The latter restriction currently affects about 260 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 feet of water. Selective herbicide application methods do result in the use of less herbicide with less potential drift or runoff.

Under Alternative 3, herbicides cannot be used within 10 feet of water. The predominant invasive species within 10 feet of water are reed canarygrass and ribbongrass, which are rhizomatous plants with extensive root mass. These species spread by root fragments, and manual treatment methods are not effective at controlling populations unless all pieces of root fragments are removed. Manual removal of flowering seed heads can prevent seed production but only if all flowering seed heads are removed. Along the streambank (the area within 10 feet of water), the dense root growth and bank substrates (rocks) make it difficult to remove all rhizomes. Annual weed whacking to remove flowering seed heads would reduce the seed source for re-colonization of treated areas in the stream channel but would have limited control of populations because the rhizomes are not removed. In addition to being ineffective, removing these species by hand digging or weed-whacking is labor-intensive and costly; the extent of removal each year would depend on budgets and/or the ability to get volunteers. Alternative 3 would reduce the infestation of reed canarygrass and ribbongrass to a lesser extent than Alternative 2 and would leave a substantial amount of acreage infested with rhizomes along the riverbanks that would need annual treatment into perpetuity to prevent rhizomatous spread and seed sourcing downstream.

On August 27, 2008, volunteers from the Camp Sherman Weed Warriors and Sierra Club joined Forest Service specialists to conduct a test trial to provide preliminary information on what it would require to manually remove the ribbongrass (Pajutee 2008c). Using this test demonstration 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 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 the ability to treat the hundreds of other invasive plant sites,

and yet the ribbongrass will continue to persist because manual methods along the riverbank would not be able to effectively remove all of the root system.

Some manual treatments would be accomplished each year, with the Metolius River ribbongrass being a high priority. Though many of the ribbongrass and reed canarygrass populations occur in large clumps or extensive patches, manual treatments could also target individual plants spaced out along river bank or lakeshores, plants on logs and plants on islands in the river to decrease the amount of sediment entering the stream (see Alternative 3 in Section 3.6). However, because manual treatments for these rhizomatous riparian species are time consuming and expensive, it is reasonable to assume that manual treatment would be limited in any one year. Therefore it is unlikely that we can keep up with the spread of these species and, under Alternative 3, ribbongrass and other rhizomatous riparian plant species are likely to continue spreading.

Riparian invasive plant species out compete native riparian species that occupy the narrow wet margins of rivers and streams, such as swaying bulrush (*Scirpus subterminalis).* 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, pers. comm.). 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-foot buffer may be successful if populations are small and easily accessible, the soil is not compacted, and roots can easily be pulled so that all pieces of rhizomes are removed. 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.

Herbicides are not allowed within 10 feet of streams; therefore, one known site of Himalayan blackberry can be expected to aggressively expand due to its ability to grow quickly from abundant rhizomes. 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. Triclopyr, a selective systemic herbicide used to treat woody and broadleaf species, especially root- or stem-sprouting species (Appendix C), is the preferred herbicide for treating Himalayan blackberry (Appendix B). Alternative 3 does not allow the use of triclopyr BEE within 300 feet of riparian areas. Aquatic Triclopyr TEA can be spot-sprayed up to 15 feet of perennial water or hand-applied up to 10 feet from perennial water. Our one known site of Himalayan blackberry occurs on ~ 0.8 acre along Cottonwood Creek on Paulina District, growing approximately 50 feet or less from this perennial creek. 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 feet diameter in 2002, and eight "daughter" plants formed in 2004 (Mafera 2006, pers. comm.).

Under Alternative 3, manual treatment would be the available option within 10 feet of perennial water. 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 the ability to effectively treat it manually.

As with Alternative 2, many of the sites proposed for herbicide treatment under Alternative 3 contain little or no biological crusts as a result of mechanical disturbance or the soil type present. Biological 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. Since the project proposes to treat invasive plants in favor of native species, conditions more conducive to the development of biological crusts are likely to develop on treated sites. PDFs would provide protection to biological soil crusts from the effects of herbicides and there would be no or minimal effects to biological soil crusts.

Effects to Sensitive Plants

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 and it would take longer to control invasive plant infestation and may not be possible in some situations. As discussed earlier in Alternatives 1 and 2, two Project Area Units 15-10 and 72-50 were selected for comparison purposes to represent how the alternatives differ in treating invasive plants that occur with sensitive plants (see more detail in the Botany Report, Appendix H).

In both PAUs, Alternative 3 would control invasive plants more quickly than Alternative 1 but not as quickly as Alternative 2 because treatment options are limited to manual treatments within 10 feet of water which can reduce treatment effectiveness, depending on the invasive plant species and size of infestation. Even for taprooted species that can be effectively hand-pulled, it could take longer to control large infestations that occur in riparian areas under Alternative 3 than under Alternative 2. In the year 2014 there would be 1.0 acres left in Alternative 3 in PAU 15-01 compared to 0.1 acres in Alternative 2. Similarly, there would be more acres remaining in PAU 72-50 as a result of implementing Alternative 3: 2.7 acres compared to 0.03 acres estimated under Alternative 2.

Table 35 summarizes the effects analysis for sensitive plants. Alternative 3 would result in a beneficial impact for sensitive plant species and their habitat as invasive plants are controlled (*see notes in table heading*). For the majority of sensitive plants, Alternative 3 would result in No Impact or "*MIIH***"from herbicide application *(see notes in the heading of Table 35).* PDFs would minimize or eliminate effects of herbicides to sensitive plants but an effects determination of MIIH is given as a conservative approach due to remaining uncertainty because the priority herbicide could cause some plant damage if it were to inadvertently contact a sensitive plant. Alternative 3 would not result in a loss of viability of sensitive plants nor cause a trend toward federal listing, but would protect sensitive plants and their habitat from invasive plants.

The same PDFs apply for both Alternatives 2 and 3 (Table 34). 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 Survey and Manage) 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 treatments be designed 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, site-specific project design (e.g., application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) would be developed for applying herbicide treatments near sensitive plants.

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. If an herbicide has the potential to impact a sensitive plant, then PDFs listed in Chapter 2 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. However, no substantial effects to sensitive plant populations are expected from herbicides. There are many sensitive plant populations that are not near invasive plants and no population is expected to decline from the use of herbicides. There could be damage to some individual plants if herbicide inadvertently came into contact with a plant, but this would be short-term (1-5 years). 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 have short term impacts but would not result in a loss of viability of the species because protection measures, such as PDFs, are designed to ensure that protection of sensitive plants and their habitats from invasive plant treatments. Using control methods other than herbicides would be less effective, therefore would take longer to contain or control, if at all. 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 sensitive plants that would be affected are:
   a. Swaying bulrush (*Schoenoplectus subterminalis*) occurs along the Davis Lake shoreline on Crescent District, where reed canarygrass and Canada thistle occur.
   b. Lesser bladderwort (*Utricularia minor*) and a liverwort (*Tritomaria exsectiformis*) occur in Trout Creek Swamp, Sisters District; reed canarygrass occurs throughout the wetland. These sensitive plants occur in areas where the water table is high and there is standing water.
2. **In some situations, a reduced ability to control non-rhizomatous invasive species that occur within the 10-foot zone.** For example, Peck's penstemon occurs in wet swales 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 PAU 15-01, intermittent channels dissect the area. At this site, hand-pulling methods would continue to result in expansion of knapweed within the riparian area. This site has been hand treated for many years with little density reduction and an expansion of the perimeter.

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 feet 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.

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. 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 moonwort (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.

Effects to Survey and Manage Plants

As with sensitive plants, controlling invasive plants ultimately protects native plant habitats and biological diversity, which benefits rare 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 Survey and Manage plants (Table 38 *and see discussion for Survey and Manage plants under Alternative 2*).

Although there are Survey and Manage plants that have likely not been discovered (e.g., fungi species do not fruit every year), 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 plants. Alternative 3's broadcast spray restrictions within 300 feet of water may reduce potential impacts to non-target Survey and Manage plant species and/or host plants that occur in this zone.

Within the 10 foot no-herbicide zone, there are no known rare plant sites threatened by rhizomatous invasive riparian plant species (e.g., reed canarygrass or ribbongrass). Potential habitat exists in this zone for *Tritomaria exsectiformis* and *Marsupella emarginata* var. *aquatica*. 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.

Table 38 summarizes the effects evaluation for Survey and Manage plant species. Alternative 3 would result in No Impact or "MIIH**" (see notes below Table 38). PDFs would minimize or eliminate effects of herbicides to Survey and Manage plants but an effects determination of MIIH is given as a conservative approach due to remaining uncertainty because the first priority herbicide could cause some plant damage if it were to inadvertently contact a rare plant or the mycelium of a fungus. Alternative 3 would not result in a loss of viability of Survey and Manage plants, but, rather, would protect Survey and Manage plants and their habitat from invasive plants in the long-term (5+ years).

Alternative 3 would not result in adverse impacts to these Survey and Manage species, including fungi, bryophytes, and lichen populations or habitats because PDFs are tailored to protect non-target vegetation. For example, PDF 5 is designed to protect non-target vegetation. PDFs 9 and 16 minimize off-site drift, reducing potential inadvertent contamination of fungi, bryophytes and lichens. Additional PDFs, such as 12, 13, 15, and 16 protect non-target vegetation by reducing the potential for run-off or drift of herbicides. The Soils analysis determined that PDFs 9-17 and 45-47 minimize the effects of herbicides on the soil resources, which provides protection to fungal mycelium. PDFs 63-71 are designed to ensure protection of known populations of sensitive and Survey and Manage plant species. Other layers of caution, such as Forest Invasive Plant Standards and herbicide label restrictions, would be incorporated into planning and implementing treatments and provide added layers of protection. Known sites of these species would be identified in implementation planning and appropriate PDFs identified and implemented. Potential impacts to Survey and Manage plants are expected to be minimal (i.e., reduced the lowest extent possible) or eliminated because changes in species distribution or loss of habitat are not expected. Controlling invasive plants would have a beneficial effect for these species by maintaining habitat diversity and microclimatic conditions.

Summary of Effects to Non-target Vegetation for Alternative 3

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 a high level of protection to non-target plants from invasive plants.***
    - Reduces the percent of infested acres remaining in Year 2014 compared to Alternative 1, yet results in a higher percent of infested riparian acres than Alternative 2.
    - An Early Detection/Rapid Response Strategy allows quick response to treat 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.
    - 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.
    - 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.
- ***The effects of herbicides on non-target plants is minimized or eliminated.***
    - Less than 1% of Forest Service land would be treated with herbicides (0.62% upland and 0.01% riparian acres).

- Effects to non-target plants are minimized or eliminated by incorporating PDFs and other layers of caution.
- More selective herbicides provide options to reduce the risk to non-target plants.
- Even with all these protective measures in place, there could be inadvertent damage to individual non-target plants from herbicides. However, there would be no changes in species distribution or loss of habitat for non-target plants, and sensitive and Survey and Manage plants (including fungi, bryophytes, and lichens) from the use of herbicides.

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 FSEIS exists, if there is a condition outside the effects of this FSEIS, new NEPA would be required. If not, the team will identify the preferred method of treatment and determine if these methods are within the scope of the analysis of this FSEIS. For each site, applicable PDFs will be identified so they can be adhered to during treatment implementation.

The annual implementation planning process will identify areas that need botanical surveys for sensitive and Survey and Manage plants prior to treatments and will identify new sites found since this analysis was conducted (PDFs 63, 63.1, 63.2). Applicable PDFs will be identified for all new sensitive and Survey & Manage plant sites. The most current management recommendations for these species would be consulted and incorporated into the planning process to manage known sites.

The EDRR strategy increases treatment effectiveness. 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 to Non-Target Vegetation

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. The overall basis of cumulative effects can be found in Section 3.1.3. 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.

Chapter 3.3 discusses how effective treatments on National Forest System land would help reduce the potential for invasives to spread to adjacent lands of other ownerships. Conversely, effective treatments on adjacent lands of other ownerships would also reduce the potential for spread onto Forest System land. To the degree that each alternative inhibits effective treatment, invasive plants would continue to threaten non-target vegetation on and off national forest. Many sensitive and Survey and Manage 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 (the R6 2005 ROD requires invasive plant prevention on grazing allotments). See Appendix G for examples of how prevention measures change grazing practices. This would improve conditions for Peck's mariposa lily in the long-term.

The release or re-distribution of biological control agents on National Forest System lands and adjacent lands by the Oregon Department of Agriculture (ODA), as analyzed by Animal Plant Health Inspection Service (APHIS), will continue to reduce the invasive plant infestations and decrease the spread of some species of invasive plants. Biocontrol agents would cross land ownership boundaries in all alternatives. APHIS approves all biological control agents into the United States. A Technical Advisory Group assists APHIS officials in the testing and approval process. This FSEIS tiers to the R6 2005 FEIS, see pp 3-83 to 85, and its Appendix J for more detail on the APHIS testing procedure. Once the control agent is approved and established, re-distribution of the agent is done by ODA. The time frame for controlling invasives using biocontrols is very long, and agents are expected to spread throughout the forest and other ownerships, wherever food sources are available. Despite review and approval by APHIS, there is a slight risk that an approved agent released by ODA or the Forest Service may unintentionally affect native plants. Due to the long timeframes and slow changes associated with biocontrol success, there are no cumulative effects expected from an overlap in time or space from other activities.

The 18 Fire Competing Vegetation Management project (U.S. Forest Service 2006c) approved the use of spot herbicide treatments of grasses and shrubs using the herbicide hexazinone. 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 can also be treated in the 18 Fire project, providing a beneficial effect by reducing this invasive species. There are PAUs for invasive plant treatments that are proposed within the 18 Fire, which may occur in the same year as hexazinone application for competing vegetation control. Hexazinone use is not proposed for invasive plant control, so target plants are different, there will be no overlap with existing PAUs, and treatment caps would not be exceeded.

Both the Ochoco and Deschutes National Forests have completed limited treatments of invasive plants with herbicides after fire disturbance using the Burned Area Emergency Rehabilitation (BAER) authority. The amount of herbicide control using this authority is limited because generally invasive plant infestations are introduced several years after the BAER authority. There have been cases where an existing infestation burned and responded with rapid expansion. For example, a one-half acre Canada thistle infestation burned during the 747 Fire on the Paulina Ranger District in 2005. Three days later, all rhizomes sprouted new plants. These were controlled when in the seedling stage, and by the next spring, the infested area was completely recovered with native vegetation (Mafera 2007 pers.

comm.). BAER treatments are infrequent and would not result in a cumulative effect when added to other herbicide control proposed, due to the limited extent of use.

The Travel Management Project ROD (2011) prohibits motorized cross-country travel outside of existing designated routes (roads and trails) on 99% of the project area. In addition most of the project area is closed to dispersed camping (74% on the Deschutes and 83% on the Ochoco/Grassland). Existing designated routes remain open for motorized use. This project is beneficial overall in reducing the risk of invasive plant introduction, by prohibiting off-road vehicle travel across most of the Forests. The designated routes and areas that would be open to motorized use and dispersed camping would continue to introduce and spread invasive plants as is happening at present, as would the future site specific OHV projects planned on the Deschutes and Ochoco Forests.

Site specific OHV projects designating new trail systems are planned on the Deschutes and Ochoco Forests (Three Trails, Lava Rocks and Ochoco Summit). These three projects propose new trails designated for motorcycles, ATVs and jeeps, and improvements to handle increased use (Three Trails is currently in the implementation stage). It is expected that despite prevention measures, invasive plants would be introduced through concentrated use. The frequency and density of weed introduction is expected to increase in these areas due to an expected increase in the number of riders from across Oregon, and neighboring states. Native vegetation adjacent to trails, trailheads, play areas and associated camping areas would be impacted from trampling, dust, and changes in plant composition with the increase of invasive plants.

Three Trails OHV project is being implemented. Foreseeable actions were reviewed that are ground disturbing and have the potential to contribute to an incremental effect when combined with the Three Trails OHV project. All past and present activities have been accounted for in the existing weed population discussion for this project. Foreseeable actions include the Rim-Paunina project. The origin of most invasive plants in the analysis area can be found along most major highways, and the Crescent Ranger District has successfully managed a prevention program through monitoring and rapid response through handpulling. There is no indication the Three Trails OHV project and additive effects from past, present, and foreseeable actions would change this success.

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 would be very limited in temporal and spatial scales, occurring only in the immediate vicinity of the invasive plants treated. Also, the PDF and buffers minimize the amount of herbicide exposure possible and eliminate scenarios where concentration of herbicide could affect population levels.

The analysis assumes that possible repeated treatments within the same season do not overlap in time or space, or result in a cumulative effect. If repeated treatments are necessary it is usually a result of missed plants during the first herbicide application. In this instance a second herbicide application would not overlap spatially or in time.

The 18 Fire Competing Vegetation Management project (U.S. Forest Service 2006c) included herbicide use that continues in the project area. This project is having an overall beneficial impact on tree growth by reducing competing vegetation and increasing the vigor of desirable native species. The project identified potential impacts on green-tinged paintbrush, yet no plants were located by field surveys

within the project area. There are no sensitive plants growing in a medusahead site within a rock pit that was approved for treating with herbicides under the 2006 project (ibid). Thus, there are not likely to be significant cumulative adverse effects to sensitive plants, or other native vegetation from this project combined with the 2006 project, or any other foreseeable future activity.

See a further discussion of cumulative effects of herbicide use on adjacent lands under Section 3.1.3. The R6 2005 FEIS estimated 3 percent of the herbicide use within Oregon and Washington is on Forest System land (p. 4-1). Further narrowing that to the proposed use on the Deschutes, Ochoco and Grassland, along with the layers of caution integrated for herbicide use (see Figure 5) is not expected to have an adverse incremental impact to native vegetation.

Section 3.1.3 also lists foreseeable future projects that have the potential to introduce and spread invasive plants. Vegetation management projects involving timber harvest (eg. Jackson, Popper, EXF) result in bare ground from landings and skid trails. Bare ground creates a susceptible seed bed for invasive plant establishment. Project design features will be developed for those projects that help prevent establishment of invasive plants, such as revegetating skid trails and landings to provide competition to invasive plants and improve site productivity. Despite prevention measures, invasive plants may be introduced; the EDRR strategy included in this FSEIS would allow control of infestations when they are small and more effectively controlled, and less likely to cumulatively increase effects. Invasive plants tend to appear a couple years after the disturbance, so there is no time overlap between the timber harvest and fuels treatments, and invasive plant control.

In summary, there would be no cumulative effects to non-target plants (including sensitive and Survey and Manage species) from invasive plant treatments.

3.5 Soils

Introduction

Scope of the Analysis

The Deschutes, Ochoco and Crooked River Grasslands Invasive Plant Treatments FSEIS include a variety of methods to treat invasive plants that have the potential to affect 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. See Appendix F for a description of the EDRR protocol.

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 FSEIS (Figure 5). 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 2005 FEIS analysis area. This analysis tiers to the R6 2005 FEIS. The incorporation of all of these layers into the planning and implementation of the FSEIS would reduce the risks and effects of herbicide applications on the soil resource and maintain them within those described under the R6 2005 FEIS. See the risk reduction

framework description at the beginning of Chapter 3 in Section 3.2. The Soils Specialist Report is incorporated by reference in its entirety.

Analysis Assumptions

The effects of herbicide treatments and manual treatments described in the R6 2005 FEIS Chapter 4 (and discussed in R6 2005 FEIS Appendix J) 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, 2004 and 2011). 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.

The extent and duration of effects to the soil resource from herbicide applications proposed under this FSEIS 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 FSEIS are within the bounds described in the R6 2005 FEIS and the pathways and transformations of herbicides proposed for application are not expected to be outside of those described in the R6 2005 FEIS. However, differences in characteristics of soils located on the Deschutes and with those on the Ochoco and Crooked River Grassland 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 2005 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.

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. See the Water Resources Affected Environment section 3.6.1 for a discussion of geology and groundwater.

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).

Project Area Units

Project Area Units (PAUs) are potential treatment areas under this FSEIS that were designated around known Invasive Plant sites across both Forests and the Grassland. 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 National Forest. 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, road maintenance, 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 invasive plants are removed and physical conditions at the site are actively or passively rehabilitated to allow more desirable native individuals to populate the site. 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 colonized 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 spread of reed canarygrass following its introduction as a forage species.

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 the Soils 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 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 the primary invasive species associated with riparian areas on the Deschutes NF. 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). Invasive vegetation can also negatively affect biotic crusts by increasing cover on soils in which they occur (Belknap et al. 2001).

- **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

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 2005 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 2005 FEIS 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 FSEIS (section 2.4) 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 2005 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 FSEIS 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 (PDFs 45-47); and those that limit the amount of herbicide residue applied to the environment through appropriate application rates and methods (PDFs 9-17, 54).

Alternative 1 – No Action

Current use of select herbicides (dicamba, picloram, glyphosate, and triclopyr) 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 (USDA Forest Service 1998a), and on specific sites analyzed in the Integrated Weed Management Environmental Assessment and Decision Notice (USDA Forest Service 1995) and Integrated Noxious Weed Management Environmental Analysis and Decision Notice (USDA Forest Service 1998b) for the Ochoco National Forest and Crooked River National Grasslands. Table 39 includes the extent of acres currently applied with herbicides annually under these decisions.

Table 39. 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 and Indirect Effects

The effects of herbicide applications were analyzed for the soil resource in the previously mentioned NEPA documents (USDA Forest Service, 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 effects on soil productivity have been observed; sites are occupied with native vegetation (Langland; pers. comm.). 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 J) 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, pers. comm.).

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 water.

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 herbicide treatment of sites additional to those already approved under existing NEPA documents would occur, and the effects of manual treatment is negligible. Although herbicide applications could occur where new populations were observed between previously treated populations along road corridor sites, the treatment of these sites would cause negligible overlap accumulation of herbicide residues on the previously treated areas. In addition the amount applied annually on all individual sites would be expected to decrease in successive years at rates similar to those reported under the current working agreement, primarily as a result of observed herbicide effectiveness (Langland, pers. comm.).

The acres of soil occupied by invasive plants would increase each year at a continued rate of spread due to physical limitations of manual treatments, potentially reaching 13,500 acres in five years, despite thirteen years of treatment under existing NEPA (see Section 3.3). In addition, grazing, timber harvest, OHV use and other recreational activities would continue to introduce invasive plants into the Grassland and the Ochoco and Deschutes National Forests. Vectors associated with OHVs are expected to change as a result of implementing the Travel Management EIS across the National Forest land. The Travel Management decision eliminates cross country travel of OHVs and designates their use on existing roads and trails, thereby reducing the extent over which OHVs could directly transport and deposit invasive plant seeds (USDA Forest Service 2011c). Other foreseeable Travel Management decisions include the designation of new OHV trails under the Ochoco Summit and Lava Rock OHV projects in areas where existing OHV activity level varies, and where new invasive plant populations could be created. However, EDRR management of new populations would be able to treat the spread of new invasive populations in these areas quickly. Also the overall surface extent of the soil resource dedicated to trail tread as disturbed ground is a very small percentage of the landscape. As a result, the cumulative effect of these projects on soil productivity is expected to be minimal.

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 FSEIS 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 covered in the SERA risk assessments. Thus, effects of herbicide treatments to the soil resource are expected to be within the scope of those described in the risk assessments. 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 Plants FSEIS, 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 to the R6 2005 FEIS. 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) 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 and 5).

Extent of Herbicide Application

Total annual applications of herbicides are bounded by treatment caps and also 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), and this maximum acreage is used for this analysis. New populations identified under Early Detection Rapid Response (EDRR), could add acres of treatment, although this would be limited to 10% or less of the current extent of inventoried populations within any 6th field subwatershed due to treatment caps described in Chapter 2. 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 Forest Service 2005a). PDFs are included in the document to use the lowest effective application rate for each herbicide and all proposed application rates under this FSEIS 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 the higher application rate listed in Table 12 to effectively treat the site (Langland, pers. comm.). However, application rates and location are regulated by PDFs 12, 46, 47, 56, and 67 on sensitive sites such as riparian areas and shallow soils.

Table 40 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 located in the project file and are incorporated by reference (Sussman 2012). The "low" rating displayed in Table 40 is a qualitative rating specific to the toxicity of herbicide residues to soil microbes in the laboratory environment. Herbicides in the low category required concentrations higher than those possible under allowable application rates before adverse effects to soil microbes were observed and showed limited reductions of microbial growth at concentrations representative of application rates proposed in the FSEIS and (USDA Forest Service 2005a). 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 FSEIS 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 40. General research findings of 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 to moderate)	Soil microbes 25 to 180 days	acetolactate synthesis inhibitor (Uptake by roots & leaves; active in soil as pre-emergent)
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 FSEIS 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 and Indirect Effects of Herbicide Treatments- Alternative 2

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. Herbicide treatments proposed under this FSEIS were analyzed under the R6 2005 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 FSEIS 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 PDFs 9-17 and 45-47.

Soil Microbes

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 potential effects on soil microbes are summarized in a comprehensive risk rating of toxicity for each herbicide displayed in Table 40. The risk rating of toxicity comes from information on the product labels and the SERA Risk Assessments referenced in the R6 2005 FEIS. The relative toxicity to soil microbes is a qualitative rating specific to the toxicity of herbicide residues to soil microbes in the laboratory environment. These are 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 Forest Service 2005a).

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. Approximately 993 acres, 4,783 acres, and 402 acres are proposed respectively (Table 9). 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 (R6 2005 FEIS). 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. Specifically, PDFs 46 and 47 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 short-term effects of triclopyr, imazapyr and sulfometuron methyl on ectomycorrhizal formations in soils treated with these herbicides included no alteration of the capabilities of mycorrhizal fungi to infect roots, even at concentrations detrimental to seedling growth (Busse 2003).

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 40. 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 40.

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. However, evidence from research on the effects of residues produced by typical application rates shows minimal effects to soil microbes under field conditions. Effects that have been identified are generally not measurable by quantified losses of microorganisms in the soil environment (Busse et al. 2001). Although laboratory research shows direct toxicity of most herbicides to soil microbes when applied at increasingly higher concentrations in solution (Estok et al. 1989; Chakravarty 1987; El-ghamry et al. 2000), direct effects on growth rates of microbes do not appear to be significant until concentrations higher than those possible under allowable application rates (Estok et al. 1989; Chakravarty 1987). Changes to microbial and fungal populations from herbicides applied at rates proposed in the FSEIS are likely to be transitory (Roslycky 1982; Tu 1994), and do not appear to inhibit the long term health of microbial populations in the soil (Tu et al. 2001) or the productivity of treated sites (Ratcliff 2006).

Direct effects to soil microbes can also be alluded to by changes to the productivity of a site since the productivity of a soil is often reflected by the continued presence of microbial populations and growth of vegetation on site. Local research appears to support the continued presence of microbes on site (Busse et al. 2001) and the continued growth of vegetation following herbicide applications. Research of tree growth response to herbicide treatments on ponderosa pine sites located at Pringle Falls on the Bend District of the Deschutes National Forest supports continued productivity of treated sites years after applications (Zhang et al. 2006). Seven year data from research plots treated with hexazinone to reduce grass and shrub competition with planted conifers on the Fort Rock District of the Deschutes National Forest indicates continued growth of conifers on these sites in excess of control plots or those treated with manual coverings (Fitzgerald 2009).

Soil Productivity

None of the herbicides under consideration for use has been shown to have a notable effect on soil productivity. 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, pers. comm.). 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 2006 pers. comm.), 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. PDFs 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. This group of herbicides is unlikely to directly affect soil microbes to a measurable degree. 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). Regardless of the rating shown in Table 40, the direct effects on microorganisms from all herbicides proposed for use is likely to be very low following the application of herbicides. Typical application rates of herbicides proposed for use under this decision have been measured to result in initial concentrations on the forest floor below those identified in research as causing significant reductions of growth in the laboratory environment (Estok et al. 1989; Chakravarty 1987). Concentrations likely to “reach” microorganisms in the soil would be even less for soil activated herbicide residues due to further dilution in soil solution before mycelium were able to adsorb or absorb herbicide residues. As a result, the indirect effects on soil integrity, productivity, fertility, and living microorganisms are likely to be negligible

Herbicide Degradation

PDFs are included in the FSEIS 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 41 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 40, 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 40. 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 less than 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 less than 5%) in the mineral soil.

Conditions provided by local soils are also sufficient to degrade herbicide residues at rates listed in Table 40. 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, pers. comm.). 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 regimes which generally warm to levels conducive to vegetative growth and microbial activity by April or May and remain at these levels well into October. This length of microbial activity is expected to be sufficient for the degradation of herbicide residues on treated sites. 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 FSEIS that limit application rates of applied herbicides and require weather conditions be monitored prior to application (PDFs 12 and 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 FSEIS 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, clopyralid and metsulfuron methyl in clay soils, picloram in coarse textured soils, and sulfometuron methyl in both clay and loam soils immediately after application and 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 SERA risk assessments. Although the organic matter content of these soils is relatively low, 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.

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. 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. 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. See Section 3.6.1 for a discussion on groundwater. Although soils with coarse surface textures (class 3) generally have moderate to high percolation rates conducive to this transport, the pumiceous ash soils prevalent on the Deschutes have a comparatively high moisture holding capacity for this texture class. The many vesicles present in the mineral soil colloids reduces the amount and rate at which soil water moves downward through the profile which 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). However, more soluble herbicides such as picloram, clopyralid and metsulfuron methyl have been identified with a higher risk of movement into groundwater on coarse textured soils with seasonal water tables. To alleviate this risk, PDF 45 prohibits the use of metsulfuron methyl, clopyralid and picloram on coarse textured soils with high seasonal water tables. Upland soils with seasonal water tables and riparian soils have been identified 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).

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 of the soils report. 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 41). Soils with moderate erosion hazard ratings are considered to have a low risk of transporting herbicide residues as a result of surface erosion. PAUs that include soils with moderate erosion hazard ratings total 809 acres and are summarized in Appendix C of the Soils Report and Appendix A of the FSEIS.

Table 41. Deschutes PAUs with high and high/moderate soil erosion hazards

PAU Numbers	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 SERA Risk Assessments.

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 42). Herbicides recognized to be mobile in clay soils, such as picloram, chlorsulfuron and sulfometuron methyl, are restricted from use in these locations if surface waters are at risk of receiving overland flows from these sites (PDF 47). Treatment of invasives on these sites should be substituted with herbicides such as glyphosate or imazapic.

Table 42. Ochoco PAUs with fine textured surface soils

PAU No.	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 of the soils report.

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 for the 50 PAUs identified with soils having a high erosion hazard rating, totaling 666 acres, and slightly less for the 61 PAUs with moderate to high erosion hazard ratings, totaling 29 acres (see Appendix C of the Soils Report). The 87 PAUs containing soils with moderate erosion hazard ratings, totaling 3,914 acres, have a much lower risk of erosional transport of soil containing herbicide residues.

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 (Table 15). Total amounts of herbicide applied on these sites would be reduced 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 through the walls of roots (root exudation) appears to be minimal. Studies of the effects of glyphosate on root exudation from treated plants appear to show the release of exudates 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). Residues exuded from Canada thistle or Phalaris species being treated on soils associated with emergent vegetation are likely to become solubilized or adsorbed by organic matter due to the thick organic root mass and thatch provided by the rhizomatous vegetation on these sites. Although microbial degradation is limited in these conditions, the adsorption of the residues to organic matter and aggraded mineral soil 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 be 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 and 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 in the profile. Potential amounts concentrated in soil solution that could reach groundwater sources or adjacent water bodies are likely to be small due to the high organic matter content in riparian soils that provides cation exchange sites capable of adsorbing herbicide residues in solution. The presence of water in the soil profile would also further reduce the concentration of herbicide residues that were not adsorbed on organic matter and soil colloid sites, or not absorbed by targeted plant roots. Concentrations predicted in surface waters immediately adjacent to application sites by the GLEAMs model were found to be well below levels toxic to fish when using conservatively high assumptions of runoff and mobility (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. Field 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 were made in the summer of 2009 and summarized in a 2011 monitoring report (Sussmann 2011).

Herbicide treatment of *Phalaris* sites proposed for treatment under this FSEIS 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 2005 ROD).

Other Invasive Species: Nearly all of the other invasive species targeted under this FSEIS 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 40 because of the soil CECs and the adsorption rate of the herbicides.

The risk of erosion in riparian soils is low due to relatively thick root masses and high vegetative cover. Although treated areas would see a short term (usually one growing season in riparian areas) 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.

Ochoco NF and Grasslands: The primary target species located on riparian sites on the Ochoco and Grasslands 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. Twenty-two PAUs located on the Ochoco contain mapped invasive sites on riparian soils.

A total of 7.5 acres of PAUs were identified on SRI map units A12 and A2, which represent streamside floodplains and wet to dry terrace/meadow soils associated with drainages. 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 generally do not have 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.

A total of 15 acres of PAUs were identified in SRI map units M13 & M2, which represent wet, moist and dry meadow sites overlying different bedrock types. 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 provides sites for adsorption. This reduces the risk of downward mobility of these herbicides into groundwater and subsequently to streams. However, site specific assessments may be needed on these soil types at the time of treatment in order to identify the need for choosing an alternative herbicide that is less mobile in clay soils.

Direct and Indirect Effects of Manual and Mechanical Treatments- Alternative 2

The majority of manual treatments proposed would occur as the pulling or wrenching of annual and biennial 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 effects from these treatments on the soil resource would be similar. See Table 5 and the summary of treatments within the PAUs (Appendix A) for proposed manual treatments.

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 subsequent growing seasons as natural or active re-vegetation increases cover on these sites. Potential erosion losses from treated areas in the short-term are not expected to compromise the productivity of the soil, as indicated by continued re-growth of both invasive and native plants on manually treated sites across the forest (Pajutee, pers. comm.).

Erosion that occurs on upland sites located within 100 feet of surface waters could contribute sediment to stream channels or lakes in the near term during rainfall events strong enough to exceed the infiltration rates of the soil. Although low, the risk of sediment transport would be directly related to the

existing condition of the surface organic and vegetation cover and is expected to decrease as cover of native vegetation increases on these sites. Overall, these areas would be expected to produce a negligible amount of sediment in surface waters due to their small total surface area within any given watershed. 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 currently exceed 80%.

***Phalaris* species:** Manual pulling is included as a treatment option for reed canarygrass or ribbongrass (*Phalaris* species) under Alternative 2 along with chemical control. Small sites across the project area where pulling may be somewhat effective include islands and large wood in the Metolius River, the edges of stream channels below bankfull rooted in loose cobble, and the edges of lakes below high water marks. These sites are generally seasonally saturated and comprised nearly entirely of *Phalaris* roots and thatch that are rooted in depositional substrates. See the description under Alternative 3 for more detailed effects of pulling emergent species.

Phalaris sites may also be treated with a method called soil solarization. Approximately 2.74 infested acres of *Phalaris* in Big Marsh are proposed for this treatment under both action alternatives. 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 in the Metolius Basin effectively reduced the presence of *Phalaris* but allowed it to grow out from the edges of the tarp (Sussmann 2011).

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 FSEIS on approximately 149 project area acres (about 14 net acres) within three plantations on the Paulina District of the Ochoco NF (PAUs 72-15 and 72-37). These areas are currently impacted as a result of past harvest operations and a hot site-prep burn, 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 to 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-foot buffer of non-treatment between the channel and an existing, parallel skid trail would not be harrowed to reduce the energies of potential overland flows and help filter out a portion of the sediment before reaching the channel (see Table 14). 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 could transport sediment to the intermittent channel until a vegetative component sprouted and grew from the planted seeds during the following growing season.

Direct and Indirect Effects of Herbicide Treatments- Alternative 2

Physical Transport of Residues on Soil Particles

Indirect effects of proposed treatments include the physical transport of herbicide residues adsorbed to soil colloids from treated sites by wind or water erosion. This transport is most likely to occur during the initial half-life of an applied herbicide on soils susceptible to these mechanisms. Herbicides proposed for use under this decision have varying degrees of risk related to physical transport. The herbicides in the sulfonylurea chemical family have been identified in SERA risk assessments as having an elevated risk from off-site movement by rainfall and erosion mechanisms, primarily due to direct effects to non-target plants from comparatively small doses.

The level of risk for transport following application is determined primarily by the erosion hazard of the soil type on which treatments occur. The erosion hazard identified in the Soils Resource Inventory (SRI) takes into account factors of slope gradient, slope length and the particle size characteristics of the surface mineral soil. PAUs containing soils with moderate, moderate to high or high erosion hazards for the Deschutes, Ochoco and Grasslands are identified in Appendix C of the Soil Resource Report. Soils with moderate-high and high erosion hazard ratings have been identified as having the highest potential for contributing 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 rates capable of contributing measurable amounts to adjacent surface waters. However, non-target species could be at risk from this type of transport, especially from residues in the sulfonylurea chemical family.

Off-site Transport of Residues in Solution

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 FSEIS has a different solubility in water and adsorption rate to soil and organic matter (Table 40). 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, and 30 acres are located within the 3-foot boundary designating class IV stream channels. All of 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. Approximately 260 of these acres are located within 10 feet of streams that would not be treated under Alternative 3 (see Fisheries Report).

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, which are primarily present on the Ochoco and Grasslands as scabland soils that are shallow and relatively unproductive. Research on the mobility of sulfometuron methyl is limited, although one study measured movement to greater than 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 more likely 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). Application of sulfometuron methyl, picloram and chlorsulfuron has been restricted on soils with high clay content where runoff from storm waters could reach surface waters (PDF 47). Risks for this type of transport are also reduced as a result of application methods and rates that would minimize the amount of excess herbicide residue present following application and uptake by targeted plants. Ochoco soil types with these conditions include SRI map units E8, G1-3, G7, J0, J2, J3, L3, L7, S1, T5 and X9.

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 there is a risk of offsite movement of herbicide residues from these sites, 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.

Clopyralid, picloram, and metsulfuron methyl have the highest risk of movement through the soil profile during their first half-life period. The half lifes of these herbicides are listed in Table 40 and describe the length of time it takes for 50% of the existing residue to degrade into benign byproducts. 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 restricts the application of these herbicides on coarse textured soils in order to minimize the potential for groundwater or surface water contamination. Although numerous soil types on the Deschutes have coarse textures that could enhance this movement, 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 of the soils report.

The treatment of sites located in or immediately adjacent to roadside ditches also have a risk to transport herbicide residues. Soil types and organic matter within these ditches vary across the two Forest and grasslands areas in terms of their ability to adsorb residues and promote their degradation via microbial hydroloysis or solar breakdown. Regardless of soil type, residues in these areas would be susceptible to dissolution into waters accumulated during initial storms following application for a period of time before the residues degraded into more benign forms. The risk of this transport has been reduced because of requirements to monitor weather reports for potential rainfall ahead of application (PDF 17). Additionally, herbicides with an elevated aquatic risk are excluded from broadcast application to approximately 380 miles of road within or adjacent to RHCAs that have a high risk of delivery to water (PDF 43.1)

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 in the months following treatment 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 after treatment 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 at varying rates as organic matter during the first years following treatment. Medusahead in particular breaks down more slowly due to high silica content and creates a thick mat of material on the soil surface. 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 during the first growing season following treatment, 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 discussed previously, 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, especially those along major road shoulders that are comprised of coarse material less conducive to natural re-growth. Although any delays on these areas are expected to be limited to the first growing season after treatment, 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 2 and Appendix F. 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. All EDRR treatments would follow PDFs included in this FSEIS and would include annual limitations on the amount of treatments within 6th field watersheds for uplands (less than 10% of inventoried populations), within the aquatic influence zone (less than 10 acres), and below bankfull or high water marks of surface waters (less than 1.0 acre) (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 outside of PAUs would be assessed in an implementation process (Appendix F) to ascertain whether conditions fall within the parameters of this analysis. These sites will be assessed through an inter-disciplinary team to determine whether additional NEPA is required.

Cumulative Effects of Alternative 2

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 many 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 3.1.2 Treatment assumptions and scenarios). Total amounts of herbicide applied by Deschutes County employees on Deschutes NF sites currently approved for herbicide application have progressively 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 FSEIS 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 nationwide is less than 1 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. PDF 6 requires the Forest Service to collaborate treatments with adjacent landowners to limit the potential effect.

Reasonably Foreseeable Actions: Most forest or riparian sites proposed for treatment will have treatment and monitoring of invasive populations extended through the short term of 1 to 5 years depending on the size of the infestation and persistence of the seed bank. Foreseeable management activities on these sites are likely limited and minimal, except for the possibility of prescribed burns, grazing, timber harvest, and wildfire suppression activities. Prescribed burns are not likely to incur detrimental impacts to the soil resource when conducted under acceptable moisture conditions. Although wildfire suppression activities could involve machine dozer traffic capable of detrimental impacts, suppression rehabilitation treatments occur to mitigate them as part of post-fire activities. As a result in direct detrimental disturbance to the incremental changes to soil productivity are compared to the existing condition of these sites, the cumulative effects to soils from herbicide applications proposed under this FSEIS are unlikely to incrementally change soil characteristics enough to alter the productivity of any treated sites. Activities between those activities proposed under this FSEIS and reasonably foreseeable actions are not likely to be additive to the impacts of any other activities.

Most of the proposed treatment areas are roadside sites, where the potential for cumulative forest activities is less. Road maintenance activities to maintain the road shoulders and drainage areas over the long term may occur on these sites in the future. Grading or re-shaping of roadside ditches connected to streams within the first year of herbicide treatments could expose soil particles with herbicide residues adsorbed to them and risk them being transported to streams during a susbsequent heavy rainfall event. However, concentrations of residues directly dissolved into runoff or streams are likely to be well below threshold levels for aquatic organisms as a result of PDFs that minimize initial concentrations, dilution within streams and the degradation of residues during the time since application.

Grazing, timber harvest, OHV use and other recreational activities would continue to introduce invasive plants into the Grasslands and the Ochoco and Deschutes National Forests. The overlap of grazing with treated sites could result in the direct trafficking of hooves on treated sites and reduce the recovery time of vegetative cover. This is most likely to occur on the Grasslands, where medusahead treatments are extensive and less so on the Ochoco and Deschutes. The Roba and Snowshoe allotments on the Ochoco do have extensive areas of houndstongue proposed for treatment. Although the impacts of this overlap are not likely to detrimentally affect the productivity of the soil resource enough to impede the return of vegetation, it could slow it enough to extend the risk of erosion and potential transport of herbicide

residues were it to occur. Vectors associated with OHVs are expected to change as a result of implementing the Travel Management EIS across the Grasslands and two National Forests. The Travel Management decision has eliminated most cross country travel of OHVs and designated their use on existing roads and trails, thereby reducing the extent over which OHVs could directly transport and deposit invasive plant seeds. Other foreseeable Travel Management decisions include the designation of new OHV trails under the Ochoco Summit and Lava Rock OHV projects in areas where existing OHV activity varies and new vectors could be created. However, EDRR management of new populations should be able to treat the spread of new invasive populations in these areas and the overall surface extent of the soil resource dedicated to trail tread as disturbed ground is a very small percentage of the landscape. As a result, the cumulative effect of these projects on soil productivity is expected to be minimal.

Under Alternative 2, the treatment of invasive plants on all sites would have cumulative effects under which soil productivity would be maintained. 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. Refer to Section 3.1.3 for more discussion on cumulative effects.

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 260 acres due to the changes in application methods adjacent to intermittent stream channels and restrictions of certain chemicals within 300 feet 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-foot width centered on the channel (30 acres) or within 10 feet of rivers, lakes, ponds, reservoirs, perennial or fish bearing streams, or flowing periods of intermittent streams (230 acres, for a total of 260 acres).
- Non-aquatic triclopyr, picloram, non-aquatic glyphosate, and sethoxydim would not be applied within the 300-foot buffers of perennial streams or lakes. (approximately 1,288 acres).
- Broadcast spraying would not be allowed within the 300-foot 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 exclude herbicide applications within a 3-foot strip centered on intermittent stream channels and a 10-foot buffer on either side of perennial stream channels, lakes and reservoirs. These restrictions would remove approximately 260 acres of invasive plant sites proposed for herbicide application in Alternative 2 from herbicide treatment under this alternative.

Manual treatments

The targeted invasive populations located in riparian Project Area Units (PAUs) would be manually treated under Alternative 3 on approximately 260 acres. Manual treatments would eliminate the risk of toxic effects to soil microbes from herbicide residues in these areas, although as discussed under Alternative 2, these risks are low. The risk of off-site transport of herbicide residues would also be eliminated from these sites, although as discussed under Alternative 2, this risk is low since soils within

this buffer include both riparian and upland types that are capable of adsorbing excess residues and promoting their degradation.

Manual treatments would have direct effects to the soil resource as those previously described under direct and indirect effects of manual treatments for upland areas and houndstongue populations under Alternative 2. These effects would primarily be 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 (260 acres out of 2.5 million in the project area) and would not be considered detrimental. Erosion risks would be slightly elevated until the next growing season on sites with active restoration of native or more desirable non-native species. Sites that are not actively restored are likely to be colonized by native or more desirable non-native species within the first few growing seasons.

***Phalaris* species**: Approximately 0.36 acres of ribbongrass on islands and .03 acres rooted on large wood would be manually pulled under Alternative 3. The effects of manual pulling on this type of site would be similar to those observed during a pulling trial of ribbon grass on a Metolius river island in the fall of 2008. A trial pull of ribbongrass rooted in the Metolius river channel with volunteers during the late summer of 2008 showed less efficiency. Approximately 60 sq ft of ribbongrass was removed in approximately 12 person/hours, a rate at which removing the population covering an acre would take a 10 person crew over 100 days. Another trial was done on smaller clumps during a demonstration project on private property in 2006. Fine sediment incorporated into the thatch and root mass was temporarily released into the water as the plants were loosened and pulled, although the flow of the river cleared soon after the disturbance. Broken rhizomes were also released, and measures to capture these with nets would be incorporated into the proposed operations under Alternative 3 (PDF 50). Although the treatment was relatively effective in removing the vegetative and root masses of the targeted plants rooted in the water, the amount of labor involved to pull and transport the plant and root masses from the islands is relatively high (Pajutee 2008). Root masses are voluminous and need to be transported from the site to be burned or solarized to prevent them from resprouting (see Figure 9 in the Fisheries Section).

Approximately 2,000 lineal feet (0.46 acres) of ribbongrass and yellow flag iris populations identified on the riverbank within 10 feet of the Metolius River would be manually treated under this Alternative either by manual pulling or weed whacking. Manual pulling of riverbank populations was demonstrated on private property in the Metolius basin and observed to be very difficult due to the intermingled roots of other species and rocks that made digging by hand very inefficient (Sussmann, 2011). Deep excavation of the soil and riverbank would be necessary to remove the targeted plants and reduce the rhizomes on the site. This treatment would incur direct disturbance of the soil and deposit sediment into the stream during the pulling operations. The exposed banks would be susceptible to contributing additional sediment to the stream during subsequent rain events in the short term until active restoration provided vegetative or organic cover on site (required by Standard 12 from the R6 2005 ROD). Erosion risks would be longer under passive restoration of the site before the *Phalaris* rhizomes left in the bank re-sprouted within the next growing season and provided some cover. Repeated treatments would be necessary in order reduce the populations due to the difficulty in removing all of the *Phalaris* rhizomes.

Riverbank populations within 10 feet of the water would also be treated by weed whacking, which entails cutting the vegetation mechanically to prevent the plants from producing seed. This action would cut the vegetative leaves of the ribbongrass and iris during the growing season and reduce the risk of seeds being produced on site that could be transported downstream. There would be no

disturbance to the soil but the entire rhizomatous root mat would remain intact, resulting in continued resprouting and spread, and limited control of the populations. Annual treatments into perpetuity would be necessary to effectively control these populations and the risk of expansion of these sites would continue despite this treatment.

Regardless of amount treated annually, the manual treatment of *Phalaris* sites would directly affect the soil resource by exposing mineral soil and removing soil material from the site. However, both effects would be temporary and minimal. In the short term, mineral soil exposed on alluvial islands or along stream banks would be susceptible to erosional forces from high stream flows during storm events. Most of the material within the stream channel is bedload that would either function to support new growth or be routed downstream. Riverbanks along the Metolius River or other spring fed streams would have a lower risk of susceptibility to erosional forces due to their consistent flows capable of buffering most thunderstorm and precipitation events. While all sites located on stream systems would be susceptible to erosion from large flows generated from rain on snow or extended rain events, the possibility of these storms is limited from year to year. Sites located on flashier stream types would be at risk of erosive forces from more localized 10 or 25 year events and are more likely to contribute sediment to the stream channels in the short term.

Phalaris sites proposed for treatment located in lower gradient fen or marsh systems that do not receive erosive flows have the lowest risk of contributing sediment in the first year following the manual removal of the population. Although there is likely to be an immediate influx of sediment during the manual treatments, the exposure of mineral soil would be reduced by the next growing season as a result of active or passive re-vegetation of these sites.

Houndstongue: The majority of houndstongue sites located on the Ochoco would not be affected by the changes to allowable herbicide applications. Sites located in the Dry Paulina Creek subwatershed proposed for burning and scarification are adjacent to Class 4 streams that could still receive herbicide treatments over the majority of their area. Other sites located within an intermittent stream channel or within ten feet of a perennial stream would be manually treated and incur physical impacts to the soil resource described previously, including exposure and loosening of mineral soil. These effects are expected to be temporary and the risk of erosion from rainfall events slowly reduced as active or passive restoration of vegetative cover returns.

Herbicide Treatments

Alternative 3 would have similar effects to the soil resource as those described for Alternative 2 for all sites outside of buffers that could be treated with herbicides. However, Alternative 3 would require spot spray application methods to replace broadcast spray methods within 300 feet of streams or other surface waters.

The effects of a change in application method include a possible reduction in the total amount of herbicide applied on each site and a potential reduction in the total acres of herbicide application. A reduction of total herbicide applied would reduce potential overspray and wind drift and reduce the amount of herbicide that is initially applied to the soil surface. This would reduce the amount of off-site movement of herbicides via overland flows or erosion mechanisms when compared to Alternative 2. The potential reduction in total acres of herbicide application would be the result of changes to manual treatments due to the ineffectiveness of herbicides applied to the target species identified, including Russian knapweed, Scotch broom and Himalayan blackberry, which are alternate to the non-aquatic triclopyr, picloram or sethoxydim proposed for use under Alternative 2. However, this change would be offset to some degree by the availability of clopyralid and aquatic glyphosate as options for treatment of Russian knapweed in these locations under this alternative.

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 slightly reduce the cumulative effects of herbicide application within the 300 feet stream buffers compared to those 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. However, the change to manual treatments could incur direct disturbance of mineral soil within these areas over a number of treatment years due to the inefficiency of this method. Although not expected to detrimentally affect the productivity of these sites, manual disturbance would be repeated annually as targeted species regenerated from existing seedbanks or rhizomes in the soil. The risk of erosion to mineral soil exposed by this treatment would be present until active or passive restoration provided cover with native or more desirable species during subsequent growing seasons

The cumulative effects of Alternative 3 on the soil resource would also be similar to those described for Alternative 2 when considering existing and reasonably foreseeable future projects across the Forest. The treatment of invasive plants is unlikely to disturb the soil resource to the extent considered to be detrimental and it is unlikely that their extent would be additive to the effects incurred by most of the projects listed in Section 3.1.3. The overlap of grazing with treated sites could result in the direct trafficking of hooves on treated sites and reduce the recovery time of vegetative cover. This is most likely to occur on the Grasslands, where medusahead treatments are extensive and less so on the Ochoco and Deschutes. The Roba and Snowshoe allotments on the Ochoco do have extensive areas of houndstongue proposed for treatment. Although the impacts of this overlap are not likely to detrimentally affect the productivity of the soil resource enough to impede the return of vegetation, it could slow it enough to extend the risk of erosion and potential transport of herbicide residues were it to occur.

Vectors associated with OHVs are expected to change as a result of implementing the Travel Management EIS across the Grasslands and two National Forests. The Travel Management decision has eliminated most cross country travel of OHVs and designated their use on existing roads and trails, thereby reducing the extent over which OHVs could directly transport and deposit invasive plant seeds. Other foreseeable Travel Management decisions include the designation of new OHV trails under the Ochoco Summit and Lava Rock OHV projects in areas where existing OHV activity varies and new vectors could be created. However, EDRR management of new populations should be able to treat the spread of new invasive populations in these areas and the overall surface extent of the soil resource dedicated to trail tread as disturbed ground is a very small percentage of the landscape. As a result, the cumulative effect of these projects on soil productivity is expected to be minimal.

Summary of Effects to Soil Indicators

Alternative 1

- Toxicity to microbes from herbicides

  Dicamba, Picloram, Glyphosate, and Triclopyr would be applied annually within approximately 250 net acres currently approved for treatment under the 1998 Noxious Weed EAs. Typical application rates of these herbicides are below recommended label rates and have a low risk of toxicity to soil microbes on these sites.

- Soil productivity

Potential effects to soil microbes and organic matter input are used as surrogate indicators for soil productivity in this analysis. Soil productivity is likely to be maintained on treated sites due to the low toxicity of herbicides on soil microbes when applied below recommended label application rates and the input of organic matter from treated individuals. The application of herbicide on invasive species would also promote the growth of native herbaceous species capable of contributing higher amounts of annual organic matter input to the soil.

- Erosion potential from treatment methods.

  Alternative 1 would incur short term erosion risks associated with the disturbance and exposure of mineral soil on acres treated with manual methods. This alternative would incur a short term risk of soil erosion on approximately 1,265 net acres of invasive plants treated manually each year.

Alternative 2 & 3

- Toxicity to microbes from herbicides

  Alternatives 2 & 3 propose the application of ten different herbicides across approximately 14,547 and 12,531 acres gross acres, respectively. Dicamba would not be applied under these alternatives. The ten herbicides proposed for use all have a low risk of toxicity to soil microbes when applied at typical application rates analyzed in the SERA Risk Assessments for each herbicide. However, picloram, sulfometuron methyl and triclopyr were identified to have a slightly higher risk of toxicity to microbes at or above the maximum application rates identified on the label. These three herbicide are the first choice of treatment across approximately 6,178 gross acres and PDFs were developed to limit the effects of these herbicides, including restrictions on the amount of re-applications that can occur within one or two years of the initial application (PDF 46).

- Soil productivity

  Potential effects to soil microbes and organic matter input are used as surrogates for soil productivity in this analysis. Herbicide application would occur on approximately 14,547 gross acres identified for treatment under Alternative 2 and 12,531 acres under Alternative 3. Soil productivity is likely to be maintained on treated sites due to the low toxicity of herbicides on soil microbes when applied below recommended label application rates and the input of organic matter from treated individuals. The application of herbicide on invasive species would also promote the growth of native herbaceous species in treated areas that are capable of contributing higher amounts of annual organic matter input to the soil surface.

- Erosion potential from treatment methods.

  Short term erosion risks are primarily associated with the disturbance and exposure of mineral soil from manual treatment methods. Alternatives 2 & 3 include the possible manual treatment of approximately 706 and 956 net acres, respectively, although the risk of short term erosion from these treatments is likely to occur over fewer net acres as a result of existing budgets that would prioritize herbicide treatments. There would be a slightly elevated risk of producing sediment capable of reaching streams from manual treatments under Alternative 3 due to the wider non-herbicide buffers along riparian corridors and streams.

3.6 Water Resources

Introduction

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 1995a), 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 Water Resources Specialist Report is incorporated by reference in its entirety.

A National Pollutant Discharge Elimination System (NPDES) permit is required for herbicide use into water or adjacent conveyances with a hydrologic surface connection to water at the time of herbicide application. This applies to creeks, rivers, lakes, riparian areas, wetland, and other seasonally wet areas when water is present. Project design features and buffers are intended to minimize any pollution discharge to the extent practicable and this project conforms to current requirements. This 2300-A general permit will be obtained before herbicide is used within 3 feet of waters of the state or flowing ditches that are connected to the waters (http://www.deq.state.or.us/wq/wqpermit/indinfo.htm).

The proposed herbicide use in Alternatives 2 and 3 incorporate multiple layers of caution into the planning and implementation process of this FSEIS (Section 3.2), and is used in the analysis of water resources. These layers of caution reduce the risk of effects, including State and Federal laws, EPA label requirements, SERA Risk Assessments, and stanadards in the R6 2005 ROD minimize impacts throughout R6. The incorporation of all of these layers, plus site-specific project design features (PDFs), minimizes or eliminates the risks and effects of herbicide applications to the water resource. However, possible scenarios for the minimal effects of all treatment methods are discussed below.

The water quality parameters of interest that are assessed in this analysis are those hydrologic features that may be directly and/or indirectly influenced by invasive plant treatments. These parameters include:

- sediment and turbidity
- water temperature
- water chemistry (dissolved oxygen, pH, and chlorophyll a)

Each of these parameters is used as an analysis measure to compare and contrast the effects among the alternatives within the document. For this analysis the water chemistry measure will only include dissolved oxygen, pH, and chlorophyll *a* because these are the parameters with data.

Included here is a brief synopsis of several key directives that regulate activities on the Deschutes/Ochoco NFs and Crooked River National Grassland. More detailed information can be found in the Hydrology Specialist's Report (Tanner 2012).

Clean Water Act and the 303(d) List

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.

A part of the CWA is Section 303(d), which 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. Then ODEQ and EPA typically develop a Total Maximum Daily Load (TMDL) and a Water Quality Management Plan (WQMP) for those 303(d) listed water bodies. The TMDL and WQMP address a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. The projected date for completion of a TMDL and WQMP for the Deschutes Basin is 2013. The John Day Basin TMDL was approved by EPA in December of 2010 which essentially took all 303(d) listed waterbodies in the John Day Basin off of the 303(d) list. These delisted waterbodies are still important and the delisting essentially means that there has been a 'load' allocated and a water quality management plan developed for each previously listed waterbody. Delisting these waterbodies will not necessarily allow less restrictive management of activities along them. As part of the TMDL process, the Forest Service is expected to develop and implement a Water Quality Restoration Plan (WQRP) within 18 months to address how management of activities on National Forest Lands will comply with load allocations set forth in the TMDL. This joint effort with the Umatilla, Wallowa-Whitman, Malheur, and Ochoco National Forest is underway. The John Day Basin TMDL addresses loads for stream temperature, bacteria, and biological conditions and dissolved oxygen. Since ODEQ is in the process of developing quantitative methods and benchmarks to evaluate sedimentation impairment in Oregon streams, ODEQ is postponing a sediment TMDL until these methods are in place.

The measures used to analyze the effects to water resources (i.e. sediment and turbidity, water temperature and water chemistry) encompass the parameters to which streams are currently on the 303(d) list (i.e. all 303(d) listed waterbodies in the project area are impaired for one or more of the measures identified above). Current management on National System Lands is directed towards protecting not only 303(d) listed waterbodies, but all waterbodies. Therefore any 303(d) discussion within this document is a subset of the larger protection of all waterbodies. See Table 44 for the 2004/2006 303(d) listed waterbodies for the Deschutes and Ochoco National Forests. At the time of the Draft SEIS the 2004/2006 303(d) list was the most recent. However, the 2010 303(d) list was approved on March 15, 2012. See the Affected Environment section below for a summary of changes.

PDFs within this project serve as Best Management Practices (BMPs) and are the primary measures that ensure that State standards are being met.

Riparian Management Objectives

Within PACFISH and INFISH, Riparian Management Objectives (RMOs) have been established to provide the criteria against which attainment or progress toward attainment of riparian goals is measured. The term Riparian Habitat Conservation Area (RHCA) is used to identify the stream ecosystem area. RMOs provide the target for RHCAs 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 (PACFISH/INFISH 1995/1995a). The RMO parameters that are applicable to hydrology and this project are water temperature, which has already been identified as a measure, and bank stability. The bank stability RMO is considered a surrogate parameter for sediment input to the stream, of which is already identified as a measure. The remaining RMOs of pool frequency, large woody debris, width to depth ratio and lower bank angle will not be considered in this analysis because they are not affected by the proposed treatments. RMOs are listed in

Table 43. See the Hydrology Specialist Report for an in-depth explanation of PACFISH and INFISH standards.

Table 43. Riparian Management Objectives (INFISH 1995a, PACFISH 1995)

Habitat Feature	Interim Objectives
Pool Frequency	Varies by channel width
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 inches diameter; >35-foot 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

Aquatic Conservation Strategy

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). The Northwest Forest Plan is applicable only to portions of the Deschutes NF. This plan outlines how Federal Lands within the range of the Northern Spotted Owl will be managed. The term "riparian reserves" is used to identify stream ecosystems, and is synonymous with RHCA, which is used by PACFISH and INFISH. 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 Section 3.6.3 below.

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 FSEIS 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 FSEIS. Refer to the Water Quality Report in the project file for information on which plans (i.e. Northwest Forest Plan, INFISH, etc. incorporated by reference) apply to the watersheds, identification of key watersheds, and for a map of watersheds.

Climate and 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 drier climate in the four Basins in the planning area. 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.

Water Quality Parameters

The Forest Service responsibilities under the Clean Water Act are defined in a 2003 Memorandum of Understanding (MOU) between DEQ and the Forest Service (the MOU will be updated in 2012). The MOU designates the Forest Service as management agency for the State on National Forest System Lands.

A list of waterbodies on the 2004/2006 Oregon State 303(d) list of impaired waters within the planning area is shown in Table 44. This list was approved by EPA on February 26, 2007 and was the List available during the analysis of effects for the Draft SEIS. The 2010 303(d) list was recently approved by EPA on March 15, 2012. This list is very similar to the 2004/2006 list as described previously. Inventoried invasive plant sites and associated PAUs within 100 feet of the 2004/2006 303(d) listed streams and lakes/reservoirs are shown in Table 45. This table demonstrates a total of 292.1 acres of mapped invasives sites within 100 feet of 303(d) listed waterbodies out of a total of 15,447.4 acres within 100 feet of 303(d) listed waterbodies, or 1.9% of the total area.

A review of the 2010 303(d) list revealed the following changes from the 2004/2006 list:

- A delisting of those waterbodies in the John Day Basin due to the approval of the John Day Basin TMDL and Water Quality Management Plan in December 2010.
- Additional waterbody listings in the Deschutes Basin for mercury and algae as follows:
    - East Lake – listed for the pollutant mercury
    - Paulina Lake/Creek – listed for harmful algae
    - Haystack Reservoir – listed for harmful algae
    - Crane Prairie/Deschutes River – listed for harmful algae
    - Wickiup Reservoir/Deschutes River – listed for harmful algae
    - Odell Lake/Creek – listed for harmful algae

Effects of algae are discussed in depth in the Environmental Consequence section 3.1.2 under the Water Chemistry parameter for all alternatives.

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.

Sediment and Turbidity

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 due to high infiltration rates.

Eliminating invasive plants can temporarily reduce 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).[12] Currently there is no quantitative State standard for sediment, however ODEQ's statewide narrative criteria (340-041-0007(12) states, "The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious[13] to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed."

Turbidity is the measure of the ability of light to pass through water. Changes in turbidity may be due to the presence of suspended matter such as clay, silt, organic debris, plankton, various effluents. Excessive turbidity reduces light penetration into water and therefore, reduces photosynthesis by phytoplankton, algae, and submerged vegetation. 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 can be a close correlation between turbidity and suspended sediment in a given stream, but this correlation may 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 quantitative 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

[12] 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.

[13] Deleterious – implies slower, less irreparable injury than pernicious.

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.

Water Temperature

Water temperature is an important factor which influences aquatic productivity. Temperature changes may result from natural climatic conditions, surface water - groundwater interactions, or human manipulation of in-stream flow and 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 (Beschta 1997). 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).

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 increased 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 (Spuher 1994). Reed canary grass, ribbon grass and yellow flag iris generally provide very limited effective shade due to their limited height. This is especially true in wider streams like the Metolius and Deschutes Rivers.

Water Chemistry

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.

As part of the Regional Environmental Monitoring and Assessment Program (REMAP), ODEQ (1999) found DO fluctuations in the Deschutes River were linked 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 on the South Fork of the Crooked River to high oxygen production from photosynthesis. Since five of the seven waterbodies with 303(d) listing for pH are also listed for chlorophyll a, it is reasonable to assume that high oxygen production from photosynthesis is the cause.

Chlorophyll a

This parameter is used to identify streams, reservoirs, or lakes where phytoplankton may impair the beneficial uses of that water and is usually indicative of high nutrient levels. High levels of phytoplankton may result in swings in DO and pH between periods of photosynthesis and respiration and during die off. In addition, Wickiup Reservoir, Crane Prairie Reservoir, Lava Lake, Paulina Lake, Suttle Lake, Odell Lake, and Haystack Reservoir have had Oregon Department of Human Services (ODHS) public health advisories for blue-green algae blooms in the last several years. The 2010 303(d) list has included Paulina Lake/Creek, Haystack Reservoir, Crane Prairie Reservoir/Deschutes River, Wickiup Reservoir/Deschutes River and Odell Lake/Creek as water quality limited waterbodies due to harmful agae. These listings are not identified in Table 44. Not all algae blooms are harmful, but some species of algae, such as blue-green algae can produce toxins or poisons that at higher concentrations can cause serious illness or death in pets, livestock, wildlife and humans. Skin irritation or rash are the most common health affects during blue-green algae blooms, but other symptoms can range from diarrhea, cramps and vomiting, to fainting, numbness, dizziness, tingling, and paralysis/death. The most serious reactions occur when large amounts of water are swallowed. Children and pets are the most susceptible.

Table 44. 2004/2006 Oregon State 303(d) listed streams on the Deschutes and Ochoco National Forests, with listing parameter*

Watershed	Waterbody	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
John Day Basin								
Lower John Day Subbasin								
Bridge Cr.	Bear Cr.	X**						
	Bridge Cr.	X**						
	Gable Cr.	X**						
	Nelson Cr.	X**						
Upper John Day Subbasin								
Lower South Fork John Day R.	South Fork John Day R.	X**						
Middle South Fork John Day R.	Murray Cr.	X**						
	Porcupine Cr.	X**						
	Sunflower Cr.	X**						
Mountain Cr.	Badger Cr.	X**						
Rock Cr.	Rock Cr.	X**						

Watershed	Waterbody	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
Upr Middle John Day R.	Cottonwood Cr.	X**						
Deschutes Basin								
Lower Deschutes Subbasin								
Headwaters Deschutes	Lake Simtustus					X		X
Willow Cr.	Willow Cr.	X						
Trout Creek Subbasin								
Upper Trout Cr.	Auger Cr.	X		X				
	Big Log Cr.	X		X				
	Bull Cr.	X		X				
	Cartwright Cr.	X		X				
	Dick Cr.	X		X				
	Dutchman Cr.	X		X				
	Potlid Cr.	X		X				
	Trout Cr.	X		X				
Upper Deschutes Subbasin								
Wickiup/Browns Cr.	Deschutes R.	X						
	Odell Cr.	X				X		X
	Odell Lake					X		X
Crain Prairie/Charleton Cr.	Deschutes R	X						
	Lava Lake						X	
Fall River	Deschutes R.	X		X	X		X	
Lake Billy Chinook	Lake Billy Chinook					X		X
Lower Metolius R	Lake Billy Chinook					X		X
Middle Deschutes/McKenzie Canyon	Deschutes R.	X				X	X	
Pilot Butte	Deschutes R.	X		X	X		X	X
Tumalo Cr.	Tumalo Cr.	X						
Whychus Cr.	Indian Ford	X						
	Whychus Cr.	X						
Upper Metolius R.	First Cr.		X***					
	Link Cr	X						
	Metolius R.	X						
	MFk S. Fork Lake Cr.	X						
	Middle Fork Lake Cr.	X						
Whychus Creek	Indian Ford	X						
	Whychus Creek	X						
Little Deschutes Subbasin								
Crescent Creek	Crescent Cr.	X						
	Big Marsh Cr.	X						
Lower Little Deschutes	Paulina Cr.	X						
Upper Little Deschutes	Little Deschutes R.	X					X	
	Hemlock Cr.	X						

Watershed	Waterbody	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
Lower Crooked River Subbasin								
CR Nat. Grassland	Lake Billy Chinook					X		X
	Crooked R. RM 0-51	X				X		
McKay Cr.	Little McKay Cr.	X						
	McKay Cr.	X						
Mill Cr.	East Fork Mill Cr.	X						
	Harvey Cr.	X						
	Mill Cr.	X						
	West Fork Mill Cr.	X						
Upper Ochoco Cr.	Marks Cr.	X						
	Canyon Cr.	X						
	Hamilton Cr.	X						
	Little Hay Cr.	X						
	Ochoco Cr.	X						
Upper Crooked River Subbasin								
Bear Cr.	Bear Cr.	X						
	Cow Cr.	X						
	Klootchman Cr.	X						
Camp Cr.	Double Cabin Cr.	X						
Deep Cr.	Crazy Cr.	X						
	Deep Cr.	X						
	Double Corral Cr.	X						
	Happy Camp Cr.	X						
	Jackson Cr.	X						
	Little Summit Cr.	X						
	Toggle Cr.	X						
Lower N. Fork Crooked	Fox Canyon Cr.	X						
	North Fork Crooked R.	X						
Upper N. Fork Crooked	Allen Cr.	X						
	Fox Cr.	X						
	Gray Cr.	X						
	Howard Cr.	X						
	Indian Cr.	X						
	Lookout Cr.	X						
	Lytle Cr.	X						
	North Fk Crooked R.	X						
	Peterson Cr.	X						
	Porter Cr.	X						
Upper Crooked Valley	Horse Heaven Cr.	X						
	Little Horse Heaven Cr.	X						
	Shortgun Cr.	X						
	Wildcat Cr.	X						
Beaver - South Fork Crooked River Subbasin								
Lower Beaver Cr.	North Fork Wolf Cr.	X						
	Wolf Cr	X						

Watershed	Waterbody	303 (d) Listing Parameter						
		Temp	Temp (spwn)	Sed	Turb	pH	DO	Chlor a
Upper Beaver Cr.	Beaverdam Cr.	X						
	Powell Cr.	X						
	Rager Cr.	X						
	Sugar Cr.	X						
Paulina Cr.	Dipping Vat Cr.	X						
	Dry Paulina Cr.	X						
	Roba Cr.	X						
South Fork Beaver Cr.	Begg Cr.	X						

*The 2010 303(d) list adds waterbodies listed for harmful algae (Crane Prairie Reservoir, Wickiup Reservoir, Odell Lake, Haystack Reservoir, and Paulina Lake) and mercury (East Lake).

** These waterbodies were addressed under the John Day Basin TMDL and Water Quality Management Plan (2010) and are technically no longer on the 2010 303(d) list.

*** 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 for spawning temperatures based on criteria change.

Table 45. Mapped invasive plant sites, Project Area Units, and total acres of land within 100 feet of 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 Subbasin			
Bridge Creek	0	3.5	137.9
Upper John Day Subbasin			
Lower SFk John Day River	9.8	15.5	18.2
Middle SFk John Day River	0	18.7	134.6
Mountain Creek	0	0	91.6
Rock Creek	0	2.9	202.9
Upper Middle John Day River	0	2.9	229.4
Deschutes Basin			
Lower Deschutes Subbasin			
Headwaters Deschutes	0	0	34.3
Willow Creek	0.6	0.9	210.6
Trout Creek Subbasin			
Upper Trout Creek	0.7	129.9	1357.0
Upper Deschutes Subbasin			
Wickiup Reservoir	4.7	5.7	705.3
Crane Prairie Reservoir	12.9	28.8	41.2
Fall River	17.2	20.7	1207.7
Lake Billy Chinook	0	0	17.2
Lower Metolius River	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 Subbasin			
Crescent Creek	2.8	3.4	164.8

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
Lower Little Deschutes River	2.0	10.1	202.5
Uppre Little Deschutes River	0	1.6	428.9
Lower Crooked River Subbasin			
Crooked River Nat. Grassland	0	0	206.2
McKay Creek	8.3	145.6	601.1
Mill Creek	0.6	58.1	399.9
Upper Ochoco Creek	2.7	99.5	735.7
Upper Crooked River Subbasin			
Bear Creek	0.4	32.3	347.4
Camp Creek	0	0	0
Deep Creek	1.9	114.5	1283.3
Lower North Fork Crooked River		22.7	425.0
Upper North Fork Crooked River	0.1	33.1	1290.0
Upper Crooked River Valley	6.5	15.2	337.6
Beaver - South Fk Crooked R Subbasin			
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

*This table was created by using the 2004/2006 303(d) list as that was the list available during the analysis. Effects on algae are analyzed below.

** 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 be 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.

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* (USGS 2001a). 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 (USGS 2001a).

The Forests' use GIS maps derived from USGS data, along with satellite imagery, for groundwater dependent ecosystem (springs and fens) location information. For the last two years the Ochoco NF has participated in testing a new National Groundwater Dependent Ecosystem protocol for the inventory and monitoring of springs and fens. This is an interdisciplinary process comprised of a geologist, botanist, soil scientist and hydrologist to assess the function, soils, vegetation, and condition of groundwater systems. To date 32 springs have been inventoried, records are on file at the Ochoco NF Headquarters, with several showing an upward trend in condition (based on local knowledge). Although constrained by budget, this effort is expected to continue over the next several years, improving the understanding of groundwater systems. The Deschutes NF is just starting this protocol, with 6 springs inventoried; assessments showed that all springs were in good condition (Wills pers. comm. 2011)

Direct connections between surface precipitation and groundwater aquifers across the two Forest areas are minimized by the combination of soils, bedrock geology and precipitation patterns documented in groundwater studies of the Deschutes Basin (USGS 2001). Groundwater recharge on the Deschutes National Forest occurs primarily from snow melt in the higher elevations in the Cascade Range. Approximately half of this recharge flows through the subsurface rocks of the Deschutes Formation before eventually discharging to streams near the confluence of the Deschutes, Crooked, and Metolius Rivers. The Ochoco National Forest has a similar re-charge system for the large confined aquifers that underlie the entire Forest. The lithology of the underlying bedrock is consistent from north to south and provides subsurface clay layers and bedrock that cutoff access of surface waters to these groundwater reservoirs. The primary source of recharge to these aquifers is also from snowmelt waters that travel significant lateral distances before contributing to storage (USGS 2001). Very few proposed treatment sites are located within these recharge contribution areas.

Localized discharge of groundwater can occur above the regional aquifers on both Forests where lenses of impermeable rock or soil are present. These occur as seeps or springs, and are generally associated with the dormant landslide terrain on the northern end of the Ochoco or impermeable deposits of glacial outwash, till or ash tuffs on the Deschutes. Approximately half of the snowmelt recharge on the Deschutes discharges to spring-fed streams along the margins of the Cascade Range.

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). 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.

Table 46 identifies inventoried invasive plant sites and Project Area Units (PAUs) within riparian habitat conservation area buffers and riparian reserve buffers, and shows where these occur within 100 feet of streams. The last column of the table is the total acreage that falls within the 50-300 foor buffer widths identified as protection areas by PACFISH, INFISH, and the NWFP (see Appendix I for a list of buffer widths) which account for approximately 0.3% of the Deschutes and Ochoco National Forest total acreage. The table gives a perspective of the amount of treatment that would occur within 100 feet of water, which normally has the highest risk of delivery of sediment and other contaminants, and is within the band where label restrictions for distance are applied. One of the routes by which herbicides reach a water body within this 100 foot zone is by adsorption of herbicide molecules to soil particles, which can then travel overland with sediment movement. Research on sediment movement has shown

that 100-foot-wide untreated buffers generally minimize soil input to nearby water bodies after ground disturbing operations such as logging. Lynch et al. (1985), Clinnic (1985), Haupt & Kidd (1965), Heade (1990), and Rashin 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. De Snoo & De Wit (1998) found a 3-meter (10-foot) no spray 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 effective width for minimizing herbicide concentrations in streams from broadcast applications and that increased buffer widths produced even less to no concentrations.

Table 46. Acres of invasive plant sites and Project Area Units (PAU) within 100 feet of streams, and within PACFISH, INFISH, and NWFP buffers

	≤ 100 ft Class I-II (acres)		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		PACFISH/INFISH/ NWFP buffers (acres)	
	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU
John Day River Basin								
Upper John Day Subbasin								
Middle SFk John DayRiver	0.1	37.5	0.3	6.0	0.9	33.0	2.5	113.1
Lower So Fork John Day River	9.8	34.1	0	9.3	0.7	23.6	13.0	210.1
Upper Middle John Day River	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
Subbasin Total	***10.6***	***84.2***	***0.3***	***25.3***	***2.0***	***64.3***	***17.6***	***405.2***
Lower John Day Subbasin								
Bridge Creek	6.5	68.7	11.6	41.0	8.3	61.9	50.9	425.9
Subbasin Total	***6.5***	***68.7***	***11.6***	***41.0***	***8.3***	***61.9***	***50.9***	***425.9***
Deschutes River Basin								
Upper Deschutes Subbasin								
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
Subbasin Total	***265.5***	***635.2***	***13.2***	***34.4***	***394.3***	***860.5***	***1368.4***	***3,604.8***

	≤ 100 ft Class I-II (acres)		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		PACFISH/INFISH/ NWFP buffers (acres)	
	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU
Little Deschutes Subbasin								
Upper 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
Middle 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
Subbasin Total	***16.2***	***27.0***	***0***	***0***	***6.5***	***22.2***	***193.9***	***289.0***
Beaver - South Fork Crooked River Subbasin								
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
Subbasin Total	***31.1***	***149.5***	***123.5***	***198.1***	***270.3***	***488.9***	***465.9***	***1,093.0***
Upper Crooked River Subbasin								
Crooked River above No. Fork	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 No. Fork 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 No. Fork 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
Subbasin Total	***7.1***	***295.1***	***2.0***	***95.3***	***20.3***	***191.1***	***51.8***	***1,310.1***
Lower Crooked River Subbasin								
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
Upper Dry R.	0	0	0	0	0	0	0	0

	≤ 100 ft Class I-II (acres)		≤ 100 ft Class III (acres)		≤ 100 ft Class IV (acres)		PACFISH/INFISH/ NWFP buffers (acres)	
	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU	Invasive Plant Site	PAU
Lower Dry R.	0	0	0	0	0	0	0	0
LowerCrooked River 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
Subbasin Total	***7.5***	***415.7***	***22.6***	***120.3***	***160.4***	***440.2***	***210.5***	***1,656.8***
Lower Deschutes Subbasin								
Headwaters Deschutes R.					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
Subbasin Total	***8.8***	***29.8***	***58.4***	***82.3***	***165.1***	***281.9***	***296.8***	***553.6***
Trout Creek Subbasin								
Upper Trout Cr	0.4	59.2	0.1	20.6	0.2	36.1	2.0	235.8
Hay Creek								
Mud Springs Cr		2.0			52.6	122.5	55.9	159.4
Subbasin Total	***0.4***	***61.2***	***0.1***	***20.6***	***52.8***	***158.6***	***57.9***	***395.2***

3.6.2 Environmental Consequences

General Effects of the Alternatives

Treatment Methods

Biological (BIO), chemical (CH), cultural (CU), fire (FI), manual (MA), mechanical (ME), and no (NO) treatment or a combination of these are proposed in Alternatives 2 and 3. Table 47 shows the distribution of these treatments for Alternative 2 for the top 4 priority invasive plants listed per PAU (see Appendix A). The distribution in Alternative 3 is approximately the same but the percentage in chemical treatments would be reduced by a small amount due to not permitting any 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 47. 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

Treatment	Forest	
	Deschutes NF (%)	Ochoco/CRNG (%)
MECH	1.6	0
MECHMACU	2.8	0
MEFICHMA	0	0.5
NONE	0.6	2.0
TOTAL	100%	100%

Water quality analysis is based on Project Area Units, 70% of which are along roads. Roadside PAUs on the Deschutes NF 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). Actual invasive plant infestations usually cover a small percentage of the PAU, about 28 percent of the area, for both the Deschutes National Forest and the Ochoco National Forest/CRNG. The whole length of the road is often designated as a PAU due to the fact that vehicles are the primary vector of noxious weed spread, and weeds can show up anywhere along the length of the road. See Figure 2 in Chapter 2 for an illustration of how PAUs are designated.

Biological Controls - As indicated in Table 47, 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, and control infestations over a long time period (more than 10 years). The species targeted (mostly Canada thistle and dalmatian toadflax) 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 FSEIS is to effectively reduce invasive plant infestations to a level where they can be hand-pulled, to effectively treat expansive areas (such as roadsides) using EDRR 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. This is discussed in more detail in the Treatment Effectiveness Section in Chapter 3. Herbicide is included as part of the proposed treatments for 65 percent of the PAUs on the Deschutes National Forest and 82 percent of those on the Ochoco National Forest/CRNG. As discussed above, weed infestations are often present on only a small portion of the PAU. For example in Alternative 1, currently less than one percent of the area in the treatment units are being sprayed annually due to the non-continuous nature of infestations and reductions in populations due to spray effectiveness. The same analysis method applies to proposed treatments in Alternatives 2 and 3 - only the area infested is analyzed for effects (see Appendix A for site-specific acreage). Multiple treatments may occur in one year, except where prohibited by PDFs, however the second treatment targets missed areas from the first application and is therefore not additive.

Cultural Controls – Cultural treatments in this FSEIS 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. Solarization treatments along streambanks would have the potential for sediment delivery to streams until the area was revegetated.

Manual Controls – Manual treatments proposed in this FSEIS 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, especially for ribbongrass and reed canarygrass discussed under Alternative 3.

Mechanical Treatments – Mechanical treatments proposed in this FSEIS are in combination with other treatments to increase overall treatment effectiveness.The majority of proposed mechanical treatments mow down vegetation using a weed-whacker or mower. 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 FSEIS to burn houndstongue 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.

Early Detection-Rapid Response (EDRR)

Effects of early detection-rapid response treatments would be the same as those analyzed below in Section 3.6.2 Environmental Consequences. In order for a new infestation to be controlled outside of an established PAU, the range of treatment methods must be the same, and each year an Interdisciplinary Team would meet to review all proposed EDRR treatments (see Appendix F) to determine if site locations and treatments are within the parameters of this FSEIS analysis. All EDRR treatments would follow PDFs included in this FSEIS and would include annual limitations on the amount of treatments within 6th field subwatersheds for uplands (less than 10% of inventoried populations), within the aquatic influence zone (less than 10 acres), and below bankfull or high water marks of surface waters (less than 1 acre) (Chapter 2 and Appendix F). These limitations are expected to keep the direct, indirect and cumulative effects to the water resource within the bounds of this analysis.

Accidental Spills

Accidental spills are not considered a direct or indirect effect of treatments in any of the alternatives. PDFs would reduce the potential for spills to occur. PDFs 18 and 21 limit the amount of transported herbicide to what can be used in a day, and the route that is taken for transport. This greately reduces the magnitude of a spill. PDFs 19 and 20 require a spill kit, spill response plan, and immediate action in the case of a spill. The potential for a spill is further reduced around water through PDFs 24, 25 and 52 that limit the amount of herbicide that can be carried near water and require that fueling and mixing be done away from water.

It is not possible to predict the risk or magnitude of a spill and it is not required to evaluate worst case scenarios in NEPA. However, even though it is not required, a spill scenario was evaluated. The R6 2005 FEIS Appendix Q considered plausible acute and chronic exposures for the herbicides proposed for use in Alternative 2 and 3. One of these was from a small child drinking from a ¼-acre pond shortly after a 200 gallon spill without containment measures being taken and is summarized in Alternative 2.

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).

Streams and Lakes on the 303(d) List

The published Draft SEIS used the most current 303(d) list from 2004/2006. On March 15, 2012 EPA approved the 2010 303(d) list. Notable differences between the two lists have been discussed previously. Differences in the effects due to these changes were analyzed and determined not to amount to measureable differences, primarily due to mitigation measures 29.2 and 43-49.

Within this project PDF 29.2 restricts invasive treatments adjacent to waterbodies during Public Health Advisory periods for harmful algae. In addition PDFs 43-49 further mitigate potential effects to water quality

Table 44 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) 2004/2006 303(d) list. Differences in the 2010 list are noted. Inventoried invasive plant sites and Project Area Units within 100 feet of the 2004/2006 303(d) listed streams and lakes/reservoirs are shown in Table 45.

Temperature

Most invasive plants identified in this document are less than 4 feet tall and would need to be within 5 feet of a stream channel to contribute measurable shade (assuming no overstory vegetation is present). 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 and yellow flag iris site currently inventoried along a 303(d) listed water body is in the Camp Sherman area on the Metolius River (PAU 15-32).

The invasive plants at these sites are not tall enough or continuous enough to provide shade enough to result in a measurable increase in stream temperature. For example, assuming the Metolius River was 50 feet wide and all vegetation was an average of 2 feet high, was completely removed, had no overlapping shade (which there is), 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 (PAU 11-80) should produce similar results. This very small reduction in shade would not result in a measurable increase in water temperature.

Sediment & Turbidity

Manual and mechanical treatments can cause ground disturbance, increasing the potential for erosion and sediment delivery. Appendix A indicates that most of the invasive species in PAU 71-55 have a proposed treatment method combination of CHMA (chemical/manual) adjacent to 303(d) listed streams in the Upper Trout Creek Watershed. Pulling of knapweed, sulfur cinquefoil, St. Johnswort, and Medusahead would normally be used when populations are small and where chemical treatments have reduced densities to where manual controls would be effective. 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 knapweed (PAU 11-10). Mechanical treatments (mowing or weed whacking) are proposed in association with treating the reed canarygrass and quack grass in PAUs 11-80 & 11-57. The grass is first weed whacked to reduce the amount of biomass before applying herbicide. This type of mechanical treatment would not result in any increase in sediment or turbidity (further analyzed under the alternatives).

Water Chemistry

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) due to the scale of treatments discussed under the alternatives. However, there

is a very small potential for chemical treatment of emergent vegetation (reed canarygrass, quackgrass, ribbon grass, and yellow flag iris) to affect pH, DO, and chlorophyll a, in adjacent waters with high levels of 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. PDFs 29.2 and 43-49 would mitigate potential effects to those waterbodies added to the 2010 303(d) list for harmful algae and mercury.

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, wetlands, and dry channels. 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 drift.

Wicks are designed to be dripless, however, there is a low risk that drips from some wicks or plants overhanging the water could occur during hand wicking applications to reed canarygrass, quackgrass, yellow-flag iris, or ribbongrass. A National Polluntant Discharge Elimination System General Permit would be obtained for about 218.5 acres on 18 sites (see Appendix A) where drips have the possibility to enter the water in Alternative 2. 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.

Effects from drift, runoff and leaching considered in the SERA 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 could 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.

Groundwater and Geology

Localized discharge of groundwater can occur above the regional aquifers on both Forests where lenses of impermeable rock or soil are present. These occur as seeps or springs, and are generally associated with the dormant landslide terrain on the northern end of the Ochoco or impermeable deposits of glacial outwash, till or ash tuffs on the Deschutes. Approximately half of the snowmelt recharge on the Deschutes discharges to spring-fed streams along the margins of the Cascade Range.

The possible presence of herbicide residues in these waters is very low due to the lack of treatment sites present in the upper elevation recharge areas, the requisite percolation through soil and bedrock capable of adsorbing residues, and a large dilution factor within the flow. The possible influx of herbicide residues into these surface waters is also low due to application buffers around springs and other riparian water sources.

The risk of herbicide transport into groundwater from proposed treatment applications outside the higher elevation recharge areas is also quite low. Areas located east of the Cascade Range on both Forests have little or no direct ground-water recharge from precipitation (USGS 2001). PDFs included in the document reduce the risk of generating excess herbicide residues capable of being transported

vertically through the soil profile. These include restricted application rates of all proposed herbicides to minimize excess residues, restricted application of highly mobile herbicides, restricted timing of application prior to forecasted precipitation, and restricted application within intermittent stream channels. Application of herbicides would also occur during drier times of the year, which reduces movement of herbicide through the soil and allows the targeted plants to uptake the herbicide. In addition, soils across the planning area are capable of adsorbing herbicide residues which allows the herbicide time in the soil to degrade and minimizes downward movement through the profile toward groundwater.

Alternative 1

The 1998 Weed Environmental Assessment (EA) for the Deschutes National Forest included herbicide prescribed for 42 percent of the treatment areas. The 1998 Weed EA for the Ochoco NF and Crooked River National Grassland has treatments varying by species within the treatment area (TA); all TAs prescribed herbicide treatments, with approximately 67 percent of the TAs having a prescription of manual/herbicide.

This prescription says as a general rule, small populations of less than 10 plants would be hand pulled while larger infestations would be sprayed with herbicide. The effectiveness of this strategy is species specific; it works well on some biennial species such as scotch thistle and bull thistle (see page 101). It does not often work well on annual grasses and perennial species. Evidence of this is the introduction and spread of invasive plants since 1998, as described in Chapter 2, and noting the vast increase in weed sites that are manually pulled each year.

The 1998 Weed EA for the Deschutes NF directs that herbicides not be applied within 100 feet of water (including wetlands). On the Crooked River National Grassland and the Ochoco NF spot herbicide treatment is allowed within riparian areas, and to minimize the risk of herbicide entering water, only wicking was authorized within 10 feet of live water. Approximately 701 acres in TAs have herbicide prescriptions for at least some species within 100 feet of wetlands and springs.

Table 48 shows there are substantial areas of new infestations, and spread of those being treated manually. Herbicide use within Alternative 1 treatment areas (TAs) has decreased due to reductions in invasive plant populations resulting from treatment effectiveness (see Chapter 3.3), while most treated manually are increasing. This table also provides a comparison between Alternative 1 and the current inventoried invasive plant sites and the proposed Project Area Units (PAUs) in Alternatives 2 and 3. Column 2 depicts the total acres in Treatment Areas for Alternative 1. Column 3 indicates the number of acres in Alternative 1 that still have invasive plants due to ineffectiveness of manual control, or have new infestations. Column 4 shows the acres of currently inventoried invasive plant sites that are in Alternative 1 designated Treatment Areas.

Table 48. Alternative 1 Treatment Areas compared to proposed Project Area Units

Subbasin	Alt. 1 TAs (Acres)	Acres of TAs overlapping PAUs	Inventoried Invasive Plant Site Acres
Upper John Day River	506.4	426.2	3.5
Lower John Day River	1,590.0	990.6	176.8
Upper Deschutes River	4,628.1	3,360.2	2,008.6
Little Deschutes River	2,355.0	927.5	866.4
Beaver – S. Fork Crooked River	623.0	491.5	20.9
Upper Crooked River	2,238.3	1,967.4	141.2
Lower Crooked River	2,313.5	1,697.1	231.3
Lower Deschutes River	779.9	577.1	61.0
Trout Creek	1,237.1	856.4	7.4
Summer Lake	258.1	234.0	233.9
Williamson	0	0	0

Direct and Indirect Effects

Alternative 1 authorizes pulling, clipping, burning, biological, and herbicide treatments. Based on the treatments authorized under the 1998 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 waterbodies is shown in Table 49. As indicated previously, less than one percent of the area where herbicide application was authorized is currently being so treated annually.

Sediment and Turbidity

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 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 would 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 would be 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 would not result in any measurable increase in sediment or turbidity. For the reasons explained above, Alternative 1 would not produce any measurable increase in sediment or turbidity within streams in the planning area and would comply with the Clean Water Act, PACFISH, INFISH, RMOs and NWFP ACS objectives pertaining to sediment and turbidity.

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 no 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.

Several lakes, reservoirs, and meadows currently have reed canarygrass (RCG) along shorelines, impoundments, and on drainage channels within meadows (PAUs 11-24, 11-33-35, 11-39, 11-53, 11-54, 11-66, 12-05, 15-22). Some of these areas have had reed canarygrass present for many years, as it was introduced for soil stabilization in the past. Due to the rhizomatous nature of reed canarygrass, its dense growth slows water flow and increases siltation (Sheaffer and Marten 1995). LaVergne et al. (2004) report that reed canarygrass (RCG) invades quickly and its presence impacts the structure of natural habitats. RCG can persist as floating mats, which then form numerous nodes with adventitious roots. Fragmentation at these nodes enhances the spread of RCG until it completely chokes water circulation in ponds and along shores. By growing vigorously on stream banks, RCG also increases sediment deposition, which further limits water circulation.

Pulling and killing invasive plants can reduce shade which can increase the amount of solar input into streams. However, most local invasive plants provide little or no shade to streams because they are not tall enough. Reed canarygrass is the tallest, about 4-5 feet. Clipping reed canarygrass, the proposed treatment method in 1998 on the Deschutes NF, would not produce a measurable effect to stream temperature.

Ongoing treatments under Alternative 1 would not produce any measurable increase in water temperatures; as explained above invasive plants are typically not tall enough to produce quality shade. Alternative 1 would comply with the Clean Water Act, PACFISH, INFISH, RMO's and NWFP ACS objectives pertaining to stream temperatures. However, without an effective program for active eradication or control, riparian invasive plants are likely to spread, and may actually decrease shade potential from native shrubs (Spuher 1994). Tall native shrubs, such as willow, alder, hawthorn, currents, and dogwood have branched crowns that produce wide, multi-layered overhanging branches that are important for shade. The dense root mats of reed canarygrass, ribbongrass and yellow-flag iris can inhibit growth of these shrubs along streambanks and lakeshores.

Water Chemistry

EPA mandates that the maximum contaminant level (mcl) for picloram and glyphosate is 0.5 and 0.7 mg/liter, respectively. However, 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 of the administrateive rules, 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 49 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 49. 1998 treatment areas within 100 feet of waterbodies with herbicide treatments*

Subbasin	≤ 100 ft Class I-III (acres)	≤ 100 ft Class IV (acres)	≤ 100 ft Lakes (acres)	≤ 100 ft Wetlands (acres)**	≤ 100 ft Springs (acres)	PACFISH / INFISH / NWFP buffer (acres)**
Upper John Day R.	19.6	7.4	0	33.8	<0.1	73.1
Lower John Day R.	128.9	61.5	0	26.8	1.8	371.6
Upper Deschutes	84.6	61.6	8.6	106.7	2.4	323.5
Little Deschutes R.	2.2	0	0	3.0		14.4
Beaver – S.F. Crooked R.	63.8	11.9	0	5.1	0.3	159.9
Upper. Crooked R.	220.0	93.9	1.6	256.9	3.5	775.2
Lower Crooked R.	359.4	108.0	30.1	259.5	1.7	1003.5
Lowr. 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. PACFISH/INFISH/NWFP buffers include all the previously listed hydrologic systems but buffer widths may be different (see Appendix I for buffer widths).

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 are:

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 delivery 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.
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 was not proposed.

With the above design criteria and analysis performed within the existing analyses the levels of herbicides found in water from treatments are expected to below levels of concern and within water quality standards. Alternative 1 would comply with the Clean Water Act, PACFISH, INFISH, RMO's and NWFP ACS objectives pertaining to water chemistry.

Summary for Alternative 1

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. Herbicide use would be limited and no herbicides would be used within 10 feet of perennial water bodies on the Deschutes NF. 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, and may change the form and function of the Metolius River. Island formation from colonization of logs in the river, can influence the dynamics and morphology of the river. The effects of a monoculture may also result in retarding shrub recruitment, which provides shade and nutrients. See also the Native Vegetation Section 3.4.

Alternative 2 – Proposed Action

Direct and Indirect Effects

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.

Alternative 2 allows for 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 15);
- 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.

Sediment and Turbidity

Eliminating invasive plants can temporarily reduce ground cover which can increase the potential for erosion and sediment delivery. Within this project the extent and continuity of treatements within 100 ft of water would be small and isolated within Alternative 2.

Proposed biological, cultural, and chemical treatments would not cause measurable increases in erosion or turbidity for the following reasons. Mowing, weed whacking, tarping (solarization), and chemical treatments leave the dead vegetation in place, thus maintaining effective ground cover (i.e., there is no ground disturbance). Tarping (solarization) is proposed for reed canarygrass in Big Marsh (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. Again there would be no ground disturbance associated with this treatment.

The treatment method with the most potential to affect sediment and turbidity is manual. Most manual treatments would follow an herbicide treatment, which would reduce the scale of the manual treatments. 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. 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) because of the small scale and lack of continuity. In addition, PDF 50 requires measures such as sediment barriers, native planting/seeding and/or restrictions of work periods to allow control and dissipation of any sediment asscociated with manual treatments.

Turbidity levels generated by manually pulling reed canarygrass and ribbongrass within a stream channel would be reduced by dilution and mixing as it moves downstream and by (PDF 50). Pulling plants in the channel would need to be within the dates permitted for in-channel activities by the State (PDF 42). Turbidity generated by pulling plants off Large Woody Debris (LWD) and from in the channel (mainly on the Metolius River) would move downstream with the current and dissipate rather rapidly (within minutes) but ribbongrass pulled in backwater areas and side channels would take longer (up to an hour) to dissipate. Turbidity generated from pulling reed canarygrass from lake areas may take even longer to dissipate. Again PDF 50 would mitigate any potential sediment. 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 ribbongrass, it would generally be not very effective to pull it out of the bank, which is where the most potential for sediment would be (see Sussmann 2011). 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.

Hand pulling reed canarygrass (following herbicide treatment) 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 based on the small scale and lack of continuity. Herbicide treatments prior to follow-up manual treatments would greatly reduce the concentration of invasive plants, minimizing the amount of manual treatment needed and subsequently the amount of

ground disturbance. PDF 50 would address any areas of concern in terms of erosion and sediment input to the stream. Hand pulling quackgrass (following herbicide treatment) at Tethrow Meadow (PAU 11-57) is also proposed adjacent to the 303(d) listed reach of the Deschutes River below Wickiup Reservoir. This treatment will involve herbicides to initially reduce the concentration of quackgrass, followed by manual treatment (if necessary) of smaller, isolated areas that persisted herbicide treatment. Due to the expected limited spatial scale of manual treatment areas, intensity of treatments and the required PDFs there is very little likelihood of measureable levels of sediment reaching the river as a result of the manual treatment portion of treating quackgrass

Prescribed fire and some mechanical treatments have a potential to increase erosion and sediment delivery. Burning can reduce effective ground cover, 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 PAUs in the Dry Paulina Creek subwatershed 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 14 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 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 (see project design features in Table 14).

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 potential of sediment delivered to streams and seeding would result in an additional 25 percent reduction in sediment delivery (Packer and Christensen, 1964). Rashin et al. (2006) found a 10 meter (32.8 feet) 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 feet) 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 five treatment sites along the intermittent east & west forks of Dipping Vat Creek. Erosion should return to pre treatment levels within 1 year and fall below current levels within 5 years 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 in this area.

While fire can cause nutrient flushes resulting from rapid mineralization and mobilization of nutrients (Baker 1988) (Tiedeman et al. 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. In regards to sediment and turbidity, this Alternative would comply with the Clean Water Act, and State water quality turbidity standards, narrative sediment standards, and PACFISH, INFISH RMOs pertaining to bank stability, and the Aquatic Conservation Strategy objectives of the Northwest Forest Paln (see also ACS section 3.6.3). This project will maintain or restore aquatic and riparian habitats; long term beneficial impacts to these habitats outweigh the minimized risk of adverse effects at any one site, watershed or PAU. The PDFs and buffers eliminate adverse effect to the degree possible, and minimize risks that cannot be avoided.

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. Due to their generally short nature, 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), ribbongrass (PHARP), and yellow-flag iris (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 very small decrease in shade on 303(d) listed streams, which would not produce a measureable difference in stream temperature. The Metolius ribbongrass survey (PAU 15-32) found 7.58 percent of the riverbank occupied for the first 0.66 mile below Lake Creek. As stated earlier, assuming the Metolius River was 50 feet wide and all vegetation was an average of 2 feet high, was completely removed, had no overlapping shade (which there is), and provided shade throughout the day, treatment of the ribbongrass 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 (PAU 11-80) should produce similar results. This very small reduction in shade would not result in a measurable increase in water temperature.

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 50. The values in Table 50 are maximum shade values and do not account for overlapping shade. In most cases across both Forests, especially in those locations where emergent invasives are to be treated, overstory vegetation provides most of the shade.

Table 50. 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 50. 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.

With the exception of Trout Creek in Trout Creek Swamp (PAU 15-22) the other 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 (not shrubs) in the PAU are shorter than the invasive reed canarygrass. However, Trout Creek Swamp is a fen with most of the water movement occurring below the surface of the ground and between channels of the marsh which would buffer any potential surface water temperature increase.

Alternative 2 would comply with the Clean Water Act, and State water temperature standards, PACFISH and INFISH RMOs, and the Aquatic Conservation Strategy Objectives of the NWFP (see also section 3.6.3 ACS). This project will maintain or restore aquatic and riparian habitats; long term beneficial impacts to these habitats outweigh the minimized risk of adverse effects at any one site, watershed or PAU. The PDFs and buffers eliminate adverse effect to the degree possible, and minimize risks that cannot be avoided.

Water Chemistry

Treatments of non-emergent vegetation within 100 feet of all waterbodies would not add measurable amounts of organic matter or nutrients to streams or lakes or further degrade pH, chlorophyll a, or DO due to the discontinuity of the treatments, limited spatial scale, required PDFs, and stream buffers. Since Alternative 2 allows herbicide application on seasonally intermittent streams when they are dry, there is a very small risk of elevated herbicide concentration associated with precipitation runoff events. However, PDFs have been developed to mitigate this small potential primarily by limiting treatments prior to forecast precipitation (PDF 17).

Road ditch lines would function similar to intermittent or ephemeral streams. They are designed to collect water from the road surface and route it to either the forest floor or adjacent streams. Wood (USGS 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 runoff collected directly below ditchline test plots within 24 hours of application, Wood found 0.3 – 0.6 ppb of sulfometuron-methyl, and 0.8 – 1.8 ppb of glyphosate with a simulated 0.3 inch/hr storm (equivalent to a 2 year storm event in the project area). This equated to about 3-7% of sulfometuron-methyl applied and 1-2% of glyphosate. There was about a

1.5 order of magnitude decline from results within 24 hours of application to results from test plots taken the second week after application. The highest risk of herbicide applications in dry channels and hydrologically connected road ditches is from spraying such as aerial spraying and broadcast spraying. Aerial spraying is not proposed in this FSEIS and due to the effectiveness of herbicide treatments on authorized sites under the existing Noxious Weed EAs, very little broadcast spraying is currently being done. PDFs 43.1, 44 and 56 would substantially reduce the potential of chemical application in either dry intermittent stream channels or hydrologically connected road ditches within 100 feet of flowing streams and water bodies.

Additional monitoring studies of herbicide drift and runoff results are summarized here. An 8 month post treatment study was accomplished of herbicide spray 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 (Oregon Dept. of Forestry 2000).

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). Active ingredients totaling 40,631 pounds of 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 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 FSEIS Appendix D – Herbicide Information and PDF Crosswalk.

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. The listings for the Deschutes River at Bull Bend and for Odell Creek appear to be the result of algae blooms in Wickiup Reservoir and Odell Lake respectively. 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 several years. PDF 29.2 would eliminate invasive plant treatments adjacent to water bodies during a public health advisory for toxic blue-green algae. Outside the public health advisory period emergent vegetation would be treated with the aquatic formulation (labeled for in-water use) of glyphosate or imazapyr. Even though the aquatic formulation of these two chemicals is approved for in water use, no direct application to water is proposed in this FSEIS and to further prevent accidental overspray or drift into adjacent water, the minimum spot spray buffer is 10 feet from the edge of water (see Table 15). Ten feet is approximately three times the average spray width for spot spray applications so is sufficient to account for any overspray. Only hand application (wicking) or non chemical methods could be used for treating emergent vegetation between the edge of water and the minimum spot spray buffer. Since emergent vegetation has a shallow water table, there is also a risk for herbicide to enter the stream or water body in groundwater, but this would be offset for glyphosate due to its strong absorption to soil particles. While wicks can drip into the water during hand application, the risk of effects from this is very low due to the discontinuity and scale of treatment areas, using herbicides labeled for use in water and dilution from mixing with waterbodies.

The Syracuse Environmental Research Associates, Inc. (SERA) risk analysis for imazapyr in the R6 2005 FEIS determined there was no risk to algae and would not stimulate growth or result in die-off. 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 this FSEIS 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).

Studies by Evans and Duseja (1973) and Johnsen and Warskow (1980) showed rapid dilution after herbicide entered the water. Evans and Duseja sprayed picloram at 1 to 2 lbs/ac (2.9 to 5.7 times the typical application rate) on 1 to 2-acre plots. They took samples 5, 10, 100, and 1000 meters (16, 33, 328, and 3,281 feet) below the treatment areas in a drainage ditch with no base flow after 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 concentrations 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 application concentration analyzed by the herbicide risk assessment completed by SERA for the R6 2005 FEIS. Alternative 2 would use the lowest effective rate (PDF 12).

The studies above are results from direct application to water. In Alternative 2, hand application (wicking) between the edge of water and the minimum spot spray buffer of 10 feet would apply the herbicides directly on the target plant for absorption and poses a very low risk of delivering of herbicide to adjacent waters. Potential delivery of glyphosate in groundwater from spot spraying further than 10

feet from the edge of water would be substantially reduced by its high absorption and low mobility in soil.

Best Management Practices (BMPs) are employed to help assure that water quality is not degraded. Relevant Water Quality BMPs were incorporated into the Project Design Features listed in Chapter 2.4 of this FSEIS. 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), soils, water quality, fisheries and aquatic organism protection (PDFs 43 through 56), and using only the lowest effect rate (PDF 12).

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.

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 and may only have scattered invasive plants in the delineated area, 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.

Despite the presence of aquifers and recharge mechanisms within the planning area, the overall risk of groundwater contamination from herbicide applications proposed in this FSEIS is 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 (17,43,45, and 47) and physical treatment limitations that would minimize the extent, timing, and rates of herbicide applications. The extent of herbicide applied annually within any 6th-field subwatershed would be limited by riparian PDFs, treatment caps, physical 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 this FSEIS.

The timing of herbicide applications proposed under this FSEIS 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. Invasive plant infestations are much more limited at these higher elevations compared to lower elevations in the project area. 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.

Application PDFs included in the FSEIS also prohibit 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 lowest effective rates which 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 FSEIS.

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.

Water Chemistry Summary

Based on the limited spatial scale of infestations, intensity of treatments, the required PDFs and buffers, sediment adsorption, biodegradation, dilution and peer reviewed literature, concentrations of herbicides or residues in surface water and groundwater would be well within state standards and likely be well below harmful concentrations. There would be no measurable affects to pH, DO, harmful algae, or chlorophyll a in response to invasive plant treatments adjacent to waterbodies.

Another layer of caution to reduce the risk of multiple treatments in the same drainage cumulatively resulting in herbicide concentration above the threshold 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 bankfull 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 any given 6th-field subwatershed and no more than 1 acre below bankfull. Since GLEAMs analyzed 10 acres within 50 feet of water using broadcast spraying this would further reduce potential herbicide contamination, especially since there would not be any broadcast spraying within 50 feet of live water.

Based on the levels of precaution listed below, concentrations of herbicides or residues would be well below levels of concern in surface water and groundwater:

- 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 wind speeds 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) 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 above the threshold of concern
- limited spatial scale of infestations
- intensity of treatments
- information from this analysis (project file) and peer reviewed literature

Based on the above information, Alternative 2 would comply with the Clean Water Act and State water quality standards for toxic substances, NWFP ACS objectives, PACFISH, and INFISH RMOs. This project will maintain or restore aquatic and riparian habitats; long term beneficial impacts to these habitats outweigh the minimized risk of adverse effects at any one site, watershed or PAU. The PDFs and buffers eliminate adverse effect to the degree possible, and minimize risks that cannot be avoided. Alternative 2 provides the most options for what, how and where different control methods can be used. This would increase treatment effectiveness by providing more options to gain control over current infestations, therefore reducing further spread and protecting water resources.

Alternative 3

Alternative 3 was developed to address issues and concerns related to fisheries and other aquatic organisms and 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. This includes along road segments that are within 300 feet of perennial streams or lakes.
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.

Alternative 3 includes approximately 260 acres of mapped treatment areas (not necessarily completely infested) along streams that would not be treated with herbicides. These acres are primarily located within 10 feet of water, and would be treated only with manual methods. For example, the Metolius River has approximately 2,000 lineal feet (or 0.85 acres within 10 feet of water’s edge) of stream bank that is infested with ribbongrass and yellow iris. These areas would not be chemically treated under

Alternative 3. Instead, infestations would be treated either by pulling or digging out the ribbongrass and/or weed whacking of plants to reduce vigor and minimize seed production and spread from seed.

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.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.

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, yellow-flag iris, and ribbongrass) could not be treated with herbicide so would be treated with non-herbicide methods such as hand pulling, digging, weed-whacking, or solarization. Due to the rhizomatous nature of reed canarygrass and ribbon grass, it would be very difficult to eradicate/control by digging or pulling it out of the stream bank. To completely eliminate rhizomes from the stream bank this activity would require a substantial amount of ground disturbance which would result in exposed soil susceptible to erosion and transport into the adjacent water body during precipitation events. In the Metolius River area, a worst worst case scenario would result in approximately 2000 linear feet of disturbed and exposed stream bank within 10 feet of the River due to manual digging/pulling of ribbongrass. Exposed soil would be susceptible to erosion and transport into the River until vegetative re-growth of existing rhizomes (under passive restoration) or growth of native sedges (under active restoration) occurred. Without active restoration following hand pulling or digging treatments of ribbongrass in the Metolius River area, the treatments have the potential to lead to conditions that could exceed State Water Quality Standards pertaining to sediment and turbidity and the RMO standard of greater than 80% stable banks. There are other treatment areas similar to the Metolius River area within this project (i.e. hand pulling reed canarygrass at several locations along the Deschutes River, Trout Creek Swamp, Lava Lake, and Crane Praire Reservoir). Even with active restoration there would be a period of time (less than 6 months) where the sites could be susceptible to erosion and subject to violation of State water quality and RMO standards pertaining to sediment and turbidity.

Turbidity levels generated by manually pulling reed canarygrass and ribbongrass in small isolated areas in-channel and on logs would be reduced by dilution and mixing as it moves downstream and by (PDF 50). Turbidity generated by pulling plants off Large Woody Debris (LWD) and from in the channel (mainly on the Metolius River) would move downstream with the current and dissipate rather rapidly (within minutes) but ribbongrass pulled in backwater areas and side channels would take longer (up to an hour) to dissipate. PDF 50 would mitigate any potential sediment from these smaller treatment areas. Based on the discharge of the Metolius and Deschutes Rivers, two or three people pulling plants in-channel and on logs 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. 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.

In leiu of chemical use with 10 feet of water under this alternative, manually weed-whacking areas could provide some level of control of invasives such as ribbongrass. Weed-whacking could reduce

plant vigor and limit seed production; however there would be limited control of plant spread due to the rhizomatous nature and the need to treat annually to minimize the spread of seed. Weed-whacking would limit the amount of ground disturbance in relevance to hand pulling/digging and would not lead to increased sediment or turbidity in the adjacent waterbody.

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) would prevent herbicide from getting into the water or limiting it to a very small amount, well within state standards.

Specific differences for Alternative 3 in direct and indirect affects compared to 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 14 acres in the Dry Paulina Subwatershed. The restriction on herbicide application within 10 feet of perennial streams and water bodies would allow the continued spread of invasives plants within this area and limit the establishment of native vegetation. Native vegetation has been shown to be more effective in limiting erosion and sediment input to streams than invasive plants.

  As discussed previously, treatments that involve manual pulling (versus chemical treatment in Alt. 2) of invasives within 10 feet of water (like the 2000 lineal feet of ribbongrass on the Metolius River) have the potential to create disturbed soil conditions that could lead to exceeding State Water Quality Standards pertaining to sediment and turbidity and the RMO standard of greater than 80% stable banks. There are other areas that would be treated similar to the Metolius River area within this project (i.e., hand pulling reed canarygrass at several locations along the Deschutes River, Trout Creek Swamp, Lava Lake, and Crane Praire Reservoir). Even with active restoration there would be a period of time (less than 6 months) where the sites would be susceptible to erosion and subject to violation of State water quality standards pertaining to sediment and turbidity, and the RMO standard of greater than 80% stable banks.

  Manually treating these same areas by weed-whacking would limit the ground disturbance to levels in compliance with State and PACFISH/INFISH water quality standards pertaining to sediment and turbidity; however this method would limit our control of plant spread due to the rhizomatous nature and the need to treat annually to minimize the spread of seed.

- **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 ribbongrass) close to the edge of water, yet manual treatments within this area would yield results very similar to that of Alternative 2. Without control n the long term (decades) invasive riparian species such as ribbongrass and reed canarygrass could reduce shade potential in colonized areas, and could reduce shade in adjacent areas because their encroachment may inhibit the reestablishment of taller riparian deciduous shrubs as they die of old age.
- **Water Chemistry (pH/DO/Chlorophyll a)** - Alternative 3 restricts all chemical applications within 10 feet of perennial streams and water bodies including the hand application (wicking)

of the aquatic formulation of glyphosate permitted in Alternative 2. The restriction of all chemical applications within 10 feet of the edge of water combined with the high absorption rate and low mobility of glyphosate in the soil would further reduce the potential risk of delivery of glyphosate to adjacent streams and water bodies. Keeping glyphosate concentrations below 2μ/l would prevent the stimulation of algal growth in water bodies with identified algal bloom problems adjacent to treatment PAUs (Lava Lake, Crane Prairie Reservoir, Wickiup Reservoir, and Paulina Lake).

Where effective invasive plant treatments can be implemented, they 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 herbicide and non-herbicide methods, they will continue to displace native vegetation.

Within this alternative, manual treatments that include intensive pulling/digging in areas within 10 feet of of fish bearing streams, non-fish bearing perennial streams, or perennial lakes, ponds, and reservoirs (like in the case of 2000 lineal feet along the Metolius River) have the potential to exceed State water quality standards (and associated rules and regulations from PACFISH, INFISH and NWFP) in regards to sediment and turbidity. Even with active restoration (i.e., planting, seeding, etc.) there would be a time period (less than 6 months) where conditions would be susceptible to erosion and exceeding sediment and turbidity standards. All other components of Alternative 3 would comply with the Clean Water Act, State water quality standards for water temperature, sediment and turbidity, and toxic substances. All other components of Alternative 3 would be consistent with the NWFP ACS objectives, PACFISH, and INFISH RMOs. Despite the measures added to protect water resources within this alternative, this alternative would do less than Alternative 2 to maintain and restore aquatic and riparian habitats. Treatment of invasives within 10 feet of water would be limited to manual treatments of which have been shown to be relatively inefficient on rhizomatous plants on streambanks.

Cumulative Effects of All Action Alternatives

The amount of herbicide the Forest Service proposes to use for invasive plant management is a very small percentage of overall use within the Deschutes and John Day Basins, see the basis for cumulative effects in section 3.1.3. As seen from the analysis of direct and indirect effects, all of the alternatives have a very low potential to adversely affect water quality or contribute to adverse effects at the 6th field subwatershed scale. On the Deschutes/Ochoco NFs and the CRNG, 6th-field subwatersheds range from 5,000 acres to 45,000 acres. The 6th-field subwatershed scale was analyzed to establish the extent to which effects might occur. Most of the National Forest System lands analyzed in this FSEIS are in headwater areas (upstream of other sources of herbicides), with the exception of a couple locations located on the Crooked River Grassland. When project design features are implemented, the spatial extent of effects of herbicide use on NFS lands would mainly be limited to the site of application, and governed by the extent of the target species to be treated. This coupled with treatment caps, the scattered nature of treatments, and relatively quick dilution over time and space by mixing and addition of inflow, the amount of herbicide that may be delivered to a common point downstream is very small to nonexistent (see the direct and indirct effects analysis for the alternatives). Consequently the 6th-field subwatershed scale was large enough to capture any potential cumulative effects.

Herbicide would only be applied where needed; non-target vegetation and bare ground would not be treated. Project design in the 1998 EAs (Alternative 1) limited the potential for water contamination by herbicides or sediment. In addition to the discussion included in this FSEIS, 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. Conditions have not changed in the implementation, and effects of current herbicide use do not effect water temperature, sediment or water chemistry.

Sediment and Turbidity

Overall, no measurable increases in sediment or turbidity would occur as a result of the invasive plant treatments proposed in Alternatives 2. Under, Alternative 2 there are two PAUs in the Dry Paulina Creek Subwatershed (14.3 acres) that have a very small risk of small localized increase in sediment due to mechanical treatments associated with the reestablishment of desired vegetation after chemically treating houndstongue. However, 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 would be maintained alongside the stream channels, only a small area would be scarified, and active revegetation would take place to return grasses and forbs to the site. Livestock grazing may increase the length of time it takes to establish native vegetation if not kept off the areas. No other activites are planned within these PAUs in the future.

Roads and livestock use with the Dry Paulina subwatershed are potential sources of sediment although quantitative monitoring has not occurred. Road placement in this subwatershed is primarily parallel to streams, however 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 (this guideline is for big game habitat, not for water quality). 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 newly constructed road. Alternative 2 would mitigate potential effects in this location while Alternative 3 would eliminate mechanical treatments within 300 feet of all water. Consequently there are no expected cumulative effects due to this treatment from the overlap with roads.

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 (decades) affects from past management or events from current management. A new Allotment Management Plan was implemented in 2007, reducing use from 400 cow/calf pairs to 236 cow/calf pairs from June 1 to June 30. 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. Over the three seasons since implementation, there has been some amount of improvement in the density and vigor of riparian vegetation, based on visual monitoring within the West Pasture (Mafera 2010, pers. comm.). With continued improvement in riparian density and vigor there are no expected cumulative sediment effects due to cattle from treatments of PAUs in the Dry Paulina Creek Subwatershed. No other reasonably foreseeable activities were identified in this subwatershed.

A recent decision on the Travel Management Project prohibits motorized travel off existing designated routes (roads and trails) and areas - where it is not already restricted or prohibited. This project will be beneficial in reducing the risk of invasive plant introduction, by prohibiting off-road vehicle travel across 99% of the Forests landbase. The designated routes and areas open to motorized use and dispersed camping are expected to continue to have spread of invasive plants as is happening at present, as would the site specific OHV projects planned on the Deschutes and Ochoco Forests, Three Trails,

Lava Rocks and Ochoco Summit. Three Trails is currently in the implementation phase, while the other two are in the planning stages.

These three projects propose new trails designated for motorcycles, ATVs and jeeps. It is expected that despite prevention measures, invasive plants would be introduced through concentrated use. It is also expected that designating trails and building new routes is going to increase the number of riders visiting Central Oregon. As a result, these three trail projects have the potential to increase sediment into streams via trail crossings under constant use. PDFs for the trail projects prohibit building trails in weed infested areas; no overlap of weed control is at stream crossings are expected in the short-term. In the long-term (>4 yrs) EDRR may be necessary to control new infestations caused by OHV traffic. When new invasive plant sites are kept small by EDRR, the use of herbicide is not expected to create bare ground, and thus no resulting sediment.

Within Alternative 3, manual treatments that include intensive pulling/digging in areas within 10 feet of of fish bearing streams, non-fish bearing perennial streams, or perennial lakes, ponds, and reservoirs (like in the case of 2000 lineal feet along the Metolius River) have the potential to exceed State water quality standards (and associated rules and regulations from PACFISH, INFISH and NWFP) in regards to sediment and turbidity. Even with active restoration (i.e., planting, seeding, etc.) there would be a time period (less than 6 months) where conditions would be susceptible to erosion and exceeding sediment and turbidity standards. The magnitude, extent and duration of this increase in sediment would depend on several factors including but not limited to the size of the disturbance area, slope of exposed bank, soil type, and the magnitude and duration of a precipitation event. In the case of the Metolius River, if we treated 2,000 x10 lineal feet (or approximately 0.85 acres) of streambank by manual pulling/digging and did not actively restore (seed, plant, etc.) the site and thereafter received an 0.77 inches of rain in 30 minutes (a 25-year storm event for the the Metolius area) we could expect turbidity levels to exceed State standards. The exceedence would most likely extend downstream approximately 0.5 miles before the effect would be diluted. It is unlikely that the Forest Service would remove the vegetation from this large of an area adjacent to a waterbody. We would most likely manually weed whack these areas which would eliminate ground disturbance, and remove ribbongrass from smaller areas which would result in less chance for turbidity.

In addition to the unlikely chance that we would treat the 2000 lineal feet of bank along the Metolius River at one time, there is a very small chance of any cumulative effect from other projects producing sediment/tubidity at the same time. There is a slight chance of overlap in space and time with this project and the Suttle Lake Dam removal project. The dam removal project is expected to occur in the fall of 2012. The cumulative sediment/turbidity effect would likely last from a few hours to a few days.

Grazing is limited on the Deschutes NF where most emergent invasive species occur, and they occur on stream banks and lake margins that are generally protected during management activities such as timber harvest and prescribed burning. There are no other known projects that are expected to have a sediment/turbidity effect that would overlap with the manual treatments proposed within this project under Alternative 3.

Water Temperature

Overall, no measurable increases in water temperature are expected to occur as a result of the invasive plant treatments proposed. In the Upper Trout Creek Subwatershed (Wychus Creek Watershed), there is a low risk of a small decrease in shade in Trout Creek Swamp due to removing reed canarygrass, which is providing some amount of shade due to plant height (3-4 feet). The resulting temperature increase would not be measurable because subsurface flow through the fen and between channels would buffer any surface water temperature increase when the surface and subsurface flows re-combine in Trout

Creek below the swamp. Further, Trout Creek is not listed as being over temperature threshold on the 2004/2006 303(d) list. Past logging and roading have reduced shading in the Trout Creek 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.

For the most part, harvest and invasive plant treatments would not overlap spatially. Invasive plant species that create any amount of shade are ribbongrass and reed canarygrass growing directly on the streambank (in the primary shade zone). Vegetation management projects such as Upper Beaver Vegetation Management and West Bend Project propose to harvest trees within some riparian areas but these treatments would not remove shade from the primary shade zone.

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 are also expected to occur in areas where riparian invasive plants are treated on non-National Forest System lands, thereby providing additional improvements to streamside vegetation.

Water Chemistry

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. High algae concentrations in some lakes, reservoirs and streams in the planning area are primarily the result of nutrient input from the breakdown of local geology but this 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. The Upper Deschutes River Basin REMAP (ODEQ, 1999) attributed the large DO fluctuations to algae respiration and high pH values also appear to be the result of photosynthesis of large algal and microphyte assemblages. In addition to proposed treatments on streams and water bodies listed for pH, DO, and chlorophyll a, treatments are proposed for emergent vegetation (reed canarygrass) on water bodies with identified algal bloom problems: 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 blue-green algae blooms. Lava Lake is also on the state 303(d) list for DO.

The spot spray buffer for aquatic formulation glyphosate in Alternative 2 would prevent accidental overspray and drift of glyphosate into the water adjacent to treatment areas. Based on implementation of PDFs and buffers and intensity of treatments, potential herbicide delivery would be substantially reduced and should be below harmful concentrations and would not result in any measurable change in algae growth. As already discussed, precautionary measures would further prevent any similar effects from Alternative 3. No measurable increases in pH or chlorophyll a or decrease in DO are expected to occur as a result of the invasive plant treatments proposed in Alternatives 2 and 3. There would be no increase in the length of time a water body was on the ODHS Public Health Advisory for blue-green algae blooms. There would not be any cumulative effect to pH, DO, chlorophyll a, or blue-green algae blooms.

Herbicides in Water

Most of the National Forest System lands being analyzed for this FSEIS 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 gross acres of invasive plant control proposed within the aquatic influence zone (AIZ) in the Rimrock Springs 6th field subwatershed; and 120 gross acres in the AIZ within the Lower Wychus Creek 6th field subwatershed.

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 Evans 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. Application rates were 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 measurable concentrations. Protective measures include PDFs that limit application rates, limit application method near water, restrictions on the type of herbicide that can be used near water, intensity of treatments, and limited scale of infestations. Any herbicide reaching the stream would be quickly diluted as it moved downstream. 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 1.5 miles of stream per year. Additionally, Lake Billy Chinook is a short distance downstream and the large size of the lake would dilute any herbicides should they reach there. At the watershed scale, the amount of herbicide potentially reaching a common downstream point would not be measurable as discussed above.

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 private and other lands. To demonstrate the likelihood of herbicide moving downstream and mixing with herbicide residue originating from lands outside the Forests and Grassland, we consider the Headwaters Metolius River 6th field subwatershed in the Upper Deschutes Subbasin (the subbasin with the most invasive plant treatment and herbicide use within the aquatic influence zone). Because of the relatively large number of acres within the AIZ, the presence of the Metolius River, and lands of other ownerships just downstream that share 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 from Alternatives 2 and 3 is very low. The Metolius is a large-flowing waterbody which 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, there would be no contribution to cumulative effects from herbicide delivery to streams.

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.

Accumulation of residue from repeated treatments has been addressed in the PDFs. 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. The scattered nature of treatments, and dilution over time and space by mixing and addition of inflow downstream, the amount of herbicide that may be delivered to a common point downstream is very small to non-existent.

As described above, and discussed in Section 3.1.3, the effects of this project are unlikely to overlap in time and space with effects of other projects on and off the Deschutes/Ochoco and Grassland. The concentrations of herbicides that may enter the water would be small and are unlikely to combine with other chemicals that may be in the water to cause an adverse effect.

3.6.3 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 would 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 portions of watersheds is very small when compared to the size of the watersheds; most cover less than one-tenth of one percent (see Table 61).

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 analyses have not been completed for some of the 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. See Table 51 for the amount of treatment proposed within riparian reserves. Where a watershed analysis has not been completed, interim buffer widths from the NWFP are the standard. See Appendix I for a list of buffer widths for riparian reserves, some of which have been modified due to Watershed Analysis. As explained in the cumulative effects section, buffer widths, even those that are modified, do not influence the effects of proposed invasive plant treatments.

Table 51 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.

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.

Proposed invasive plant treatments that will take place in Riparian Reserves are consistent with the recommendations found in Watershed Analyses. The acres in Table 62 represent herbicide treatment only, which is often combined with manual pulling or other treatment methods. These acres are for areas where invasive plants occur, actual acres of invasive plants on the ground are usually less than 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.

Table 51. 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
Wickiup	Browns/Wickiup WA 1997 Odell WA 1999 Snow Lakes 2006	131,858	129.0
Fall River	Not completed	116,468	21.4
Pilot Butte	Not completed	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	Not completed	95,727	0.0
Whychus Creek	Whychus WA 2009	161,629	341.2
Upper Metolius River	Metolius WA Update 2004	140,809	490.0
Lower Metolius River	Metolius WA Update 2004	145,494	219.8
Upper Little Deschutes River	Not completed	80,021	16.0
Crescent Creek	Big Marsh WA 1997	118,932	162.3
Middle Little Deschutes River	Not completed	48,608	0.0
Little Walker Mtn.	Not completed	86,454	4.5

The following is a summary of how each alternative within this project either complies/does not comply with the Aquatic Conservation Strategy Objectives (ROD B-11); several of the objectives are similar to measures analyzed in detail in the Alternatives section 3.6.2 and the Fisheries Section 3.7.

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 outside designated Treatment Areas (TA) or not designated for treatment in the TA 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. Alternative 3 has more potential for sediment delivery to nearby streams due to manual pulling/digging treatments within 10 feet of waterbodies. These areas may instead be weed-whacked which would limit ground disturbance yet be less effective than herbicides at controlling the invasives population.

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 some degree of 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 with herbicide than Alternative 2. Some invasive plant populations within riparian areas would not get the most effective treatment. 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. In these areas manual pulling/digging or weed whacking would replace chemicals. 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 potentially altering the biological, physical, and chemical integrity of the aquatic system.

Alternative 2 would treat more invasive plants within riparian areas with herbicide 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 indicated that water temperatures drop below threshold within 6 months after treatments due to weather. Non-target and planted vegetation would 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 in riparian enviroments), 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 chemically treat fewer riparian acres than Alternative 2. Some invasive plant populations within riparian areas would not get the most effective treatment. Of those areas not treated manually, the populations are predicted to continue spreading at a rate of 10% annually. Alternative 3 has more potential for sediment delivery to nearby streams due to manual pulling/digging treatments within 10 feet of waterbodies. These areas may instead be weed-whacked which would limit ground disturbance yet be less effective than herbicides at controlling the invasives population. Because of this, Alternative 3 provides less opportunity for eradication of invasive plants and re-establishment of native riparian vegetation and more potential for sediment delivery (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 as discussed in the previous sections.

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 become 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 with herbicides (generally the most effective method of treatment) 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. 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 in most cases. 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 herbicide treatments in riparian areas (than Alternative 2) but more than Alternative 1. This alternative proposed to manually pull/dig or weed-whack those areas within 10 feet of streams not chemically treated. Manual treatments that involve extensive pulling/digging could result in exceeding State sediment and turbidity standards. Consequently, Alternative 2 does the most to preserve the existing sediment regime.

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. This is because of the relatively small size of invasive plant infestations (especially adjacent to water), the spatial distribution, staggered timing of treatments, and low water use of 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 chemically 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 where habitats overlap. 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 even with manual treatments, which would continue to displace and out-compete native riparian vegetation. Alternative 3 would do more than Alternative 1, but less than Alternative 2 to maintain and restore species composition and structural diversity of plant communities in riparian areas.

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 chemically 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 chemically 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.

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.

Summary

With the exception of manual pulling/digging rhizomatous invasive plants over long contiguous reaches of waterbodies in Alternative 3, the invasive plant treatments in the scope of this document are not likely to retard achievement of ACS objectives. The likelihood of the Forest Service manually treating (pulling/digging) large areas adjacent to a waterbodies is very unlikely. The Forest Service would most likely manually weed whack these areas which would eliminate ground disturbance but may not be as effective at controlling/eradicating the invasives population. Most 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 effects is low.

Less than one-half of 1 percent of National Forest Service system lands within any 5^{th-}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 small risk of adding some minor amounts of sediment and herbicide to surface water from emergent species control, but due to PDFs 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 major concern. Treatment areas comprise a small

portion of any watershed and Best Management Practices would be applied, 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 could reduce cover and shade for a short period of time along the stream's edge. However, a substantial 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 and spot spray applications of herbicides 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.

3.7 Fisheries and Aquatic Organisms

Introduction

Fish species and associated habitats within the aquatic environment being analyzed under this FSEIS 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. Effects to spotted frogs and Crater Lake tightcoil snails can be found in section 3.9- Wildlife. The Fisheries Report and Biological Evaluation, the Fisheries Biological Assessment, Worksheets, Management Indicator Species Report, and Supplemental Biological Assessment for Bull Trout Critical Habitat are incorporated by reference.

Proposed herbicide application incorporates a risk reduction framework (section 3.2) to ensure safe and effective use of herbicides. The framework is comprised of layers of caution built on the EPA herbicide approval process, label requirements, federal and state laws, results of the SERA herbicide risk assessments, required R6 2005 ROD standards, and project design features (PDFs).

The effects on aquatic organisms, including special status fish were assessed in the R6 2005 Invasive Plant Program FEIS Biological Assessment (USDA Forest Service 2005d). The main aquatic issue in the R6 2005 FEIS was the potential for herbicides to leach, drift, spill or run off into aquatic habitats and harm aquatic organisms. One aquatic approved herbicide, glyphosate, has been shown to affect fish olfaction in lab settings (Tierney et al. 2006). 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, minor 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. High concentrations could enter waterbodies as a result of an accidental spill. Accidental spills are not part of this proposed action and measures will be taken to prevent spills.

Forest Plan Standard 19 (see Chapter 1, section 1.5.1) 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 feet 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 (USDA Forest Service 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 feet. Riparian areas wider than 100 feet in Central Oregon are usually associated with wetland habitats and these will be buffered similar to streams (see a detailed explanation of the 100-foot zone and effects on pages 220-221).

3.7.1 Affected Environment

Federally Listed Fish and Critical Habitat, Sensitive Species

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 (Table 52 and Table 53). 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 Invasive Plant Treatments EIS Fisheries Biological Assessment (USDA Forest Service 2009). 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.

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.

On October 18th 2010 critical habitat for bull trout was re-designated in the coterminous United States with an effective date of November 17, 2010. The previous designation (2005) did not designated critical habitat on Forest Service owned waters, while the re-designation of critical habitat does encompass streams, rivers, and lake habitats with current and historical distribution on the Deschutes and Ochoco National Forests and Crooked River National Grassland.

Federal lands were designated critical habitat and occur where all known populations of bull trout occur on the two Forests and National Grassland. Critical habitat was designated in two units in this project area. The designation in the Lower Deschutes River Unit includes 85.2 miles of habitat in the Metolius River, 5.5 miles of Whychus Creek, 2.7 miles of Street Creek and 3,926 acres of habitat associated with Lake Billy Chinook. This unit provides spawning, rearing, foraging, migratory, connecting, and overwintering habitats. Within the Odell Lake Unit the designation includes 17 miles of stream (Odell, Trapper, Crystal, and Unnamed tributary Creeks) and 3,427 acres of habitat associated with Odell Lake. This unit provides spawning and rearing habitat.

Interior Columbia River Redband Trout, Westslope cutthroat trout, and shortface lanx are on the 2008 Region 6, Regional Foresters sensitive species list (http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy). The sensitive species list was updated in 2011 however projects initiated prior to this date may use the list that was in effect when the project was initiated (USDA Forest Service 2011). The analysis

in this section was not updated to reflect the new list. Changes to the sensitive species list will be reviewed during implementation, surveys conducted and PDFs applied as necessary. 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 52. 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, 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 expected to be reintroduced in next 5 years*	Squaw Creek (Whychus Creek), Mckay Creek, Middle Deschutes River, Lower Crooked, Upper Crooked
Bull Trout	Columbia River	Threatened	64 FR 14508 03/25/99	Upper Metolius River, Lower Metolius River, Potter Canyon – Deschutes River, Squaw Creek (Whychus Creek), Juniper Butte – Crooked River, Browns Creek - Deschutes
	Lower Deschutes River Unit and Odell Lake Unit Critical Habitat	Designated	75 FR 63898 10/18/2010	Metolius River, Street Cr, Whychus Cr, Lake Billy Chinook, Odell Lake, Odell Cr, Trapper Cr, Crystal Cr, unnamed tributaries

*None of these reintroduced populations have had critical habitat designated.

Table 53. Designated Essential Fish Habitat 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 evolutionary significant unit (ESU) or distict population segment (DPS) scale can be found at the following sources, and are incorporated by reference:

- Regional Invasive Plant FEIS Fisheries Biological Assessment, Environmental Baseline (USDA 2005d).
- 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

Management indicator aquatic species were designated only on the Ochoco NF as part of the Forest Plan. 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 FSEIS and in Appendix H. Additional information, incorporated by reference, can be found in the Aquatic Management Indicator Species Analysis (Rife 2011) located in the analysis file.

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 Class II streams. 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. Additional information on brook trout can be found in the Aquatic Management Indicator Species Analysis (Rife 2011) located in the analysis file.

Fish Species and Their Status

Table 54 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 54. 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.
Lower Deschutes River (Metolius) Bull Trout Critical Habitat	Designated on the Metolius River and Tribs, Whychus Creek, Deschutes River below Steelhead Falls, Crooked River below Opal Springs.
Upper Deschutes River Populations	Upper Deschutes River/Little Deschutes River and Crescent Lake/Crescent Creek populations probably extinct.
Odell Lake Unit Bull Trout Critical Habitat	Designation includes Odell Cr., Trapper Cr., Crystal Cr. Maklaks Cr., Unnamed Tributary, and Odell Lake.

Species	Status
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 / Ochoco NF MIS*	
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 –*Region 6 Sensitive / Ochoco NF MIS*	
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 species 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 to other populations and available habitat (Rieman 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, and 532 redds were counted in 2011. 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 0.50-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 (USDA Forest Service 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 (USDA Forest Service 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, pers. comm.). 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.

Lower Deschutes River Bull Trout Critical Habitat

On October 18th 2010 critical habitat for bull trout was re-designated in the coterminous United States with an effective date of November 17th, 2010. The previous designation (2005) did not designated critical habitat on Forest Service owned waters, while the re-designation of critical habitat does encompass streams, rivers, and lake habitats on the Deschutes and Ochoco National Forests and Crooked River National Grassland.

Federal lands were designated critical habitat and occur where all known populations of bull trout occur on the two Forests and National Grassland. Critical habitat was designated in two units in this project area. The designation in the Lower Deschutes River Unit (Unit 6) includes 85.2 miles of habitat in the Metolius River, 5.5 miles of Whychus Creek, 2.7 miles of Street Creek and 3,926 acres of habitat associated with Lake Billy Chinook. This unit provides spawning, rearing, foraging, migratory, connecting, and overwintering habitats. Within the Odell Lake Unit (Unit 7) the designation includes 17 miles of stream (Odell, Trapper, Crystal, and Unnamed tributary Creeks) and 3,427 acres of habitat associated with Odell Lake. This unit provides spawning and rearing habitat.

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, pers. comm..). 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.

Snorkel surveys for juveniles 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 tributary 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.

Odell Creek Bull Trout Critical Habitat

On October 18, 2010 critical habitat for bull trout was re-designated in the coterminous United States with an effective date of November 17, 2010. The previous designation (2005) did not designated critical habitat on Forest Service owned waters in this unit, while the re-designation of critical habitat does encompass streams and lake habitats in the Odell Creek area. Within the Odell Lake Unit (Unit 7)

the designation includes 17 miles of stream (Odell, Trapper, Crystal, and Unnamed tributary Creeks) and 3,427 acres of habitat associated with Odell Lake. This unit provides spawning and rearing habitat. The re-designation of critical habitat for bull trout required the Forests and Grassland to supplement the biological assessment to describe effects to critical habitat with implementation of this project (see the Supplemental Analysis for Designated Critical Habitat for Bull Trout in the project file, and which is incorporated by reference).

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 (MIS species on Ochoco NF)

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. Steelhead are also an Ochoco NF MIS species. 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. 1992). 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. 1992).

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 steelheads 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° 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.

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.

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 recovery 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. (Lovtang 2005). 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 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 and brook trout are also designated as Ochoco NF MIS species; redband trout serve as a surrogate for brook trout in this analysis because they occupy the same streams and habitat. Brook trout are fall spawners that have been introduced and are non-native to the Western United States. Brook trout are no longer stocked in Oregon where they have the chance of intermixing with native fish populations. They can interbreed with bull trout creating sterile hybrid offspring and are often targeted for removal where native bull trout exist.

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 Forest Service 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, pers. comm.). 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 (USDA Forest Service /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 (USDA Forest Service 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 (USDA Forest Service 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 (USDA Forest Service 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 USDA Forest Service 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 Forest Service 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.

Westslope Cutthroat Trout (Forest Service Region 6 - Sensitive Species)

Westslope cutthroat trout are listed as a USDA Forest Service Region 6 sensitive species that is listed for the Ochoco N.F. However, westslope cutthroat trout have not been documented on the Ochoco N.F. but they do exist on the Malhuer N.F. and private lands outside the project area. The potential presence of westslope cutthroat trout dates back to reported sightings on Birch Creek by now retired ODFW biologist Errol Claire. Electrofishing along the length of Birch Creek by ODFW and USDA Forest Service biologists in the early 1990s found only redband trout. Birch Creek is a tributary to the John Day River and is located almost entirely on private lands with the upper most headwater tributaries

located on National Forest System lands. Because westslope cutthroat have been surveyed for but not been documented within the project area it would be hard to assess effects to this species. Effects to them would be similar to redband trout.

Other Fish Species and Aquatic Species

In the Crooked River Basin, redband trout dominate 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.

The shortface lanx was identified as a sensitive species on the 2008 USDA Forest Service Region 6 Sensitive Species list for the Ochoco National Forest. Although there have been surveys, this species has not been documented, but may occur on the Ochoco National Forest or the Crooked River National Grassland.

All documented sites on the Deschutes River for this species have occurred downstream of the Pelton Round Butte dams which is downstream of the Ochoco National Forest and Crooked River Grassland. Neitzel and Frest (1992) surveyed eight sites above the Pelton Round Butte dams including one site on the Crooked River. The eight sites were surveyed from above the Pelton Round Butte dam complex to near Bend and no shortface lanx were collected or observed. Suitable habitat only exists in very large river systems and if they were present they would be restricted to larger rivers such as the Middle Deschutes River, Lower Metolius River and Lower Crooked River. It is possible that populations exist but is unlikely due to the fact that Neitzal and Frest (1992) found none in the Deschutes upstream of the Pelton Round Butte dam complex and both the Deschutes and Crooked Rivers have had significant flow reductions due to irrigation diversion for over a century that would have likely impacted this species if they were once present.

Fish Habitat Conditions

The biological requirements of anadromous fish vary depending on the life history stage and the natural range of variation present within aquatic systems. During spawning migrations, adult fish require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*e.g.,* gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13°C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires access to these habitats. Physical, chemical, and thermal conditions may impede movements of adult or juvenile fish.

The condition of aquatic habitats on Federal lands and adjacent lands varies from excellent in wilderness, roadless, and undeveloped areas to poor in areas heavily impacted by development and natural resource extraction (FEMAT 1993, McIntosh et al. 1994, Wissmar et al. 1994, Lee et al. 1997).

Within the proposed action area, aquatic habitats on Federal lands have been degraded by road building, timber harvest, splash damming, livestock grazing, water withdrawal, agricultural activities, urbanization, and construction of reservoirs and dams (McIntosh et al. 1994, Wissmar et al. 1994, Lee et al. 1997). Road construction has increased the drainage network of watersheds, created fish passage barriers at road-stream crossings, and increased delivery of fine sediments. Timber harvest has removed shade-providing trees, decreased recruitment of large woody debris, and increased delivery of fine sediments to streams. Splash damming severely degraded stream channels by removing habitat elements such as boulders and large woody debris and increasing stream width-to-depth ratios. Unmanaged livestock grazing has led to incised stream channels, removal of riparian vegetation, alterations of riparian vegetation communities, increased stream width-to-depth ratios, and trampled stream banks. Water withdrawal reduces base flows in streams in montane environments where natural base flows are already low. Water diversion structures can block fish passage and unscreened diversions can entrain fish into canals where they become trapped and die. Streams have been straightened and diked to accommodate transportation infrastructure and agriculture development. Construction of dams and reservoirs has blocked fish passage, altered natural hydrologic cycles, and interrupted bedload movement. For more specific subwatershed baseline conditions within the action area for bull trout and steelhead see the Joint Aquatic and Terrestrial Programmatic Biological Assessment for Federal Lands within the Deschutes and John Day River Basins Administered by the Deschutes and Ochoco National Forests (USDA Forest Service 2010).

Proposed treatment areas generally have been physically disturbed by activities that have created bare mineral soil and/or compacted conditions. These activities include road construction, machinery traffic related to commercial logging operations, recreational uses, quarry excavations, pile burning of logging slash, and wildfire. The majority of infested sites identified for treatment and the areas where they are likely to expand are along road corridors (approximately 70% of project area units).

In the summer of 1997 and 1998, Oregon's Department of Environmental Quality (ODEQ) collected water samples in the Deschutes Basin above Lake Billy Chinook for herbicide analysis, as part of the EPA sponsored Regional Environmental Monitoring and Assessment Program (REMAP). Samples were collected at 49 stations in the basin. Parameters determined in the field were water temperature, dissolved oxygen (DO), pH, conductivity, and turbidity. Parameters analyzed in the lab were biochemical oxygen demand-5 (BOD-5), total solids, ammonia-N, nitrate-N, total P, sulfate, total Kjeldahl-N, alkalinity, herbicide oxygen demand, dissolved organic carbon, and total suspended solids. A water quality index (WQI) was developed for the basin using DO, DO saturation, BOD-5, pH, total solids, combined nitrogen (nitrate and ammonia), and total phosphorus. Water quality for a site was then categorized as 0-59 = very poor, 60-79 = poor, 80-84 = fair, 85-89 = good, and 90-100 = excellent.

ODEQ divided the basin into three sub-basins: the Metolius, the Deschutes, and the Crooked River (not the same as USGS sub-basins). It found that water temperatures were not much of a concern on the Metolius and all DO samples met state standards. Metolius WQI scores ranged from 91-99, indicating excellent water quality. Water temperatures and DO were more variable in the Deschutes. The R-EMAP crew found that Crescent Creek did not meet state DO standards and two out of three visits found the Little Deschutes close to non-compliance. WQI scores in the Deschutes sub-basin ranged from 66-98 with the two lowest scores occurring on the Deschutes River and on lower Whychus Creek. The lower scores on these two streams are to be expected based on the higher nutrients, low pH, and slightly higher total solids on Whychus Creek and the high temperatures, pH, DO saturation, and phosphate

levels on the Deschutes River. Temperatures in the Crooked River DEQ sub-basin tended to be higher than those in the Metolius or the Deschutes with 44 percent of the 34 stations exceeding state thresholds. DO levels dropped below the state threshold at 8 sites but only three were non-compliant by also failing to meet the 90 percent saturation requirement. WQI scores in the Crooked River sub- basin ranged from 26-97. Fox Canyon Creek (score 26) had only small residual pools and Dry Paulina Creek (score 49) was nearly stagnant. Streams in the Ochoco Mountains generally have higher water quality while those at lower elevations tended to have poorer water quality over all. The portion of the John Day River basin and the Lower Deschutes and Trout Creek USGS subbasins in the planning area should be comparable with the Crooked River. Because many of the streams in the action area are headwater streams on National Forest lands, chemical source pollution is low.

Under the current environmental baseline, the biological needs of listed fish are being met on some Federal lands in proposed action area and not being met in others. Since a typical action area of an herbicide treatment will be already degraded in one form or another, at least some biological requirements of listed fish are likely to be unmet.

Primary constituent elements (PCEs) of critical habitat for steelhead, *i.e.*, the physical and biological elements that support one or more life stages and are considered essential to the conservation of the species were identified in our critical habitat designation (Table 55)

Table 55. Types of sites and essential physical and biological features designated as primary constituent elements (PCEs) for steelhead, and the life stage each PCE supports

Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain, connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover	Juvenile and adult mobility and survival
Estuarine areas freshwater	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological, transitions between salt and freshwater
	Natural cover, forage, and water quantity	Growth and maturation

The effects to each ESA listed fish species, critical habitat and EFH can be described by further analyzing factors of proximity, probability, magnitude, duration, nature, distribution, frequency, and timing of the proposed action. The Project Element is the removal of invasive weeds either by the use of herbicides or by pulling of plants. Primary constituent elements of critical habitat are referred to as Habitat Indicators. Habitat indicators (HI) are discussed in the Biological Assessment (USDA Forest Service 2009) for invasive plant removal are “chemical (herbicide) contaminants (HI 1), sediment/turbidity (HI 2) and off channel habitat (HI 3).” The proposed action had no causal mechanisms to affect any other matrix indicators. The BA (USDA Forest Service 2009) addresses the habitat indicators mentioned above in detail.

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 2 and 3 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 feet on either side of stream was used to determine where effects to fish in streams, rivers and lakes may occur from chemical application because most riparian areas within the project area are less than 100 feet wide on either side of the stream. Level 2 Stream Survey data indicates that the majority of true riparian vegetation around major class 1 and 2 streams within the analysis area is generally less than 100 feet. (USDA Forest Service 1989-2005 unpublished data, S.O. files). There are some cases where riparian areas, wetlands or wet meadows exceed 100 feet and these areas will be protected by buffers around these zones and discussion will not be limited to the 100-foot riparian influence zone.

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.

Consistency with these design features and conservation measures will ensure that the effects to fish are within those estimated in the R6 Invasive Plant FEIS (USDA Forest Service 2005a), the NMFS

Biological and Conference Opinion (USDC 2005) and the USFWS Biological Opinion Concurrence and Conference Report (USFWS 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 FEIS ESA/MSA consultation.

Table 56. Conservation recommendations from Biological Opinion and corresponding project design features

Conservation Recommendation from R6 2005 BO	Project Design Feature No. of this FSEIS
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 Table 15 and Table 16)
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 within 24 hours of spraying.	17: precipitation
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 2005 FEIS 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 is proposed
Aerial spray should be released at the lowest height consistent with invasive plant control and flight safety.	No aerial application is proposed

Early Detection/Rapid Response

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, new or previously undiscovered infestations would be treated using the range of methods described in this FSEIS, and according to the Project Design Features. The nature of invasive plant species makes this a necessary component of the Forests' treatment program:

- The precise location of individual target plants, including those mapped in the current inventory, is subject to rapid and/or unpredictable change;

- The NEPA process does not allow for rapid response; infestations may grow during the time it takes to prepare 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 invasive 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. The assumption is that new infestations will be similar to current infestations. For instance, the majority of invasive plant sites occur along roads and that will probably be the case into the near future. It is also expected 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.

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 FSEIS 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. This strategy would follow the design of the alternative chosen. More information on EDRR and the Implementation Planning Process can be found in the proposed action (Chapter 2) of this FSEIS and Appendix F.

The following steps went into developing the EDRR approach:

1. The invasive plant inventory for the Deschutes and Ochoco NF and Crooked River National Grassland was updated. Infested sites were aggregated into Project Area Units (Units) and entered into a database.
2. The Interdisciplinary Team considered the site conditions within the units and analyzed the potential effects of the preferred treatment methods for the areas.
3. Project Design Features (PDFs) were developed to minimize or eliminate adverse effects for situations where there was potential, resulting in low risk to people or the environment (PDFs are located on section 2.4 of this FSEIS).
4. Treatments below bankfull in streams or yearly high water mark in lakes and ponds would be restricted to 1.0 acres per year within any 6th-field subwatershed.
5. Future EDRR treatments above bankfull or yearly high water mark but still within the aquatic influence zone would be restricted to 10 acres per year along 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 streams, perennial lakes, perennial ponds and wetlands.
6. Outside of the aquatic influence zone, in the uplands to account for a 10% spread of invasive plants per year an additional 10% of what is already inventoried in each watershed could be treated each year. This would allow for the treatment of inventoried plant sites (14,547 ac) plus 10% for EDRR treatments (1,455 ac) for a total of 16,002 acres as the maximum area treated.
7. The Implementation Planning process 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 FSEIS) to eliminate or minimize adverse effects. Uncertainty is addressed through monitoring and adaptive management.

8. Pre-project coordination and post-project reporting with NMFS, USFWS and local Level 1 teams would follow the process outlined in the invasive plant portion of the NMFS biological opinion for Fish Habitat Restoration Activities in Oregon and Washington (USDC 2008, 2012, USFWS 2011).

3.7.2 Environmental Consequences

Introduction

The environmental consequences discussion focuses on the potential impacts of removing invasive plant populations by herbicide 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 (USDA Forest Service 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 Table 56 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. Ochoco NF Management Indicator Species are analyzed under the Threatened and Sensitive fish species sections. 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. The shortface lanx is a designated sensitive species on the Ochoco NF and Grasslands. They have not been documented in the project area but surveys were limited to the Middle Deschutes River and lower Crooked River. Due to habitat requirements they are restricted to large river systems and will be included in the analysis. Surveys would be conducted in appropriate habitat before treatment takes place

Six different treatment methods (manual, mechanical, biological, cultural, fire, and herbicides) were analyzed in the R6 2005 FEIS (refer to Table 10 in 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, due to aquatic issues related to invasive plant management from herbicide applications.

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 small amounts of fine sediments to fish bearing streams. Invasive plants are pulled as individual plants and would only leave scattered small divots where plants are removed. All the native species of fish found within the analysis area are stream or river spawners. Excessive inputs of fine sediments that enter a stream can 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. Invasive plant pulling most often occurs on small populations or scattered individual plants. Amounts of fine sediments produced from this action would be small and undetectable against natural sources and other man made sources of fine sediment (See Soils and Water Resources, sections 3.5 and 3.6). However, pulling of emergent vegetation growing in or on the margins of waterodies would cause disturbance to juvenile fish, possible trampling and loss of overhead cover.

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 where spawning takes place, this method could potentially add fine sediments to a stream and potentially impact spawning success. However due to buffers for this activity and where it is proposed in relation to spawning areas sediment impacts to fish are not expected (for more detail see Soils, section 3.5)

Mowing and weed whacking may be used in some cases to remove biomass or seed heads, usually in conjunction with other treatments. Mowing and weed whacking are not ground disturbing activities but they would remove vegetative cover that could be important 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 (for more analysis see the Water Resources Section 3.6).

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 section.

This should be a beneficial effect to areas where invasive plants have been eliminated through different treatment methods.

Cultural – Soil enhancement such as 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.

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. Restoration of bare soil patches with native plantings and possible use of mulching and soil amendments may be necessary to speed recovery of native vegetation and minimize the potential for sediment input to waterbodies.

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

SERA risk assessments are used for this analysis to place potential effects to fish and aquatics in context. Herbicide 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 is normally used for such assessments (lower threatened and endangered species thresholds were applied to all wildlife, fish and other aquatic organisms). 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 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).

Although herbicides used for aquatic invasive plant control have been shown to affect aquatic species, concentration of herbicides coming in contact with water following land-based treatments in this proposed project is unlikely to be great enough to cause detrimental effects. 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. Sublethal effects could also result from substantial changes to habitat or food supply.

Herbicides considered for use in this project have the potential to harm aquatic plants or algae. However, following herbicide label requirements and PDFs included in Chapter 2 are expected to prevent adverse effects to fish behavior or survival. 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.

Effects of Active Ingredients in Herbicides to Aquatic Organisms

The analysis does not consider the effects of herbicides by fish species; instead, 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 57 lists the toxicity indices for fish used for this project and the R6 2005 FEIS BA (USDA Forest Service 2005d). Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Generally, the lowest toxicity index available for the species most sensitive to effects was used.

Table 57. Toxicity indices for fish (USDA Forest Service 2005d)*

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**	Juvenile 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[3]
	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** (1/20th LC50)	Chum salmon	LC50 at 5.3 mg/L[3]
	Chronic	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
Triclopyr BEE	Acute		**0.012 mg/L**	Bluegill sunfish	LC50 at 0.25 mg/L

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
	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

* 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 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 2003a).

3 This is the LC50 for the Poast formulation, which contains a toxic solvent. Exposures to Poast are about 100 times more hazardous than exposures to technical grade sethoxydim (i.e. active ingredient) (SERA 2001 Sethoxydim, p. 4-18).

4 Using Wan et al. (1989) value for lethal dose.

5 Chronic and subchronic data for triclopyr are limited to triclopyr TEA. No data is available for triclopyr BEE.

6 Exposure includes small percentage of NP and NP1-2E (Bakke 2003).

7 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 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 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. Acute exposures are generally 24 hours for fish, and data on chronic risks are typically generated by continuous exposures for 96-hours up to and including complete life-cycle studies, depending upon the chemical (SERA 2007).

Results of the R6 2005 FEIS analysis using SERA (2001, 2003, 2004, 2011) risk assessments indicates that chronic exposures to fish are not plausible or mathematically possible. Therefore, chronic exposures to fish for the proposed action would not be expected to occur. Based on SERA (2001, 2003, 2004, 2011) risk assessments a LOC (Level of Concern) for chronic exposures would not occur as a result of herbicide treatments on the ONF, DNF or CRNG.

The R6 2005 FEIS 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 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 concluded that exposure of aquatic plants to chronic toxicity concentrations of these herbicides to be mathematically impossible. 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.

The U.S. EPA/OPP (1993c) classified technical grade glyphosate (similar to the aquatic formulation) as non-toxic to practically non-toxic in freshwater fish (SERA 2003a). The use of less toxic formulations results in hazard quotients that do not approach a level of concern for any species (SERA 2003a). Various field studies have not noted any remarkable effects on aquatic invertebrates. At application rates of one liter of Rodeo per hectare for the control of purple loosestrife, Gardner and Grue (1996) noted no adverse effects on aquatic invertebrates. At application rates of 0.94 or 1.48 kg a.i./ha as glyphosate IPA (Rodeo), Hagg (1986) found no indication of lethality in two water hyacinth weevils, *Neochetin eichhorniae* and *N. bruchi*. In a forest pond mesocosm, Hildebrand et al. (1980) found no differences in invertebrate survival over an 8-day period after application of 2.2 kg/ha, 22 kg/ha and 220 kg/ha (SERA 2003a).

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, 2011) risk assessments. It must be made clear that the risk categories for herbicides identified in the R6 2005 FEIS Fish BA (USDA Forest Service 2005d) is risk to aquatic organisms (fish, invertebrates, algae, aquatic macrophytes) among the herbicides analyzed for the R6 2005 FEIS; these herbicides were compared to each other and placed in a risk level category according to results from worst-case acute exposure scenarios used in the SERA (2001, 2003, 2004, 2011) risk assessments.

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 2005 FEIS and are primarily based on the finding in the SERA (2001, 2003, 2004, 2011) 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 Herbicides analyzed in the R6 2005 FEIS were displayed in the following category of risk:

- **Lower level of concern** for aquatic species: clopyralid, imazapic, metsulfuron methyl

  Results from SERA risk assessments indicated no risk or a plausible risk to aquatic macrophytes only.
- **Moderate level of concern** for aquatic species: chlorsulfuron, imazapyr, sulfometuron methyl

  Results from SERA risk assessments indicated a plausible risk to algae or invertebrates, in addition to plants.
- **Higher level of concern** for fish species**:** glyphosate, triclopyr, picloram, sethoxydim

  Results from SERA risk assessments indicated a plausible risk to fish (may or may not be a risk to algae, invertebrates, or macrophytes).
- **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.

See the Wildlife Section 3.9.2 for an in-depth discussion of herbicide mixtures, inert ingredients including adjuvants and impurities, surfactants, endocrine disruption and synergistic effects.

Site-Specific Effects Analysis Overview

The direct and indirect effects of herbicide treatment for this FSEIS were analyzed with the GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems, SERA 2005) using a worst case site scenario along a waterbody, combined with average rainfall, high rainfall estimates and soil characteristics for each of the 6th field subwatersheds. An emergent vegetation analysis and SERA (2008) GLEAMS Driver model was also used for analyzing effects to treatment of ribbon/reed canarygrass, yellow flag iris and knapweed. The results from the GLEAMS model (SERA 20005) overestimate herbicide concentrations due to the model using a broadcast treatment of a 10 acre strip directly adjacent to a small stream with grass vegetation that assumes none of the herbicide was taken up by vegetation and the herbicide reaches the stream at one point. These are conditions that will not be duplicated with this project because of Project Design Features and on site conditions. The additional analysis using the GLEAMS Driver model (SERA 2008) takes into account much more detailed site specific variables and herbicide application variables and is therefore much more accurate and sensitive to change. Results from the GLEAMS Driver model (SERA 2008) indicate that levels of herbicide reaching waterbodies would be well below levels of concern in the Metolius site and in the Rimrock Springs site which are considered the most sensitive sites for herbicide application due to their proximity to water and species of concern (see Appendix F). As a result, sites in other sub-watersheds that are all in less sensitive areas will have even less of a potential for effects to species and habitats. As an added layer of caution where herbicide hazard quotients of 1.0 were exceeded for a certain herbicide in a subwatershed using the GLEAMS model (SERA 2005) PDF 54 was established which restricts herbicide application to the typical application rate within 100 feet of all waterbodies and prohibits or restricts the use of certain herbicides in certain subwatersheds.

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 6th-field 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. Cumulative effects were analysed at the 5th field because connectivity of spawning fish populations which are part of one genetic population are often found at the 5th field scale or larger. There are 51 5th-field 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.

SERA Risk Assessment Worksheets (Version 4.02b)

Risk assessments for individual herbicides proposed for use in this FSEIS have been compiled for the Forest Service by SERA (2001, 2003, 2004, 2011). These risk assessments were designed to adequately identify sub-lethal effects to fish and their significance to fish populations. The SERA risk assessments also cover any studies for the effects of a given herbicide on aquatic plants, algae, macroinvertebrates, and water chemistry when information from these types of studies is available. Studies on effects to aquatic fungi or unicellular organisms are generally not available. Herbicide effects to these types of organisms are possible but standards to protect other aquatic organisms should serve to protect these

organisms as well. The SERA risk assessments are accessible via the internet at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml. Risk Assessment Worksheets (SERA 2001, 2003, 2004, 2011) analysis was completed for proposed treatments in each watershed where listed steelhead or bull trout are present. These local risk assessments were designed to adequately identify sub-lethal effects to fish and their significance to fish populations using local precipitation and soils inputs.

The SERA risk assessments model the amount of herbicide that can reach water under several different scenarios, then compares results to existing monitoring data to check the accuracy of the model. A stream or water body contaminated by runoff and percolation immediately after application of an herbicide is the scenario used to predict acute exposure to aquatic species. Herbicide concentration levels in water are estimated from monitoring and modeling data. Dissipation, degradation and other environmental processes are considered to predict chronic exposure for aquatic species. Under the risk assessments, three types of estimates were used for the concentration of each herbicide in ambient water: acute, accidental, and chronic exposure. Acute exposures are short-term while chronic exposures occur over time. Acute exposures are generally 24 hours for fish, and data on chronic risks are typically generated by continuous exposures for 96-hours up to and including complete life-cycle studies, depending upon the chemical (SERA 2007).

Streams and other waterbodies can be contaminated from runoff, as a result of leaching from contaminated soil, or from a drift or droplets. Estimates for the concentration of herbicides in ambient water were completed for the R6 2005 FEIS (USDA 2005a) risk assessments. Herbicides can enter the water by atmospheric deposition, spray drift surface water runoff, percolation groundwater contamination and direct application. PDFs such as timing of application, buffers to protect waterbodies, droplet size restrictions, and lowest effective application rates have been created to minimize or avoid water contamination. In addition to these PDFs, following EPA approved label guidelines for each herbicide will help avoid or minimize contamination of water.

The SERA (2005) Worksheets (Version 4.02b) use a root zone model to examine the fate of herbicides in various types of soils under different meteorological and hydrogeological conditions. Water contamination estimates were based on outputs from the GLEAMS model plus a water dilution model. As with many environmental fate and transport models, the input and output files for the SERA Worksheets can be complex. The general application of the SERA Worksheets and the use of the output from this model to estimate concentrations in ambient water are detailed in SERA (2001, 2003, 2004, 2011). Using the SERA Worksheets, the default assumptions used to calculate plausible (mathematically possible) herbicide exposures were:

- 0.25 acre pond, 1 meter deep, with a 0.01 sediment fraction. 10 acre square field (660' by 660') with a root zone of 60 inches and four soil layers.
- Stream with base flow rate of 4,420,000 L/day with a flow velocity of 0.08 m/second (1.8 cfs) or 6912 meters/day. Stream width of two meters (about 6.6 feet') and depth of about 1 foot. With a 10 acre square field (660' by 660') adjacent to the stream.
- Broadcast spray application on sparse grass vegetation cover on 10% slope, which assumes that there is no herbicide taken up by vegetation.
- Broadcast application applied to 10 acres stretching along 1.5 miles of stream.
- Worst combination of soil and rainfall (different for each herbicide), with rainfall timing of once every 10 days, with rain event beginning 24 hours after treatment. Local soil and rainfall conditions were used for each subwatershed analyzed in this FSEIS.
- Assumes herbicide reaches the water at one point.

- The most sensitive no observable effect concentration value for the most sensitive species were used to derive the toxicity thresholds.
- For estimates of exposures, we used the central exposure limits from the SERA risk assessment worksheets and assessed impacts at the typical application rates.
- Steady delivery of herbicide into a stream over 90 days for fish and 21 days for invertebrates, algae, and aquatic plants.
- The aggregate risks of exposure to TCP (a major metabolite; 3,5,6-trichloro-2-pyridinol) from the breakdown of both triclopyr and chlorpyrifos (an insecticide) are considered in SERA risk assessment for triclopyr due to toxicity to aquatic organisms. The most conservative estimate of exposure to TCP is reflected in the applications of triclopyr and chlorpyrifos, which are spaced in such a way as to result in the maximum possible concentrations of TCP in water (SERA 2003).

Under the R6 2005 FEIS the application of herbicides was not expected to result in mortality to listed aquatic species (USDA Forest Service 2005a). Most direct effects from herbicides on listed aquatic species are likely to be from sub-lethal herbicide effects, rather than from direct mortality as a result of herbicide exposure, or from non-herbicide treatment methods. Sub-lethal effects are considered under the ESA to constitute "take", if the sub-lethal effect "harms" a listed aquatic species (50 CFR 222.102). The ecological significance of sub-lethal effects depends on the degree to which they influence behavior essential to the survival and reproductive potential of individual listed aquatic species. Sub-lethal effects are not readily apparent and it may be difficult or impossible to detect or monitor changes to fish behaviors in the wild.

A summary of acute and chronic toxicity indices for listed aquatic species is provided on page 218 of the R6 2005 BA (USDA Forest Service 2005d). These toxicity indices were used to determine whether estimated herbicide concentrations may pose a toxicity risk to ESA listed aquatic species. Risk can be estimated by first calculating a hazard quotient (HQ), defined as the estimated environmental concentration (EEC) of the herbicide divided by the most sensitive acute or chronic toxicity index available, such as no observable effect concentration (NOEC) or 0.05 of an LC50. If the HQ is less than or equal to1, then the estimated exposure is less than the toxicity index. At this exposure, the risk of adverse effects to ESA listed, management indicator species, or Sensitive Species list aquatic species is expected to be discountable. The SERA (2001, 2003, 2004, 2011) risk assessments provide a matrix of EECs for each herbicide, with rainfall and soil type as the varied input parameters.

For the R6 2005 BA (USDA 2005d) consultation, the influence of local site-specific environmental conditions (such as slope, elevation, stream flow, etc.) on the generic EEC predictions was estimated by considering the potential influence of local conditions in five geographical settings or ecotypes present within USDA Forest Service Region 6. The purpose of the ecotype analysis is to determine whether the use of input values for local environmental conditions has the potential to significantly influence stream herbicide concentration predictions in the SERA risk assessments, which used generic default input values for environmental conditions. If using local environmental conditions can result in predictions of greater stream herbicide concentrations, the risk of adverse effects to listed aquatic species may be underestimated by relying on generic environmental input values used in the SERA (2001, 2003, 2004, 2011) risk assessments. The influences of these five ecotypes on the SERA risk assessment predictions are located in Appendix C of the R6 2005 BA (USDA 2005d). The following three ecotypes, Eastern Grasslands, Blue Mountains and Eastern Cascades are similar to the ecotypes present in the action area. The Eastern Grasslands is the same or similar to the CRNG and lower elevation portions of the ONF and DNF. The Blue Mountains is similar to the higher elevation portions of the ONF and the Eastern Cascades is similar the higher elevations of the DNF.

Hazard Quotients for Herbicides

Hazard Quotients (HQ) were calculated in each watershed using soil type, precipitation and application rate as the input variables. 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, 2011) 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, 2011) risk assessments.

Project Specific SERA Worksheets Results

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 detail in the Fisheries Report and Fisheries Biological Assessment.

Results in Table 58 display locations, herbicides and application rates where the HQ of 1.0 was exceeded. It is important to note that this model cannot 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 because forest vegetation especially in riparian areas usually includes trees, shrubs, grasses and downed woody material.

Table 58 shows that hazard quotients were generally exceeded at the highest application rate (see Table 12) 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 assumes broadcast spraying will occur up to the edge 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 spraying up to the edge of water, which is not allowed under any alternative. The total area infested with ribbongrass and yellow iris along the Metolius was 0.9 acres and covered 4,008 feet of streambank when surveyed in 2006 (survey data is located in the project file). All herbicide application would use wicking/wiping methods within 10 feet of water.

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. Herbicides proposed for use would not cause direct harm to individual fish or fish populations. After considering on the ground conditions that in most cases lessen herbicide effects from what the model results show along with application of PDFs that would further reduce the potential for herbicides to reach waterbodies. 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 (see Table 14).

Table 58. 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

Emergent Invasive Species Treatments

Treatment of emergent invasive plants is proposed. For purposes of this project, the term “emergent” is applied to invasive plants that grow from below the water line to above the water line, or are saturated all year.

A calculation was developed with National Marine Fisheries Service to estimate the amount of herbicide that could enter streams from emergent invasive treatment on the Metolius River. Application methods would include spot spraying within 10 feet of the river, and with hand application (i.e., dripless wick) for emergent plants along the stream margin and on islands. These methods should keep most of the herbicide out of the water but it is possible some drift could enter the river or some drops could drip from the plants into the water. The calculation was done for aquatic-labeled glyphosate and imazapyr, which are the two suitable herbicide choices.

The Metolius is a large flowing waterbody and dilution should prevent any direct effects to fish in the mainstem and in areas with moderate velocities. Discharge measured below the Camp Sherman Bridge in September of 1999 was 358 cfs (Dachtler 2000). The only area where direct effects might occur would be in alcove and backwater rearing areas that juvenile TE fish often inhabit. These areas are located along the margins, are often shallow and have slow velocities that can be poorly mixed with the other water in the river. The fish habitat survey done by Dachtler (2000) on the upper Metolius River counted 26 alcove and backwater pool habitats in the section from Gorge Campground to Lake Creek. These totaled 13,244 ft^2 of habitat with depths ranging from 0.3 to 1.3 ft and an average volume of 560 ft^3 (15.8 m^3). The following calculation in Table 59 was used to determine what the potential concentration of glyphosate would be in the water. If a patch of reed canarygrass/ribbongrass the same size as the average alcove was treated adjacent to the alcove and half of the applied glyphosate washed off the treated area and entered the alcove.

Table 59. Calculations used for emergent vegetation treatments using aquatic glyphosate along the Metolius River (site 15-32)*

Calculations:
Step 1. (lbs of active ingredient/acre) x (mg/lb) x acre = __Mg Average aquatic glyphosate application rate = 2 lbs/acre 907,200 Mg /acre x 0.0129 acres = 11,703 Mg
Step 2. Alcove: (m^2 x m) / (1000 liter/ 1 m^3) = __Liter For an average alcove: If average alcove volume is 15.86 m^3 15.86 m^3 x (1000 liters/ m^3) = 15,860 liters
Step 3. Divide Mg by liters to get Mg/L 11,703 Mg/15,860 Liters = 0.74 Mg/L
Step 4. Multiply by potential herbicide plant wash off fraction (SERA 2003), for aquatic glyphosate = 0.5 0.74 Mg/L x 0.5 = 0.37 Mg/L
Step 5. Compare 0.37 Mg/L to toxicity threshold used in this BA Acute NOEC for Aquatic Glyphosate = 0.1 Mg/L (Tierney et al. 2006)

*Application rate = lbs of active ingredient/acre; Aquatic toxicity level is in mg/L

This analysis shows that the Acute NOEC for aquatic glyphosate is slightly exceeded. However, it is unlikely that half of the applied glyphosate would enter the alcove at one time because the dripless wick application method would apply glyphosate to the plants and much of it would not reach the ground or water. Glyphosate would also readily adhere to the plants, organic material and soils making this highly unlikely. Dibyendu et al. (1989) found no evidence of lateral movement or surface runoff of glyphosate on an 8% slope with clay soils. This analysis assumes that the alcoves would have no water flowing through them and although they are fairly slow moving there is some mixing that occurs with the main river. Water movement through the alcove would rapidly dilute the glyphosate making the duration very short that fish would be exposed to toxicity levels that would produce indirect effects. 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. Michael (2004) also found spot applications directly to the soil surface resulted in observed concentrations in streams up 0.04Mg/L. This is well below the 0.1 Mg/L used for the acute NOEC for indirect effects (Tierney et al. 2006).

The emergent vegetation analysis (Table 60) for aquatic imazapyr follows the same assumptions as those listed above for aquatic glyphosate. This analysis shows that the Acute NOEC for aquatic imazapyr is not exceeded and it is unlikely that a majority of the applied imazapyr would enter the alcove at one time because the dripless wick application method would apply imazapyr to the grass and much of it would not reach the ground or water. This also assumes that the alcoves would have no water flowing through them and although they are fairly slow moving there is some mixing that occurs with the main river.

The following calculation is for aquatic imazapyr following the same assumptions.

Table 60. Calculations used for emergent vegetation treatments using aquatic imazapyr along the Metolius River (site 15-32)*

Calculations:
Step 1. (lbs of active ingredient/acre) x (mg/lb) x acre = __Mg Average aquatic imazapyr application rate = 0.45 lbs/acre = 204,117 Mg /acre x 0.0129 acres = 2,633 Mg
Step 2. Alcove: (m^2 x m) / (1000 liter/ 1 m^3) = __Liter For an average alcove: If average alcove volume is 15.86 m^3 15.86 m^3 x (1000 liters/ m^3) = 15,860 liters
Step 3. Divide Mg by liters to get Mg/L 2,633 Mg/15,860 Liters = 0.17 Mg/L
Step 4. Multiply by potential herbicide plant wash off fraction (SERA 2004), for aquatic imazapyr = 0.9, 0.17 Mg/L x 0.9 = 0.15 Mg/L
Step 5. Compare 0.15 Mg/L to toxicity threshold used in the USDA Forest Service Region 6 BA (USDA Forest Service 2005b) Acute NOEC for aquatic imazapyr = 0.5 Mg/L (USDA Forest Service 2005b)

*Application rate = lbs of active ingredient/acre; Aquatic toxicity level is in mg/L

The Forest Service does not believe the emergent vegetation analysis is more accurate than the SERA Worksheets to indicate degree of risk to the aquatic ecosystem but is just another method to quantify risk to fish and fish habitat. Unlike the SERA Worksheets, the emergent vegetation analysis has not been peer-reviewed.

The GLEAMS Driver (SERA 2008) is even more refined. This model was used to estimate the amount of glyphosate that could enter the Metolius River from ribbongrass/reed canarygrass treatments. The model takes into account specific variables for a site including soils, precipitation, stream size, stream flow, vegetation, treatment area, hillslope and herbicide application rate. This model was run for a representative small alcove (6 feet wide) with a small amount of flowing water (0.5 cfs) along the Metolius River. Results from this 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 established by Tierny et al. (2006).

Limited water quality monitoring for herbicides was available at the time of analysis, although two local water samples were collected on Lake Creek, a large tributary to the Metolius River for a USGS (2009) water sampling study. Following spot spray treatment of streamside and emergent vegetation with aquatic glyphosate and aquatic imazapyr water was sampled immediately downstream. This study

on private lands, that treated yellow flag iris and ribbongrass, showed concentrations of imazapyr below levels of concern for fish and other aquatic species and glyphosate was not detectable (USGS 2009). Using the proposed wick application method for treatment of emergent vegetation for this project, less herbicide is expected to reach the surface water than what USGS (2009) sampled.

Triclopyr is also labeled for aquatic use and may be used near a stream to treat Scotch broom at one site (15-31) in the Candle Creek subwatershed. This species would be treated with spot spray or cut stump application of triclopyr. Site 15-31 is mapped to be 100.4 acres but the professional estimate of the actual net invasive plant infestation on the ground is only 0.95 acres. The 0.95 acres is a mix of scotch broom and four other invasive plant species. Some of this mapped site is adjacent to Candle Creek but the actual small amount of scotch broom present, the selective application method, the use of the PDFs and large volume of water in Candle Creek will dilute the chemical if any triclopyr did reach the water. Summer low-flow measurements from the most recent fish habitat survey were 72 cfs measured in August of 1995 (Houslet and Lovtang 1996).

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 Table 15 and Table 16 in Chapter 2.4. Buffer widths were developed from looking at existing studies or from best professional judgment based on 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 FSEIS. 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 would 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 adsorbed 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 feet for aerial and 10 feet 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 less than 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 meters (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. Analysis of the potential effects of herbicide applications on aquatic resources was completed to determine the viability of applying herbicides within 50 feet of water. GLEAMs model scenarios run to predict possible concentrations of herbicides in surface water following broadcast spray applications show that concentrations would be below levels of concern for fish or other aquatic species (FSEIS Appendix H, SERA 2001, SERA 2003a-d, SERA 2004a-e,h,). Since the runs assume contiguous broadcast spray application of herbicides to the water's edge, it is reasonable to conclude that herbicide concentrations in surface water following non-contiguous spot spray or hand application methods proposed would be lower than the model runs and unlikely to be in concentrations high enough to be detrimental to aquatic species. It is also likely that the amount of herbicide residue percolating into subsurface macropore flows would be less than that modeled to reach surface waters via overland transport due to local soil conditions and implementation under PDFs 43-47. Limited water quality monitoring was available at the time of analysis, although two local water samples collected for a USGS Water Sampling study following streamside herbicide application on private lands show concentrations below levels of concern for aquatic species (USGS 2009).

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 (see the Soils Section 3.5).

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. No broadcast application of picloram triclopyr BEE, sethoxydim or non-aqautic glyphosate is allowed on roads that have a high risk of delivery to waterbodies (PDF 43.1). 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 to 0.253 mg/L (corresponding to about 3 to 7% of amount applied) from simulated rainfall 24 hours following application. This is well below the effects threshold of 7.3 mg/L for sulfometuron used in this analysis as the toxicity indices for fish. Glyphosate was applied at a rate of 1.45 pounds/acre and resulted in runoff concentrations of 0.323 to 0.736 mg/L (corresponding to about 1 to 2% of amount applied from simulated rainfall 24 hours following application. This does exceed the 0.1 mg/L (Tierney et al. 2006) used in this analysis as the toxicity indices for fish. The samples were collected in the initial 15 liters of runoff from simulated rainfall at a rate of 0.3 inches per hour, and lasting 0.5 to 1.4 hours. Given this sampling scenario, these concentrations are the best estimates available for what would occur in 24 hour post application runoff from ditch/intermittent stream applications from “first flush” events for these herbicides (per amount applied, per unit area). These concentrations are most likely higher than organisms would experience in a stream due to rapid dilution unless fish were holding at the point where water from the ditch entered a stream and even here some mixing would occur.

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. Several PDFs (43.1, 44, 49, 54, 56 and 57) limit the amount and type of herbicide treatments in roadside ditches, near streams or that drain into streams greatly reducing the chance for effects to fish or aquatic biota. 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 (see Soils section 3.5).

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 in roadside ditches are likely to be similar to the parent material and may or may not have vegetation, and in some cases may contain coarse rock fragments or volcanic cinders used to armor the road bed. In forested situations organic matter in the form of woody detritus and leaf litter is often present. This can help to collect herbicide residue reducing amounts that reach waterbodies. Many of the ditch runoff studies were done in an urban environment of along roadsides that had very little parent soils or organic matter. More surface runoff in ditches is expected in areas with soils of higher clay content. Soil type summaries more specific to sub-watersheds that contain TES fish for the project area from National Forest soil resource inventories by Larsen (1976) and Paulsen (1977) are located in Table 61 and for more detailed descriptions see Soils section 3.5.
Actual exposure concentrations and durations at or near confluences with fish bearing streams from ditch runoff 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 (USDC 2008) 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.

Table 61. Soil types and soil surface textures for subwatersheds with TES fish

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

These results by NMFS (USDC 2008) 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 concentrations would likely be greatly reduced before reached any fish bearing watershed because it would readily bond to the plants it was sprayed on and any soils and organic material in the ditch. The potential for herbicide delivery to streams from roadside treatments would be reduced by not broadcast spraying roadsides with high risk herbicides that drain directly to streams, limiting herbicide choice, application rate and method near intermittent streams and ditches that feed into waterbodies.

The duration of exposure to fish and aquatic organisms 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 for aquatic plants after one day but were under the effects threshold concentrations for aquatic plants after one week. The USGS (2001) glyphosate theoretical concentrations did not come close to exceeding effects threshold concentrations for any organism. These results may 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. (2007) 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. (2007) 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 0.001 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. (2007) 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. 2007). PDFs 43.1, 54, 56 and 57 will greatly reduce the chance for detrimental effects to aquatic organisms by only applying herbicides at the typical application rate near waterbodies and not broadcasting high risk herbicides along road that drain into waterbodies, and limiting types of herbicides applied to intermittent streams.

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 (Spuher 1994). 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.

If shortface lanx do occur in the project area this alternative would have no effect on this species. It is unlikely that reed canarygrass or yellow flag iris would become established in fast water habitat this species prefers but could become established in the margins. Alternative 1 does not allow herbicide control of emergent vegetation. The effects of these invasive emergent vegetation species on the shortface lanx are not known. However, reed canarygrass is very prevalent in the Lower Deschutes River below Forest Service land, where populations of shortface lanx are known to exist.

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. The exception to this would be the treatments that will produce disturbance and loss of instream and overhead cover to bull trout and other fish along the margins of streams and lake shores. This could occur within either alternative if reed canary/ribbongrass plants are to be manually pulled, treated with herbicide or a combination of the two methods. In Alternative 2, broadcast spraying is allowed within 50 to 300 feet of perennial waterbodies, depending on the type of herbicide (see Table 15 and PDFs in Chapter 2), and three aquatic approved herbicides would be allowed in perennial and intermittent channels. Alternative 3 does not allow any chemical to be broadcast sprayed within 300 ft of a perennial waterbody, or to be applied by any method within 10 feet of any perennial waterbody (Table 16). This would add a buffer for any runoff, drift or overspray that could reach the water. Alternative 3 is also more restrictive on how close herbicides can be used near intermittent channels; no herbicide is allowed closer than bankfull distance (the point where water begins to overflow onto the floodplain) to any intermittent channels. The restrictions in Alternative 3 would further reduce, but not eliminate, the chance for herbicide residue to reach a waterbody. When compared to Alternative 2 there would be less risk in Alternative 3 for aquatic approved herbicides to enter fish bearing waters, mainly due to increased buffer distances. The actual reduction in acres that could not be treated with herbicides in Alternative 3 is 230 acres (Table 62). It is not possible to quantify how much less herbicides would reach a waterbody under alternative 3 because of highly variable site conditions during and after herbicide application. However the use of PDFs under both alternatives would limit potential effects from herbicides and no direct effects to fish are expected. Pulling of ribbongrass and reed canarygrass could occur under Alternative 3 but dense root growth and bank substrates (rocks) make it difficult to remove all the rhizomes without excavating the entire riverbank, see Figure 9 in the Fisheries section. Approximately 2,000 lineal feet of the stream bank would be highly disturbed from digging and pulling activities, and this would release sediment and rhizomes into the river. Exposed soil would be susceptible to erosion and transport into river until vegetative growth of rhizomes under passive restoration or growth of native sedges under active restoration occurred.

Hand pulling will not be as effective in eradicating certain invasive species. Alternative 3 would make effective treatment and control of reed canary/ribbongrass sites unfeasible, which would have an effect on fish and aquatic plant habitat in the long-term. Due to the rhizomatous nature of reed canarygrass, its dense growth slows water flow and increases siltation (Sheaffer and Marten 1995). LaVergne et al. (2004) report that reed canarygrass (RCG) invades quickly and its presence impacts the structure of natural habitats. RCG can persist as floating mats, which then form numerous nodes with adventitious roots. Fragmentation at these nodes enhances the spread of RCG until it completely chokes water circulation in ponds and along shores. By growing vigorously on stream banks, RCG also increases sediment deposition, which further limits water circulation.

The acres in Table 62 represent herbicide treatment only, which is often combined with manual pulling or other treatment methods. These acres are for areas where invasive plants occur, actual acres of invasive plants on the ground are usually less than this.

Table 62. Acres of invasive plants proposed for herbicide treatments by alternative on intermittent streams, perennial streams, springs and lakes within the 10 foot and 300 foot buffers

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 10 feet of perennial streams, springs and lakes	Treatment acres with mapped invasive plants within 300 feet of perennial streams, springs and lakes
2	13,587	30	0	230	1,518
3	13,357	0	0	0	1,288

Direct and Indirect Effects of Alternatives 2 and 3

Herbicide Treatment – Areas of No Effect to Threatened, Sensitive, or MIS 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 (Table 63) 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. The comment column summarizes the site distances from the streams. 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 are not expected in either alternative.

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 (PDF 60) 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. Also PDF 43.1 mandated by NOAA fisheries does not allow broadcast of high risk herbicides on roadsides that drain to streams. See Appendix H of the FSEIS, Table H-24 for a detailed list of road/stream crossings

Table 63. 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 Trout	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.

PACFISH, INFISH and Deschutes and Ochoco National Forest Plan Standards will be met for redband trout and steelhead trout when the project design criteria described in the FSEIS are met, therefore this project will improve habitat conditions for Management Indicator Species (MIS) of redband and steelhead trout and will not contribute to a negative trend in viability on the Ochoco National Forest for these MIS. This project will maintain or restore aquatic and riparian habitats; long term beneficial impacts to these habitats outweigh the minimized risk of adverse effects at any one site, watershed or PAU. The PDFs and buffers eliminate adverse effect to the degree possible, and minimize risks that cannot be avoided.

Manual Treatment (Pulling)

Pulling of invasive plants would occur under both alternatives. More pulling would occur within 10 feet of waterbodies under Alternative 3 where herbicides could not be applied. Pulling of ribbongrass and reed canarygrass could occur under Alternative 3 but dense root growth and bank substrates (rocks) make it difficult to remove all the rhizomes without excavating the entire riverbank.

Approximately 2,000 lineal feet of the stream bank would be highly disturbed from digging and pulling activities and this would release sediment and rhizomes into the river. Exposed soil would be susceptible to erosion and transport into river until vegetative growth of rhizomes under passive restoration or growth of native sedges under active restoration occurred. Pulling would create disturbance, possible trampling and loss of overhead cover to smaller juvenile fish. Under Alternative 3 pulling of other non riparian dependant invasive plants (such as houndstongue) would not measurably increase the amount of fine sediment entering a stream and its effects on fish or aquatic biota (See

Water Resources, section 3.6). This is mainly due to the patchy distribution of individual plants on the landscape and the small number that would need to be pulled within 10 feet of a perennial waterbody.

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 5 years were analyzed for site specific effects from proposed invasive plant treatments. As stated earlier, steelhead is also an Ochoco NF management indicator species; the effects are discussed in this section. 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 64. Watersheds and subwatersheds where effects of invasive plant treatments are analyzed for Threatened fisheries and EFH. Species in italics are proposed for reintroduction within the next five years.

Watershed	Subwatersheds	Species
Lower Deschutes Subbasin		
Willow Creek	Upper Willow Creek Rock Springs Middle Willow Creek Dry Canyon Lower Willow Creek	Bull Trout Steelhead
Headwaters Deschutes River	Lake Simtustus	Bull Trout Steelhead
Upper Trout Creek	Headwaters Trout Cr. Foley Creek, Opal Creek	Steelhead
Mud Springs	Upper Mud Springs Cr., Sagebrush Creek	Bull Trout Steelhead
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, Upper Fly Creek, Lower Fly Creek, Juniper Cr., Lower Metolius River	Bull Trout *Spring Chinook* *Sockeye*
Lake Billy Chinook	Stevens Canyon, Carcass Canyon, Geneva, Round Butte Dam	Bull Trout *Spring Chinook* *Sockeye* Steelhead
Squaw Creek (Whychus Creek)	Upper Squaw Creek (Whychus) Middle Squaw Creek (Whychus) Lower Squaw Cr. (Whychus)	Bull Trout *Steelhead*
Wickiup (Odell/Davis Lakes)	Odell Lake, Odell Creek, Moore Cr., Davis Lake	Bull Trout
Lower Crooked River Subbasin		
Lower Crooked River Valley and Crooked River National Grassland	Upper Crooked River Gorge, Lower Crooked River Gorge	Bull Trout Steelhead
McKay Creek	Upper McKay Creek, Allen Creek	Steelhead
Lower John Day Subbasin		
Bridge Creek	Headwaters Bridge Cr., Upper Bridge Cr., Upper Bridge Bear Cr., West Branch Bridge Cr.	Steelhead
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

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 Biological Assessment (Dachtler 2009), and are incorporated by reference. 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 67). 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 (see soils Section 3.5 and Water Resources 3.6). 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 in small enough quantities that they would not be detrimental to fish or other aquatic biota. The probability of effect is moderate, and the overall magnitude is minor.

Under Alternative 3, eradication of reed canary/ribbongrass with herbicides would not be permitted within 10 ft of waterbodies, but there would still be the potential for disturbance, trampling and loss of cover to individual fish from manual pulling. The trampling 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. It is possible some fish could get stepped on but this is unlikely as most fish would be able to move away from the disturbance.

Table 65 that follows, displays the watersheds where there is potential for herbicide effects to fish species and why there is a very low probability that herbicides would reach waterbodies in concentrations high enough to have effects based on size of treatments, distance of sites from streams and the use of PDFs. 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 native fish species is expected to be similar.

Shortface Lanx (R6 Sensitive Species)

This section will discuss the effects to shortface lanx, a USDA Forest Service Region 6 sensitive species for only the Ochoco NF. The only location where large rivers with suitable habitat exist is on the Deschutes and Crooked Rivers in areas adjacent to the Crooked River National Grasslands. All sites proposed for herbicide treatment are located at least 300 feet from these rivers. This proximity with the use of PDFs will prevent herbicides from causing detrimental effects to this species should it be present. A full list of PDFs for this project can be found in Chapter 2.4. If future EDRR treatments were undertaken to treat emergent vegetation along these two river segments it would be restricted to a similar size treatment (approximately 1 acre) as those proposed along the Metolius River. Effects from this type of treatment due to the PDFs would be limited to potentially trampling snails while wading in the water. See emergent vegetation discussion in the Fisheries Specialist Report and biological assessment. However even this is unlikely as the snails prefer faster water habitat with rocky substrate and most emergent vegetation is found in slower water along the stream margins where fine sediments have accumulated. Some pulling of emergent vegetation could occur but this would not produce enough disturbance to create or sustain turbidity or sedimentation that would negatively affect this species. The high velocity habitats that this species prefers would not accumulate fine sediments even if there were small inputs upstream.

Alternative 3 would lessen the potential for the effects discussed above because no herbicides could be used within 10 feet of the water under EDRR scenarios making herbicide treatment for emergent vegetation ineffective. However limited pulling of emergent vegetation could require wading in the river margins and would have similar effects as discussed above.

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. Redband trout is a USDA Forest Service Region 6 sensitive species in the project area and they are also a management indicator species on the Ochoco NF. 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 similar or less than the selected subwatersheds discussed in this section and previous sections because sites are smaller and/or farther away from fish bearing waters with Threatened species. Increased buffer distances due to the location of sites and the use of PDFs will make the chance for any effects highly unlikely.

Table 65. Areas where the likelihood of potential effects is low to federally listed or R6 Sensitive fish species based on site size, location in relation to waterbodies and the use of PDFs. Critical habitat is present where Bull Trout and Steelhead are found and EFH is present where Spring Chinook are found.

Watershed	Bull Trout	Steel-head	Spring Chinook	Sockeye	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	n/a	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 ft 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 54 that prohibits use of chlorsulfuron and only allows picloram use up to the typical application rate in the watershed.
Lower Crooked R. Valley & Crooked R. 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’ of perennial water.Project areas along streams that have low summer flows; high risk herbicides proposed. Picloram restricted to treating sulphur cinquefoil. Long distance from steelhead usage.
Upper John Day Watersheds	n/a	X	n/a	n/a	X	Approx. 4 acres herbicide treatment within 10 ft of perennial water. Picloram restricted to treating sulphur cinquefoil only. Small sites and use of buffers prevents direct adverse effects to fish.

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 where they have been extirpated, or areas historically fishless.

Manual, Mechanical, and Cultural Treatments – 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 invasive plants, 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 of non-rhizomatous species is not expected to add any measurable amounts of fine sediments to streams (see Water Resources Section 3.6).

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 or trampling to juvenile redband 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, treatment of reed canary/ribbongrass with herbicides would not be permitted within 10 feet of waterbodies, but there would still be the potential for disturbance, trampling and loss of cover to individual fish from manual pulling. The trampling 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 66. The infested percent length of shoreline is based on available reproductive habitat for that fish population. Values are for mapped invasive plant sites. Numbers of redband trout present and habitat use of treatment sites in Table 66 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. This is due to the Upper Metolius River and that portion of the Deschutes River at site 11-10 being primary redband trout spawning and rearing areas. Rearing of redband trout in reservoir or lake margins by redband trout during the summer or fall months would be very unlikely due to high water temperatures, which is typical in the upper 0-5 ft of lakes and reservoirs during the summer months.

The redband trout subwatersheds listed in Table 67 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 herbicides or small amounts of fine sediments entering waterbodies.

Table 66. Reed canarygrass treatment areas proposed for mowing and then hand wick and spot spray application of aquatic glyphosate

Treatment Area (s)	Waterbody	Location	Trout Species TES in Bold	Shoreline Infested Length		Mapped Infested Area (ac.)
				Ft.	%	
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
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 measured 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 (0.9 ac) than mapped values see Appendix H, Table H-7.

Table 67. Subwatersheds of redband trout habitat 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	Invasive Plant Acres within 100 ft of Int. Streams	Invasive Plant Acres within 100 ft of perennial water and fish bearing Streams	Invasive Plant Acres within 300 ft 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 Treatment Sites – As discussed earlier effects to redband trout from the use of herbicides are expected to be similar or less than those experienced by TE fish. Some minor indirect effects are anticipated and no direct mortality is expected to occur.

The Gleams Driver model was run on treatment area 75-20 at Rimrock Springs where a small spring fed pond is the headwater of a small stream that contains redband trout. Rimrock Springs Dam and some of the adjacent pond margins contain dense infestations of Russian knapweed that are proposed to be treated with clopyralid up to 15 feet from the water, and glyphosate from 15 feet to the water's edge. In order to assess the possible exposure of redband trout to herbicides from treatments of this infestation, we ran the GLEAMS-Driver model. Local soil textures, weather data, pond volume and other variables were input into the model for a foliar spray of clopyralid at 0.49 lbs/acre and glyphosate at 1.5 lbs/acre. Model results indicate that redband trout could be exposed to a maximum concentration of 0.0032 mg/L clopyralid in the pond water from treatments on the dam plus adjoining upland areas. The acute NOEC for rainbow trout is 5 mg/L so no adverse effect redband trout is likely from the use of clopyralid at this site. For glyphosate, the model results indicate that no measurable amount is expected to reach the pond, so no effect to redband trout is likely.

Controlled Burning, Herbicide, and Revegetation with Scarification Sites – Controlled burning followed by herbicide treatment for houndstongue is proposed in portions of two treatment areas (72-15 and 72-37). Active restoration with native species would follow houndstongue control. 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 to improve revegetation success by breaking up the soil surface for better germination of native seed is proposed in five locations that total 14.3 acres along or adjacent to two intermittent/perennial streams. The goal of scarifying will be to break up the soil surface, not to dig deep or turn over soil (see Soils Section 3.5 for more discussion). These two streams feed into Dipping Vat Creek and an unnamed stream that contains redband trout. For Alternative 2, following RHCA buffer guidelines for INFISH non priority watershed, no scarification would 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. In Alternative 3, no harrowing would be allowed on perennial portions of these streams (PDF 62).

Fire is proposed in the same five locations that scarifying will be used to reduce invasive plant 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 Alternative 2 to prevent sediments from entering the intermittent channels and washing downstream into potential redband trout spawning streams. Herbicide application will be used in conjunction with the prescribed fire treatments. The herbicide 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. Revegetation, including scarifying the soil to create a seedbed would follow after the invasive plants are controlled. No mechanical activities that disturb the soil would occur under Alternative 3 on any perennial portions of the streams.

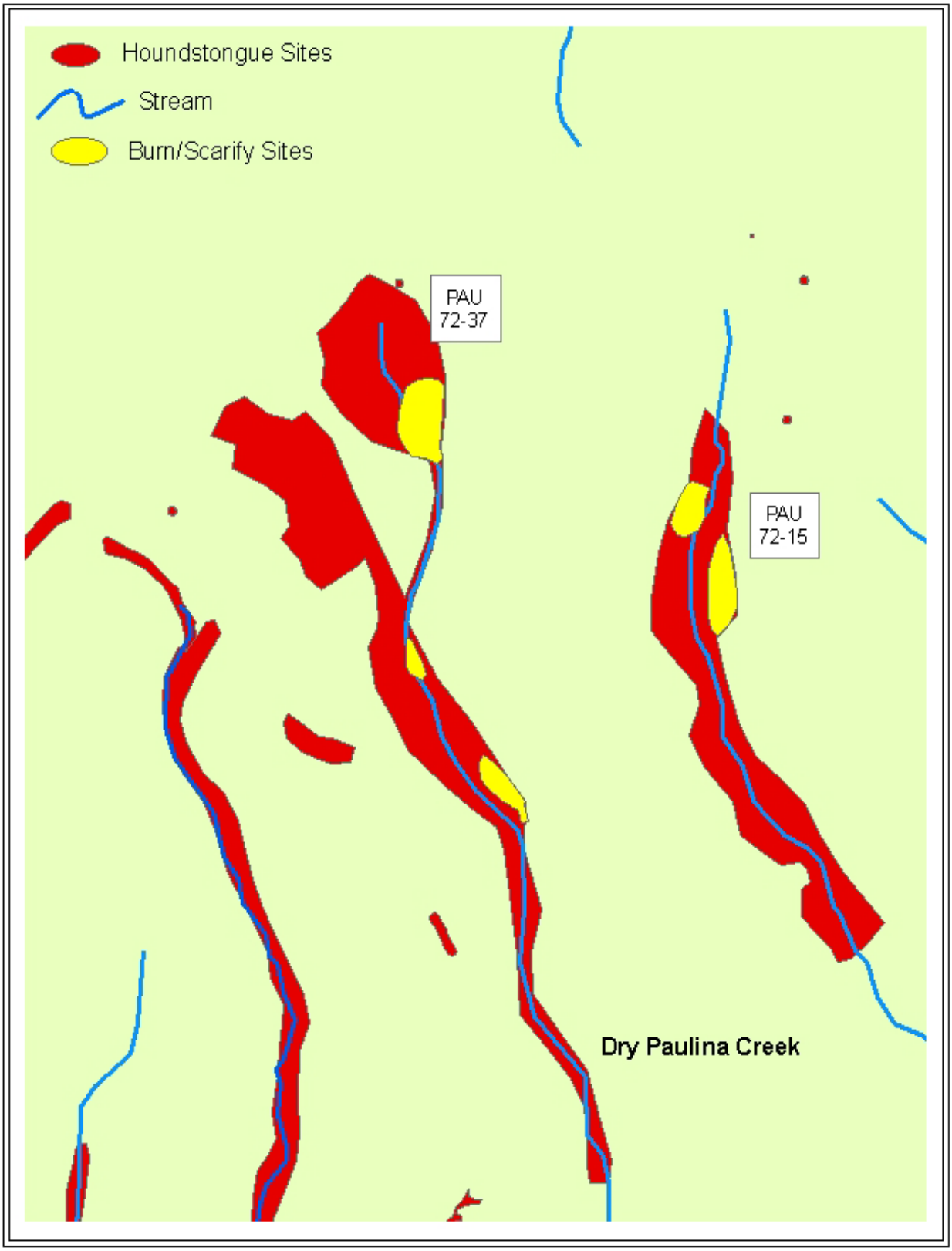

Figure 8. Sites proposed to be scarified and burned prior to herbicide treatment in the Dry Paulina Subwatershed

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 in concentrations high enough to cause effects. Effects to fish or other aquatic biota from this potential exposure is unlikely because concentrations would be below the threshold of concern due to rapid dilution. However, if some herbicides do reach perennial streams some indirect effects to aquatic macrophytes and algae could be seen. These are expected to be localized at the point runoff enters a waterbody. If herbicides were washed into these intermittent channels and downstream to areas containing redband trout, exposure would likely last for a short period of time ranging from a few minutes to a few hours (Michael 2004). This would most likely occur if a large thunderstorm event occurred within a few days of the herbicide application.

Summary of Effects to TES and MIS Fish and other Aquatic Organisms

Results of the analysis indicate that mortality to Forest Service Threatened, Sensitive, or Management Indicator Species is highly unlikely and effects are primarily limited to very short-term disturbance. No native habitat will be removed. The potential for trampling of fish and some loss of overhead cover from manual treatments is assumed in the analysis. In the absence of clear adverse effects to these species, no threat to viability of populations exists. Treatment of invasive plants will prevent loss of native habitat and improve habitat that may currently be degraded.

Effects of the proposed action on MIS species or their habitat across the project area, when considered cumulatively with other activities in the project area, would be beneficial to some of the important habitat indicators. This project is expected to improve habitat conditions in the long term for TES and MIS fish and therefore for their populations by reducing invasive plants and promoting native vegetation. Reduced sediment delivery improves important aquatic elements such as cleaner water, higher quality substrates for spawning and rearing habitat, and less pool infilling. The cumulative effects are within the scope of anticipated effects to aquatic resources determined in the Ochoco Land and Resource Management Plan EIS (USDA Forest Service 1991) and the Deschutes NF LRMP (USDA Forest Service 1990).

Manual, Mechanical and Cultural Methods

Hand pulling, mechanical and cultural methods for non-emergent 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. Invasive plant species under this analysis are not water dependent and individuals may be found anywhere their seeds have been spread, usually in disturbed areas. Individual plants or populations may occur along waterbodies but disturbance to fish and other aquatic organisms, such as shortface lanx, 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 emergent species such as 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 would 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. Some trampling of small fish could occur but would be unlikely as most fish would leave the area due to the disturbance. 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. It also is not tall enough to provide shade that regulates water temperatures in a forested environment (See Water Resources, section 3.6).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 FSEIS Section 3.6 Hydrology).

Other than reed canarygrass/ribbongrass sites 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. The reed canarygrass/ribbongrass treatment may reduce instream and overhead cover where this plant is removed until native vegetation is reestablished. Treating invasive plants would improve long term riparian function 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 under Alternative 2 are expected to be minimal and would not produce substantial amounts of fine sediments because plants would primarily be treated with herbicides. However under alternative 3 digging out the plants from approximately 2,000 lineal feet of the stream bank would highly disturb the river banks and release sediment and rhizomes into the river, despite efforts to keep sediment contained with barriers across a large river such as the Metolius (PDF 50). Exposed soil would be susceptible to erosion and transport into river until vegetative growth of rhizomes under passive restoration or growth of native sedges under active restoration occurred. Population would return via the re-sprouting if rhizomes were left behind. Sussman (2011) found that when plants were manually dug out the streambank new plants sprouted the following year due to rhizomes that were not removed.

Effects to shortface lanx would be limited to potentially trampling snails while wading in the water. The snails prefer fast-moving water, whereas emergent vegetation is generally on slower moving water on stream margins, therefore trampling effects are expected to be minor.

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 (for more water quality discussion, see the Water Resources Section 3.6). 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 concentrations 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, 2011) 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, 2011) 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 and in certain watersheds would have restricted use (PDF 54). 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 because herbicide would mostly be taken up by the plant. 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).
7. High risk herbicides would not be broadcast applied to roadsides that feed directly into waterbodies (PDF 43.1).

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 (ses Soils Section 3.5)

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 occurs from wind and wave action. Some invasive plants 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. 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 emergent vegetation treatment analysis (see previous discussion above) and SERA Worksheets showed that treating these plants with glyphosate could contaminate an 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 of a more site specific peer reviewed GLEAMS Driver model (SERA 2008) indicated that amounts of herbicide that could theoretically enter an alcove from emergent vegetation treatment would be far below levels of concern. Where Hazard Quotient results from the SERA Worksheets were found to be greater than 1.0 for fish, specific PDFs were designed to mitigate the use of a particular herbicide in a certain location (See Table 14 for restrictions).

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 juvenile bull trout and juvenile redband trout because they would be displaced and forced to find new habitat exposing them to potential predation. It is also possible some fish could get trampled but this is unlikely as most fish would leave the area from the disturbance.

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 is desired versus 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; juveniles would be displaced and cover would be reduced in the short-term (1-2 years).

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 relation to waterbodies would make direct or indirect effects to fish very unlikely. A recent laboratory study by Stehr et al. (2009) examined the potential developmental defects to zebrafish embryos resulting from exposure to six herbicides (picloram, clopyralid, imazapic, glyphosate, imazapyr, and triclopyr) and several technical formulations (Tordon K, Transline, Habitat, Plateau, Garlon3A, and Renovate). The zebrafish embryos were exposed continuously through 5 d of development at nominal concentrations ranging from 3 mg/L to 10 mg/L. Stehr et al. (2009) observed no developmental toxicity in response to the six individual herbicides or the different technical formulations. The absence of toxicity at relatively high exposure concentrations suggests that invasive plant treatments are not likely to pose a direct threat to salmonid early life stages. Any effects to macrophytes, or algae that could indirectly effect fish should they occur are expected to be small and localized at the location where an herbicide may enter a

waterbody. These potential indirect effects to aquatic plants or algae are not expected to be large enough in scale to effect fish behavior, cover or available food sources.

Effects Determinations

The following list shows all potential status, occurrence and effects 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

Effects 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, MIS, EFH, lead to TES fish waterbodies or may have TES fish reintroduced to them in the next 5 years were analyzed for effects and these were previously discussed and summarized. Results from this analysis are presented for Alternative 2 in Table 68 throughTable 72 and for Alternative 3 in Table 73 throughTable 77, using the abbreviations listed previously.

Alternative 2 Effects Determinations

Table 68. Alternative 2 effects determinations for watersheds and subwatersheds with listed bull trout populations. All bull trout populations in this analysis are federally listed as threatened.

Watershed (s)	Occurrence	Populations	Effects Call	Comments (See previous effects sections for full discussion)
Upper and Lower Metolius River, Lower Squaw Creek (Whychus), Lower Crooked River, Lake Billy Chinook	HD, D	Metolius/Lake Billy Chinook	LAA	Possible disturbance, trampling, and reduction in cover effects from herbicide treatment of ribbon/reed canarygrass and yellow iris as in site 15-32 on the Metolius River. EDRR potential for future treatment of emergent vegetation at other sites would be similar to Metolius R. site 15-32
Wickiup	HD, D	Odell/Davis	LAA	EDRR potential for future treatment of emergent vegetation would be similar to Metolius River site 15-32

Table 69. Alternative 2 effects 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	Effects Call	Comments (See previous effects sections for full discussion)
Upper Metolius River	HD, N	Upper Deschutes	LAA	Possible disturbance, trampling, and reduction in cover effects from herbicide 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 would be similar to site 15-32 on the Metolius River
Squaw Creek (Whychus), Lower Metolius River	HD, D	Upper Deschutes	LAA	EDRR potential for future treatment of emergent vegetation sites would be 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 would be 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 would be 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 would be similar to site 15-32 on the Metolius River

Table 70. Alternative 2 effects determinations for watersheds with redband trout and shortface lanx, species on the Regional Forester's 2008 sensitive species list

Watershed	Occurrence	Population	Effects 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, trampling, and reduction in cover effects from herbicide 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 would be similar to site 15-32 on the Metolius River
Shortface lanx Lower Deschutes, Juniper Butte-Crooked River	HD, S	N/A	MIIH	Possible disturbance and trampling effects, however is unlikely as the snails prefer faster velocity habitat than emergent vegetation typically occurs.

Table 71. Alternative 2 effects determinations for watersheds with Chinook and coho salmon EFH. Coho salmon EFH is only present in the Trout Creek watershed but no historical evidence indicates they were ever present in this location

Watershed	Occurrence	Population	Effects 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 reduction in cover 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 Chinook or coho rearing habitat but would have a long term beneficial effect.

Table 72. Alternative 2 effects determinations for Middle Columbia River steelhead critical habitat 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	Effects Call	Comments (See previous effects sections for full discussion)
Bull Trout	HD, D	Lower Deschutes Odell Lake	LAA	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as woody debris, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure would be affected in the short term (1-5 years) by treatments of reed canary grass or other similar sites with EDRR.
Steelhead	HD, D	Lower Deschutes, Upper John Day, Lower John Day	LAA	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 Effects Determinations

The effects calls for fish in Alternative 3 were updated to Likely to Adversely Affect, and Essential Fish Habitat changed to Adverse Effect. The Draft Supplemental EIS (June 2009) listed these as NLAA and NAE respectively. This change between draft and final documents is due to additional analysis and emphasis on manual treatments as result of public comments encouraging the use of manual methods. Manual methods for most invasive species would not have an effect on fish or fish habitat. Manual control of emergent vegetation, such as reed canarygrass and ribbongrass, which occur on the edges of, or in water, would have an effect on fish and habitat. The hand removal of these grasses would cause more physical disturbance and potential trampling to fish than chemical methods due to digging and removal of soil (Figure 9). The Water Resources section concludes that if widespread pulling from banks of ribbon/reed canarygrass is attempted because most of this population could not treated with herbicides, there is a chance that state water quality standards for turbidity and sediment could be violated. The effects analysis has not substantially changed; however the amount of disturbance and sediment produced from manual emergent vegetation removal changed the affects determinations.

Figure 9. Ribbongrass clump removed from the streambank. Photo shows the extensive rooting capability of rhizamatous emergent grass species.

Although treatment of currently known reed canarygrass and ribbongrass sites would only affect bull trout, redband trout, chinook salmon EFH and bull trout critical habitat, similar effects to steelhead and steelhead critical habitat could occur if new emergent invasive plant populations were found and treated under EDRR.

Table 73. Alternative 3 effects 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	Effects 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, trampling, and reduction in cover effects from pulling ribbon/reed canarygrass and yellow iris at site 15-32 on the Metolius River. EDRR potential for future pulling of emergent vegetation of other sites would be similar to Metolius River site 15-32
Wickiup	HD, D	Odell/Davis Lakes	LAA	EDRR potential for future pulling of emergent vegetation at other sites would be similar to Metolius River site 15-32

Table 74. Alternative 3 effects 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	Effects 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	LAA	EDRR potential for future pulling of emergent vegetation at other sites would be similar to Metolius River site 15-32.

Table 75. Alternative 3 effects determinations for watersheds with redband trout and shortface lanx, species on the Regional Forester's 2008 sensitive species list.

Watershed	Occurrence	Population	Effects Call	Comments (See previous effects sections for full discussion)
All watersheds with redband trout	HD, D	All others	MIIH	EDRR potential for future treatment of emergent vegetation at other sites would be similar to Metolius River site 15-32.
Shortface lanx : Lower Deschutes, Juniper Butte-Crooked River	HD, S	N/A	MIIH	Possible disturbance and trampling effects, howver is unlikely as the snails prefer faster velocity habitat than emergent vegetation typically occurs.

Table 76. Alternative 3 effects determinations for watersheds with Chinook and coho salmon EFH. Coho salmon EFH is only present in the Trout Creek watershed but no historical evidence indicates they were ever present in this location.

Watershed	Occurrence	Population	Effects Call	Comments (See previous effects sections for full discussion)
All watersheds	HD, D	All others	AE	Ribbon grass treatment along the Metolius River at site 15-32 may have a short term reduction in cover (1-5 years) for juvenile Chinook rearing habitat but will have a long term beneficial effect. Similar effects could occur at future EDRR sites.

Table 77. Alternative 3 effects 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	Effects Call	Comments (See previous effects sections for full discussion)
Bull Trout	HD, D	Upper Deschutes Odell Davis	LAA	Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as woody debris, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure would be affected in the short term (1-5 years) by treatments of reed canary grass or other similar sites with EDRR..
Steelhead	HD, D	All	LAA	EDRR potential for future pulling 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.

Cumulative Effects – Alternatives 2 and 3

Manual, Mechanical and Cultural Methods

Pulling, tarping or weed whacking invasive plants, even repeated entries, would not result in adverse cumulative impacts for the proposed action (Alternative 2) when combined with other activities 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 FSEIS are most often located in the uplands or along roads and are not riparian dependent with the exception of ribbon/reed canary grass and yellow-flag iris.
4. Pulling reed canary/ribbongrass will mainly be confined to plants 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 (PDF 42 and 55) to avoid mobilizing any fine sediment that could wash into bull, trout, steelhead, kokanee, redband trout or chinook redds. PDF 53 limits the number of workers in the stream and PDF 50 also requires erosion control methods. 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.

Under alternative 3 if pulling of ribbon/reed canarygrass along approximately 2,000 ft of river bank is attempted because most of this population could not treated with herbicides, there is a chance that state water quality standards for turbidity and sediment could be violated (See Water Resources, section 3.6, Alternative 3). There is a chance that a cumulative effect for turbidity could occur if the pulling is done

this fall at the same time when the dam at Suttle Lake is being removed, which is planned for the fall of 2012. This cumulative turbidity effects would likely last from a few hours to a few days. The actual effects to fish is not quantifiable but is expected to be minimal because very little spawning takes place that time of year in the mainstem Metolius River and work would take place within instream work timing guidelines to protect spawning fish and incubating eggs.

The pulling of ribbon/reed canarygrass along streams would occur on the Deschutes NF, where grazing is limited, and there is no grazing along the Metolius River, therefore grazing would not cause a cumulative effect combined with emergent species removal. Handpulling or grubbing of houndstongue directly adjacent to streams on the Ochoco NF may overlap with grazing, timber harvest and prescribed burning. The combination of weed control and these other activities could increase sediment delivery to streams. Grazing reduces the height of vegetation, prescribed burning removes duff and can expose soil, and timber harvest and grubbing invasive plants disturbs the soil. This could cumulatively have short-term effects to water quality from increases in sediment or turbidity, removal of streamside vegetation, and disturbance within the channel. In turn, water quality can affect fish and other aquatic organisms. The redundant layers of caution in place including treatment caps, and project design features ensure that these effects will be localized and short term.

Cumulative effects of sedimentation to fish populations from hand pulling or tarping under Alternative 2 would not increase or be detectable against other sedimentation produced by natural processes, past agricultural practices, grazing, timber harvest, wildfires, prescribed fires, development or roads in the project area (For more discussion see Soils and Water Resources, sections 3.5 and 3.6). 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 weed whacking would not reduce overhead cover or shade because riparian dependent invasive plant species do not supply enough shade to influence water temperatures; see Water Resources section 3.6.2 for an in-depth discussion of shade effects on water temperature.

Cumulative effects to shortface lanx could occur from trampling by other people recreating in the river such as fisherman or boaters. However, the extent of these cumulative effects is unknown because the species is only suspected within the project area, no populations have been located, and no population size data is available. The extent, location and duration of the public recreating in the river have not been measured. However, even trampling by fisherman or boaters is not expected to significantly affect this species due to the relatively light use of the rivers in this area with many sections located in steep canyons where public access is limited.

Herbicide Methods

See Chapter 3.1.3 for a discussion about the basis for cumulative effects analysis, which describes the known use of herbicides locally and from across the State. While there is some uncertainty about the location of herbicide and other chemical applications off national forest, the potential effects are low. Herbicides applied by the Forest Service adjacent to private agricultural lands are not expected to enter these waterbodies in significant quantities that would cause measurable effects to fish or aquatic organisms. Some aquatic plants and algae may be killed by small amounts of herbicides that reach surface waters, confined to the location where runoff with herbicide residue enters a waterbody (see previous direct and indirect effects discussion). The implementation of the risk reduction framework, PDFs and buffers on channels and waterbodies ensure any potential effects would be eliminated or greatly minimized.

The analysis assumes that possible repeated treatments within the same season do not overlap in time, or result in a cumulative effect. If repeated treatments are necessary it is usually a result of missed

plants during the first herbicide application. A second herbicide application would generally not overlap spatially and occurs at a different point in time.

There could be 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 gross acres of invasive plant control proposed within the aquatic influence zone (AIZ) in the Rimrock Springs 6th field subwatershed; and 120 gross acres in the AIZ within the Lower Wychus Creek 6th field subwatershed. See the cumulative effects analysis in the Water Quality section for further discussion of effects of private use of herbicides on water quality.

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 rights-of-way will be undertaken to ensure amounts of herbicide applied on Forest Service lands do not exceed the actions and effects discussed in this document (PDF 6).

The primary concern of effects to fish and other aquatic organisms is herbicide application directly adjacent to water. This occurs in Alternative 2 for a total of 230 acres, or about 1% of the PAUs. Treatment caps, project design features, buffer widths, method restrictions, and chemical restrictions combine to reduce the potential for any direct and indirect effects, which reduces the potential for cumulative effects from other management activities. However, activities such as grazing, timber sales, road construction, culvert replacement, watershed restoration projects, wildfire suppression, prescribed fires, and both developed and primitive recreation activities will continue in riparian areas on the Forests and Grassland in the foreseeable future. These activities may occur simultaneously with invasive plant treatments. The spatial overlap is expected to be scattered and small because the acres to be treated next to streams are scattered across the two Forests, are small in size, and would not happen all at one time. This overlap could produce some loss of shade and increase of sediment, however the magnitude and duration is not expected to have a discernable cumulative impact to fish or aquatic organisms.

The following list of herbicide properties and study results explains why herbicide residues from previous herbicide treatments will be undetectable or at low enough levels that effects would be insignificant and would not cause a cumulative effect to fish or aquatic organisms:

- 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 2004a). 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 FSEIS 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 2004b, 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 FSEIS 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. Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of clopyralid as high as 10 mg/l for five days and concluded that there is little potential threat to the early life stages of salmonid development.
- 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). Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of glyphosate as high as 10 mg/l for five days and concluded that there is little potential threat to the early life sages of salmonid development.
- 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 2004c). 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 2004c). 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. Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of imazapic as high as 10 mg/l for five days and concluded that there is little potential threat to the early life sages of salmonid development.
- Imazapyr photodegrades in water and is degraded by soil microbes. It has a half life of 1 to 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 2004d, 2011b). 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. Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of imazapyr as high as 10 mg/l for five days and concluded that there is little potential threat to the early life sages of salmonid development.

- The persistence of Picloram has been measured to be up to one year with a half life of around 90 days (SERA 2003, USDA Forest Service1998a). 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 FSEIS. Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of picloram as high as 10 mg/L for five days and concluded that there is little potential threat to the early life sages of salmonid development. 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.
- 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 either alternative 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 a third-choice herbicide to treat emergent invasive plants and the fact that it is highly toxic to fish from the petroleum inert in the formulation requires a 50 foot buffer from perennial or intermittent water in Alternative 2 (300 feet in Alternative 3). This means it would not be used near water, and 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 less than 4 hours in soil and less than 1 hour 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 within riparian areas.
- 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 FSEIS.
- 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). Stehr et al. (2009) found no indication of defects to zebrafish embryo development when exposed to concentrations of triclopyr as high as 10 mg/L for five days and concluded that there is little potential threat to the early life sages of salmonid development.

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.

3.8 Human Health – Worker and Public Exposure to Herbicides

Introduction

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 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. Information about non-herbicide hazards are incorporated herein by reference. 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 R6 2005 FEIS and its Appendix Q: Human Health Risk Assessment detailed the potential for adverse effects to human health and safety from the invasive plant treatments, and this analysis tiers to these documents. Risks and hazards associated with herbicide ingredients (including inert ingredients, adjuvants and surfactants, synergistic relationships, and metabolites) are discussed at length. R6 2005 ROD Standard 16 limits herbicide active ingredients to those posing low risk to people and restricts application of triclopyr to spot and selective methods. These restrictions minimize risks of herbicide exposure to workers and the public. Site-specific PDFs were developed to further minimize or eliminate exposures of concern to workers and the public plausible to ensure that herbicides and surfactants are used in rates low enough, or methods selective enough, to avoid exposures over a threshold of concern. While workers and the public may be exposed to herbicides used to treat invasive plants under all alternatives in this project; no exposures exceeding any 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 finding applies to all alternatives and is explained throughout the following sections.

The following analysis includes consideration of potential herbicide contamination of potable water sources. Project Design Features (PDFs) have been established to mitigate any potential effects, including from spills; drinking water standards would be met in all alternatives and the amount of herbicide that could possibly leach, run off or drift into potable water sources would be too small to cause a discernable effect.

Herbicide Risk Assessments

As described previously, the R6 2005 FEIS and Appendix Q, and subsequent project analysis of herbicide risks are informed by assessments prepared for the Forest Service by Syracuse Environmental Research Associates (SERA). Forest Service/SERA herbicide risk assessments use methods adopted from peer-reviewed articles from the open scientific literature and EPA protocols. SERA had access to Confidential Business Information including data about inert ingredients. Specific methods used in preparing the Forest Service/SERA herbicide risk assessments are described in SERA 2001.

A risk assessment for the adjuvant NPE (nonylphenol polyethoxylate) was specifically 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 FSEIS.

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 2003).

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 2005 FEIS and its Appendix Q. SERA reports "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 greater degree of caution 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 the amount of herbicide to which a person may be exposed is kept below the amount that could cause someone to get sick, based on the risk assessment information. However, some people may be particularly sensitive to individual chemicals and report impacts at very low doses. While the threshold of concern is set very low for the analysis, there remains a potential for someone to experience symptoms from even minimal exposure. Forest Service risk assessments incorporate an uncertainty factor of 10 to account for sensitive individuals, which may or may not eliminate risk that an individual may suffer symptoms (R6 2005 FEIS Appendix Q).

Multiple Chemical Sensitivity (MCS)

The following information was adapted from SERA 2009, Control/Eradication Agents for the Gypsy Moth – Support Material for Response to Comments on the Draft SEIS.

Some people feel that they suffer from Multiple Chemical Sensitivity (MCS), which is sometimes referred to as Idiopathic Environmental Intolerances (IEI). In general, individuals with MCS report that they experience a variety of adverse effects as a result of very low levels of exposure to chemicals (including herbicides) that are generally tolerated by individuals who do not have MCS.

Forest Service risk assessments incorporate an uncertainty factor of 10 to account for sensitive individuals, which may or may not eliminate risk that an individual may suffer symptoms. While not explicitly noted. However, the uncertainty factor for sensitive individuals addresses variability in tolerances within a normal population. Individuals reporting MCS assert, either explicitly or implicitly, that they are atypically sensitive. There is no current consensus on the diagnosis and cause of MCS.

Until the etiology and pathogenesis of MCS has been clarified an organic cause of the MCS, associated symptoms and symptom complexes cannot be entirely ruled out. The Forest Service has no way to resolve concerns for MCS at the project level.

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 mushrooms, but more are not.

Matsutake mushroom harvesters visit the Deschutes National Forest, primarily Crescent Ranger District, during a specified commercial season in the fall. There is the possibility that these people may enter areas that have been treated with herbicide. Special forest product harvesters may have more contact with contaminated vegetation than the general public. However, the majority of invasive plant sites are along roadsides, whereas special forest products are more often found in natural settings. 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).

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. Applicators 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 and are required to have a current State or Federal pesticide applicators license (R6 2005 ROD Standard 15).

Drinking Water

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 (NFMA 1976). 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:

- Municipal Watersheds
- Community Water Systems
- Potable water at campgrounds and picnic areas
- Domestic water at special use cabins (Deschutes NF only)
- Special use diversions for domestic use off forest
- Domestic uses (source off forest) on in-holdings and adjacent to Forest boundaries

The beneficial uses are discussed in relation to existence of project area units (PAUs) and mapped invasive plant sites. The non-potable water discussion was deleted from the FSEIS, and can be found in the draft SEIS.

Surveys of all potable water sources on the two Forests and Grassland are on-going. Surveys on the Ochoco NF and Grassland were completed by October 2010, and included campgrounds, picnic areas, special use cabins, diversions off-forest, wells, and sources adjacent to boundaries. Surveys are

continuing on the Deschutes NF, those in the Metolius Basin have been surveyed and mapped at this date. Maps, photos and inventory information are located at the Ochoco NF Headquarters.

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 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. PAU 71-23, along Forest Service Road 2630, is above the Bridge Creek diversion for the Maxwell Ditch which flows through the municipal watershed. 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 78. Municipal watersheds with invasive plant project area units (PAUs)

Forest	District	Watershed	Municipality	PAU
Deschutes NF	Bend-Fort Rock	1707030105	Bend	N/A
	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 the 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. 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 79. In addition, overlap of project area units and community water source areas (where delineated by DEQ) are shown in Table 80.

Table 79. Wellhead Protection Areas (WPAs) overlapping with invasive plant PAUs

Unit	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	No	11-07
		Wickiup	Twin Lakes Resort	1	Yes	11-54
		Fall River	Avion - Wild River	1	No	11-01, 11-02, 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, 11-02, 11-28
			Avion - Parrell	1	No	11-08
			Avion – River Bend	2	No	11-08
			Avion - Sundance	1	No	11-02
			Avion - Tekempe	3	Yes	11-08
			Widgi Cr. Village	1	No	11-07
	Crescent	Crescent Cr.	Manley's Tavern	1	Yes	12-02
	Sisters	Whychus Cr.	Black Butte Elem.	1	No	15-18
			Sisters High Sch.	1	Yes	15-06
			Tollgate	1	Yes	15-05

Table 80. Community water source/recharge areas (within Project Area Units)

Unit	District	Watershed	Sub-watershed	Invasive Plant Site within Recharge Area	PAU
CRNG	CRNG		170702040303	Yes	71-10
Deschutes	Bend-Ft Rock	Crane Prairie	170703010101	No	11-07
		Fall River	170703010301	No	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

Unit	District	Watershed	Sub-watershed	Invasive Plant Site within Recharge Area	PAU
			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	No	12-02
	Sisters	Whychus Cr	170703010802	Yes	15-22
			170703010803	Yes	15-22
			170703010805	No	15-07
			170703010806	Yes	15-05, 15-06, 15-22
			170703010807	Yes	15-05, 15-06
		Upper Metolius	170703010904	Yes	15-18
			170703010906	No	15-18
Ochoco	Lookout Mtn.	Upper Ochoco	170703050203	No	71-02, 71-30
	Paulina	Upper Beaver Cr	170703030802	Yes	72-01

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 81. 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 Table 81 and Table 82. 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, rental houses, the bunk houses and Ochoco Campground. The storage tank is not in an inventoried invasive plant site or PAU. 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 bunkhouses. 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 storage tank appears to be outside the proposed project area.

Table 81. Potable water at Ranger Stations, Guard Stations, and Government Housing

Unit	District	Watershed	Facility	Well	None	Invasive Plant Sites Present	WPA in PAU
Deschutes	Bend-Ft Rock	Crane Prairie	Elk Lake GS	X		No	11-07
		Pine	Cabin Lake GS	X		Not known	*
		Devils Garden	China Hat GS	X		No	11-02
		Fall River	Fall River GS		X	No	
	Crescent	Crescent Creek	Crescent Lake GS (on CG system)	X		No	
	Sisters	Upper Metolius	Allingham GS	X		No	15-32
		Upper Metolius	Suttle Lake GS (on resort well)	X		No	15-05/09
CRNG	CRNG	Willow Creek	CRNG Fld. Hq.		X	No	
Ochoco	Lookout Mtn.	Upper Ochoco Cr.	Ochoco RS/GH	X		Yes	71-19
		Upper N. Fork Crooked River	Cold Spr. GS	X		No	
	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 82 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 82. Potable water at campgrounds, organization camps, horse camps, and day use areas

Forest / Grassland	District	Watershed	Campground w/ Drinking Water	Well	Spring	Disconnected from Source	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
		Lower. Little Deschutes R.	Cinder Hill	X			None
		Crane Prairie	Crane Prairie	X			None
		Crane Prairie	Cultus Corral HC	X			None
		Crane Prairie	Cultus Lake	X			None
		Crane Prairie	Deschutes Bridge	X			11-07
		Lower Little Deschutes R.	East Lake	X			11-03
		Crane Prairie	Elk Lake (GS well)	X			11-07
		Wickiup	Gull Point (S Twin WS)	X			None

Forest / Grassland	District	Watershed	Campground w/ Drinking Water	Well	Spring	Disconnected from Source	WPA in PAUs
		Lower Little Deschutes R.	Hot Springs (E Lake CG geothermal well in CG)	X			None
		Crane Prairie	Lava Lake	X			None
		Pilot Butte	Lava Lands Visitor Cntr.	X			11-01
		Lower Little Deschutes R.	Little Crater	X			None
		Crane Prairie	Little Cultis Lake	X			None
		Crane Prairie	Ltl. Fawn CG/GC	X			None
		Crane Prairie	Ltl. Lava Lake (Lava Lk CG well)	X			None
		Lower. Little Deschutes R.	Newberry GC	X			None
		Wickiup	North Davis Cr.	X			None
		Lower Little Deschutes R.	Ogden GC (Prairie CG well)	X			None
		Lower Little Deschutes R.	Paulina Lake	X			11-03
		Crane Prairie	Point (Elk Lake GS well)	X			11-07
		Lower. Little Deschutes R.	Prairie	X			None
		Crane Prairie	Quinn Mdw. HC	X			None
		Crane Prairie	Quinn River	X			None
		Crane Prairie	Rock Cr. (2 wells)	X			None
		Wickiup	Sheep Bridge	X			None
		Wickiup	South Twin	X			None
		Wickiup	W. South Twin Lk. (S Twin Lk well)	X			None
	Crescent	Crescent Cr.	Crescent Cr.	X			None
		Crescent Cr.	Crescent Lake	X			None
		Wickiup	East Davis	X			*
		Wickiup	Odell Cr.			X	None
		Wickiup	Princess Cr. (only hosts use spring - for cleaning)	X	X		12-02
		Crescent Cr.	Simax GC	X			None
		Crescent Cr.	Spring	X			None
		Wickiup	Sunset Cove	X			None
		Wickiup	Trapper Cr.	X			None
		Wickiup	W. Davis Lake			X	None
		Crescent Cr.	Whitefish HC	X			12-03
	Sisters	Upper Metolius	Allen Spring	X			15-32
		Metolius	Allingham	X			15-32
		Upper Metolius	Blue Bay (Suttle Lake WS)	X			15-05/09
		Upper Metolius	Camp Sherman (Allingham WS)	X			15-32

Forest / Grassland	District	Watershed	Campground w/ Drinking Water	Well	Spring	Disconnected from Source	WPA in PAUs
		Upper Metolius	Cinder Beach DU (Suttle Lk Resort WS)	X			15-05/09
		Whychus Cr.	Cold Spring	X			None
		Whychus Cr.	Gorge (Allingham WS)				15-32
		Whychus Cr.	Graham Corral HC			X	None
		Whychus Cr.	Indian Ford			X	None
		Upper Metolius	Link Cr. (Suttle Lake WS)	X			15-15/09
		Upper Metolius	Lower Bridge		X		15-32
		Lower Metolius	Perry South (4 wells)	X			15-12
		Upper Metolius	Pine Rest (Allingham WS)	X			15-32
		Upper Metolius	Pioneer Ford (Lwr Bridge Spr)		X		15-32
		Upper Metolius	Riverside	X			15-05/09
		Upper Metolius	Scout Lk. GC/DU (Suttle Lk WS)	X			15-05/09
		Upper Metolius	Sheep Spring HC	X			*
		Upper Metolius	Smiling River (Allingham WS)	X			15-32
		Upper Metolius	South Shore (Suttle Lake WS)	X			15-05/09
		Upper Metolius	Suttle Lake DU (Suttle Lake WS)	X			15-05/09
CRNG	CRNG	Willow Cr.	Haystack Reservoir	X			75-24
Ochoco	Lookout Mtn	Bear Cr.	Antelope Res.	X			71-51
		Upper Ochoco Cr	Crystal Spr. OC	X			None
		Upper NF Crooked River	Deep Cr.	X			72-03
		Upper Ochoco Cr	Ochoco Forest Camp (RS well)	X			71-19
		Upper Ochoco Cr	Ochoco Divide (horizontal well)	X			None
		Upper Ochoco Cr	Walton L. CG/DU (well S side/Spr N side)	X	X		71-07
		Mill Cr.	Wildcat CG/DU	X			71-57
	Paulina	Upper Beaver Cr.	Sugar Cr. (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 83.

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 83. Potable water at special use cabins and 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 84. Special use diversions for domestic use off National Forest lands

Forest / Grassland	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 Cr.	Richardson	Storage tank	Well on pvt
		Willow Cr.	Williams	Well/storage tank	
Ochoco	Lookout Mtn	McKay Cr.	Edmonds	Unnamed spring Upr McKay Cr	
		Upr. Crooked River Valley	Meisner	A spring	
		Bear Cr.	Unauthorized use	A spring	Hunters camp
		Upper Ochoco Cr.	Unauthorized use	Unnamed spring Marks Cr.	Residence
	Paulina	Upper Mdl John Day River	Unauthorized use	Unnamed spring Cottonwood Cr	
		Lwr Beaver Cr	Miller	Unnamed spring	To Salter's Cabin

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.

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 in a range 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).

One exposure scenario that was not entirely resolved by the R6 2005 ROD Standards is worker exposure to triclopyr, especially the Garlon 4 formulation, which could exceed an HQ of 1. Under a backpack (spot) application scenario, using the Garlon 4 formulation of triclopyr, workers could be exposed to herbicides at beyond a threshold of concern. Thus, PDF 14 requires use of Garlon 3A instead of Garlon 4 where it is effective. This PDF, in addition to following safe work practices and label advisories, reduce the potential for workers to become exposed to Garlon 4.

Project Design Feature 12 for all action alternatives also reduces the application rate for NPE to 0.5 lbs per acre to reduce exposure of this surfactant if the broadcast method is used. This reduces the worker exposure potential identified in the R6 2005 FEIS Appendix Q below a level of concern.

Public Herbicide Exposure Analysis

The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project.The SERA risk assessments (and Appendix Q of the R6 2005 FEIS) evaluated the public health hazards associated with direct contact under worst case conditions. Appendix Q describes the assumptions behind the risk assessment exposure scenarios. While there is virtually no chance of a person being directly sprayed during this project, a person could brush up against sprayed vegetation soon after herbicide is applied. Even in the unlikely event of direct contact (given public notification, signage, and temporary closures), the threshold of concern would not be exceeded (meaning Hazard Quotients are predicted to be below 1) for all of the herbicides except triclopyr, particulary Garlon 4.

Risk assessments indicate that exposures exceeding the threshold of concern could occur if a person accidentally brushes up against vegetation sprayed with Garlon 4®. Thus, Garlon 4® would be specifically avoided in special forest product gathering areas, campgrounds, administrative sites to reduce the potential for such exposure and other high public use areas). Campgrounds, picnic areas, administrative sites, special forest harvesting areas, or other places may be closed during and after triclopyr application to prevent accidental exposures.

Another possible contamination route is a person eating contaminated fish, berries, or mushrooms (etc). Several exposure scenarios for recreational and subsistence fish consumption were considered in the SERA Risk Assessments; none approach any herbicide exposure level of concern because the amount of herbicide exposure plausible is so low. The PDFs minimize herbicide delivery to surface waters and reduce the potential for non-target vegetation, wildlife or fish to be exposed to herbicides.

Members of the public could eat invasive blackberries that have been sprayed, however the target vegetation would quickly be browned and unappetizing. Notification as discussed previously would minimize inadvertent exposure. 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 (ibid.).

Appendix Q of the R6 2005 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 was associated with exposure scenarios exceeding a level of concern if berries or mushrooms containing herbicide residue are consumed. In addition, under worst-case scenarios and maximum label rates, exposure to NPE surfactant may also exceed a level of concern. PDFs, especially 9, 12, 13, and 14 reduce the potential for harmful exposure by limiting the rate and method of exposure to these chemicals.

A risk assessment of herbicide residue contamination to edible mushrooms from direct spray applications (Durkin and Durkin, 2005) indicated that there would be no exposure over a threshold of concern from eating mushrooms that have been sprayed with the herbicides proposed for use in this project. The habitat preference of the majority of edible mushrooms reduces the likelihood of them being sprayed.

The potential for mushrooms to contain herbicides as a result of growing up through contaminated soil was also investigated. There is no data available on the transport of herbicides from sub-surface soil into the fruiting body of a mushroom. A few studies have looked at the uptake of some herbicides by fungal mycelia (the portion of the fungus that would be in the soil) (Klimek et al. 2001, Benoit et al.

1998, Baarschers et al. 1988). Results are variable with fungal species and herbicides, but in general, fungal mycelia can hold herbicide on their outer surface (adsorb), take herbicide molecules into the mycelia (absorb), metabolize and degrade herbicide molecules. Time, environmental conditions, and perhaps the fungal mycelia themselves degrade herbicides and would make less available for uptake into fruiting bodies. These considerations along with the lack of data on transport of herbicide into mushrooms indicate that the amount of residues persistent in the soil and capable of accumulating on the surface of a fruiting body would be less than that applied directly to a fruiting body from spray applications. More detailed information can be found in the Soils Specialist Report.

People who both harvest and consume special forest products or cultural-use plants (Table 85) 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 85. 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
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

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. However, the season that matsutake are harvested is generally outside the timeframe that herbicides are used for treatments. Mushrooms are not invasive target species. 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 (PDFs 26, 40, 41, 31-34). 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. The herbicide risk assessments and site-specific analysis indicates that minority forest workers or subsistence gatherers are not likely to be exposed to a dose which exceeds a threshold of concern.

General Effects of all Alternatives on Drinking 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 Chapter 4.5, and Appendix Q. 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 PDFs 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. Amounts of herbicide that would be transported on the Forests and Grassland would be much smaller than the amount modeled for a spill.

In addition PDFs 45, 46, and 47 require special considerations for certain soil types, beyond label requirements, for protecting ground water and to avoid accumulation in soil.

See Section 3.6 for more information about potential herbicide delivery to water and impacts to beneficial uses. All drinking water quality standards would be met in all alternatives because little herbicide is likely to contaminate drinking water sources.

Alternative 1 - No Action

Direct and Indirect Effects of the Alternatives

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.

There are no herbicide treatments in any of the municipal watersheds in this alternative. Alternative 1 treatment areas where herbicide treatments are permitted within 200 feet of wells or springs and delineated recharge areas are shown in Table 86. Recharge areas were estimated by the Oregon Water Resources Department for larger public systems. Not all potable water sources have delineated source areas at this time. It is not known how interconnected the surface water is with the aquifers.

Table 86. Potable water areas with potential herbicide treatments

Subbasin	Wellheat Protection Areas (WPA)		Drinkable Water Source Area (DWSA)	
	Number of Treatment Areas**	Acres	Number of Treatment Areas	Acres*
Upper John Day River	0	0	0	0
Lower John Day River	0	0	1	1.3
Upper Deschutes	5	14.7	12	330.5
Little Deschutes River	2	24.5	2	23.3
So.Fork Crooked River	1	2.8	1	13.7
Upper Crooked River	3	1.2	0	0
Lower Crooked River	4	4.1	2	143.4
Lower Deschutes River	0	0	0	0
Trout Creek	0	0	0	0
Summer Lake	0	0	0	0
Williamson	0	0	0	0
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 one sub-basin

Design elements from the 1998 EAs for Alternative 1 direct the Deschutes NF to use glyphosate, manual treatments, or biological treatments within ¼ mile of public water systems. There are no special design elements 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. Weeds at Ochoco Ranger Station and Rager Ranger Station (office/residential compounds), are usually sprayed every year. Testing of public water wells at these Stations has occurred roughly every two years from 1998 through 2010. Seven years worth of water testing of these wells show no detectable levels of any herbicides. In addition to common herbicides such as 2, 4-D, the test includes glyphosate, picloram, dicamba, and hexachlorobenzene (a contaminant in picloram) which are approved for use in the

noxious weed program, and no detectable levels have been found. The test results are included in the project file.

Alternatives 2 and 3

Direct and Indirect Effects

Both alternatives similarly resolve issues related to human health. Human health concerns are addressed through PDFs that limit that application method, rate, timing or other aspect of treatment to minimize accidental exposure.

PDFs 9 through 41 specifically minimize the intensity of potential adverse impacts on human health and the likelihood the effects would actually occur.

Table 87. PDFs that address human health concerns

Type of PDF	PDF
Method of application, selection of herbicide, or rate capped to avoid exposure scenarios associated with risk over the threshold of concern (keep HQ < 1).	9, 10, 12, 13, 14, 33, 36, 37
Worker training, certification, and safety practices.	11, 22,
Spill avoidance and clean up	18, 19, 20, 21, 24,25,
Drinking water protection	17, 27, 28, 29, 29.1, 20,
Field practices to reduce leaching, drift and chemical run off	15, 16, 17, 23,
Public notification and area closure	26, 31, 32, 22, 34, 38,
Special forest products	39, 40
American Indian Tribes and cultural plants	41

Drinking Water – Alternative 2

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). Drinking Water Source Areas (DWSAs) for moderate to large wells were also evaluated. See the Hydrology Report and the Draft SEIS for detailed information on the analysis use to calculate WPAs and DWSAs.

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 88. WPAs shown in Table 88 include those calculated for wells that also have state delineated DWSAs.

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 88. 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 88. Acres of PAUs within 200 feet of wells or springs and delineated 1-2 year DWSAs overlain by PAUs

	Calculated Values for Wellhead Protection Areas		State Designated Drinkable Water Source Area	
Subbasin	**No. of PAUs**	**Acres**	**No. of PAUs**	**Acres**
Upper John Day R.	0	0	0	0
Lower John Day R.	0	0	1	1.3
Upper Deschutes	15	45.6	28	1,794.2
Little Deschutes R.	4	2.4	0	0
So Fk Crooked River	1	3.7	1	17.4
Upper Crooked River	2	0.8	0	0
Lower Crooked River	3	10.3	3	737.0
Lower 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	2,549.9

* 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. 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 by 100-foot no chemical treatment buffer was derived from Evans 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. 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 0.25 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 and 47), to avoid excessive runoff or leaching (percolation).

Both picloram and chlorsulfuron have a very high solubility rate and mobility in the soil. Clopyralid is highly soluble, and 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 (see PDF 45 which limits use in these areas). 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. The study concluded, “In terms of water quality impacts, there was no adverse effect on water quality of the springs.” There are approximately 4.5 acres of inventoried invasive plants on the combined Ochoco National Forest and Crooked River National Grassland where picloram is listed as the first choice herbicide, or less than 0.001% of the total area in these two units. On the Deschutes National Forest, there are about 186 acres where picloram would be the first choice or about 0.01% of the Deschutes. Most invasive plant populations on the two Forests and the CRNG are adjacent to roads. No application of picloram or clopyralid would occur within 200 feet of domestic wells or spring boxes under Alternative 2 (PDF 29). As indicated, the scale, intensity, and concentration of active ingredient picloram in Pang and others and Neary and others was substantially greater than anything proposed in this alternative.

Effects to municipal water sources are unlikely. There are chemical treatments proposed in the Sisters municipal watershed (PAU 15-22) in both Alternative 2 and 3, where picloram may be used for treating Canada thistle (second choice herbicide) in within the 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 Mitchell 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 (Evans & 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 15would be used, and as directed in PDF 27, chemical treatments would be coordinated with the municipal department in charge of the water system.

Twenty-two of the 27 PAUs that intersect WPAs, and 31 of the 33 PAUs that cross DWSAs delineated by the State, 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

potentially unsealed casings. To address this concern with groundwater contamination and HCB, the following restrictions were developed (PDF 29):

- no herbicide will be applied within 100 feet of a domestic well
- no herbicide will be applied within 200 feet of a domestic springbox (zone 1 & 2 of the calculated wellhead protection area)
- no broadcast spraying within 200 feet of a domestic well or spring box
- no picloram or clopyralid use within 200 feet of a domestic well or spring box

This 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 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 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.

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, limited scale of infestations, intensity of treatments, and typical herbicide application rates, concentrations would be extremely small and should be below detection levels.

Based on the following:

- 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 0.25 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) 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 R6 2005 EIS and would protect groundwater recharge areas.

Alternative 2 would comply with State water quality standards for toxic substances.

Drinking Water – Alternative 3

Alternative 3 was developed to address issues and concerns related to fisheries and other aquatic organisms but would also reduce the potential of 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. Effects to potable water from wells and springs would be similar to those in Alternative 2. The more stringent application of waterbody buffers (see Table 16) in Alternative 3 would reduce potential herbicide delivery to the waters in Municipal Watersheds and it is reasonable to assume additional BMPs would be developed during coordination with the managing agency or association for the two surface water municipal 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.

Specific differences for Alternative 3 in direct and indirect affects compared to Alternative 2 include:

- Potable Water – precluding the use of picloram within 300 feet of streams, lakes, or wetlands in Alternative 3 would reduce the risk of measurable concentrations of this chemical reaching irrigation ditches, streams, springs, or water bodies used for irrigation or domestic purposes through runoff or percolation (see PDF 58).

Alternative 3 would comply with State water quality standards for toxic substances.

Cumulative Effects of All Alternatives

The proposed use of herbicides in all alternatives along with proposed use elsewhere 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. Thus, cumulative effects on human health are unlikely.

The Basis for Cumulative Effects section previously in Chapter 3.1.3 discusses the background pesticide use in the United States, Oregon, and in the specific watersheds in the project areas. Despite the ubiquitous nature of chemicals in the environment, there is virtually no potential for herbicide use from this project to combine with other projects and trigger cumulative adverse impacts to human health.

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. For an adult drinking from a pond contaminated by leaching from and adjacent treated area over a lifetime, none 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 threshold 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 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 2005 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[14]) 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 FSEIS, 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” (USDA Forest Service 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 2003) 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. All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

[14] 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

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.

No federally listed endangered species occur in the project area, however, the project area does provide important habitat for several rare species, including one federally listed threatened species, three species that are federal candidates, several species included on the Regional Forester's Sensitive Animal List (USDA Forest Service 2008), and two species that are considered Survey and Manage. 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. Those species that spend time on land are analyzed here; those that spend most of their time in water are addressed in the Fisheries Section 3.7.

The Regional Forester's sensitive species (RFSS) list was updated in 2011, however the cover letter attached to the new list stated: *"Projects initiated prior to the date of this letter may use the updated RFSS list transmitted in this letter or the RFSS list that was in effect when the project was initiated"* (USDA Forest Service 2011). The analysis included here is based on the 2008 RFSS list. However, the most current species list would be reviewed during annual implementation planning, habitat would be evaluated, and surveys conducted as needed.

The analysis of existing habitat for the various wildlife species considered in this document was initially completed for the Travel Management Project for the Deschutes and Ochoco National Forests and Crooked River National Grassland (Turner 2010a, 2010b). The Travel Management project did not alter the existing amount of habitat and there have been no other large-scale disturbances since that time so habitat estimates are still valid. The existing amount of habitat on the Deschutes and Ochoco National Forests and Crooked River National Grassland for the various species was determined by the Viable Ecosystems Model (VIABLE). Viable stratifies the environment along a gradient of size, structure, species composition, and relative tree density. The 2004 satellite imagery layer was used to develop the VIABLE map. Data is mapped on a 25 meter pixel grid, meaning the map is divided up on a 25 meter grid and that every 25 meter square (pixel) is assigned a value that relates to a stratum of size, structure, tree species composition, and relative tree density. The various classifications are then linked to wildlife habitat requirements. Criteria used (vegetation, seral state, structure, and density) to determine habitat for each species is described in existing condition of each species.

Viable was not able to map habitat for riparian, special habitat, or niche species. Riparian associated wildlife species select for riparian vegetation or other characteristics found adjacent to streams and water bodies. Riparian buffers were used as a surrogate for riparian habitat. For wildlife species associated with riparian, habitat may be over-estimated in this analysis as riparian habitat characteristics are not likely to occur within the entire buffer distance and not every water body may contain suitable habitat for each species. For wetland and lake associated wildlife species, wetland buffers and lake buffers were included in the total acreage given for wetlands and lakes and therefore estimates of habitat quantity. This will over-estimate habitat because the entire water body is included.

Mapped special habitats on the Deschutes National Forest include hardwoods, alpine meadows, meadow, alpine shrubs, mesic shrubs, rock, xeric shrublands (scablands), and caves. Mapped special habitats on the Ochoco National Forest include alder/willow, aspen, cottonwood, grassland, mtn. mahogany, meadow, rock and sage/scab. Special habitat information is available as separate layers in

GIS for each forest. As with the riparian habitat, habitat may be over-estimated as each area mapped may not contain suitable habitat for each species within the entire mapped area.

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 to 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. To determine potential effects to the various wildlife species, the Geographic Information System (GIS) program ArcMap was used to overlay this habitat with the project area units proposed in this FSEIS to determine and illustrate the amount of habitat that is likely to be affected by invasive plant treatments.

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 (USDA Forest Service 2005d). The Wildlife Specialist Report and Biological Evaluation, Wildlife Biological Assessment, and Management Indicator Species information are 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, Forest Service, 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).

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

No federally listed "endangered" species occur in the project area. 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 (USFWS) maintains a list of "candidate" species. Candidate species are those taxa which the USFWS 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*), wolverine (*Gulo gulo*), fisher (*Martes pennanti*), and greater sage grouse (*Centrocercus urophasianus*). The Canada lynx (*Lynx canadensis*), a Threatened species, has not been documented in the project area and Forest Service review found there is insufficient habitat to support lynx. On May 29, 2001 the Forests received concurrence from the U.S. Fish and Wildlife Service that implementation of any activities contained within the Deschutes and Ochoco National Forests is not likely to adversely affect the Canada lynx outside of an existing Lynx Analysis Unit. There are no Lynx Analysis Units on the Deschutes or Ochoco National Forests. 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 wildlife species potentially within the project area

Species	Status	Critical Habitat	Presence
Northern spotted owl	Threatened	Designated	Deschutes
Oregon spotted frog	Candidate	None	Deschutes
Wolverine	Candidate	None	Deschutes, Ochoco
Greater sage grouse	Candidate	None	Deschutes, Ochoco
Pacific fisher	Candidate	None	Deschutes

The bald eagle (*Haliaeetus leucocephalus*) 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. It is addressed under the section titled "Forest Service Sensitive Species".

The wolverine, Oregon spotted frog, greater sage grouse, and Pacific fisher are also included on the Regional Forester's Sensitive Species List (USDA Forest Service 2008) and the wolverine is a Management Indicator Species (MIS) on the Deschutes National Forest. All of these species 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 Deschutes and Ochoco Aquatic and Terrestrial Programmatic Biological Assessment for the Forests' activities (USDA 2010). This information is incorporated by reference and is summarized in the Project Area Information section.

Project 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. There are currently a total of 78,109 acres of NRF on the Deschutes National Forest (USDA 2010 Appendix B). 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 (Glaucomys sabrinus). Secondary prey species include western red-backed vole (Clethrionomys californicus), bushy-tailed woodrat (Neotoma cinerea), western pocket gopher (Thomomys mazama), Douglas squirrel (Tamiasciurus hudsonicus), snowshoe hare (Lepus americanus), voles (Microtus spp.), mice (Peromyscus spp.), and insects.

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 Deschutes and Ochoco National Forests (USDA Forest Service 2010) identifies breeding season limited operating periods near northern spotted owls. Table 90 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 effect will occur. Disruption is a disturbance that exceeds the "discountable and insignificant" threshold and rises to a level of an adverse effect. The breeding period is from March 1 – September 30.

Table 90. Disturbance and disruption distances for nesting spotted owls.

Activity	Disturbance Distance	Disruption 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 or weed wackers	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 1,129 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 154 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 123 acres of these spotted owl core areas are in these project area units. Four additional activity centers were located in 2011 on Sisters and Bend/Ft. Rock Ranger Districts. None of these are within PAUs; however one location is adjacent to PAU 15-14. Implementation of PDF 77 which restricts disturbing work activities (i.e. weed wacker, heavy equipment, etc) within ¼ mile of the nest site or activity center of all known pairs or resident singles between March 1 and September 30 would prevent disturbance.

Critical Habitat in the Project 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

On March 5, 2010, the U.S. Fish and Wildlife Service announced that listing of the greater sage-grouse under the Endangered Species Act (ESA) was warranted, but listing is precluded by the need to complete other listing actions of higher priority. Similarly, the U.S. Fish and Wildlife Service announced that the wolverine (December 14, 2010 announcement) and Pacific fisher (April 8, 2004 announcement) are warranted for listing under the ESA however, are precluded by other higher priority listing actions. All of these species now have federal candidate species status on the Ochoco and Deschutes National Forests, and the Crooked River National Grassland. 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.

Terrestrial wildlife species found in the project area that are included in the Region’s “Special Status/Sensitive Species Program (January 2008)” are listed in Table 91. 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 (January 2008)

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
Townsend/s big-eared bat	*Corynorhinus townsedii*	D	D	
Birds				
Bald eagle[2]	*Haliaeetus leucocephalus*	D	D	D
Horned grebe	*Podiceps auritus*	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	
Tricolored blackbird	*Agelaius tricolor*	D	S	S
Northern waterthrush	*Seiurus noveboracensis*	D		
Lewis' woodpecker	*Melanerpes lewis*	D	D	
White-headed woodpecker	*Picoides albolarvatus*	D	D	D
Amphibians				
Oregon spotted frog	*Rana pretiosa*	D		
Columbia spotted frog	*Rana luteiventris*		D	D
Invertebrates				
Crater Lake tightcoil	*Pristiloma arcticum crateris*	D		
Johnson's hairstreak	*Callophyrs johnsoni*	S	S	
Silver-bordered fritillary	*Boloria selene*	D	D	

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.

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.

In the 19th century, wolverines were found throughout the Cascade Mountains, Rocky Mountains, Central Great Plains, Great Lakes, Upper Midwest, and the northeast United States. Currently, the U.S. population is estimated at 250 to 300 individuals, mostly concentrated in Northern Rocky Mountain Range, with some occurring in the Pacific Cascade Region. Populations in Canada and Alaska do not appear to be in decline. In Oregon, there have been only six verified reports of sightings since 1920. In 1936, the wolverine was thought to have been extirpated from Oregon; however in 1965, a male was killed on Three Fingered Jack in Linn County. In 1973, a wolverine was trapped and released on Steens Mountain, Harney County. In 1986, a wolverine was trapped in Wheeler County. In 1990, a dead wolverine was picked up on I-84 in Hood River County. In 1992, a partial skeleton was recovered in Grant County. Most recently, three wolverines have been photographed at bait stations with camera sets in Wallowa County, near the Eagle Cap Wilderness bringing the total verified sightings to nine as of summer 2011.

Project Area Information – Habitat for the wolverine occurs in the higher elevations on the Deschutes National Forests in the following plant associations – mountain hemlock where average tree size is 15”dbh or greater. Approximately 92,588 acres of habitat currently exist across the Deschutes National.

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. Wolverine surveys were also conducted on the Lookout Mountain RD of the Ochoco NF (formerly the Prineville RD) in 1999 and 2000 using winter bait stations with video surveillance cameras and hair traps. No wolverine sightings or evidence were recorded at any of the bait stations. (Prineville Wolverine Survey files 2000). 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.

Pacific 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.

Project Area Information – Habitat for the Pacific fisher occurs in very minor amounts on the Deschutes National Forest in the following plant associations: lodgepole pine wet, white fir, Shasta red fir, western hemlock, silver fir, and mountain hemlock in closed stands where average tree size is 20 inches dbh or greater. Approximately 4,176 acres of habitat currently exist across the Deschutes National Forest.

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 project 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.

Project 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).

Mapped sage grouse habitat will be used as a surrogate for pygmy rabbit habitat as these species occupy similar habitats. Three sage grouse habitats were mapped and defined – winter, nesting, and brood rearing and foraging habitat. Winter habitat is defined as Mtn. Big Sagebrush – Bitterbrush plant associations with large structure and appreciable shrub heights capable of providing cover above the accumulated snowpack. Nesting habitat is comprised of Mtn. Big Sage – Bitterbrush and Mtn. Big Sage/Idaho Fescue plant associations with appreciable live shrub cover, structural height, and forb diversity. Brood rearing and foraging habitat are defined as Mtn. Big Sage plant associations with lower shrub cover and more grass and forb components. These habitats will be analyzed for the Deschutes NF while sage/scab habitat will be used to simulate pygmy rabbit habitat on the Ochoco. Habitat may be over-estimated on the Ochoco and Deschutes NFs as not all sage/scab habitats will provide suitable conditions for the pygmy rabbit, especially soil conditions needed by the rabbit.

On the Deschutes National Forest there are approximately 10,120 acres of potential pygmy rabbit habitat while on the Ochoco National Forest there are approximately 62,186 acres.

Invasive plants are currently degrading potential habitat for the pygmy rabbit within the project 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.

Townsend's Big-Eared Bat

The Townsend's big-eared bat is a non-migratory species dependent on caves, or cave-like structures including mines year-round. These caves occur in a wide variety of habitat types and elevations from sea level to 10,000 feet (NatureServe 2011, Siemers 2002). Townsend's will also use rock crevices, rock faces/cliffs, buildings, tunnels, bridges, and trees as day or night roost sites (Dobkin et al. 1995, Ellison et al. 2003, Mazurek 2004).

In addition to cave or cavelike habitat, primary components include suitable foraging habitat that provides insect prey and water sources for both drinking and foraging. Considered a moth specialist, preferred prey items include small moths 0.23-0.47 inches (6 to 12 mm) from the families Noctuidae, Geometridae, Notodontidae, and Sphingidae, with opportunistic foraging on beetles and flies (Pierson et al. 1999). Townsend's are considered moth specialists (primarily Lepidoterans); however, they can be considered habitat generalists in terms of foraging as they appear to forage successfully in a wide range of habitats, and particularly in edge habitat.

They forage in riparian areas, intermittent streams (Seidman and Zabel 2001), wetlands, and lakes, and along forest/shrub edges, ridges, or canopy, where insects concentrate (Burford and Lacki 1998, Clark et al. 1993). They also glean insects directly from foliage or other substrates. Although they appear to avoid large, open areas (Pierson et al. 1999), and areas of dense, regenerating forests, estimates of canopy coverage necessary to create suitable foraging conditions are unknown. Clark et al. (1993) found foraging in open, uncluttered areas enhanced the ability of Ozark big-eared bats to navigate and distinguish insects but it increased their risk to predation. Woodland edge habitat offered a less cluttered environment, some cover, and a high prey density.

Project Area Information – Townsend's big-eared bats have been confirmed at caves on the Sisters and Bend/Fort Rock Ranger Districts, and at the Blue Ridge Mine on the Lookout Mountain Ranger District of the Ochoco National Forest. Approximately 400 caves exist on the Deschutes National Forest and adjoining private and Bureau of Land Management Land (BLM). The majority of C. townsendii on the Deschutes inhabit caves in the eastern semi-arid desert areas of the Bend-Ft. Rock Ranger District. However, some are known to inhabit caves in forested lava areas at higher elevations on the Forest. They have been reported in other areas of the western U.S. at elevations up to 10,000 feet. There are several mines that occur on the Ochoco NF that may also provide habitat.

To analyze the amount of potential habitat in the project area rock is used. On the Deschutes National Forest there is approximately 29,026 acres of rock habitat while on the Ochoco there is approximately 1,990 acres. Habitat is likely over-estimated for this analysis because not all cave or rock habitat identified is considered suitable Townsend's big-eared bat habitat.

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.

Bald Eagle

The project area provides habitat for residents as well as wintering migratory eagles. 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 are sit-and-wait predators, which predominantly capture prey from perches over water; ideal perches are large trees and snags within 330 feet (100 m) of water (Anthony et al. 1995). 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).

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). Currently, there are no populations of Hydrilla in the project area.

With the delisting of the bald eagle, the Fish and Wildlife Service released new National Bald Eagle Management Guidelines (USDI Fish and Wildlife Service 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.

Project Area Information – On the Deschutes and Ochoco National Forests, ponderosa pine and Douglas-fir trees averaging 32 inch+ d.b.h. with live large, open limb structure are preferred for nesting. Nests consist of bulky stick platforms built in the super-canopy of such trees, or less frequently on cliffs. They are typically constructed within one mile of appropriate foraging habitat, which includes rivers and large lakes and reservoirs.

There are 49 known bald eagle territories on the Deschutes National Forest and 7 known territories on the Ochoco National Forest primarily associated with large water bodies, rivers, and streams. Annual surveys are conducted but not for all sites

Bald Eagle Management Areas (BEMAs) (MA-3) are designated in the Deschutes National Forest Plan (USDA 1990c) to manage habitat to enhance the carrying capacity of bald eagles. 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. Generally within MA-3, nesting and foraging areas are protected and enhanced, emphasizing old growth stands with large trees. In addition, human disturbance is to be minimized during the nesting season. Therefore, seasonal restrictions may be warranted between January 1 through August 31 to protect nest sites and key feeding and roost sites. Currently, approximately 22,245 acres are within BEMAs on the Deschutes NF

The Ochoco National Forest LRMP (USDA Forest Service 1989, Part 1) contains direction specific to bald eagle winter roost sites (MA-F12) and does not contain specific direction for nest sites. BEMA plans give the specific direction for protection of eagle habitat. For winter roosting the emphasis is to provide winter roosting habitat for migrating bald eagles that is free of potentially disturbing human activity during the period of December 1 through May1. In addition to winter roost sites there are specific standards and guidelines in the Ochoco National Forest LRMP (LRMP pp 4-248) that provide protection for nesting and roosting bald eagles. There are approximately 2,673 acres on the Ochoco National Forest that are managed for bald eagle winter roost sites.

Suitable habitat (includes habitat within LRMP management areas) for the bald eagle occurs sparingly throughout the Deschutes and Ochoco National Forests in most plant associations except juniper where average tree size is 20 inches dbh or greater. Approximately 25,965 acres of habitat currently exist across the Deschutes National Forest and approximately 5,245 acres of habitat occurs on the Ochoco National Forest for a total of 31,210 acres.

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	8	5
CRN Grassland	0	0	0

A Programmatic Wildlife Biological Assessment (Programmatic BA) for the Deschutes and Ochoco National Forests (USDA Forest Service 2010) 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 the table, 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. December 1 to May 1 is identified in the Ochoco LRMP.

Table 93. Disturbance distances for bald eagle within which adverse effects may occur, as specified by the USFWS 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.

Horned Grebe

The horned grebe is a Regional Forester's sensitive species on the Deschutes NF.Nesting habitat is found in tall vegetation in shallow water. Horned grebes eat fish, crayfish and aquatic insects.

Project 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 project area, but no known breeding sites are located within the project area.

Habitat for the horned grebe includes Class 1, 2, and 3 streams, lakes, and wetlands. Wetlands and lakes include both the wetland and water body and the associated buffer. Habitat will be over-estimated for this analysis because not every stream, lake, or wetland mapped provides suitable habitat. This query also includes the entire water body, rather than just the calm, backwater areas required for nesting by this species.

On the Deschutes National Forest there is a total of 86,436 acres of potential habitat; 11,729 acres of Class 1 stream, 11,436 acres of Class 2 stream, 3,030 acres of Class 3 stream, 18,106 acres of lake habitat, and 42,135 acres of wetlands.

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.

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).

Project 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.. pers. comm. 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 Ranger District with the potential for breeding habitat to occur in the Meadow Lakes area and Round Lake.

To assess potential habitat on the Deschutes and Ochoco National Forests habitat for the bufflehead was considered to include Class 1, 2, and 3 streams and lakes. Lakes include the water body and associated buffer. Habitat will be over-estimated for this analysis because low elevation lakes, ponds, and streams are also included in this query. In addition, large snag habitat may not be available along all mapped streams and lakes required for nesting by this species.

On the Deschutes National Forest there is a total of 44,301 acres of potential habitat; 11,729 acres of Class 1 stream, 11,436 acres of Class 2 stream, 3,030 acres of Class 3 stream, and 18,106 acres of lake habitat. On the Ochoco National Forest there approximately 50,781 acres of potential habitat; 9,590 acres of Class 1 stream, 28,172 acres of Class 2 stream, 12,575 acres of Class 3 stream, and 446 acres of lake habitat.

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.

Project 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. Potential habitat of the harlequin duck on the Deschutes National Forest includes Class 1, 2, and 3 streams. Habitat will be over-estimated for this analysis because this includes more than low to moderate gradient streams. In addition, streams are included regardless of substrate identified as necessary for caddisfly production. On the Deschutes National Forest there is a total of 26,195 acres of potential habitat; 11,729 acres of Class 1 stream, 11,436 acres of Class 2 stream, and 3,030 acres of Class 3 stream.

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.

Project Area Information – Yellow rails are not known or suspected to occur on the Ochoco National Forest. There is a small breeding population of yellow rails at Big Marsh on the Deschutes National Forest, Crescent District. Habitat for the yellow rail includes wetlands, including both the wetland and the associated buffer. Habitat will be over-estimated for this analysis because all wetlands are mapped and may not contain conditions suitable for nesting, wetland size may be too small, and includes low elevation wetlands.

On the Deschutes National Forest there is a total of 42,135 acres of potential habitat. There are about six 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.

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.

Project Area Information – Upland sandpipers are not known to occur within the project 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. pers. comm. 2006).

Potential habitat for the upland sandpiper on the Ochoco includes meadows. On the Ochoco National Forest it's estimated that there are approximately 11,143 acres of potential habitat. Habitat is likely over-estimated in this analysis because not every meadow will be the size needed, occur at the appropriate elevation, are near a water source, or are comprised of suitable vegetation needed by this species for nesting.

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). In March 2010, the US Fish and Wildlife Service announced that the sage grouse was warranted for listing under the ESA, but precluded by higher listing priorities. Therefore, the sage grouse has federal "candidate" status but would not receive statutory protection under the ESA. It remains a FS Sensitive Species.

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).

Project 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).

Habitat on the Deschutes and Ochoco National Forests is categorized into winter, nesting, and brood rearing and foraging habitat (USDA Forest Service 2006b). Winter habitat is defined as Mtn. Big Sagebrush – Bitterbrush plant associations with large structure and appreciable shrub heights capable of providing cover above the accumulated snowpack. Nesting habitat is comprised of Mtn. Big Sage – Bitterbrush and Mtn. Big Sage/Idaho Fescue plant associations with appreciable live shrub cover, structural height, and forb diversity. Brood rearing and foraging habitat are defined as Mtn. Big Sage plant associations with lower shrub cover and more grass and forb components. On the Ochoco sage/scab plant associations also provide potential habitat. Habitat may be over-estimated on the Ochoco NF as not all sage/scab habitats will provide suitable conditions for sage grouse.

On the Deschutes National Forest there are approximately 10,120 acres of total habitat; 4,115 acres of nesting, 2,266 of brood rearing habitat, and 3,739 acres of winter habitat. On the Ochoco National Forest there are approximately 62,186 acres of potential habitat. Winter, nesting, and brood rearing habitat have not been differentiated on the Ochoco National Forest.

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, but not leks. 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 USFWS 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).

Project Area Information – There are no known peregrine falcon nests within the planning area, but individual birds have been sighted on both forests. Nesting habitat for the peregrine falcon includes rock. On the Deschutes National Forest there is approximately 12,618 acres of rock providing potential habitat while on the Ochoco National Forest there is approximately 1,990 acres of potential habitat. The analysis of rock habitat on the two forests likely over-estimates the amount of suitable habitat because most rock mapped does not equate to cliff habitat suitable for nesting by the peregrine falcon.

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.

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.

Project 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 Forest Service 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).

Habitat for the tri-colored blackbird includes wetlands, wetland buffers, and mesic shrub on the Deschutes, and alder/willow on the Ochoco. On the Deschutes National Forest there is a total of 48,315 acres of potential habitat; 28,518 of wetland, 13,617 of wetland buffer, and 6,179 of mesic shrub. On the Ochoco there is a total of 18,429 acres of potential habitat; 9,105 of wetland, 7,745 of wetland buffer, and 1,579 of alder and willow. The amount of habitat is over-estimated for this analysis because not every wetland mapped, mesic shrub area, or alder/willow patch provides suitable habitat.

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.

Northern Waterthrush

The Northern Waterthrush is a Regional Forester's Sensitive species on the Deschutes National Forest. It is a small songbird of northern forests. It prefers bogs and waters that are flat and breeds in thickets near slow-moving streams, ponds, swamps, and bogs. In migration and winter, it uses a variety of wooded habitats, generally near water. The northern waterthrush feeds mainly on the ground and occasionally wades in shallow water in search of insects, arthropods, snails, and occasionally small fish (Eaton 1995).

The northern waterthrush is one of Oregon's rarest and most local breeders. An isolated population has summered and presumably bred in the south central Cascades since 1977. This population extends from the Little Deschutes River north of Gilchrist south to the vicinity of Highway 58 west along Crescent Creek and to Salt Creek in Lane County (Marshall et al. 2003). In addition, one male was seen at Lost Lake along the crest in the late 1980s. No nest has ever been found. Along Crescent Creek, birds are found in dense willow 5-8 feet tall with some alder interspersed, often in standing or slow moving water. Northern waterthrushes have been observed singing from willows, pines, and snags in the vicinity. Their diet is unknown. No population surveys have been done but several pairs have been detected for the past 30 years along Crescent Creek and the Little Deschutes River (Marshall et al. 2003).

Project Area Information – Habitat for the northern waterthrush includes hardwoods, mesic shrubs and Class 1-4 riparian areas on the Deschutes NF. It is estimated that there is a total of 48,136 acres of potential habitat; 496 of hardwood, 6,179 of mesic shrub, 11,729 of Class 1 stream, 11,436 of Class 2 stream, 3,030 of Class 3 stream, and 15,266 of Class 4 stream. This habitat estimate is likely an over-estimate because not every special habitat area will be comprised of suitable vegetation needed by this species for nesting or located near standing or slow moving water.

Lewis' Woodpecker

Marshall et al. 2003 indicates the Oregon distribution was formerly widespread, although it is currently only common in the white oak-ponderosa pine belt on the eastern slopes of the cascades east of Mt. Hood. It occurs in low numbers along the stream and river bottoms of eastern Oregon. It is a regular transient in small numbers west of the Cascades, uncommon east of the Cascades, and most common in open habitats and burns in and near the Cascades forests (Marshall et al. 2003).

Lewis' woodpecker prefers open riparian woodland habitats dominated by cottonwoods, open ponderosa pine, and burned or logged ponderosa pine. Marshall et al. 2003 indicates from various studies the preferred nest trees are cottonwoods although nests are also found in ponderosa pine, juniper, fir, and willow. Brushy undergrowth that supports insects on which Lewis' woodpeckers feed is an important component of their preferred breeding habitat (Tobalske 1997). This species is a weak cavity excavator and typically uses cavities excavated by other species. Lewis' woodpeckers are aerial insectivores during the breeding season relying on flying insects as forage. They require large snags in an advanced state of decay that are easy to excavate, or they use old cavities created by other woodpeckers because they are not strong cavity excavators. Nest trees generally average 17 inches to 44 inches (Saab and Dudley 1998, Wisdom et al. 2000). Burned ponderosa pine forests created by stand-replacing fires provide highly productive habitats as compared to unburned pine (Wisdom et al. 2000).

Project Area Information – Habitat for the Lewis' woodpecker occurs sparingly throughout the Deschutes and Ochoco National Forests in the following plant associations—lodgepole pine, ponderosa pine, Douglas-fir, and white fir in open stands where average tree size is 15 inches d.b.h. or greater.

Approximately 7,390 acres of habitat currently exist across the Deschutes National Forest and approximately 4,471 acres of habitat occurs on the Ochoco National Forest for a total of 11,861 acres.

White-headed Woodpecker

The white-headed woodpecker is a species that prefers ponderosa pine habitat that has a more open stand conditions with large pine for foraging and large snags for nesting habitat. They prefer stands with live, old ponderosa pine, abundant snags and relatively open understory conditions. White-headed woodpeckers favor live ponderosa pine as foraging substrate, but have also been observed in lodgepole pine, sugar pine, Engelmann spruce and other species. They concentrate their foraging activities on live ponderosa pine, but they may also glean insects from other tree species. The whiteheaded woodpecker feeds primarily on live tree insects and utilizes pine seeds. They generally select large diameter ponderosa pine snags as nest sites, though they are not always in tall snags (Dixon 1995; Marshall 1997). They typically select for single-strata ponderosa pine dominated LOS.

Project Area Information – The white-headed woodpecker is infrequently observed on both the Deschutes and Ochoco National Forests. Habitat occurs sparingly throughout the Deschutes and Ochoco National Forests in the following plant associations –ponderosa pine, Douglas-fir, white fir, and Shasta red fir in open stands where average tree size is 20 inches d.b.h. or greater. Approximately 36,167 acres of habitat currently exist across the Deschutes National Forest and approximately 8,220 acres of habitat occurs on the Ochoco National Forest for a total of 44,387 acres.

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.

The Programmatic Biological Assessment (USDA Forest Service 2010) includes project design criteria (equivalent to PDF) for 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 USFWS biologists is being conducted for this project and the analysis for spotted frogs will be made available to USFWS. Local biologists will be consulted prior to implementation of invasive plant treatments (spotted frog PDF 83).

Project Area Information – Habitat for the Oregon spotted frog includes Class 1, 2, and 3 streams, lakes, and wetlands. On the Deschutes National Forest there is a total of 89,376 acres of Oregon spotted frog habitat; 11,729 acres of Class 1 stream, 11,436 acres of Class 2 stream, 3,030 acres of Class 3 stream, 34,663 of lake habitat, and 28,518 acres of wetlands. Habitat is likely over-estimated for this analysis because habitat for this species is only limited to warmer waters with emergent vegetation.

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, pers. comm.). Small populations of reed canarygrass throughout the Upper Deschutes watershed are recommended to be high priorities for management (C. Pearl, pers. comm.).

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 is a sensitive species on the Ochoco National Forest. Columbia spotted frogs that are found on the Ochoco National Forest, Crooked River National Grassland, and potentially on the eastern edge of the Deschutes National Forest are not considered part of the Great Basin Distinct Population Segment (Lake, Harney, and Malheur counties) pending further genetic analysis and are therefore not considered a "candidate" for listing under ESA. However, the project design criteria in the

Programmatic BA and its applicability to this project and this species are as discussed above for the Oregon 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.

Project 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, tributaries of the Crooked River and in the pond behind Rimrock Springs Dam. It can also be found in stock ponds.

Habitat for the Columbia spotted frog includes Class 1, 2, and 3 streams, lakes, and wetlands. On the Ochoco National Forest and Crooked River National Grassland there is a total of 59,830 acres of Columbia spotted frog habitat; 9,590 acres of Class 1 stream, 28,172 acres of Class 2 stream, 12,575 acres of Class 3 stream, 388 acres of lake habitat, and 9,105 acres of wetlands. Habitat will be over-estimated for this analysis because habitat for this species is only limited to warmer waters with emergent vegetation.

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, pers. comm..).

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 is a minute snail, approximately 2.75 millimeters in diameter, that may be found in perennially moist situations in mature conifer forests and meadows among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 meters of open water in wetlands, springs, seeps and streams, generally in areas which remain under snow for long periods in the winter. Riparian habitats in the Eastern Oregon Cascades that are suitable for this species, limited to the extent of permanent surface moisture, are often much less than 10 m. from open water. Essential habitat components include uncompacted soil, litter, logs, and other woody debris in a perennially wet environment. They may be found on or under woody debris or on the bases of sedges (Duncan et al. 2004). The habitats that support this species are often centered on small hydrologic features (Duncan et al. 2004). Frest emphasized that the sites where he has found P. a. crateris are small openings such as "spring meadows" in generally undisturbed forests (cited in Duncan et al. 2004). Riparian sites which experience periodic flooding or large fluctuations in water level are not suitable habitat for this species (Duncan et al. 2004).

Most Pristiloma on the Deschutes National Forest (Sisters RD) have been located along perennial streams within 15 feet (4.5 meters) of the water's edge. Streams within the project area that are intermittent, lack 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.

Besides being a Forest Service Sensitive species the Crater Lake tightcoil is also a Survey and Manage species. The Survey and Manage section of this document discusses the potential for habitat disturbance to the Crater Lake tightcoil from project activities. The direct, indirect, and cumulative effects are addressed in the sensitive species section.

Project Area Information – Surveys for the Crater Lake tightcoil have been conducted across the Deschutes National Forest for numerous projects but not all invasive plant project area units have been surveyed. Survey areas that intersect the invasive plant treatment project area units on the Crescent Ranger District include the Baja 58 PAC Survey (1998), Seven Buttes Return PAC Survey (1999), Baja Sunny PAC Survey (1999), Metolious-Windigo Horse Trail PAC Survey (1999), Rocky Mountain Elk PAC Survey (2000), Crescent Lake Campground PAC Survey (2000), and Crescent WUI PAC Survey (2002). The Crater Lake tightcoil was not found in any of these survey areas. There are no occurrences of the Crater Lake tightcoil in project area units on the Crescent Ranger District. The only confirmed population of Crater Lake tightcoil snails on the Crescent Ranger District occurs near the confluence of Princess Creek and Odell Lake and was located in June 1999.

On the Bend/Fort Rock Ranger District Crater Lake tightcoil surveys that intersect the invasive plant project area units include the Charlie Brown PAC Survey (2000), Tumalo Complex PAC Survey (2000), Lava Lake Dam Removal PAC Survey (2001), Tumalo Restoration Project PAC Survey (2003), Ryan Ranch Mollusk Survey (2009), Goose Creek Culvert Replacement PAC Survey (2010), Soda Creek Culvert Replacement PAC Survey (2010), and Todd Creek Culvert Replacement PAC Survey (2010). Crater Lake tightcoils were located in the Tumalo Complex, the Tumalo Restoration Project area, and in the Charlie Brown project area in Brown's Meadow. There are no project area units in Brown's meadow. There is one Crater Lake tightcoil observation within project area unit 11-17 in the Tumalo Complex area.

Survey areas that intersect project area units on the Sisters Ranger District include the Metolious Basin PAC Survey (2001), South Trout PAC Survey (2001), First Creek Cottonwood PAC Survey (2002), Eyerly PAC Survey (2002), and the Bull Trout Restoration PAC Survey (2003). Crater Lake tightcoils were located in all survey areas except Eyerly. Project area units where tightcoils were observed include 15-12, 15-15, 15-22, and 15-32,

Potential habitat for the Crater Lake tightcoil includes areas within 10 meters (33 feet) of Class 1, 2, 3, and 4 streams, lakes, and wetlands. On the Deschutes National Forest there is a total of 26,261 acres of Crater Lake tightcoil habitat; 1,290 acres adjacent to Class 1 streams, 1,258 acres adjacent to Class 2 stream, 667 acres of Class 3 stream, 10,076 of Class 4, 3,983 acres adjacent to lakes, and 8,987 acres of wetland buffer. Habitat associated with lake habitat will be over-estimated for this analysis because the estimate includes water bodies in drier plant associations that are not known to support the Crater Lake tightcoil.

Johnson's Hairstreak

These butterflies occur within coniferous forests which contain the mistletoes of the genus Arceuthobium, commonly referred to as dwarf mistletoe. These plants are highly specialized and are known to occur on a number of different conifers (Schmitt and Spiegel 2008). Dwarf mistletoe-infected conifers are common in northeastern Oregon, and current dwarf mistletoe levels are not believed to be substantially less than historic levels in this area. It is likely that surveys have not been numerous enough to reveal all locations of breeding populations and the range of *C. johnsoni* is probably more widespread.

It has been speculated that old growth forests are particularly suitable to this species of butterfly, although Arceuthobeium mistletoes also occur in younger forests as well where there is an absence of recent large scale disturbance (Schmitt and Spiegel 2008). Larsen et al. (1995) states that old-growth and late successional second growth forests provide the best habitat for this butterfly, although younger forests where dwarf mistletoe is present also supports *C. johnsoni* populations. All sightings in both Washington and Oregon have been in coniferous forests. Perhaps one reason for infrequent sightings of this butterfly could be due to the species spending a majority of its time in the top of the forest canopy (Scott 1986; Pyle 2002).

Evidence of a declining range with populations is very localized and scarce. Many records of this insect tend to be old, those from Washington range from 1891–1995, with many being pre-1970 when there were more old growth forests at lower elevations (Hinchliff 1994; Anne Potter pers. comm. 2005 cited by Xerces Society 2009). Although there have been some more recent sightings (Ross pers. comm. 2005 cited by Xerces Society 2009), most records for Oregon occurred before 1980 (Hinchliff 1994). Callophrys johnsoni populations were recently found near Larch Mountain in eastern Multnomah Co., Oregon in primarily old growth hemlock.

Project Area Information – Currently the range of this butterfly is not certain (Xerces Society 2009). Ecoregions where this species occurs in Oregon, as determined by the Oregon Biodiversity Information Center include the Ochoco, Blue and Wallowa Mountains, Coast Range, East Cascades, Klamath Mountains, West Cascades and Crest and Willamette Valley. This species has been documented on the Deschutes NF, as well as at different sites on the Willamette NF; Umpqua NF; Rouge River/ Siskiyou NF; Fremont-Winema NF; Mt. Hood NF; Umatilla NF; and Wallowa-Whitman NF. Pyle (2002) says that *C. johnsoni* ranges from 0-2000 feet elevation. In Oregon, most records indicate that this butterfly survives from 2000' or higher, with the majority living at approximately 3500 feet, and a few as high as 5 and 6000 feet (Hinchliff 1994; Ross pers. comm. 2005 cited in Xerces Society 2009).

Great gray owl habitat analysis will be used as a surrogate for the Johnson's hairstreak habitat as it includes those plant associations with mistletoe. Habitat for the great gray owl occurs throughout the Deschutes and Ochoco National Forests in the following plant associations – lodgepole pine, ponderosa pine, Douglas-fir, white fir, silver fir, western hemlock, and subalpine fir where the average tree size is 15 inches d.b.h. or greater.

On the Deschutes and Ochoco National Forests there are a total of 271,972 acres of potential habitat for the Johnson's hairstreak; 197,976 on the Deschutes and 73,996 acres on the Ochoco. Habitat will be over-estimated for this analysis because not all habitats assessed will have mistletoe.

Silver Bordered Fritillary

The silver bordered fritillary can be found in bogs, open riparian areas, and in marshes containing a large amount of willow and larval food plants (Warren 2005). Sunny wet habitats encourage adult flight. According to Pyle (2002), adults lay eggs on or near violets, usually marsh violet (*Viola*

palustris) and bog violet (*V. nephrophylla*). Butterfly adults feed on nectar of various composites including mints and Verbena, and the larvae or caterpillars feed on the leaves of violets. Between early June to mid-August populations in the vicinity of Big Summit Prairie, Crook County and in central Grant County fly in a single annual brood (Warren 2005). Two annual broods are likely to occur in Baker County from mid- and late May. Pyle observed depredation by ambush bugs (*Phymata*) in 2002. Threats to this species include habitat succession and drying of habitat.

Project Area Information – This species of butterfly can be found throughout much of the Northern Hemisphere, south in the Appalachians, Midwest, Rockies, and Cascades. It is also not uncommon to find them in S.E. British Columbia. Boloria selene is known possibly from twenty sites in Washington in the Pend Oreille, Okanogan, Columbia and Yakima drainages (Pyle 2002). In Oregon, these butterflies have been found in Big Summit Prairie, Crook Co. the Strawberry Mountains, Grant Co., and in the Southern Wallow Range north of Halfway, and Baker Co. (Christensen 1981; Pyle 2002; Warren 2005). Occurrences of these butterflies have been documented in the Prineville District BLM and in the Malheur and Wallowa Whitman National forests.

Habitat for the silver-bordered fritillary includes wetlands. Wetlands include both the wetland and the associated buffer. On the Deschutes and Ochoco National Forests there is a total of 58,985 acres of wetland habitat; 42,135 on the Deschutes and 16,850 acres on the Ochoco. Habitat will be over-estimated for this analysis because all wetlands are mapped and may not contain food plants used by this species.

Survey and Manage Species

In 1994, the Forest Service and Bureau of Land Management adopted the Northwest Forest Plan and the standards and guidelines for the management of habitat for late-successional and old-growth forest-related species ("Survey and Manage" species) within the range of the northern spotted owl. Survey and Manage species are species that, either because of genuine rarity or lack of species information, it was uncertain whether they would be adequately protected by other elements of the Northwest Forest Plan. The Northwest Forest Plan and the Survey and Manage direction applies to the western portions of the Deschutes National Forest and does not apply to the Ochoco National Forest, Crooked River National Grassland or eastern portions of the Deschutes National Forest. There are two terrestrial Survey and Manage wildlife species located within the project area on the Deschutes National Forest; the great gray owl (*Strix nebulosa*) and the Crater Lake tightcoil snail (*Pristiloma arcticum crateris*).

This FSEIS applies the Survey and Manage species list in the 2011 Settlement Agreement and thus meets the provisions of the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.*

The 2001decision amended the Survey and Manage direction and reorganized Survey and Manage species into six species categories (Categories A-F) based on rarity and survey practicality (USDA Forest Service and USDI Bureau of Land Management 2001). The Crater Lake tightcoil snail is a category "A" species and the great gray owl is a category "C" species. Categories A and C require that site-specific, pre-disturbance surveys be conducted prior to signing NEPA decisions or decision documents for habitat-disturbing activities. Habitat-disturbing activities are defined as those disturbances likely to have a significant negative impact on the species' habitat, its life cycle, microclimate, or life support requirements.

Pre-disturbance surveys are not necessary or required prior to invasive plant treatments for either the great gray owl or Crater Lake tightcoil snail. The invasive plant treatments proposed do not create habitat-disturbance or have a significant negative impact on species' habitat, life cycle, microclimate, or

life support requirements. The following analysis provides the rationale for why the weed treatments are not habitat disturbing.

Table 94. Survey and Manage Wildlife Species on the Deschutes National Forest

Common Name	Scientific Name	Survey and Manage Category	Management Direction
Crater Lake Tightcoil Snail	*Pristiloma arcticum crateris*	A (Rare, Pre-disturbance surveys practical)	Manage All Known Sites Project Level Surveys Prior to Habitat Disturbing Activities Strategic Surveys
Great Gray Owl	*Strix nebulosa*	C (Uncommon, Pre-disturbance surveys practical)	Manage High Priority Sites Surveys prior to Habitat-Disturbing Actities Strategic surveys

Crater Lake Tightcoil Snail

The Crater Lake tightcoil may be found in perennially moist situations within 10 m. of open water. Riparian habitats in the Eastern Oregon Cascades that are suitable for this species are often much less than 10 m. from open water. Essential habitat components include uncompacted soil, litter, logs, and other woody debris in a perennially wet environment. They may be found on or under woody debris or on the bases of sedges. Riparian sites which experience periodic flooding or large fluctuations in water level are not suitable habitat for this species (Duncan et al. 2004).

Scale – On the Deschutes National Forest there are an estimated 26,261 acres of potential Crater Lake tightcoil habitat within 10 meters of surface or perennial water. Within the Northwest Forest Plan area, invasive plant treatments would occur in approximately 611 acres (2%) of the potential habitat within 10 meters of surface or perennial water. Not all of these project area unit acres are currently infested with invasive plants.

Treatments of any type greater than 10 meters from surface or perennial water, including the broadcast application of herbicide would not be habitat disturbing because these areas do not provide habitat for the Crater Lake tightcoil. Considering the portions of project units that are within 10 meters of perennial water (611 acres), the majority of invasive plants that are found in perennially wet areas include reed canary grass and ribbongrass,. These species are located along streambanks or on islands in rivers that area seasonally inundated during spring run-off or high water events, or in seasonally inundated wetland areas that are flooded for a significant amount of time. Riparian sites that experience periodic flooding or large fluctuations in water level are not suitable habitat for this species (Duncan 2004). These areas are unsuitable as habitat for the Crater Lake tightcoil. The Crater Lake tightcoil may be found along the outer margins of these infestations if soils are moist and do not get seasonally inundated with water, however this margin represents a very small fraction of the treatment area. In total, there are 217 acres of ribbongrass and reed canarygrass treatment proposed; 1 acre of ribbongrass and 215.6 of reed canarygrass. The other invasive plants to be treated within 10 meters of water such as knapweeds and thistles are generally found in disturbed areas that have lower soil moistures and do not provide suitable habitat for the Crater Lake tightcoil. Overall, invasive species do not provide habitat for the Crater Lake tightcoil or provide the type of habitat important for the conservation of this species.

Scope – This snail is known to occur in project area units that contain riparian or wetland habitat on the Bend/Fort Rock and Sisters Ranger Districts. Project area units with known sites include 11-17, 15-12, 15-15, 15-22 and 15-32. The invasive plants to be treated in these project area units do not provide suitable habitat for the tightcoil. Invasive plants in project area unit 11-17, 15-12, and 15-15 are knapweed species, St. Johnswort, Scotch broom, and bull thistle and invasive plants in project area

units 15-22 and 15-32 are ribbongrass and reed canarygrass. Treatments would not occur in the portions of these units that provide suitable Crater Lake tightcoil habitat. Management of the known sites within these project area units will follow the Deschutes LRMP, as amended by Survey and Manage direction, and the recommendations provided in the Management Recommendations for Survey and Manage Terrestrial Mollusks (Burke et al. 1999). Applicable recommendations include maintaining shading to minimize temperature and humidity fluctuations, maintaining natural understory vegetation, avoiding activities that cause compaction, and maintaining the existing logs and other woody debris.

Intensity – Some individuals may be subject to trampling during treatment of ribbongrass or reed canaryrass infestations as workers get to and from sites in riparian areas. Trampling could occur for any treatment method and under any alternative. The impact of trampling would be limited to a few individuals in habitat adjacent to or on the periphery of the vegetation to be removed. Herbicides are proposed for the control of invasive plants in riparian areas. Regardless of alternative, broadcast spraying of herbicides is prohibited within 50 feet of perennial water. Within 50 feet of perennial water hand application would be used to target invasive plant species. Impacts to non-target vegetation and habitats that the tightcoil may occur would be minimal. 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.

Treatment of invasive plants regardless of treatment method or alternative would not cause habitat disturbance for the Crater Lake tightcoil or have a significant negative impact on the species' habitat, life cycle, microclimate, or life support requirements. Invasive plant treatments will not remove or degrade the essential habitat components of uncompacted soil, litter, logs, and other woody debris, nor alter water availability, so their environment will remain perennially moist. Invasive plant treatments, when necessary close to streams in potential habitat will protect or enhance habitat for native sedges and thus improve their habitat. Pre-disturbance surveys are not required prior to the invasive plant treatments because the invasive plant treatments proposed do not create habitat disturbance for this species.

The Crater Lake tightcoil snail is also a Forest Service Sensitive species. The existing condition of the Crater Lake tightcoil and its habitat, as well as the environmental effects including the direct, indirect and cumulative effects is discussed in the Forest Service Sensitive Species sections.

Great Gray Owl

The great gray owl is found in mature conifer stands associated with meadows or openings. Great gray owls hunt from perches and forage on small prey, primarily pocket gophers and voles, in openings, along forest edges, or in open understory stands.

The Survey and Manage direction requires pre-disturbance surveys when activities may be habitat-disturbing. The great gray owl survey protocol (Version 3.0 2004), supporting the Survey and Manage direction, requires pre-disturbance surveys when proposed projects occur within the range of the great gray owl, contain suitable habitat and have the potential to cause significant negative effect on habitat or persistence at a site.

Scale – The Deschutes NF has 776,514 acres of land within the Northwest Forest Plan area. Herbicide treatments are proposed within 12,487 acres in Invasive Plant Project Area Units within the Northwest

Forest Plan (invasive plants are actually mapped on 260 acres). Of these 12,487 acres, 10,714 acres are along roads and in rock quarries; these areas do not provide habitat for the great gray owl or their prey. The remaining 1,773 acres (0.2% of the Northwest Forest Plan area on the Deschutes) occur in general forest or along streams, lakes and wetlands. A very small portion of Northwest Forest Plan area would be treated with herbicides. Manual treatments, such as hand-pulling are proposed at many sites as a follow-up to herbicide spraying to get individual plants missed by the herbicide treatment, or as the only treatment where the invasive plant populations are small and the species can be effectively controlled manually. Manual and herbicide treatment acres overlap in most cases. Manual treatments are proposed within 14,106 acres of PAUs in the NWFP area (invasive plants are actually mapped on 294 acres). Of these 14,106 acres, 10,714 acres are along roads and in rock quarries, which are not habitat for the great gray owl or their prey. The remaining 3,392 acres of manual treatment would occur within a small portion of the NWFP area (0.4%).

Scope – Invasive plants do not provide suitable habitat for the great gray owl or their prey. Invasive plant treatments, regardless of method or alternative, will not cause significant negative effects on habitat of the great gray owl because the treatments do not affect the essential habitat components of the great gray owl or their prey. Treatment of invasive plants would not modify or degrade nesting, roosting or foraging habitat of the great gray owl or fall potential nest trees. The majority of treatments are along roadsides that do not provide great gray owl habitat or habitat of their prey.

Intensity – The treatment of invasive plants would not generate habitat disturbance from noise or repetitive and continuous activity. The great gray owl survey protocol (Version 3.0 2004) indicates that projects that generate noise or activity above ambient levels and occur within 100 meters of suitable nesting habitat or an active nest may cause harassment effects. 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 great gray owls. Because noise levels of this type of equipment were not known, an analysis was conducted to determine potential effects on nesting raptors. 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). Using disturbance values for the northern spotted owl as a surrogate, 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 great gray owls from noise disturbance will occur. Within 10 yards of a nest or unsurveyed suitable habitat, roadside spraying could create a brief noise of notice (e.g. slightly above 70 dB), but not loud enough to create disturbance. 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.

Great gray owl surveys have been conducted on the Deschutes National Forest in the past with known sites in the Big Marsh, Metolius Basin, Eyerly, and B&B Fire Recovery Areas. There is one known nest site within 0.25 mile of project area unit 15-16. Project design feature 94 would be implemented when treating this unit to eliminate any potential disturbance to the great gray owl at this site. If, during the course of invasive plant treatments great gray owls were discovered, project design feature 94 would be implemented to eliminate disturbance to the great gray owl.

Over the long term, invasive plant treatments including the use of herbicides are expected to benefit the great gray owl and its prey by eradicating or reducing the amount of invasive plants and improving

native grass and forb habitats preferred by pocket gophers, voles, and other small rodents. Treatment of invasive plants regardless of treatment method or alternative would not cause habitat disturbance for the great gray owl or have a significant negative impact on the species' habitat, life cycle, microclimate, or life support requirements. Pre-disturbance surveys are not required prior to the invasive plant treatments because the invasive plant treatments proposed do not create habitat disturbance for this species.

The great gray owl is also considered a Management Indicator Species on the Deschutes National Forest. The existing condition of the great gray owl and the environmental effects, including direct, indirect and cumulative effects are discussed in the Management Indicator Species sections.

Management Indicator Species

Management indicator species (MIS) are species selected because their welfare is presumed to be an indicator of the welfare of other species using the same habitat or whose condition can be used to assess the impacts of management actions on a particular area, or other species of selected major biological communities. Management indicator species are selected from several categories including State or Federal Threatened or Endangered species lists; species commonly hunted, fished, or trapped; non-game species of special interest; and species with special habitat needs that may be influenced significantly by planned management programs. Table 95 includes those species that were identified as MIS for the Deschutes and Ochoco National Forests, and the Crooked River National Grassland (USDA Forest Service 1990, and USDA Forest Service 1989). Aquatic MIS are discussed in the Fisheries and Aquatic Organism section 3.7.

Table 95. Deschutes and Ochoco National Forest Management Indicator Species

Common Name	Scientific Name	Deschutes	Ochoco	CRNG
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	X	X	
Golden Eagle	*Aquila crysaetos*	X	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		
Prairie Falcon	*Falco mexicanus*		X	
Osprey	*Pandion haliaetus*	X		
Great Blue Heron	*Ardea herodias*	X		
Pileated Woodpecker	*Dryocopus pileatus*		X	
Northern Flicker	*Colaptes auratus*		X	X
Three-toed Woodpecker	*Picoides tridactylus*	X		
Primary Cavity Excavators	see below	X	X	
Waterfowl	see below	X		
Mammals				
American Marten	*Martes martes*	X		
Townsend's Big-eared Bat	*Corynorhinus townsendii*	X		
Elk and Mule Deer	see below	X	X	
Wolverine	*Gulo gulo*	X		

Bald Eagle

The bald eagle was selected as a MIS on the Deschutes National Forest because it was listed as "Threatened" under the federal Endangered Species Act of 1973 and because it is a species with special habitat needs that may be influenced significantly by planned management programs (Deschutes LRMP 4-53, Ochoco LRMP 4-248). It was removed form the endangered species (delisted) list on June 28, 2007 (USFWS 2007). It is now included on the Region 6 Regional Forester's Sensitive Species List. The bald eagle is sensitive to human disturbance during reproductive, fall, and winter periods. A detailed discussion of the life history, habitat, threats, conservation status, and project area information of the bald eagle was previously discussed in the section "Forest Service Sensitive Species" above.

Golden Eagle

The golden eagle is a MIS on both forest and was selected to represent species that are associated with large open areas with cliffs and rock outcrops (Deschutes LRMP 4-52, Ochoco LRMP 4-248). Golden eagles 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).

Habitat for the golden eagle occurs sparingly across the Deschutes and Ochoco National Forests and the Crooked National Grasslands in open habitats (grasslands and shrub steppe) and open ponderosa pine where trees are absent or large enough to hold a nest. Habitat occurs primarily on the CRNG, fringe habitats near the forest boundaries, and in old fire areas. Approximately 53,360 acres of habitat currently exist across the Deschutes National Forest and approximately 84,054 acres of habitat occurs on the Ochoco National Forest for a total of 137,414 acres.

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. Four project area units are in close proximity to currently known nest sites on the Crooked River National Grassland (75-10, 75-47, 75-56, 75-62).

Invasive plants are not known to be specifically affecting golden eagle habitat, but some of their prey could be adversely affected by large infestations.

Northern Goshawk

The northern goshawk was selected as an MIS on the Deschutes National Forest for the mature and old growth ponderosa pine forest community, although it also inhabits mixed conifer and lodgepole pine forest communities (Deschutes LRMP FEIS 3-19). 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. Habitat occurs throughout the Deschutes and Ochoco National Forests in most plant associations except juniper where average tree size is 15"dbh or greater. Approximately 278,926 acres of habitat currently exist across the Deschutes National Forest and approximately 73,229 acres of habitat occurs on the Ochoco National Forest for a total of 352,155 acres.

Surveys have been conducted on the Deschutes and Ochoco NFs. On the Deschutes 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

The Cooper's hawk and sharp-shinned hawk were selected as MIS on the Deschutes National Forest (LRMP 4-53) to represent species that can utilize forests with high canopy closure and tree density. These hawks prefer dense, young-forest stands of mixed conifer or ponderosa pine for nesting. Sharp-shinned hawks prefer even-aged stands of 40-60 year old trees with a canopy cover of 65 percent or greater. The Cooper's hawk will use a slightly more open stand of pole-sized or second-growth trees (50-80) years old, average height of 30 feet with a 60 percent or greater canopy cover (Deschutes LRMP FEIS 3-21).

These hawks often use dense cover in which to hunt and nest. Generally, nesting habitat has been grouped into three 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.

Habitat for both species occurs throughout the Deschutes and Ochoco National Forests in the lodgepole pine, ponderosa pine, white fir, Douglas-fir, western hemlock, silver fir, mountain hemlock and white-bark pine plant associations. Cooper's hawk habitat occurs where average tree size is 15"dbh or greater in dense stands and sharp-shinned hawk habitat occurs in even-aged stands with trees 10-20" dbh. Approximately 279,019 acres of Cooper's hawk habitat currently exist across the Deschutes National Forest and approximately 68,791 acres of habitat occurs on the Ochoco National Forest for a total of 347,810 acres. Approximately 342,974 acres of sharp-shinned hawk habitat currently exists across the Deschutes NF and approximately 128,091 acres of habitat occurs on the Ochoco NF for a total of 471,066 acres.

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-tail hawk is a MIS on the Deschutes National Forest (Deschutes LRMP 4-52). 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.

Northern Spotted Owl

The northern spotted owl was selected as a MIS on the Deschutes National Forest (Deschutes LRMP 4-52) because it was federally listed as a "Threatened" species under the federal Endangered Species Act of 1973. The northern spotted owl represents other wildlife species associated with mature and older coniferous forests. A detailed discussion of the life history, habitat, threats, conservation status, and project area information of the northern spotted owl was discussed above under the section titled "Federally Listed Species" above.

Great Gray Owl

The great gray owl is a MIS on the Deschutes National Forest (Deschutes LRMP 4-54) as well as being a Survey and Manage species within the range of the northern spotted owl. It is a species with special habitat needs that may be influenced significantly by planned management programs. 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.

Habitat for the great gray owl occurs throughout the Deschutes and Ochoco National Forests in the following plant associations – lodgepole pine, ponderosa pine, Douglas-fir, white fir, silver fir, western hemlock, and subalpine fir where the average tree size is 15 inches d.b.h. or greater. Approximately 197,976 acres of habitat currently exist across the Deschutes National Forest and approximately 73,996 acres of habitat occurs on the Ochoco National Forest for a total of 271,972 acres. The amount of habitat is likely overestimated as the analysis only accounts for the size, structure, and species composition preferred by the great gray owl and does not account for the spatial aspect where suitable habitat is only adjacent to openings and/or meadows. Therefore, large blocks of habitat may be identified without being adjacent to the other habitat component (openings). 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 Big Marsh, 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.

Peregrine Falcon

The peregrine falcon was selected as a MIS on the Deschutes National Forest because it was federally listed as "Threatened" under the federal Endangered Species Act of 1973 (Deschutes LRMP FEIS 3-14). The peregrine falcon was delisted in 1999 and the FWS has committed to monitor populations nationwide five times at three-year intervals and report results. A detailed discussion of the life history, habitat, threats, conservation status, and project area information of each was previously discussed in the section "Forest Service Sensitive Species" above.

Prairie Falcon

The Prairie falcon is a MIS on the Ochoco National Forest. The prairie falcon represents species associated with cliffs, talus, or cave habitats (Ochoco LRMP 4-249). Prairie falcons are found in the open country of eastern Oregon. They nest in rimrock or cliffs near these areas. They prey on small mammals and birds, with the latter particularly important in the winter (Marshall et al. 2003).

Habitat for the prairie falcon includes rock. Habitat estimates will be over-estimated for this analysis because most rock mapped does not equate to cliff habitat suitable for the prairie falcon to nest on or are adjacent to open grassland habitat. On the Deschutes National Forest it is estimated that there are approximately 12,618 acres of habitat, and on the Ochoco National Forest there are approximately 1,990 acres of nesting habitat.

There are frequent sightings and known nest locations of prairie falcons in the open country on both the Deschutes and Ochoco NFs.

Invasive plants are not affecting habitat for the prairie falcon, but some of their prey could be adversely affected by large infestations.

Osprey

The osprey was selected as a MIS on the Deschutes National Forest because it is a species of special interest and that has special habitat needs (Deschutes LRMP 4-52, LRMP FEIS 3-14, 19). 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).

Habitat for osprey on the Deschutes and Ochoco NF's includes Class 1 and 2 streams and lakes. Lakes include both the water body and associated buffer. On the Deschutes National Forest there are approximately 41,271 total acres of habitat; 11,729 acres of Class 1 stream, 11,436 acres of class 2 stream, and 18,106 acres adjacent to lakes. On the Ochoco National Forest there are approximately 38,208 total acres of habitat; 9,591 acres of Class 1 stream, 28,172 acres of Class 2 stream, and 447 acres of lake habitat. Habitat may be over-estimated for this analysis because the entire buffer may not contain large snags suitable for nesting.

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, and 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 was selected as a MIS on the Deschutes National Forest because it was a species that has special habitat needs that may be influenced significantly by planned management programs. (Deschutes LRMP 4-55). 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.

Habitat for the great blue heron on the Deschutes and Ochoco NF's include Class 1, 2, and 3 streams, lakes, wetlands, and meadows. Wetlands and lakes include both the wetland or water body and the associated buffer. On the Deschutes National Forest there are approximately 94,698 total acres of habitat; 11,729 acres of Class 1 stream, 11,436 acres of class 2 stream, 3,030 of Class 3 stream, 18,106 acres adjacent to lakes, 42,135 acres of wetlands, and 8,262 acres of meadow habitat.

On the Ochoco National Forest there are approximately 78,778 total acres of habitat; 9,591 acres of Class 1 stream, 28,172 acres of class 2 stream, 12,575 acres of Class 3 stream, 447 acres adjacent to lakes, 16,850 acres of wetlands, and 11,144 acres of meadow habitat. There is one active rookery 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 pileated woodpecker was selected as a MIS on the Ochoco National Forest to serve as an indicator for other species that require large snags, large amounts of down-dead wood, and large trees with defects (Ochoco LRMP FEIS 3-21). On the Deschutes National Forest the pileated woodpecker is included in the woodpeckers (cavity nesters) group. The pileated woodpecker represents the presence of favorable habitat for species that require mature coniferous forest and old growth habitat and may also indicate the presence of favorable habitat for secondary cavity nesters, such as the northern flying squirrel, pygmy owl, saw whet owl, and flammulated owl. 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).

Habitat for the pileated woodpecker occurs throughout the higher elevations of the Deschutes National Forest and across the Ochoco National Forest in the following plant associations – ponderosa pine, Douglas-fir, white fir, western hemlock, silver fir, and mountain hemlock, in dense stands where the average tree size is 15 inches d.b.h. or greater. Approximately 89,768 acres of habitat currently exist across the Deschutes National Forest and 14,508 acres of primary nesting habitat on the Ochoco National Forest.

There are approximately 200 documented pileated woodpecker sighting records on the Ochoco National Forest. The majority of the pileated woodpecker records are associated with blocks or aggregated patches of mapped nesting habitat that are distributed across the Forest.

Pileated woodpeckers could occur near any treatment areas within or adjacent to suitable habitat. Invasive plants are not affecting habitat for pileated woodpeckers.

Northern Flicker

The Ochoco NF LRMP uses the northern flicker as an indicator of snags and old growth juniper habitat on the National Forest and Crooked River National Grassland (Ochoco LMRP FEIS 3-21, Crooked River National Grassland LRMP 4-119).. The northern flicker uses many habitats, but is 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.

Habitat for the northern flicker occurs throughout the Deschutes and Ochoco National Forests in minor amounts in the following plant associations—juniper steppe, juniper woodlands, lodgepole pine, ponderosa pine, Douglas-fir, white fir, western hemlock, and silver fir in open stands where the average tree size is 15 inches d.b.h. or greater. Approximately 24,660 acres of habitat currently exist across the Deschutes National Forest and approximately 11,569 acres of habitat occurs on the Ochoco National Forest for a total of 36,229 acres.

Invasive plants are not currently affecting habitat for northern flickers.

Three-toed Woodpecker

The three-toed woodpecker was chosen as a MIS on the Deschutes National Forest to represent most other species found in the mature and old growth lodgepole pine forest type. Wisdom et al. (2000) describe source habitat as old forests in subalpine and montane forest (lodgepole pine, grand fir-white fir, Engelmann spruce-subalpine fir, white-bark pine and mountain hemlock), specifically mature and overmature stands with bark beetles, disease, and heart rot or recent stand-replacing burns with abundant bark beetles. In central Oregon, Goggans et al. (1989) report three-toed woodpeckers showed a preference for unlogged forests and avoided harvested areas. They foraged primarily in mixed-conifer stands, but also used stands that were pure, or dominated by, lodgepole pine. Foraging occurred on primarily recently dead lodgepole pine and Engelmann spruce.

Three-toed woodpeckers are associated with locally abundant insect outbreaks, and their populations are irruptive as they follow the outbreaks across the landscape. They specialize on bark beetles (*Scolytidae*) versus the black-backed woodpecker which specializes on wood-boring beetles (*Cerambycidae*). (Leonard 2001)

Habitat for the three-toed woodpecker occurs throughout the Deschutes and Ochoco National Forests in the following plant associations—lodgepole pine, ponderosa pine, white fir, Shasta red fir, silver fir, mountain hemlock, and whitebark pine in dense stands where the average tree size ranges from 5 inches dbh to 20 inches d.b. h. Approximately 594,481 acres of habitat currently exist across the Deschutes National Forest and approximately 197,271 acres of habitat occurs on the Ochoco National Forest for a total of 791,752 acres.

Invasive plants are not currently affecting habitat for three-toed woodpeckers.

Primary Cavity Excavators/Nesters

The primary cavity excavator (Ochoco) or woodpecker (Deschutes) group was selected as a MIS to represent the species that utilize snags for nesting or denning (Deschutes LRMP FEIS 3-17 & LRMP 4-55, Ochoco LRMP FEIS 3-21& LRMP 4-243). 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 sapsucker, 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.

Habitat for species in the primary cavity excavator group is provided by snags in forested and wildfire areas throughout both forests and the Crooked River National Grassland. On the Deschutes National Forest there are approximately 1,672,520 acres of forested habitat within the forest boundary, including recently burned areas that are capable of providing snag habitat for primary cavity excavators. On the Ochoco National Forest there are approximately 611,872 acres of forested habitat, including wildfire areas, capable of providing primary cavity excavator habitat. Each of the species within the primary cavity excavator group has a preference for specific habitats, i.e., wildfire areas, specific plant association groups, or tree species. The critical component for each species however, is the availability of snag habitat for nesting, foraging and day or night roosting within their preferred habitat type

Invasive plants are not affecting critical habitat components for primary cavity excavators or nesters.

Waterfowl

Waterfowl were selected as MIS on the Deschutes National Forest because they are a hunted species and that, as a group, are species that have special habitat needs (Deschutes LRMP FEIS 3-19 & LRMP 4-55). 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.

Habitat for waterfowl on the Deschutes and Ochoco NF's include Class 1, 2, and 3 streams, lakes, wetlands, and meadows. Wetlands and lakes include both the wetland and water body and the associated buffer. On the Deschutes National Forest there are approximately 94,698 total acres of habitat; 11,729 acres of Class 1 stream, 11,436 acres of class 2 stream, 3,030 of Class 3 stream, 18,106 acres adjacent to lakes, 42,135 acres of wetlands, and 8,262 acres of meadow habitat. On the Ochoco National Forest there are approximately 78,778 total acres of habitat; 9,591 acres of Class 1 stream, 28,172 acres of class 2 stream, 12,575 acres of Class 3 stream, 447 acres adjacent to lakes, 16,850 acres of wetlands, and 11,144 acres of meadow habitat. Habitat may be over-estimated for this analysis because the entire buffer may not be suitable for nesting.

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*) was selected as a MIS on the Deschutes National Forest to represent species that inhabit mature and old growth mixed conifer forest community, although it inhabits lodgepole pine and mountain hemlock forest communities as well (Deschutes LRMP FEIS 3-14, 19 and LRMP 4-59). 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.

Habitat for the marten occurs sparingly throughout the Deschutes and Ochoco National Forests in higher elevations in the following plant associations—lodgepole pine, ponderosa pine where lodgepole pine is a component, Douglas-fir, white fir, subalpine fir, Shasta red fir, western hemlock, silver fir, mountain hemlock, and whitebark pine in dense stands where the average tree size is 15 inches d.b.h. or greater. Approximately 76,377 acres of habitat currently exist across the Deschutes National Forest and approximately 22,505 acres of habitat occurs on the Ochoco National Forest for a total of 98,882 acres. Although suitable habitat occurs on the Ochoco there are no documented sightings on the Ochoco National Forest.

Invasive plants are not affecting habitat for American marten.

Townsend's Big-eared Bat

The Townsend's big-eared bat was selected as a MIS on the Deschutes National Forest because it was a Sensitive species (Deschutes LRMP 4-59). The Townsend's big-eared bat inhabits 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). A detailed discussion of the life history, habitat, threats, conservation status, and project area information of the Townsend's big-eared bat was discussed above under the section titled "Forest Service Sensitive Species" above.

Rocky Mountain Elk and Mule Deer

Rocky mountain elk and mule deer are hunted species that are MIS on both forests. 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.

On the Deschutes National Forest there is one allocation for managing deer habitat–MA-7 (Transition and Winter Range) that provides approximately 207,322 acres of winter and transition habitat. The goal for managing MA-7 is to manage vegetation to provide optimum habitat conditions on deer winter and transition ranges while providing for some livestock forage, wood products, visual quality, and recreation opportunities. In addition, a biological winter, transition and summer range map was developed by Oregon Department of Fish and Wildlife (ODFW) that is referenced but is not considered an official allocation in the Deschutes LRMP and summer range which has specific standards and guidelines in the LRMP but is not a specific allocation. Management of summer range is designed to provide adequate habitat quantity and quality to meet herd management objectives established jointly with ODFW. This requires a mosaic of forested conditions utilizing security and thermal cover, travel corridors, visual screens, and management of harassment potential from other activities (e.g., roads and other recreation use).

The Crooked River National Grassland (CRNG) has one allocation for managing deer – MA-G2 Metolius Deer Winter Range which provides 12,770 acres of winter habitat. The primary objective of this area is to manage for big game winter range habitat by producing high quality deer winter range habitat.

The Ochoco National Forest has two allocations for management of big game habitat (including deer, elk, and antelope to a small degree). MAF-20 – Winter Range (36,372 acres) is managed for big game use on winter range with this seen as the primary activity and other management activities and human use restricted from December 1 through May 1. MAF-21 – General Forest Winter Range (82,623 acres) is managed for timber production with management activities designed and implemented to recognize big game habitat needs.

The Deschutes NF has one primary allocation for the management of elk habitat on forest in addition to forest-wide standards and guidelines for vegetation management. Eleven Key Elk Habitat Areas (KEHAs) totaling approximately 53,852 acres occur across the forest to provide optimum habitat conditions for both summering and wintering elk herds.

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. Important foraging areas and habitats on the Ochoco NF where invasive plants threaten forage quality include the Snowshoe Point, Crystal Springs, and the vicinity of Roba Butte. Treatments within these areas are proposed (71-28, 71-16, 72-14, 72-20, 72-37 to 72-47).

Wolverine

The wolverine was selected as a MIS on the Deschutes National Forest because it was a Sensitive species (Deschutes LRMP FEIS 3-15 & LRMP 4-55). A detailed discussion of the life history, habitat, threats, conservation status, and project area information of each was previously discussed in the section “Forest Service Sensitive Species.” Habitat for the wolverine occurs in the higher elevations on the Deschutes National Forests in the following plant associations—mountain hemlock where average tree size is 15 inches d.b.h. or greater. Approximately 92,588 acres of habitat currently exist across the Deschutes National. No potential habitat was mapped on the Ochoco National Forest.

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 (2008) 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 2008 report provides species lists by Bird Conservations Regions (see Table 96 that follows). The project area includes Bird Conservation Regions 9 (Great Basin) and 10 (Northern Rockies).

Table 96. Birds of Conservation Concern by Bird Conservation Region (BCR)

Common Name	Scientific Name	Great Basin BCR (BCR 9)	Northern Rockies BCR (BCR10)	Occurrence in Project Area
Swainson's Hawk	*Buteo swainsoni*	X	X	D
Ferruginous Hawk	*Buteo regalis*	X	X	D
Bald Eagle	*Haliaeetus leucocephalus*	X	X	D
Golden Eagle	*Aquila crysaetos*	X	X	D
Prairie Falcon	*Falco mexicanus*	X	X	D
Yellow Rail	*Coturnicops noveboracensis*	X	X	D
Eared Grebe (non-breeding)	*Podiceps nigricollis*	X		D
Snowy Plover	*Charadrius alexandrinus*	X	X	
Upland Sandpiper	*Bartramia longicauda*		X	S
Long-billed Curlew	*Numenius americanus*	X	X	S
Marbled Godwit	*Limosa fedoa*	X	X	
Willow Flycatcher	*Empidonax trailii*	X	X	D
Olive-sided Flycatcher	*Contopus cooperi*		X	D
Green-tailed Towhee	*Pipilo chlorurus*	X		D
Pinyon Jay	*Gymnorhinus cyanocephalus*	X		D
Calliope Hummingbird	*Stellula caliope*	X	X	D
Yellow-billed Cuckoo	*Coccyzus minor*	X	X	
Flammulated Owl	*Otus flammeolus*	X	X	D
Black Swift	*Cypseloides niger*	X	X	
Lewis's Woodpecker	*Melanerpes lewis*	X	X	D
Williamson's Sapsucker	*Sphyrapicus thyroides*	X	X	D
White-headed Woodpecker	*Picoides albolarvatus*	X	X	D
Loggerhead Shrike	*Lanius ludovicianus*	X	X	D
Sage Thrasher	*Oreoscoptes montanus*	X	X	D
Black Rosy Finch	*Leucosticte atrata*	X	X	
Cassin's Finch	*Carpodacus cassinii*		X	D
Virginia's Warbler	*Vermivora virginiae*	X	X	
Black-chinned Sparrow	*Spizella atrogularis*	X		
Brewer's Sparrow	*Spizella breweri*	X	X	D
Sage Sparrow	*Amphispiza belli*	X		D
Tricolored Blackbird	*Agelaius tricolor*	X		D
McCowns's Longspur	*Calcarius mccownii*		X	
Greater Sage-Grouse	*Centrocercus urophasianus*	X		D

D = documented; S = suspected

The bald eagle, golden eagle, prairie falcon, greater sage grouse, yellow rail, Lewis's woodpecker, Williamson's sapsucker, white-headed woodpecker, upland sandpiper, and tricolored blackbird have been addressed in either the *Forest Service Sensitive Species* or *Management Indicator Species* sections of this report. The following species do not occur in the project area and will not be discussed further:

yellow-billed cuckoo, black swift, black-chinned sparrow, black rosy finch, Virginia's warbler, McCown's longspur, snowy plover, and marbled godwit (Marshall et al. 2003, Ridgley et al. 2003, Sibley 2000).

The remainder of the species: Swainson's hawk, ferruginous hawk, willow flycatchcr, olive-sided flycatcher, green-tailed towhee, sage thrasher, pinyon jay, eared grebe, calliope hummingbird, long-billed curlew, flammulated owl, loggerhead shrike, Cassin's finch, Brewer's sparrow, and sage sparrow, 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.

Colony 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).

3.9.2 Environmental Consequences

Introduction

The following section is a general overview of the potential impacts to federally listed wildlife from all control methods included in the proposed action. Impacts are described for federally listed threatened and candidate species, Regional Forester's Sensitive Species, management indicator species, USFWS Birds of Conservation Concern, and Landbirds. For all methods of control, project design features could be used to mitigate the majority of these impacts.

Recent amendments to the Deschutes and Ochoco Forest Plans occurred as a result of the Pacific Northwest Region Invasive Plant Program Record of Decision (USDA Forest Service 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 discussions of the Northern spotted owl and Oregon spotted frog above for information regarding project design criteria for these two species in the Forests' Programmatic BA.

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 2005 FEIS (USDA Forest Service 2005a) and in Appendix D of this FSEIS.

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 FSEIS 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 FSEIS. 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, 2011) 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 are incorporated by reference, and may be found in the project record for the FSEIS.

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 sublethal effect that occurred at the lowest dose) from the most sensitive species to determine the "toxicity indices" for each herbicide[15]. 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.

[15] 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).

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 less 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. Dose addition analysis provides a reasonable estimate of the cumulative toxicity of chemical mixtures when doses of each component are below toxic levels (ATSDR 2004, Choudhury et al. 2000). 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 less than 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.

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) which showed interaction when mixture chemical components were present in concentrations at or near their respective LOAELs, but no interaction was observed between chemical components when present at concentrations 1/10 or 1/3 or their respective NOAELs. Ferone et al. (1995) concluded, "…the most important practical lesson from this study is that in comparison with exposure to single chemicals, exposure to a combination of chemicals may not constitute an evidently increased hazard provided the exposure level of each individual chemical in the combination is similar to or (slightly) lower than its own NOAEL."

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 FSEIS. 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. 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 non-herbicide 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 dependent 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 proposed for use are known to affect native plant species. Refer to Appendix B for the approved biological control agents.

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 (refer to Chapter 2, section 2.4) 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.

Impurities, Inerts and Adjuvants

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 amount 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). The EPA's 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 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® contains 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 Forest Service 2007) and "Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications" (USDA Forest Service 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). Detailed information on NPE is found in USDA Forest Service 2003 and is incorporated by reference. Available data on NPE indicate that it is slightly toxic to practically non-toxic to mammals, it is not toxic to soil microbes, and that it can cause adverse effects to aquatic organisms. More discussion of effects of NPE to aquatic organisms can be found in this FSEIS in the section titled "Fisheries and Aquatic Organisms." Effects of NPE to amphibians include mortality, inhibited growth, mild narcosis, and tail resorption (Mann and Bidwell 2000, 2001; Fort and Stover 1997, as cited in USDA Forest Service 2003). Toxicity data for birds and terrestrial invertebrates is lacking.

NPE and its component parts exhibit estrogen-like properties, although they are much weaker than the natural estrogen, estradiol. The potential for endocrine effects from exposure to NPE was considered in the risk assessment (USDA Forest Service 2003).

Results of quantitative analysis in the risk assessment indicate that the use of NPE-based surfactants could result in toxic effects to some mammals at typical and high application rates (USDA Forest Service 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, includes 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.

Similarly, worst-case scenario modeling results indicated potential for adverse effects to amphibians; however, operational use of NPE is unlikely to result in water concentrations modeled, and concentrations would not hold for the durations used in the laboratory studies. Overspray or accidental spills could produce concentrations of NPE 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 FSEIS, 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 FSEIS (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, USEPA 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 of Potential Effects to Wildlife for all Alternatives

The following sections summarize the effects of invasive plant treatments, including potential herbicide contact and the effects to threatened, endangered, candidate, and sensitive wildlife species, management indicator species, and other species of concern and their habitat.

Effects of invasive plant treatment methods to wildlife were evaluated and discussed in detail in the R6 2005 FEIS and its Appendix P, the corresponding Biological Assessment (USDA Forest Service 2005d), project files, and SERA risk assessments (2001, 2003, 2004, 2011). 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. To mitigate potential disturbance effects to spotted owls and bald eagles, PDFs 77, 78, and 79 were developed to prohibit potential disturbances during nesting or roosting periods (FSEIS p 60).

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. Both action alternatives propose burning 14.3 acres of houndstongue in four discreet spots in the Dry Paulina Creek watershed. Treatment areas are within sparsely regenerated conifer plantations and the predominant vegetation is annual grasses and noxious weeds, primarily houndstongue. Burning will take place in spring. 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 as proposed in the FSEIS 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 (USDA Forest Service 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 (USDA Forest Service 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. In addition, PDFs 43, 45, 47, 49, 54, and 56-62 were specifically developed to eliminate exposure and provide additional protection to mollusks, amphibians and other aquatic species.

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 USDA Forest Service 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 FSEIS.

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) – Direct and Indirect Effects

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 on both Forests; in addition, triclopyr is approved for use on the Deschutes NF. 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. Those areas that were approved for herbicide use have been controlled, with maintenance occurring when needed. The impact to these areas was short-term reduction in vegetation until native plants occupied the site (Alexanian pers. comm. 2006). Replacing non-native vegetation with native plant communities has had a long-term benefit on wildlife habitat by not allowing infestation expansion. Those sites with perennial invasive plants that only approved manual control have spread (Mafera, D. Invasive Pant Coordinator, pers. comm. 2006). Under Alternative 1 those infestations that have spread and those new since 1998 would go untreated by effective methods, and would likely continue to 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 14,547 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.

Alternatives 2 and 3 – Direct and Indirect Effects

The two action alternatives both utilize manual, mechanical, cultural, biological, prescribed fire, and herbicide tools and methods for invasive plant treatment. Alternatives 2 and 3 propose a maximum treatment acreage of approximately 52,015 acres. This estimate is substantially larger than the current estimate of infested acres. There currently are approximately 14,547 acres of mapped invasive plant sites across the Forests and Grassland. The project area units are delineated to allow for expected weed spread so the environmental effects are estimated based on the maximum treatment scenario. Only the acres that are actually infested with invasive species would be treated in any given year.

The majority of the treatments proposed occur in areas that are low quality or non-habitat of the wildlife species considered. Approximately 38,767 acres (75%) of the 52,015 acres of the project area units are located in recreation sites, administration sites, summer home residences, rock quarries, utility corridors, roadsides or trails.

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 ester (BEE form), picloram, or sethoxydim at all, and no herbicide application within the bankfull channel. 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 either 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.

Federally Listed Species

Effects to Northern Spotted Owl (Threatened)

There are no spotted owls on the Ochoco National Forest or Crooked River National Grassland. There are currently (as of October 2009) 78,109 acres of nesting, roosting, and foraging (NRF) habitat on the Deschutes National Forest. There are a total of 1,129 acres of NRF within 40 project area units planned for invasive plant treatment, the majority of which are roadside treatments. Of these suitable acres, there are 975 acres of project area units proposed for herbicide treatments and 154 acres planned for mechanical treatments, in combination with other treatments. Project area units overlay 18 core areas for spotted owls with 758 acres planned for herbicide treatments and 123 acres of mechanical treatments. Three project area units propose some mechanical treatment within 35 yards of spotted owl

core areas, however, there is no mowing or brushing proposed in these treatment areas. Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods was considered a potential disturbance effect for owls.

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 disturbances 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 Forest Service 2010).

Projects that generate noise or activity above ambient levels and occur within 0.25 mile from an active spotted owl nest may cause harassment effects (USDA Forest Service 2010). 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.

Treatment areas that may use brushing or mowing include 154 acres of suitable NRF habitat for spotted owls, with 123 of these acres being within spotted owl core areas. 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. In addition, PDF 77 (FSEIS pp 60) prohibits disturbing work activities (i.e. chainsaw, heavy equipment, etc.) within 0.25 mile of nest sites or activity centers of all known pairs or resident singles between March 1 and September 30.

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 prey 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 USDA Forest Service 2005d, Appendix B, p. 461. For the Northern spotted owl the exposure scenario of a predatory bird consuming a contaminated small mammal was used. None of the herbicides proposed for use in this FSEIS 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 leave 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, an application rate that is four times the typical application rate, did exceed the NOAEL. To eliminate the potential for exceeding the NOAEL, project design feature 12 requires the lowest effective rates of NPE surfactant to be used and limits the application rate to less than 0.5 lb a.i./acre (FSEIS pp 53). For evaluation and comparison, the typical application rate of NPE is 1.67 lb a.i./acre, more than three times the amount specified in PDF 12. The high application rate is 6.68 lb a.i./acre. 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 FSEIS are plausible. Invasive plant treatment with herbicides would not result in adverse effects to spotted owl in any alternative.

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

Summary of Effects to Northern Spotted Owl

Effect determinations are summarized in Table 97. 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 FSEIS 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 (PDF 77).
- 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 97. 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[16]. Control of invasive plants will not reduce their available habitat or food nor affect any life history attributes. Herbicides proposed in this FSEIS 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

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.

On the Deschutes National Forest there are 353 acres of suitable habitat proposed for herbicide treatment and 107 acres proposed for treatment using manual or mechanical treatment methods. There are no treatments of any type proposed in suitable habitat on the Ochoco National Forest.

Disturbance (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. Invasive plant treatments in the project area will avoid conducting the project in proximity to an occupied nest during these time-frames. Disturbance near winter roost sites is not likely to occur because invasive plant treatments generally do not occur during the winter.

Projects conducted at anytime that are more than 0.25 mile, or 0.50 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 0.25 mile, or 0.50mile 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 78 and 79 (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.

[16] 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.

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 PDFs; 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 on the Ochoco National Forest (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.

Effects of Herbicides – Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005d, Appendix B, p. 461. For the bald eagle the exposure scenario of a *predatory bird consuming* contaminated *fish* was used. None of the herbicides proposed for use in this FSEIS 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 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. 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). All expected doses to fish-eating birds for all herbicides and NPE are well below any known no-observable-adverse-effect-level (NOAEL) (see USDA Forest Service 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 (PDFs 78 and 79), 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

Based on past records, wolverines may occur in remote areas of the Deschutes and Ochoco National Forests. There are a total of 92,588 acres of potential wolverine habitat on the Deschutes National Forest. The action alternatives would treat 123 acres of potential habitat with herbicides and 1 acre with manual treatment. For the wolverine the herbicide exposure scenario of a *carnivore consuming a contaminated small mammal* was used. No herbicide or NPE exceeded a level of concern in the scenario of carnivore consuming contaminated small mammals. Invasive plant infestations are unlikely to occur in wolverine habitat except along disturbed roadsides. With only one acre of manual treatment disturbance is extremely unlikely to occur. 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. There are 4,176 acres of suitable habitat on the Deschutes National Forest. For the Pacific fisher the herbicide exposure scenario of a carnivore consuming a contaminated small mammal was used. No herbicide or NPE exceeded a level of concern in the scenario of carnivore consuming contaminated small mammals. In addition, 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 disturbances 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 potential pygmy rabbit habitat. Neither of the infestations proposed for treatment is located in a potential 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. On the Deschutes National Forest there are approximately 10,120 acres of potential pygmy rabbit habitat that is provided by mountain big sage brush and bitterbrush plant associations containing large shrub structure. Herbicides treatments would occur on 199 acres (<2%) of these acres. On the Ochoco there are approximately 62,186 acres of mountain big sage brush and bitterbrush plant associations with large shrub structure and herbicide treatment would occur on 1,583 (2.5%) of these acres.

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. PDF 37 limits use of NPE-based surfactants to the typical application rate, so exposures exceeding the NOAEL will not occur. The highest application rate is four times the typical application rate. For comparison purposes, the highest application rate of NPE is 6.68 lb a.i./acre while the typical application rate is 1.67 lb a.i./acres.

The herbicides available for use in the proposed action, or in Alternative 3 do not bioaccumulate nor 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. Pygmy rabbits have not been observed at these potential burrow sites. There is only one treatment proposed in burrow habitat. Future projects under EDRR could also occur in suitable burrow habitat. The pygmy rabbit PDF 92 restricts treatments in burrow habitat to only one or two individuals applying herbicide, 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 93 which prohibits the use of NPE in breeding or foraging areas.

The proposed prescribed fire treatment in the Dry Paulina Creek watershed on the Ochoco NF does not occur in pygmy rabbit habitat and will not affect pygmy rabbits.

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.

Townsend's Big-eared Bat

No project area units are associated with known locations of Townsend's big-eared bats.

There are approximately 400 caves on the Deschutes National Forest and 29,026 acres of potential habitat provided by rock. On the Ochoco National Forest there are approximately 1,990 acres provided by rock and several mines and mine adits, including Blue Ridge Mine, that provide potential habitat for the Townsend's big-eared bat. Total treatment of potential habitat on the Deschutes National Forest is 169 acres (<1% of potential habitat); 160 acres with herbicide and 9 acres of manual treatments. On the Ochoco the total treatment of potential habitat is 69 acres (3.5% of potential habitat); 67 with herbicide and 2 acres of manual treatments.

The effect of herbicides to the Townsend's big-eared bat was evaluated using the scenario of an insectivorous mammal. Currently known occupied 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 an ATV, 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 near bridges 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 herbicide treatment, 160 on the Deschutes and 67 on the Ochoco, 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.

The proposed prescribed fire treatment in the Dry Paulina Creek watershed on the Ochoco National Forest does not occur near caves, mines or mine shacks, rock crevices, or rock habitat and will not affect the big-eared bat.

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. Invasive plant treatments will have "no impact" on the Townsend's big-eared bat and not contribute to a negative trend in viability (negatively impact ability to meet target population levels or habitat goals) on either National Forest or Grassland.

Greater Sage Grouse

There are approximately 10,120 acres of sage grouse habitat on the Deschutes National Forest and 62,186 on the Ochoco National Forest. There are seven project area units containing or within 300 feet of potential sage grouse habitat. Proposed treatments on the Deschutes National Forest include 210 total treatment acres (2% of potential habitat); 199 acres with herbicide and 17 acres of manual weed treatment. On the Ochoco National Forest there would be 1,589 total treatment acres (2.5% of potential habitat) in potential sage grouse habitat; 1,583 acres with herbicides and 6 acres of manual treatment. There are no project area units near leks.

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). There are no project area units near leks, however, if a lek is found, or a new invasive plant site is found under EDRR, PDFs for sage grouse prohibit activities within 0.3 mile of leks during the dawn and dusk periods (PDF 81) and within breeding habitat from February 15 to June 30 (PDF 82). 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. Treatment areas are within sparsely regenerated conifer plantations and the predominant vegetation is annual grasses and noxious weeds, primarily houndstongue. Burning will take place in spring. Scabland habitats dominated by sagebrush that are in this general area receives incidental use by an occasional sage grouse in late summer (August/September) (M. Feiger, pers. comm. 2007). There is not a lek, or known nesting in this area and treatment areas do not provide sage grouse habitat. 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.

Effects of Herbicides – 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 (Table 98; also 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. To mitigate this potential risk, PDF 80 prohibits the use of NPE-based surfactants in areas where sage grouse may forage.

Table 98. Summary of exposure scenario results showing the herbicides and NPE, scenario, and application rates that produce risk to sage grouse

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

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

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 acute toxicity thresholds. NPE-based surfactants are prohibited in areas where sage grouse may forage (PDF 80). 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 acute 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). PDF 80 prohibits the use of NPE-based surfactants in sage grouse foraging habitat and limits the application rate of glyphosate to the typical rate of 2.0 pounds a.i. /acre. For comparison, the high application rate for glyphosate that exceeded the NOAEL is 7 pounds a.i./acre.

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 (7 pounds a.i./acre) 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 along roadsides 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. Given the uncertainty and due to the potential for negative effects to sage-grouse, however unlikely, the use of NPE is prohibited in areas where sage grouse may forage and the application of glyphosate is limited to the typical rate of 2.0 pounds a.i./acre. Consultation with the District Wildlife Biologist would occur prior to treatment (PDF 80).

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 Grebe

On the Deschutes National Forest there is a total of 86,436 acres of potential habitat; 11,729 acres of Class 1 stream, 11,436 acres of Class 2 stream, 3,030 acres of Class 3 stream, 18,106 acres of lake habitat, and 42,135 acres of wetlands. There are seven project areas that include or are adjacent to grebe winter locations at Wickiup Reservoir and Davis Lake. One site proposes to use biological controls and the other six sites propose to use a combination of herbicide, manual, mechanical, and cultural techniques. 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. Horned grebes are not usually present during the breeding season when most invasive plant treatments would occur.

Risk from herbicide exposure was 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). No herbicide or NPE has the potential for plausible adverse effects, so there would be no difference in effects between alternatives. Horned 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 grebes regardless of alternative.

Bufflehead

On the Deschutes National Forest there is a total of 44,301 acres of potential habitat while on the Ochoco there is a total of 50,781 acres. Habitat is provided by Class 1, 2, and 3 streams, and lakes. 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). There is one historic sighting on the Deschutes NF on the Metolius River between Wizard Falls and Canyon Creek (M. Gregg pers. comm. 2011).

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 six acres of reed canarygrass 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, PDF 90 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, a level that is 3.5 times the typical rate, glyphosate did exceed a dose of concern. Because of this concern, PDF 89 was developed which limits the use of glyphosate to typical application rates of 2 pounds a.i./acre. 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, in addition to PDF 89, 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. 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 89 and 91 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. On the Ochoco National Forest there are approximately 11,143 acres of meadow habitat that provides suitable habitat for the upland sandpiper. Invasive plant treatments would occur on a total of 698 (6%) of these acres; 650 acres with herbicides, 43 acres treated with manual or mechanical methods, and 5 acres treated with bio-controls.

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 PDF 12. Ingesting insects contaminated with NPE-based surfactant applied at typical rates could exceed a level of concern. However, the sandpipers would have to eat

contaminated insects exclusively and it is unlikely that this would happen. Upland sandpipers are not known to nest or forage in stands of invasive plants that are likely to be treated. 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.

Due to their very low likelihood of being present within treatment areas and the very low likelihood of ingesting contaminated insects exclusively, the proposed treatments will have "no impact" on upland sandpipers regardless of alternative.

American Peregrine Falcon

Peregrine falcons are not dependent 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. Suitable nesting habitat for the peregrine falcon includes rock. On the Deschutes and Ochoco National Forests there are a total of 14,608 acres of rock habitat; 12,618 acres on the Deschutes and 1,990 acres on the Ochoco. Invasive plant treatments would occur on a total of 238 acres (2%); 169 acres on the Deschutes and 69 on the Ochoco. Herbicides are the primary treatment method with a total of 227 acres being treated with herbicides.

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. PDF 12 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 FSEIS 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.

There are no nest sites for peregrine falcon that occur within 1.5 miles of any proposed treatment area, in the event that there were, 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.

White-headed Woodpecker

The white headed-woodpecker prefers open stands of large diameter ponderosa pine. The white-headed woodpecker concentrates its foraging activities on live ponderosa pine and feeds primarily on live tree insects and utilizes pine seeds. There are approximately 44,387 total acres of habitat on the Deschutes and Ochoco National Forests; 36,167 acres on the Deschutes and 8,220 acres on the Ochoco. Invasive plant treatments would occur on a total of 908 acres (2%); 833acres on the Deschutes and 75 acres on the Ochoco. Herbicides are the primary treatment method with a total of 709 acres being treated with herbicides.

To analyze the effects of herbicides to the white-headed woodpecker the scenario of birds consuming insects was used. 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, a level that is 3.5 times the typical rate, glyphosate did exceed a dose of concern. Glyphosate is the first choice herbicide for treatment of several riparian associated invasive species including quack grass, reed canary grass, and ribbon grass. These plant species do not provide foraging or nesting habitat for the white-headed woodpecker and therefore it is very unlikely that the white-headed woodpecker would be exposed to areas treated with glyphosate. Even it glyphosate was used where white-headed woodpeckers forage PDF 12 limits the use of herbicides to the lowest effective rate and PDF 89 limits the use of glyphosate to the typical application rate (2 lbs a.i/acre). The white-headed woodpecker would not be exposed to a level of concern. NPE-based surfactants exceeded the dose of concern for insectivorous birds at both typical and highest application rates. However, PDF 12 for all alternatives restricts the application rate of NPE to 0.5 lb a.i./acre. PDF 12 eliminates plausible exposures of concern so no doses of concern will occur to the white-headed woodpecker.

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. Herbicide treatment occurs in a very small amount of white-headed woodpecker habitat and exposure to herbicides to levels of concern is very unlikely. Insects preferred by the white-headed woodpecker are also very unlikely to be exposed to herbicides. 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. The white-headed woodpecker would not be susceptible to the low magnitude, extent, and duration of disturbance caused by treating patches of invasive plants. Invasive plant treatments will not cause negative effects to this species as a result of human or mechanical disturbance. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives. Invasive plant treatments will have "no impact" to the white-headed woodpecker.

Lewis' Woodpecker

Lewis' woodpeckers prefer open riparian woodland habitats dominated by cottonwoods, ponderosa pine, and burned or logged ponderosa pine. The Lewis's woodpecker is an aerial insectivore, relying on flying insects. There are approximately 11,861 total acres of habitat on the Deschutes and Ochoco National Forests; 7,390 acres on the Deschutes and 4,471 acres on the Ochoco. Invasive plant treatments would occur on a total of 157 acres (1%); 122 acres on the Deschutes and 34 acres on the

Ochoco. Herbicides are the primary treatment method with a total of 111 acres being treated with herbicides.

To analyze the effects of herbicides to the Lewis' woodpecker the scenario of birds consuming insects was used. 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, a level that is 3.5 times the typical rate, glyphosate did exceed a dose of concern. Glyphosate is the first choice herbicide for treatment of several riparian associated invasive species including quack grass, reed canary grass, and ribbon grass. These plant species do not provide foraging or nesting habitat for the Lewis' woodpecker and therefore it is very unlikely that the Lewis' woodpecker would be exposed to areas treated with glyphosate. PDF 12 limits the use of herbicides to the lowest effective rate and PDF 89 limits the use of glyphosate in wetland areas to the typical application rate (2 lbs a.i/acre).

NPE may exceed toxicity index at typical and highest application rates given the worst case scenario of feeding exclusively on contaminated insects. However, PDF 12 requires the lowest effective rates of NPE surfactant to be used and limits the application rate to less than 0.5 lb a.i./acre (FSEIS pp 53). For evaluation and comparison, the typical application rate of NPE is 1.67 lb a.i./acre, more than three times the amount specified in PDF 12. The high application rate is 6.68 lb a.i./acre. 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. The Lewis' woodpecker is not susceptible to the low magnitude, extent, and duration of disturbance caused by treating patches of invasive plants.

Invasive plant treatments will not cause negative effects to this species as a result of human or mechanical disturbance. Herbicide treatment occurs in a very small amount of Lewis' woodpecker habitat and exposure of the Lewis' woodpecker to levels of concern is very unlikely. Aerial insects preferred by the Lewis' woodpecker are also very unlikely to be exposed to herbicides. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives. Invasive plant treatments will have "no impact" to the Lewis' woodpecker. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact ability to meet the target population levels or habitat goals) on either National Forest or Grassland.

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. PDF 12 in all alternatives restricts spraying of NPE to 0.5 lb a.i./acre so doses of concern will not occur.

Invasive plant treatments 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.

Northern Waterthrush

The Northern waterthrush prefers bogs and waters that are flat and breeds in thickets near slow-moving streams, ponds, swamps and bogs. It feeds mainly on the ground and occasionally wades in shallow water in search of insects, arthropods, snails, and occasionally small fish. There are approximately 48,136 total acres of habitat on the Deschutes National Forest; 496 of hardwood, 6,179 of mesic shrub, 11,729 of Class 1 stream, 11,436 of Class 2 stream, 3,030 of Class 3 stream, and 15,266 of Class 4 stream. Invasive plant treatments would occur on a total of 6,765 acres (14%); 6,425 with herbicides, 331 acres with manual treatment methods, and 9 with bio-controls.

The potential effects would be the same regardless of alternative chosen. Disturbance effects to the Northern waterthrush are unlikely because PAUs are not in areas known to be occupied by the northern waterthrush. Areas known to be occupied by the Northern waterthrush on the Deschutes National Forest are in dense willows stands along the Little Deschutes River and Crescent Creek. Invasive plant treatments do not occur in these areas. The potential effects of herbicide and NPE exposure are the same as discussed for the yellow rail and tri-colored blackbird. There is little difference between the alternatives as PDFs eliminate plausible exposures of concern for the Northern waterthrush.

Invasive plant treatment projects "may impact, but are not likely to lead to a trend toward federal listing" for the Northern waterthrush.

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, and frogs are very mobile and generally flee as people approach. 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 in riparian and wetland areas.

Prescribed Fire – Both action alternatives propose burning 14.3 acres of houndstongue in four discreet spots in the Dry Paulina Creek watershed on the Ochoco NF, treatment areas 72-37 and 72-15. The Oregon spotted frog does not occur on the Ochoco NF. Prescribed burning would have no impact on the

Oregon spotted frog. 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.

Effects of Herbicides – 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 (USDA Forest Service 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 2005 FEIS BA (USDA Forest Service 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 (2005) 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 (2005) 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 PDFs and buffers (section 2.4 in Chapter 2) proposed in both action alternatives, along with the amount and spatial distribution of infestations prevent this level of water contamination and therefore avoid potential mortality. PDF 43 specifies that only aquatic formulations or low aquatic risk herbicides are to be used on soils with seasonally high water tables where label restrictions allow. PDF 54 limits the application rate of herbicides within 100 feet of perennial water bodies to the typical application rate. PDF 44 prohibits the use of POEA within 100 feet of surface water, wetlands or along roads with ditches that feed into streams. PDF 58, which is specific to Alternative 3 prohibits the use of POEA surfactants within 300 feet of streams, lakes, and wetlands. Finally, PDF 83 specifies that there will be no broadcast spraying of POEA or NPE-based surfactants in or within 100 feet of occupied spotted frog habitat or suitable wetland habitat. Treatment methods, timing, and location will be coordinated with the local biologist prior to implementation. 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. PDF 49 provides additional protections by restricting the ester formulation of triclopyr within 150 feet of any perennial water body for alternative 2 and 300 feet for alternative 3 (see also Tables 15 and 16). PDFs 56 (applies to alternative 2) and 57 (alternative 3) specify buffer distances and application methods for both forms of triclopyr that also provide protections for spotted frogs. At typical application rates, neither version is likely to result in adverse effects to amphibians. At the highest application rate analyzed in the risk assessment (SERA 2003), tadpole responsiveness could be reduced from ester formulations. However, the highest application rate analyzed exceeds that which is legally permitted on the herbicide label for Oregon, so this rate could not be applied. At the highest rate allowed in the project area, water concentrations do not exceed toxicity values and no adverse effects are expected. Also, the concentrations of concern are not likely to occur from applications in the proposed action due to the restriction on broadcast spraying (R6 2005 ROD).

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 of 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 over-sprayed directly, with no foliar interception. In this case, levels of NPE related compounds could reach those that pose a risk of toxic effect. To mitigate the potential risk of NPE-based surfactants to aquatic organisms, including spotted frogs, PDFs 44, 58 and 83 would be implemented.

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 POEA and 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 (Table 15 and Table 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 sprayed within 15 feet of water and triclopyr BEE cannot be used within 150 feet of perennial water in Alternative 2. Triclopyr BEE cannot be used within 300 feet of water, and triclopyr TEA cannot be spot-sprayed within 15 feet of water in Alternative 3 (refer to Table 15 and Table 16, pp. 58-59). 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.

Rimrock Springs Dam – Rimrock Springs Dam and some adjacent pond margins contain a dense infestation of Russian knapweed which are proposed to be treated with clopyralid up to 15 feet from the water, and glyphosate from 15 feet to the water's edge. In order to assess the possible exposure of Columbia spotted frogs to herbicides from treatments of this infestation, we ran the GLEAMS-Driver model. Local soil textures, weather data, pond volume and other variables were input into the model for a foliar spray of clopyralid at 0.49 lbs/acre and glyphosate at 1.5 lbs/acre. Model results indicate that the frogs could be exposed to a maximum concentration of 0.0032 mg/L clopyralid in the pond water from treatments on the dam plus adjoining upland areas. The acute NOEC for amphibians is 0.75 mg/L so no adverse effect to Columbia spotted frogs is likely from the use of clopyralid at this site. For

glyphosate, the model results indicate that no measurable amount is expected to reach the pond, so no effect to the frogs is likely from exposure in the water.

Metolius River – The Oregon spotted frog is suspected to occur near the Metolius River in the vicinity of planned ribbongrass treatments. We ran the GLEAMS-Driver model for these proposed treatments to assess possible exposure to fish and the Oregon spotted frog from herbicide that may enter the water. The model was run for low-flow margins of the main stem of the river as well as extremely low-flow alcoves. The highest peak concentration of glyphosate in the alcove is 0.0003 mg/L and in the stream, 0.00005 mg/L. These concentrations are many orders of magnitude below the level of concern for effects to fish or amphibians (NOEC 0.1 mg/L), so no effect to Oregon spotted frog from herbicide exposure is anticipated.

Relation to Programmatic BA Project Design Criteria – The Programmatic BA contains a project design criteria (equivalent to a PDF) that prohibits the use of herbicides in and adjacent to spotted frog habitat (USDA Forest Service 2010 pp 166). 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 was initiated and new project design features for invasive plant treatment projects have been developed. The Deschutes and Ochoco NFs received biological concurrence with the effects determinations to Oregon Spotted frogs from the U.S. Fish and Wildlife Service's September 17, 2010, given the adherence to the project design criteria set forth in the programmatic BA.

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 is known to occur in project area units that contain riparian or wetland habitat on the Bend/Fort Rock and Sisters Ranger Districts. Project area units with known sites include 11-17, 15-12, 15-15, 15-22 and 15-32. The tightcoil is not likely to occur in the portions of the project area units that are infested with invasive plants, however. The invasive plants that are found in perennially wet areas where the Crater Lake tightcoil may occur include reed canary grass and ribbongrass. These species are located along streambanks or on islands in rivers that area seasonally inundated during spring run-off or high water events, or in seasonally inundated wetland areas that are flooded for a significant amount of time. Riparian sites which experience periodic flooding or have large fluctuations in water level are not suitable habitat for this species (Duncan et al. 2004). The other invasive plants to be treated within these project area units, such as knapweeds and thistles are generally found in disturbed areas that have lower soil moistures and do not provide suitable habitat for the Crater Lake tightcoil.

At least some individuals may be subject to trampling during treatment of ribbongrass or reed canaryrass infestations as workers get to and from sites in riparian areas. Trampling could occur for any

treatment method under any alternative. The impact of trampling would be limited to a few individuals in habitat adjacent to or on the periphery of the vegetation to be removed.

Herbicides are proposed for the control of invasive plants in riparian areas. Regardless of alternative, broadcast spraying of herbicides is prohibited within 50 feet of perennial water. Within 50 feet of perennial water hand application would be used to target invasive plant species. Impacts to non-target vegetation and habitats that the tightcoil may occur would be minimal. 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 vegetation near invasive plants targeted for treatment. Management of known and potential sites will follow the Deschutes LRMP as amended by Survey and Manage direction.

Johnson's Hairstreak Butterfly

These butterflies occur within coniferous forests which contain dwarf mistletoes. It has been speculated that old growth forests containing mistletoes are particularly suitable for this species although younger forests with mistletoes are also suitable. Of the 52,015 acres of project area units, 8,374 (16%) are within forested habitat where the Johnson hairstreak may be found. Manual treatments would have effect. The Johnson's hairstreak is unlikely to be exposed to herbicides because no trees will be treated and no aerial application, which could create drift over large trees, is proposed. Invasive plant treatments will have "no impact" on this species or its habitat.

Silver-bordered Fritillary Butterfly

These butterflies are found in bogs, open riparian areas, and in marshes containing a large amount of willow and larval flood plants. They lay their eggs on or near violets, usually marsh violet and feed on nectar of various composites and mints. There are an estimated 58,985 acres of wetland habitat on the Deschutes and Ochoco National Forests that provide potential habitat of the silver-bordered fritillary. Invasive plant treatments using herbicides or a combination of treatments are proposed on a total of 3,004 acres. Sulfur cinquefoil and bull thistle are invasive composites that may be found within these treatment areas and that may provide nectar and larval foraging habitat for the silver-bordered fritillary. There are 46 sites with approximately 8 acres of sulfur cinquefoil and 16 acres of bull thistle that would be treated with herbicides within the 3,004 acres of wetland treatment. Given the total number of treatment sites and and minimal number of acres of treated it is very unlikely that there would be any negative effects to the silver bordered fritillary.

Invasive plant treatments "may impact, but are not likely to lead to a trend toward federal listing" for the silver-bordered fritillary butterfly.

Summary of Effects to Forest Service Sensitive Species

The determinations and reasons for them for Forest Service sensitive species are listed in Table 99.

Table 99. 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, herbicide effects highly unlikely, treatments improve habitat
Townsend's big-eared bat	No impact	Not likely present in treatment areas; herbicide effects highly unlikely, disturbance unlikely
Greater sage grouse	MINL	PDFs minimize potential effects, herbicide effects highly unlikely, invasive plant treatments important for habitat improvement
Horned grebe	No impact	Not likely present during treatment, herbicide effects highly unlikely, disturbance unlikely
Bufflehead	No impact	Not likely present in treatment areas; herbicide effects highly unlikely, disturbance unlikely
Harlequin duck	MINL	May be present in only a few treatment areas, potential disturbance is short term and low magnitude, herbicide effect highly unlikely
Yellow rail	MINL	PDFs minimize potential for effects; herbicide effect highly 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, herbicide effects highly unlikely
White-headed woodpecker	No impact	Not likely present in treatment areas; herbicide exposure and effects highly unlikely, disturbance unlikely
Lewis' woodpecker	No impact	PDFs limit herbicide exposure; herbicide effect highly unlikely, disturbance unlikely
Northern waterthrush	MINL	Not likely present in treatment areas; herbicide exposure and effects highly unlikely, PDFs limit herbicide exposure
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
Silver-bordered fritillary	MINL	Low likelihood of disturbance, adverse effects from herbicide unlikely, PDFs minimize potential for effects
Johnson's hairstreak	No impact	Not likely present in treatment areas; herbicide effects highly unlikely, no disturbance effects

*MINL = may impact, but not likely to lead to a trend toward federal listing.

Results of the analysis indicate that mortality to Forest Service Sensitive Species is highly unlikely and effects are primarily limited to very short-term disturbance. No native habitat will be removed. The potential for trampling of Crater Lake tightcoil snail is assumed in the analysis, but they are not known to occur in the target vegetation or treatment sites and it is not possible to quantify an effect to their population. In the absence of clear adverse effects to Forest Service Sensitive Species, no threat to viability of populations exists and population-level viability analysis is unnecessary. Treatment of invasive plants will prevent loss of habitat and improve habitat that may currently be degraded.

Direct and Indirect Effects to Management Indicator Species

The bald eagle, northern spotted owl, peregrine falcon, Townsend's big-eared bat, and wolverine are management indicator species (MIS) as well as *Federally Listed Species* or *Regional Forester Sensitive*

Species. The white-headed woodpecker and Lewis's woodpecker are species that are within the primary cavity excavator group of MIS and are also *Regional Forester Sensitive Species*. The effects to all of these species were previously discussed and, therefore, will not be addressed again in this section. Effects to the other 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:

- *Bird consuming insects*: primary cavity excavators, pileated woodpecker, three-toed woodpecker, northern flicker
- *Predatory bird consuming a contaminated small mammal*: golden eagle, northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tail hawk, great gray owl, prairie falcon.
- *Predatory bird consuming contaminated fish*: osprey, great blue heron, waterfowl.
- *Herbivorous bird consuming contaminated vegetation*: waterfowl
- *Large mammal consuming contaminated vegetation*: deer and elk
- *Carnivore consuming contaminated small mammal*: American (pine) marten

Effects to Primary Cavity Excavators, Pileated Woodpecker, Three-toed Woodpecker, and Northern Flicker

To analyze the effects of herbicides to the primary cavity excavator group, the pileated woodpecker, northern flicker, and three-toed woodpecker the scenario of birds consuming insects was used. Other primary cavity excavators that are within the birds consuming insects scenario that have not been previously discussed and which occur on the Deschutes, Ochoco and Crooked River National Grassland include the hairy woodpecker, downy woodpecker, Williamson's sapsucker, red-naped sapsucker, black-backed woodpecker, red-breasted nuthatch, white-breasted nuthatch, and pygmy nuthatch.

There are approximately 9,654 acres in project area units that are in forested habitat or wildfire areas where herbicides could be used for invasive plant treatment. This estimate is substantially larger than the actual amount of infested acres where herbicide use is proposed. 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. The pileated woodpecker and northern flicker are the only cavity excavators that may feed on the ground or in low shrubs or on logs 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. PDF 12 restricts application of Triclopyr to the lowest effective rate. In addition, Triclopyr is primarily used for control of scotch broom and Himalayan blackberry, species that do not provide nesting or foraging habitat of any of the species within the primary cavity excavator group, including the pileated woodpecker, three-toed woodpecker, or northern flicker. NPE may exceed toxicity index at typical and highest application rates given the worst case scenario of feeding exclusively on contaminated insects. To eliminate the potential for negative effects PDF 12 requires the lowest effective rates of NPE surfactant to be used and limits the application rate to less than 0.5 lb a.i./acre.

For evaluation and comparison, the typical application rate of NPE is 1.67 lb a.i./acre, more than three times the amount specified in PDF 12. The high application rate is 6.68 lb a.i./acre. Given the varied diet and movement of these birds, it is very unlikely that they'd 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. Invasive plant treatments will not cause adverse effects to these species as a result of

human or mechanical disturbance. Since there are no likely adverse effects from disturbance or herbicide exposure, there is no appreciable difference in effects between alternatives. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact ability to meet the target population levels or habitat goals) of any primary cavity excavator, including the pileated woodpecker, northern flicker, and three-toed woodpecker on either National Forest or Grassland.

Effects to Golden Eagle, Northern Goshawk, Cooper's Hawk, Sharp-shinned Hawk, Red-tail Hawk, Great Gray Owl (also a Survey and Manage Species), and Prairie Falcon

To analyze the effects of herbicides to the golden eagle, northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tail hawk, great gray owl, and prairie falcon the scenario of predatory birds consuming contaminated small mammals was used. These species occur in forested habitat, wildfire areas, meadow, wetland, floodplain, lakeside, streamside, and can occasionally be found foraging along roadsides.

On the Deschutes, Ochoco and Crooked River National Grassland there are approximately 137,414 acres of suitable golden eagle habitat; 352,155 acres of suitable northern goshawk habitat; 347,810 acres of suitable Cooper's hawk habitat; 471,066 acres of suitable sharp-shinned hawk habitat, 11,861 acres of red-tail hawk; 271,972 acres of suitable habitat for the great gray owl, and 14,608 acres of suitable prairie falcon habitat. The use of herbicides for invasive plant treatment is proposed on less than 1% of the suitable habitat for each of these species with the exception of the golden eagle for which herbicides would be used on 2% of suitable habitat (refer to Table 100). The majority of the treatment areas are along roadsides which would likely receive very little use by these species, particularly by the forested habitat species such as the northern goshawk, Cooper's hawk, sharp-shinned hawk, the mature forest and meadow/edge preferring great gray owl, or the open country prairie falcon. The golden eagle and red-tail are the two species that are occasionally observed foraging along roadsides. The acreage within the project area units is substantially larger than the actual amount of infested acres.

Effects from herbicide exposure are the same as those previously discussed for the northern spotted 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. Project design feature number 12 requires the lowest effective rates of NPE surfactant to be used and limits the application rate to less than 0.5 lb a.i./acre. For evaluation and comparison, the typical application rate of NPE is 1.67 lb a.i./acre, more than three times the amount specified in PDF 12. The high application rate is 6.68 lb a.i./acre. 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. Mechanical treatments are proposed for only 23 project area units. Of these sites, 21 propose use of string trimmers and two propose use of a disc. Noise from heavy equipment has the highest probability for disturbance, which is proposed for PAUs 72-15 and 72-37, for a total of 14 acres. Eighteen (78%) 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 PDF 94 that lists seasonal restrictions for nesting raptors and herons. 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. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact ability to meet target population levels or habitat goals) of any raptor species on either National Forest or Grassland.

Over the long term, invasive plant treatments will benefit raptors by maintaining or improving habitat of prey species. Invasive plant treatments will maintain or improve native understory vegetation and plant diversity, improving habitat of prey species such as small mammals and birds.

Effects to Osprey and Great Blue Heron

The effects of herbicides to the osprey and great blue heron were evaluated using the scenario of predatory birds consuming contaminated fish. On the Deschutes, Ochoco and Crooked River National Grassland there are approximately 79,479 acres of class 1 stream, class 2 stream, and areas adjacent to lakes that provide habitat for the osprey. The blue heron has approximately 173,476 total acres of potential habitat provided by streamside (class 1-3 streams), meadow, wetland and floodplain, and lakesides. There are approximately 3,004 acres (4% of osprey habitat, 2% great blue heron habitat) in project area units that are in meadow, wetland and floodplain, lakeside, or streamside areas where herbicides could be used for invasive plant treatment. This estimate is substantially larger than the current amount of infested acres. None of the herbicides proposed for use in this FSEIS nor NPE surfactants, applied at typical application rates, pose a risk to birds that may consume contaminated fish.

The potential for the herbicides to adversely affect the osprey or great blue herons was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond. Assumptions used include no dissipation of herbicide, bioconcentration is 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 USDA Forest Service 2005d, Appendix B). Project design feature number 12 requires the lowest effective rates of NPE surfactant to be used and limits the application rate to less than 0.5 lb a.i./acre. Doses of concern will not occur. The weight of evidence suggests that adverse effects to the osprey or great blue heron from NPE or the herbicides included in the action alternatives are not plausible.

Potential effects of invasive plant treatment methods on the osprey and great blue heron 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 these species during the breeding season, causing the birds to leave nests and rookeries, or stay away from the nest long enough to have detrimental effects to eggs or young. Effects from mechanical methods (e.g. tractors, chainsaws, or string trimmers) may be more likely to occur, and occur at greater distances from the project site, because machinery creates louder noise.

Potential effects to the osprey and great blue heron from disturbance would be avoided by adhering to PDFs that list seasonal restrictions for nesting raptors and the great blue herons. Invasive plant treatments in the project area will avoid conducting the project in proximity to an occupied nest during

these time-frames. PDF 94 lists seasonal restrictions for nesting raptors (osprey) and the great blue heron. In addition to these species-specific timing restrictions, treatments along streams are also restricted to no more than 1.0 acre per year in the stream channel per 6th field watershed, and no more than 10 acres of riparian area treatments for every 1.5 miles of stream.

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. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact ability to meet target population levels or habitat goals) of the osprey or great blue heron on either of the Forests or the Grassland.

Effects to Managemetn Indicator Waterfowl Species

On the Deschutes, Ochoco and Crooked River National Grassland there are approximately 173,476 total acres of habitat for waterfowl provided by Class 1-3 streams, lakes, wetlands, and meadows; 94,698 acres on the Deschutes and 78,778 on the Ochoco and Crooked River National Grassland. There are approximately 3,004 acres (<2% of total habitat) in project area units that are in meadow, wetland and floodplain, lakeside, or streamside areas that provide habitat for waterfowl and where herbicides could be used for invasive plant treatment. This estimate is substantially larger than the current amount of infested acres proposed for treatment.

The effects of herbicides to waterfowl were evaluated using two scenarios; predatory birds consuming contaminated fish, and herbivorous bird consuming contaminated vegetation. 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 PDF 12 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. In addition, PDF 44 prohibits the use of POEA and NPE-based surfactants within 100 feet of surface water, wetlands or along roads with ditches that feed into streams. For alternative 3, PDF 58 prohibits the use of NPE or POEA surfactants within 300 feet of stream channels, lakes and wetlands, and PDF 89 prohibits broadcast or spot spraying of NPE-based surfactants in or adjacent to suitable wetland habitat. 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 2005 FEIS BA (USDA Forest Service 2005d) demonstrated that chronic exposures 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. Tables 15 and 16 list the buffer widths for all herbicides for Alternatives 2 and 3. 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 from treatments by any method, but will be short term, low intensity, and limited in extent (usually less than one acre). The possibility for disturbance would be reduced by the amount of treatment allowed in one year: no more than 1.0 acre per year within a stream channel per 6th field watershed, and no more than 10 acres of riparian area treatments for every 1.5

miles of stream. Short term, low intensity disturbance may affect individuals but would be insignificant at a forest-scale.

There are no likely adverse effects from herbicide exposure. There is no appreciable difference in effects between alternatives. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact ability to meet target population levels or habitat goals) of any species of waterfowl on either National Forest or Grassland.

Effects to Deer and Elk

Deer and elk are found across both national forests and the Crooked River National Grassland in a variety of habitat types. Deer and elk eat a wide variety of plants including grasses, forbs, aspen, and woody shrub species. Because these two species are so widespread and forage on a variety of species the amount of treatments in their most critical areas and habitat types was conducted. These areas include; MA-7 Deer Habitat (Transition and Winter Range) on the Deschutes, MA-F20 Winter Range and MA-F21 General Forest Winter Range on the Ochoco, MA-G2 Metolius Deer Winter Range on the Crooked River National Grassland, and Key Elk areas on the Deschutes National Forest. Densities of deer and elk are greater in these areas during specific times of year and there is more concentrated use of forage. They are also more susceptible to negative effects of disturbance in these areas.

Combined, there are a total of 339,087 acres within these management areas for deer and elk. Invasive plant treatments would occur on less than 3% of these areas. Herbicides would be used on a total of 8,714 acres; 3,541 acres in MA-7 on the Deschutes, 1,513 acres in MA-F20 and 1,340 acres in MA-F21 on the Ochoco, 779 acres in the Metolius Mule Deer Winter Range, and 1,541 in Key Elk areas on the Deschutes National Forest. Manual or mechanical types of treatments would occur on a total of 166 acres; 18 acres in Deer Habitat on the Deschutes; 1 acre in General Forest Winter Range on the Ochoco, and 147 acres in Key Elk Areas on the Deschutes. Biological control would occur on 261 acres in Key Elk areas on the Deschutes. The acreage within the project area units is substantially larger than the actual amount of infested acres and treatment would not all occur in a single year.

The effects of herbicides to deer and elk were evaluated using the scenario of large mammals consuming contaminated vegetation. 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. Treatments would occur primarily during the summer months, a period when deer and elk are not typically found in the winter range or key elk area management areas, so they would be very unlikely to be exposed to these treatments.

Invasive plant treatments can create some disturbance, but the level of disturbance would be short term, low intensity, and limited extent. The majority of treatment areas are along roads (>70%) where existing ambient disturbance occurs regularly. 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. Invasive plant treatments will not contribute

to a negative trend in viability or negatively impact ability to meet target population levels on either National Forest or Grassland, or the ability to meet the State's population management objectives.

Treatment of invasive plants in winter range and key elk management areas, as well as all other areas including meadows and along roadsides in meadow habitat will beneficially affect deer and elk by preserving native forage species, maintaining or improving nutritional value, 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). Maintaining and improving native herbaceous plants and shrubs will increase the nutritional value in these areas and contribute to increased animal health and ability of critical areas such as winter range and key elk habitat to support deer and elk.

Effects to American Marten

There are a total of 98,882 acres that provide suitable habitat for the American marten on the Deschutes and Ochoco National Forests. There is a very minor amount of suitable habitat proposed for invasive plant treatments. There are approximately 692 acres in project area units that are in suitable habitat where herbicides would be used for invasive plant treatment, 136 acres where manual treatments would occur, and 6 acres where bio-controls would be used. The estimate of treatment acreage is substantially larger than the current amount of infested acres that would be treated.

The marten inhabits mature and old growth mixed conifer, mature lodgepole pine, and mountain hemlock forest communities and tend to avoid areas that lack overhead protection. Invasive plants are not typically found in the mature forest habitat types preferred by the marten. No herbicide or NPE exceeded a level of concern in the scenario of carnivores consuming contaminated small mammals. Invasive plant infestations are unlikely to occur in marten habitat except along disturbed roadsides, so disturbance to martens from manual or mechanical treatments are 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. Invasive plant treatments will not contribute to a negative trend in viability (negatively impact the ability to meet target population levels or habitat goals) of the American marten on either National Forest or Grassland.

Summary of Effects to Management Indicator Species

Results of the analysis indicate that mortality to Forest Service MIS is highly unlikely and effects are primarily limited to very short-term disturbance. No native habitat will be removed. In the absence of clear adverse effects to MIS, no threat to viability of populations exists and population-level viability analysis is unnecessary. Treatment of invasive plants will prevent loss of habitat and improve habitat that may currently be degraded.

Table 100. Summary acres of invasive plant treatments by method in relation to MIS habitat on the Deschutes and Ochoco National Forests

Management Indicator Species	Total Habitat Available	Herbicide	Manual/Mechanical	Biological	Total Habitat Treated	% of Habitat Treated
Birds						
Bald Eagle	31,210	353	107	0	460	1.5%
Golden Eagle	137,414	2,292	85	1	2,378	2%
Northern Goshawk	352,155	2,783	823	0	3,606	1%
Cooper's Hawk	347,810	2,783	823	0	3,606	1%
Sharp-shinned Hawk	471,066	5,739	1,028	26	6,793	1%
Red-tail Hawk	11,861	111	46	0	157	1%
Northern Spotted Owl	78,109	4,028	836	0	4,864	6%
Great Gray Owl	271,972	2,729	843	0	3,572	1%
Peregrine Falcon	14,608	227	11	0	238	2%
Prairie Falcon	14,608	227	11	0	238	2%
Osprey	79,479	3,914	249	17	4,180	5%
Great Blue Heron	173,476	1,159	164	6	1,329	<1%
Pileated Woodpecker	104,276	467	110	0	577	<1%
Northern Flicker	36,229	328	72	0	400	1%
Three-toed Woodpecker	791,752	11,678	1,384	24	13,806	2%
Primary Cavity Excavators	2,284,392	9,654	475	17	10,146	<1%
Waterfowl	173,476	3,004	81	18	3,103	2%
Mammals						
American Marten	98,882	692	136	6	834	<1%
Deer and Elk	339,087	8,715	166	261	9,142	3%
Townsend's Big-eared Bat	31,016	226	11	0	237	<1%
Wolverine	92,588	123	1	0	124	<1%

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 would 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 PDF 94 for nesting raptors and great blue heron.

There would be no effect to the yellow-billed cuckoo, black swift, black-chinned sparrow, black rosy finch, Virginia's warbler, McCown's longspur, snowy plover, and marbled godwit as these species do not occur in the project area (Marshall et al. 2003, Ridgley et al. 2003, Sibley 2000).

Effects to bald eagle, golden eagle, prairie falcon, sage grouse, yellow rail, upland sandpiper, Lewis's woodpecker, Williamson's sapsucker, white-headed woodpecker, and tricolored blackbird have been

discussed previously in the Forest Service Sensitive Species and Management Indicator Species sections. Similar to the discussion for MIS, risks of herbicide exposure to the remainder of the Birds of Conservation Concern were evaluated by placing them into groups based on diet.

Predatory bird consuming small mammal: Swainson's hawk, ferruginous hawk, and flammulated owl. Risks are the same as those discussed for the the golden eagle, northern goshawk, Cooper's hawk, sharp-shinned hawk, red-tail hawk, great gray owl, and prairie falcon. Invasive plant treatments would have no negative effect to these species from either disturbance or herbicide exposure.

Insectivorous bird: willow flycatcher, olive-sided flycatcher, Long-billed curlew, Wilson's phalarope, sage thrasher, and loggerhead shrike. Risks are the same as those previously discussed for the sage grouse and upland sandpiper. Project design feature 12 limits herbicide application rates to less than levels of concern and it is highly unlikely that any of the birds listed above could consume enough contaminated insects to exceed the level of concern. Invasive plant treatments would have no negative effects to these species from either disturbance or herbicide exposure.

Fish-eating bird: eared grebe. Risks are the same as those previously discussed for the horned grebe. Invasive plant treatments would have no negative effects from either disturbance or herbicide exposure to the eared-grebe.

Brewer's Sparrow, Sage Sparrow, Green-tailed Towhee, Pinyon Jay, and Cassin's Finch

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.

Calliope Hummingbird

The calliope hummingbird is a species that is found in open forests, meadow edges, and riparian areas. They have been observed in various habitats including young tree plantations with snowbrush, currant, and greenleaf manzanita; and in meadow and riparian habitats containing willows, alder, red-osier dogwood, and other shrubs. Their diet has not been studied in Oregon but elsewhere this hummingbird has been observed taking nectar from various flowers including squaw currant, paintbrushes, monkeyflowers, penstemons, and scarlet gilia, all of which can be found in Oregon (Marshall et al. 2003). Invasive plant treatments would not affect these types of plants and therefore, would have no negative effects from either disturbance or herbicide exposure to the calliope hummingbird. Over the long term, invasive plant treatments will benefit the calliope hummingbird by maintaining or improving native understory vegetation and plant diversity, including the abundance of nectar producing flowers and shrubs preferred by the calliope hummingbird.

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 terrestrial insects, although data is limited (USDA Forest Service 2005d, SERA 2001, 2003, 2004, 2011). 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). However, herbicides are used near these crops to control invasive plants.

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 addition, recent studies (Cameron et al. 2011) show that the declining species have been reported to have lower genetic diversity and higher infection rates from the pathogen *Nosema bombi* than co-occurring species that are not declining. Causes for the higher susceptibility of declining species are unknown, but current research has not suggested that herbicides are a factor.

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 of All Alternatives

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 than 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 FSEIS is 2.5 million acres in Central Oregon, while treatments are limited to no more than 16,000 acres per year total, no more than 1.0 acre per year in the stream channel per 6th field watershed, and no more than 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, PDFs 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 analysis assumes that possible repeated treatments within the same season do not overlap in time, or result in a cumulative effect. If repeated treatments are necessary it is usually a result of missed plants during the first herbicide application or manual treatment effort. In the first instance a second herbicide application would not overlap spatially or in time, and in the second scenario, the duration of manual treatment and resulting effects are small. See direct and indirect effects for analysis of repeated human disturbance to Northern spotted owl and bald eagles.

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 PDFs.

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. Projects that are within the range of the northern spotted owl and that are ongoing or reasonably foreseeable include the EXF project and West Bend project on the Bend Fort Rock Ranger District, and the Popper project on the Sisters Ranger District.

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. Invasive plant treatments and activities associated with the previously mentioned vegetation and fuels management projects would be required to follow project design features that limit disturbance when in proximity to known owl nest sites. The probability of an effect from the No Action or either of the action alternatives is so low that it could not be added to other activities in a meaningful way. Therefore, none of the alternatives will create any cumulative effects to northern spotted owls.

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: bald eagle, California wolverine, Pacific fisher, Townsend's big-eared bat, horned grebes, bufflehead, upland sandpiper, American peregrine falcon, white-headed woodpecker, Lewis' woodpecker, tricolored blackbird, or Johnson's hairstreak butterfly.

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 habitat sites are protected by exclosures. Livestock grazing within potential pygmy rabbit habitat would reduce the amount of native vegetation, however, the invasive plant treatments target invasive plants and effects to native vegetation would be minimal. There is a very low potential for disturbance from invasive plant treatments to add to disturbance caused by grazing or other land management activities. 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 if 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 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. The greatest potential for cumulative effects to sage grouse is by the removal of native vegetation by livestock grazing. Invasive plant treatments will not treat native sagebrush or forb habitat, so cumulative effects from livestock grazing are unlikely. 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. The only sighting of a Harlequin duck in the project area occurred on the Metolius River, an area that receives intensive recreation use. 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 the Deschutes and Ochoco National Forests, Crooked River Grassland, and other ownerships. This is very unlikely because the harlequin duck and yellow rail are not known to occur on the Ochoco National Forest or Crooked River National Grassland. 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, where the majority of treatments would take place. The ongoing and reasonably foreseeable vegetation and fuels management projects would not have any cumulative effects as these projects are designed to avoid areas with invasive plants, as well as adhere to riparian management standards and guidelines that limit activities in riparian and aquatic habitats where these frogs occur. The recently approved Deschutes and Ochoco Travel Management Plan prohibits motor vehicle off-road and cross country travel which also reduces the potential for cumulative effects. 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. Treatments of reed canarygrass and ribbongrass that are in high use recreation areas such as the Metolius River and recreation sites at Wickiup Reservoir, Crane Prairie Reservoir, Paulina Lake, Lave Lake, and Hosmer Lake may be cumulative to the existing recreational activities. Trampling of Crater Lake tightcoils could occur from treatments and recreational use or similar activities in riparian areas. The magnitude and extent of trampling from invasive plant treatments is very low, however, and restricted to a few individuals present adjacent to invasive plant species. Reed canarygrass and

ribbongrass are found in areas that are inundated with water or seasonally flooded and do not provide habitat for the Crater Lake tightcoil. Trampling from invasive plant treatments are unlikely to add significantly to trampling or disturbance from other activities such as recreational 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 would be no cumulative effects to Crater Lake tightcoil snail.

The silver-bordered fritillary can be found in bogs, open riparian areas, and in marshes containing a large amount of willow and larval flood plants (violets). Invasive plant treatments occur in a minimal number of sites and acres where the silver-bordered fritillary may occur. Livestock grazing could occur in these areas. Given the spatial and temporal scale of treatment, and the minimal number of acres proposed for treatment cumulative effects to the silver bordered fritillary are very unlikely.

Management Indicator Species (MIS)

None of the MIS listed in Table 95 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. Ongoing and reasonably foreseeable projects including vegetation and fuels management projects, allotment management planning, and travel management would not contribute to cumulative effects to any of the MIS. The recently approved Deschutes and Ochoco Travel Management Plan which prohibits off-road and cross country motor vehicle travel, is expected to be beneficial to MIS by reducing disturbance and loss of habitat. Travel management regulations are also expected to reduce the spread of invasive plants into MIS habitat. 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 2005 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 two Forests and Grassland and are targets of this proposal: yellow starthistle, spotted knapweed, diffuse knapweed, Russian knapweed, leafy spurge, Scotch thistle, tansy ragwort, Scotch broom, 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 (USDA Forest Service 2005a, Table 4-32, 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. Costs listed in Table 101 are taken from the R6 2005 FEIS and modified slightly for local conditions. Cultural and biological methods are not included in this assessment because they account for such a small portion of the treatments proposed (86 and 16.6 infested acres respectively).[17]

Table 101. 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

[17] Biological control is about $70 per acre and cultural methods average around $50 per acre according to the R6 2005 FEIS, page 4-94.

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)[18], 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), as opposed to PAU acres.

Cost estimates in Table 102 are based on current approved NEPA documents for Alternative 1, about 46% of on-going treatment is herbicide application, and 40% is manual (remainder is biological and cultural). Only about 2,300 acres of the nearly 15,000 acres infested is treated under Alternative 1.

Based on Table 103 for the action alternatives, about 95% of the first year's treatment would be herbicide application, and 4% 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 102. Estimated cost of treating all acres in the first year

	Alternative 1	Proposed Action	Alternative 3
Cost for First Year's Treatments (all acres)	manual - $310,100 herbicide (spot/hand) - $261,250 ---------- $572,350	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) - $ 996,500 ---------- $2,724,590

The difference in cost for Alternatives 2 and 3 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 herbicide use on these sites has declined as treatment has been effective, costs will become more associated with manual work (see Table 103).

[18] For example, medusahead sites on the Grassland are very large, but the containment strategy involves treating the perimeter and along roadways.

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 103. Pattern of herbicide to non-herbicide use over time in Alternatives 2 and 3, if all 1,892 sites were treated beginning in 2011

Year	Percent Herbicide Use	Percent Non-Herbicide Use
2011	95%	4%
2012	75%	25%
2013	50%	50%
2014	0%	100%

Data shown in Table 103 is based on analysis done by the Olympic National Forest (USDA Forest Service 2006), and assumes that all infestations are effectively controlled, and that new infestations do not occur. For Alternatives 2 and 3, assuming a constant budget of $500,000 per year[19], about 20% of the infested sites could be effectively treated in the first year. For Alternative 1, about 46% of the infested sites currently covered under NEPA decisions could be effectively treated in the first year, but leaving high priority sites and species untreated. To make the best use of the budget, high priority sites would be the most likely to be treated, while other infestations would continue to spread until there was a change in priority, or until more dollars become available. Cost of treating existing infestations would continue to increase. Over time, Alternative 3 would become less cost-effective when compared to Alternative 2. This is because the difference in effectiveness in riparian areas would be exponential over time; the design of Alternative 3 would result in more acres to be treated and higher costs per acre each year throughout the life of the project.

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 with 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 a cost-benefit ratio of as much as 34:1 (ODA 2000).

Cumulative Effects

There are costs associated with implementing the prevention standards of the R6 2005 FEIS (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.

[19] The figure of $500,000 was used as an annual budget, which is based on the combined average received by the Forests and Grassland for invasive plant treatments for years 2008, 2009, and 2010.

With the implementation of prevention standards and guidelines, invasive plant spread is anticipated to slow (R6 2005 ROD, 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.

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 2005 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 (USDA Forest Service 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 (USDA Forest Service 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 (USDA Forest Service 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 (USDA Forest Service 2006c).

Table 104. 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	0.23
Herbicide-Spot/Hand	250	85	1.6
Mechanical	100	40	0.3
Manual	340	100	3.0
Restoration	500	50	1.18

Table 105. 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
Alternative 1	3320	4430	37
Alternative 2	14,546	10,610	88
Alternative 3	14,546	13,497	112

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 over the life of the project.

In addition, project implementation planning and monitoring of treatment effectiveness under all alternatives, especially Alternatives 2 and 3, will support a number of jobs, mainly Forest Service personnel.

Cumulative Effects

The job level associated with any of the alternatives is not significant to the economies of the counties surrounding the Deschutes or Ochoco National Forests, or the Crooked River National Grassland in and by itself. However, invasive plant control within the states of Oregon and Washington create roughly 8,038 jobs annually (applying the average of one $20,000 job equivalent for every 138.3 acres treated) (USDA Forest Service 2005a), some of which occurs within the surrounding communities. As a result, the invasive plant control activities in the alternatives, in conjunction with plant control on other local federal, state and private lands, would have a positive effect on local economies.

3.11 Rangeland Resources

3.11.1 Affected Environment

Introduction

The Crooked River National Grassland and the Deschutes and Ochoco National Forests (Forests) combined administers 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 than 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.

Domestic and wild grazing animals contribute to invasive plant establishment and spread through selective eating, redistribution of invasive plant seeds in scat, fur, hooves and soil disturbance, therefore creating conditions favorable for seed germination. Unintentional introductions of invasive plants have been associated with livestock management, resulting in widespread invasions (Sheley 1999). However, 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 (see Table 107 for a list of closed and vacant allotments on the Deschutes NF that have invasive species present.)

Invasive species are not confined uniquely to grazing allotments, as these plants are commonly present where no allotments exist. For the most part, livestock are not considered to be a major contributor to the spread of invasive plants with the exception of houndstongue; seeds stick to cattle hair and drop off later. For a complete review of the influence of ungulates on non-native plant invasions in forests and rangelands, see the 2005 R6 FEIS, Appendix D, PNW Causal Paper on Ungulates. This paper presents the current understanding in the Region with respect to ungulates as contributors to the spread of invasive plants. Selective foraging, effects of site disturbance or alteration, and knowledge gaps and future research needs are discussed.

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 grasses 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. Medusahead is uncommon on the Deschutes NF, and very common on the Crooked River National Grassland. Medusahead infestations on the Ochoco are small and localized. These two grass species readily occupy areas of soil disturbance, particularly on drier sites, and have been known 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. Ventenata also has minimal forage value, low palatability as it dries out early leaving hardened vegetation (Scheinost 2008). 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. 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 and Walter 2001).

Table 106. 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 107. Grazing allotments with known invasive plant populations on the Deschutes National Forest

Allotment Name	Invasive Weed Species	Total gross acres
Status: active		
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 108. Grazing allotments with known invasive plant populations on the Ochoco National Forest

Allotment Name	Invasive Weed Species	Total gross acres
Status: active		
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 and eggs	1.2
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

Allotment Name	Invasive Weed Species	Total gross acres
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**
Status: vacant		
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 109 that follows. 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 109. 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.

Control of invasive plants within the project area has had success with existing invasive sites, under existing environmental documents completed in 1998. Treatment of sites established after 1998 excludes the use of herbicides. In addition, under existing 1998 treatment options, the choice of herbicides that can be used is much more restrictive than that which would be allowed under Alternative 2.

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. Invasive plants compete directly with forage grasses and reduce the nutritional value and longevity of pastures. An example is the increasing amount of medusahead rye that is becoming the dominant plant on much of the Grassland. Medusahead is a winter annual grass that is only palatable for a short time in early spring before most cattle are on the allotments. Only 1/3 of the allotments on the Grassland turn out for grazing in early April, where there is about one month of grazing opportunity on medusahead (Gibson, pers. comm. 2006). As the plant matures, it has a high silica content which makes it unpalatable and non-nutritious, providing no forage value for much of the year on most allotments infested (Sheley 1999). Most of the Grassland range allotments are impacted by annual grasses, and the density and extent are increasing with the lack of effective control measures (Gibson, pers. comm. 2006). Alternative 1 does not provide an effective means for control of species such as annual grasses.

An example where herbicide would be effective 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. Several small areas are infested, along with one large site at a mining claim managed under a special use permit. Approximately 4.3 acres is infested. 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 control techniques are limited to hand treatment which seems to be keeping the infestations from dominating the landscape, but not eradicating the problem. 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 the Grazing Restriction Table in Appendix D). Six of the 10 formulations have no grazing restrictions. Those herbicides that do (clopyralid, imazapic, picloram and triclopyr) require that the sprayed vegetation be dry before grazing. Appendix D also notes for these four herbicides that animals should be removed from treated areas 3 days prior to slaughter. A key element to program implementation using herbicides where livestock may be present will be proper coordination and notification of permittees and rangeland managers (PDF 74). Timely notification and coordination will 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 (Pers. comm.. 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 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.

Early Detection and Response (EDRR)

A key part of this effort will be early detection and response for any new infestations. An upper limit of 16,000 acres per year 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 (PDF 74).

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) (PDF 75). 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 the 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.

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 occur 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.

Cumulative Effects – All Alternatives

The Basis for Cumulative Effects is found in section 3.1.3. 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 Alternatives 2 and 3 will complement the efforts of state control programs and community volunteer efforts. For example, the inclusion of orange hawkweed 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 (R6 2005 FEIS).

The R6 2005 FEIS Appendix D summarizes the cattle cause-effect relationship with invasive plants in two ways: 1) spread of invasive plant seeds, and 2) altering plant succession by favoring palatable species, thus increasing susceptibility to invasion. Houndstongue within the heaviest infested Allotments, Roba and Snowshoe, may be spread by cattle because they cling to hair. The Roba Allotment in particular has areas of bare ground, such as around Hewed Log Spring. As cattle can move seeds, there could be a cumulative effect, and increase in infestation if the houndstongue is not treated in Alternative 1. In Alternative 2 this area is prescribed for burning, spraying, and scarifying for revegetation; cattle grazing may delay the length of time for native vegetation establishment. No scarification/harrowing would be allowed in Alternative 3 because the area lies within the riparian buffer. This would further delay, and possibly reduce the effectiveness of revegetation.

The control of invasive plants, regardless of method, is expected to expose little bare ground, as most sites occur along roadsides. However, on the Crooked River Grassland the weed/cattle interaction is more pronounced as invasive annual grasses occupy rangeland. This could result in longer duration of treatments compared to other site types, such as road shoulders. More years of treatment may be required. Prevention measures such as temporarily prohibiting grazing from invasive plant areas would help reduce the time for control of invasive species. This has been used on the Roba Allotment on the Ochoco NF (see Appendix G) which increased the effectiveness of manual contol of houndstongue. The early detection-rapid response strategy would also improve the ability to control infestations while small, which results in lowering the overall use of herbicide.

Invasive Plant management and other land management practices such as timber harvest, fuel reduction burning, and reduction of cross-country OHV travel, are expected to positively influence forage quantity and/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.

3.12 Cultural Resources

Introduction

In July, 2005, the Forests contacted the tribes to inform them of this proposed project and let them know that a formal public scoping letter was forthcoming. After the scoping letter was mailed, follow up phone calls, letters, and meetings with the tribes occurred between July 2005 and May 2006 to solicit input on this project. The Cultural Resources Report and Appendicies are incorporated by reference.

Discussions with the Tribes brought out the following:

- Concerns about gathering areas being overrun by invasive plants.
- Some supported an invasive plant spray program but prefer no spraying in gathering areas for both eating and basketry gathering. If spraying is to occur, one Tribe suggested spraying in the spring when the [invasive] plants are immature and then in the fall after the fall rains to eradicate any germinated seeds before spring.
- Some said it would be nice if we have flexibility to use new herbicides as they come on board and supported our efforts to use all tools in the toolbox as long as it is implemented in a logical, prudent way and we are not just using herbicides without much thought behind it.

- Tribes mentioned they want to be notified when and where spraying will occur, and have areas signed.
- Support was expressed for manual and biological controls and cultural plantings after treatments to restore areas.
- Some expressed concern about prescribe fire because it increases germination of invasives. Some said that prescribe fire would be okay in areas where there is no likelihood of traditional plants; other said they do not want to see fire used, especially in areas with heavy fuel loading or riparian areas where most of their basketry materials grow.
- A concern was raised that we follow through on our long-term commitments to treat and monitor sites (as long as it takes – many sites can be a 10+ year commitment).
- Prioritization is important and supported a flexible strategy so we can work with adjacent ownerships and partners and deal with new invasive species as they arise.

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, frequently used plants include bitterroot, lomatiums, yampah, and camas (see Table 85 in the Human Health Section for a more extensive list of plants). 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.

Cultural use plants are often gathered for food or basketry materials. Food plants may be harvested for their roots (e.g., bitterroot and yampah) or berries (e.g., huckleberries, elderberries, chokecherries, rose hips). Bark from trees and shrubs (e.g., western red cedar, redosier dogwood, and willows) and stems of wetland grass-like plants (e.g., cattails and tules) are used for basketry.

3.12.2 Environmental Consequences

Alternative 1 – No Action

Invasive plant treatments that occur under Alternative 1 were analyzed in 1998 Environmental Assessments (USDA Forest Service 1998a and 1998b) which determined no effects on cultural resources. Both Assessments require that only target vegetation be sprayed in areas off of roadsides. To further reduce possible impacts to non-target vegetation, only equipment such as backpack sprayers or weed wipers are used in application on sites away from roadsides. This type of equipment is very selective, no boom or broadcast spraying is used.

Since these environmental assessments were completed, there has been an increase in invasive plant populations. Under Alternative 1, the majority of invasive plant sites would not be treated, resulting in the continued displacement of native plant species and habitats. Limited herbicides are available and treatment effectiveness would be reduced under Alternative 1, resulting in continued loss of native plant habitats. Invasive annual grasses in particular, such as medusahead, cheatgrass and North Africa grass,

are beoming more prevalent on the Ochoco National Forest within dry and moist meadows. These meadown often contain a diversity of cultural-use plants like wild carrots, wild onions and yampah. As invasive plants spread, the risks to habitats that contain culturally-important plants are greater. Due to potential loss of native plant habitats, Alternative 1 provides the least protection to long-term viability of cultural use plants. See Section 3.4.2 for effects to native vegetation under the No Action Alternative.

Alternatives 2 and 3

Effects Common to Both Action Alternatives

Under this project, only burning and disking (scarifying) 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.

Project Area Units (PAUs) 72-15 and 72-37 in the Hewed Log area on Paulina Ranger District will include both burning and discing (scarifying) of the soils to aid in revegetation. 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.

PDF 41 was developed specifically to ensure continued coordination with the tribes to protect cultural use plants and protect tribal members from inadvertent contact with herbicides. As part of the annual implementation plan, we would consult with the tribes to identify overlaps between proposed treatments and cultural gathering areas. This information would be used to finalize the annual treatment plan so that appropriate PDFs are applied. PDF 41 requires that we avoid using herbicides where cultural use plants are present during their season of collection. In addition, all PDFs that protect non-target vegetation apply to cultural plants (e.g., PDFs 5, 12, 13, 15, 16, 17, 47, 61, 62, 64-69) as well as PDFs 36-39, which aim to ensure there is no inadvertent public contact with herbicide in known areas of wild food collection. This includes popular berry and mushroom picking areas. PDF 38 requires that

known cultural gathering sites would be posted or otherwise marked where treatment with herbicides is occurring during harvest season (see 3.8 Human Health section for analysis related to public exposure to herbicides).

Alternative 2

The analysis for non-target vegetation applies to cultural use plants (see Non-Target Vegetation Section 3.4). Alternative 2 was determined to provide the greatest protection to non-target plants from invasive plants for the following reasons:

- Most currently mapped invasive plant infestations would be controlled or contained using a variety of treatment methods (manual, biological, chemical).
- Maximum number of available herbicides would increase treatment effectiveness, and offer options to be more selective to target vegetation.
- An Early Detection/Rapid Response Strategy allows us to respond quickly to new infestations.

Effects to non-target cultural use plants from herbicide treatments are minimized or eliminated by working with the tribes to identify important areas (PDF 41) and by incorporating PDFs and other layers of caution (*see "Common to both action alternatives", above*). 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. Changes in species distribution or loss of habitat for cultural use plants from invasive plants treatments are not expected.

Alternative 3

The analysis for non-target vegetation applies to cultural use plants. Alternative 3 provides a high level of protection to non-target plants from invasive plants, but less in riparian areas. Some culturally-important plants occur in riparian areas, such as cattails, bulrush, willows, and red-osier dogwoods. The non-target vegetation analysis determined that riparian native plants may continue to be impacted by rhizomatous invasive plant species, such as ribbongrass and reed canarygrass, mostly on the Deschutes NF. Areas such as PAU 15-32 on the Metolius River, and Trout Creek Swamp (PAU 15-22) have increasing populations of these grasses. There may be impacts to culturally important plants and plant habitats where these invasive species cannot be effectively treated. Manual methods would be used within 10 feet of water in this alternative. Hand removal of these grasses is slow and costly due to the extensive mat of roots (Pajutee 2008). It is not unreasonable to conclude that fewer acres of riparian invasive species control would occur in this alternative.

As with Alternative 2, effects to non-target cultural use plants from herbicide treatments are minimized or eliminated by working with the tribes to identify important areas (PDF 41) and by incorporating PDFs and other layers of caution (*see "Common to both action alternatives", above*). 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. Changes in species distribution or loss of habitat for cultural use plants from invasive plants treatments are not expected.

Summary of effects for all Alternatives of treatments on cultural resources

- Alternative 1:
    - There are no effects to historic or pre-historic resources from burning and mechanical treatment methods; these methods are not approved by current NEPA Invasive Plant decisions.

  - Operating procedures under the Deschutes and Ochcoc NF 1998 Noxious Weed EAs require backpack/wipe methods directly to target vegetation, resulting in no effects to cultural plants. Invasive species would continue to displace cultural plants in some areas.
- Alternative 2:
  - PAUs proposed for burning and scarifying have already been surveyed, no historic or pre-historic resources occur at those sites, therefore there would be no effect.
  - PDFs, selective treatment methods reduce the potential for effects to cultural use plants. In the long-term (>10 years) invasive plants would be less of a threat to cultural plant habitat.
- Alternative 3:
  - PAUs proposed for burning and scarifying have already been surveyed, no historic or pre-historic resources occur at those sites, therefore there would be no effect.
  - Rhizomatous grasses may affect riparian cultural plants and shrubs in the long-term on a few areas.

Cumulative Effects – All Alternatives

There would be no direct or indirect effects to historic properties or potential historic properties by any of the alternatives, therefore no cumulative effects to rock art, obsidian flakes, historic cans and bottles would occur.

The No Action Alternative does not pose any additional risk to cultural plants from treatment above baseline conditions. While some adverse effects on non-target vegetation are possible from treatments considered in the action alternatives, they are unlikely to be substantial because the extent and threats posed by treatment are generally very small and localized compared to the known range of cultural species. Project Design Features mitigate known risks and the monitoring and adaptive management plan would ensure uncertain risks are also mitigated. Invasive plant treatments within the range of cultural plants may occur on lands outside the National Forest. The amount of treatment and/or specific risks from such treatments is unknown. See the Basis for Cumulative Effects in section 3.1.3 for what is currently known to be occurring adjacent to the planning area.

Continued treatment and suppression of invasive plants would reduce competition for available resources and provide an opportunity for culturally important plants to develop and spread. While there may be short-term effects to culturally important plants, cumulative effects would be beneficial and restorative. The positive effects to native plants are discussed in more detail within Sections 3.3 and 3.4 - Treatment Effectiveness and Non-target Vegetation. Any additional activities occurring or proposed with the potential to affect culturally important plants were also considered for cumulative effects (Section 3.1.3). These activities include grazing, timber harvest, underburning, road obliteration or decommissioning, and watershed restoration. Each of these activities was analyzed separately for environmental effects. Each project has the potential for eliminating single plants or isolated pockets of culturally important plants, with a short-term and localized effect to populations. Grazing animals are likely to consume edible plants, especially in riparian areas on the Ochoco NF. It is possible to have both control of invasive plants and grazing occurring at the same time within cultural plant habitat. As most application methods target the invasive plant itself, the effects of the treatment would be negligible, as wiping and selective spot spraying would be the application method in riparian areas. The exception is broadcast spraying, of medusahead on the Grassland for example, where some amount of non-target vegetation may be weakened or killed, and may be preceded or followed by grazing. The amount of cultural plants in these medusahead areas is low, and the overall viability of habitat is

expected to increase. Multiple treatments may occur in the same year on the same site, especially for manual methods. Multiple herbicide entries would be used only to apply herbicide on missed plants. Roadsides are where this is the most likely to occur, as the seedbed is constantly disturbed.

Any ground disturbing activities associated with timber harvest, and watershed restoration is likely to destroy plants due to the nature of the activity. However, most culturally important plants in Central Oregon occur in riparian areas and scablands. Scablands are avoided by timber harvest, and generally do not carry fire due to lack of fuel continuity; and riparian areas are protected by PACFISH and INFISH standards, therefore cumulative effects from these activities are not anticipated. Occasionally, burning is done to purposely stimulate food-bearing plants such as huckleberries. Road obliterations and decommissioning would destroy plants that have encroached into the open roadbeds.

Projects that affect both riparian and scabland habitat are those related to off-highway vehicles. The Travel Management ROD of 2011 closed all cross-country off-road vehicle use except for designated routes (USDA Forest Service 2011c). Most of these routes follow existing roadbeds, where any damage to cultural plants has already occurred, causing no additional impacts. Closing the rest of the Forest area is beneficial to meadows, scablands, and riparian areas where OHV use was occurring. Other proposed projects include Ochoco Summit OHV Trails, and Lava Rocks OHV Trails. These projects are proposing new trail systems for jeeps, motorcycles, and ATVs, that would cross riparian areas, meadows, and scablands. Project design (bridges, trail hardening, etc) is expected to curtail most effects to cultural plant habitat, providing vehicles stay on designated routes. Dust may be an impact to cultural plants along the trails, but due to the narrow linear nature of trails, the overall cumulative impact of acres affected is very low.

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 and 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 (LRMP) 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. (USDA Forest Service 1995d)

The Forest Service implementing regulations also establish a variety of Scenic Quality Standards for scenic views allocation areas (Deschutes LRMP refers to Visual Management System; Ochoco LRMP refers to Visual Quality Objectives). These include:

Scenic integrity measures the degree of valued landscape character expressed or reduced as a:

- Natural-appearing landscape unaltered by human activity with a very high scenic integrity level (Preservation);
- 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, USDA Forest Service 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 (Powers 2006). 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).

Most invasive species infestations occur on roads with a Visual Quality Objective (VQO) of partial retention and modification. The tables below show visual corridors that have a VQO of preservation, retention, and partial retention. The Summit Trail on the Ochoco NF is a road system (2630 Road) that varies in VQO level from partial retention to very minor segments in preservation. In addition to these

minor segments of the Summit Trail, Wilderness Areas and Research Natural Areas have a VQO of preservation.

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; information is 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.

Table 110. Scenic corridors on the Deschutes National Forest with invasive plant infestations

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 111. Scenic corridors on the Ochoco National Forest with invasive plant infestations.

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 112. Scenic corridors on the Crooked River National Grassland with invasive plant infestations

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, and Highway 26 will continue to be treated. These sites have been controlled using herbicide since 1998. Treatments now result in a few plants pulled and left on side of the road or in the ditch, or scattered brown and dying plants on the road shoulders and ditches.

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 8-12% 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 in the long-term.

Effects to scenic resources would include changing the landscape character in many areas to a homogeneous species composition in grassland areas and in the forest understory that is inconsistent with the valued landscape character. Examples include medusahead rye, an annual grass that is becoming the dominant plant on areas of the Crooked River National Grassland, and ribbongrass lining the banks of the Metolius River. Reduced native plant species diversity affect the overall ecosystem, eventually displacing wildlife and invertabrates which may also affect the overall recreation experience.

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 forbs and grasses, 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 a period of each growing season. Shrubs sprayed with herbicide may display brown leaves longer than one growing season. Manual treatment often leaves plants and plant parts lying on the ground after pulling and grubbing has taken place. If control efforts occur during the flowering period, the plants are bagged and taken out of the visual corridor. Otherwise, it usually takes a couple months to one season for plant decomposition.

Of those areas with a VQO of preservation, manual methods are proposed within Black Canyon and Mill Creek Wilderness Areas, and The Island Research Natural Area (see Section 3.14). Visitors may notice soil disturbance from pulling and grubbing efforts, and plants lying on the ground near the trail. These areas, at the present time, are very small (< one-tenth of an acre), and scattered, and are not expected to last over a few months, until plants decompose and rains compact the soil disturbance. Manual treatment is less effective than herbicide, so these treatments would occur, and may be noticeable each year. Herbicide control of houndstongue, knapweed and medusahead is proposed in the Ochoco Divide Research Natural Area. This proposal is consistent with RNA direction (see Section 3.14). The PNW Research Station's RNA Coordinator would assist in developing treatment prescriptions and tactics for infestations within RNAs (see PDF 6.1 and Appendix F). Visitors to parts of the RNA may observe dying and dead invasive plants, especially along the road system that bisects the RNA. In addition, temporary signs would be posted to inform the public that herbicide treatment has taken place. Sign placement would be short-term (< 2 months); then they would be removed.

Biocontrol measures would not be noticeable to the casual forest visitor. It is a long term method of treatment that does not eradicate the invasive plant, but instead keeps the population in check so that native species can compete. Some agents such as the toadflax stem weevil has had results within 2-3 years in Central Oregon, while the knapweed flower weevils have taken over 15 years to suppress populations. 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.

Invasive plant treatment would not adversely impact scenic quality. Most of the treatment areas on the Deschutes/Ochoco NF and Grassland are along roadsides and in recreation sites. Therefore, the existing scenic condition for most of the treatment areas is of a developed setting in the immediate foreground. Short-term browning and dying scattered vegetation would quickly blend in with the colors of the dirt road shoulders. Treatments would maintain the scenic integrity of these areas by helping to restore native vegetation and are consistent with visual quality objectives associated with undeveloped areas. 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 (< 1 season), 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. Some forest visitors may object to using areas where chemicals have been used, and may feel they must go elsewhere to avoid chemicals in their favorite recreation spots. These effects are temporary. New herbicides proposed for use, such as sulfometuron methyl, have a broader effective application period compared to herbicides used under Alternative 1. This allows treatments to occur both early and late in the year, avoiding peak recreation periods which limits the potential for exposure. For example, medusahead can be controlled late in the fall with a residual herbicide such as sulfometuron methyl. Controlling this plant in the fall would avoid brown dead vegetation during the growing season.

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 through worker intrusion, than other effects. To lessen that potential, 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 most recreationists. PDFs 32 and 35 require limiting the number of entries into recreation areas and avoiding peak user periods when possible. 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. Potential for exposure to herbicides by the public is analyzed in the 3.8.2 Human Health Section, and SERA Risk Assessments (2001 through 2011b).

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. Spot spraying of small infestations within recreation areas and scenic corridors is the primary treatment scenario. Spot spraying allows the applicator the ability to selectively apply herbicides to invasive plants; recreationists would see individual weeds or groups of weeds dying and turning brown. This is a short-term impact (< 1 growing season), and not all recreation or scenic areas would be sprayed in any given year. Effects to VQOs are the same as under Alternative 2.

Where more long-term visual degradation from control measures is a concern, for example tarping – where all vegetation is killed in a unnatural square pattern, revegetation with native plants should occur within six months following treatment. In some areas such as along the Metolius River, fishing and recreating public may 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. Weed-whacking the ribbongrass and reed canarygrass clumps prior to herbicide application would reduce the height of the vegetation, this along with PDFs 26, 31-35 provide further protection. Potential for exposure to herbicides by the public is analyzed in the 3.8.2 Human Health Section, pages 333-338.

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.

3.13.3 Potential Wilderness Areas / Roadless, Undeveloped Characteristics – All Alternatives

Introduction

This section of the FSEIS discloses the affected environment and environmental consequences for inventoried roadless areas (IRA), potential wilderness areas (PWAs), and other remaining unroaded/undeveloped areas. These three resource topics are grouped and discussed together because they share a complicated set of terminology and interrelated history. A wide range of terms have been used by Agencies and the public when referring to these topics such as roadless, unroaded, uninventoried roadless, undeveloped areas, and roadless expanse. The terms and definitions used in this

analysis for the three resource topics are based on current law, regulation, agency policy, and the Forest LRMPs as amended.

Proposed treatments within designated wilderness areas are analyzed in Section 3.14.1 of the FSEIS.

Potential Wilderness Areas (PWA): Areas of potential wilderness identified using inventory procedures found in Forest Service Handbook (FSH) 1909.12 Chapter 71 are called potential wilderness areas. The inventory is conducted with the express purpose of identifying all lands that meet the criteria for being evaluated for wilderness suitability.

Potential wilderness areas are not a land designation decision, they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Chapter 72), and lastly they are not preliminary administrative recommendations for wilderness designation (Chapter 73).

Typically, PWAs substantially overlap, and/or are contiguous with inventoried roadless areas and PWAs may be contiguous with wilderness. Some newly inventoried PWAs may be stand-alone areas that were not identified as 'roadless areas' in Appendix C of the 1989 Ochoco Forest Plan and 'inventoried roadless areas' as identified in a set of maps in the 2001 Roadless Area Conservation Rule (RACR). PWAs overlap inventoried roadless areas only where those acres of land are consistent with the inventory criteria (FSH 1909.12 Chapter 71) and may extend beyond IRA boundaries consistent with inventory criteria.

Inventoried Roadless Areas (IRA): These areas were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas. Most IRA boundaries are substantially identical to those identified as 'Roadless Areas', referred to in the 1982 planning rule (36 CFR 219.17) however some localized, minor differences in boundaries may exist. Proposed treatments within IRAs are analyzed in Section 3.14.6 of the FSEIS.

Other Unroaded/Undeveloped Lands: These areas of land should have limited amounts of management disturbance (e.g., no modern history of harvest activity; do not contain forest roads); and are not classified as a wilderness area, potential wilderness areas, or IRA.

Affected Environment

The project area was analyzed to identify areas that may meet the criteria for potential wilderness or may meet roadless characteristics that overlap with proposed invasive plant treatments. Only those areas where invasive plant treatments occur within an area away from roads were analyzed. Treatments that are proposed along roads, even those adjacent to IRAs or Wilderness, were not analyzed because they would occur within the road prism. The identification process was conducted through a sequence of GIS analyses and application of professional judgment. The PWA analysis followed the direction contained in FSH 1909.12, Chapter 71- Identification of Potential Wilderness. Specifically, the following criteria were used:

- Area is at least 5,000 acres, or
    - Area can be preserved due to physical terrain and natural conditions
    - Area is contiguous to existing wilderness, IRA, primitive area, etc., regardless of its size

- Area does not contain forest roads or other permanent authorized roads
- Stumps and skid trail or roads are substantially unrecognizable

In addition, National Grasslands may contain developments:

- Structures or evidence of vegetative manipulation resulting from past management practices in National Grasslands and Prairies. National Grassland and Prairie areas that contain the following features may qualify for the inventory:
    - Areas where vegetation type conversions are reverting to native vegetation with minimal evidence of cultivation.
    - Areas with less than one mile of interior fence per section.

The roadless/undeveloped characteristics analysis used the criteria contained in the Roadless Rule 294.11 "Roadless Area Characteristics". Specifically:

- **High quality or undisturbed soil, water, and air:** These three key resources are the foundation upon which other resource values and outputs depend. Healthy watersheds catch, store, and safely release water over time, protecting downstream communities from flooding; providing clean water for domestic, agricultural, and industrial uses; helping maintain abundant and healthy fish and wildlife populations; and are the basis for many forms of outdoor recreation.
- **Sources of public drinking water:** National Forest System lands contain watersheds that are important sources of public drinking water. Maintaining these areas in a relatively undisturbed condition saves downstream communities millions of dollars in water filtration costs.
- **Diversity of plant and animal communities:** Roadless areas are more likely than roaded areas to support greater ecosystem health, including the diversity of native and desired non-native plant and animal communities due to the absence of disturbances caused by roads and accompanying activities. Inventoried roadless areas also conserve native biodiversity by serving as a bulwark against the spread of non-native invasive species. Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: roadless areas function as biological strongholds and refuges for many species.
- **Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land:** Roadless areas function as biological strongholds and refuges for many species. Roadless areas support a diversity of aquatic habtiats and communities.
- **Primitive, Semi-Primitive Non- Motorized, and Semi-Primitive Motorized classes of dispersed recreation opportunities:** Roadless areas often provide outstanding dispersed recreation opportunities such as hiking, camping, hunting, fishing, nordic skiing and canoeing. While they may have many wilderness-like attributes, unlike Wilderness, mountain bikes and other mechanized uses are often allowed.
- **Reference landscapes:** Knowledge about the effects of management activities over long periods of time and on large landscapes is very limited. Reference landscapes of relatively undisturbed areas serve as a barometer to measure the effects of development on other parts of the landscape.
- **Natural appearing landscapes with high scenic quality:** High quality scenery, especially scenery with natural-appearing landscapes, is a primary reason that people choose to recreate.
- **Traditional cultural properties and sacred sites:** Traditional cultural properties are places, sites, structures, art or objects that played an important role in the cultural history of a group.

Sacred sites are places with special religious significance to a group. Traditional cultural properties and sacred sites may be eligible for protection under the National Historic Preservation Act. However, many of them have not yet been inventoried, especially those that occur in inventoried roadless areas.

- **Other locally identified unique characteristics:** Roadless areas may offer other locally identified unique characteristics and values. Examples include uncommon geological formations, valued for their scientific and scenic qualities, or unique wetland complexes.

Twenty areas (called 'blocks') were identified within the planning area near proposed invasive plant Project Area Units (PAUs) as candidate areas to be analyzed. These blocks range in size from 45 acres to 1,900 acres. The ID team analyzed the twenty blocks against the criteria above, and the results are summarized below.

For more information, see the report titled "Potential Wilderness Areas (PWA)/Roadless, Undeveloped Characteristics", located in the Invasive Plant Treatments project file on the Ochoco National Forest, Prineville, OR.

Table 113. Proposed invasive plant treatments away from roads, that may have Potential Wilderness Area or Unroaded/Undeveloped attributes

Area Name	Acres	Location
Buck Butte	235	Crooked River National Grassland
Rimrock	264	Crooked River National Grassland
Scales Corral	307	Crooked River National Grassland
North Grizzly	396	Crooked River National Grassland
South Grizzly	852	Crooked River National Grassland
Wychus	665	Crooked River National Grassland
Blaster	65	Lookout Mtn. RD, Ochoco National Forest
Maury	736	Lookout Mtn. RD, Ochoco National Forest
Burnt Corral Spring	120	Paulina RD, Ochoco National Forest
Burnt Corral Creek	96	Paulina RD, Ochoco National Forest
Indian Creek	162	Paulina RD, Ochoco National Forest
Roba Creek	45	Paulina RD, Ochoco National Forest
Fly Creek	159	Sisters RD, Deschutes National Forest
Little Montana	392	Sisters RD, Deschutes National Forest
Glaze Meadow	285	Sisters RD, Deschutes National Forest
Sisters Dump	523	Sisters RD, Deschutes National Forest
Sparks Lake	528	Bend/Ft. Rock RD, Deschutes National Forest
Deer Run	945	Bend/Ft. Rock RD, Deschutes National Forest
Cardinal Bridge	48	Bend/Ft. Rock RD, Deschutes National Forest
Big Marsh	1900	Crescent RD, Deschutes National Forest

Environmental Consequences

Direct and Indirect Effects – All Alternatives

Areas (blocks) that meet any of the above criteria, and overlap with proposed invasive plant treatments were identified, and are listed in the table above. Only those that do not occur along roadsides were considered in the analysis. None of the Alternatives propose invasive plant treatments that cut trees, build roads or trails, or add developments. Future EDRR treatments would not affect and PWA or IRA because no tree cutting, road/trails or developments are not being proposed in this project.

Five of the blocks overlap with control efforts authorized in the Ochoco and Deschutes NFs 1998 Noxious Weed Control EAs: Wychus, Grizzly North, Grizzly South, Little Montana, and Sisters Dump. These were authorized for manual and fire treatments in 1998, and are proposed for more effective herbicide control in Alternatives 2 and 3. It is expected that all blocks would also have continued expansion of invasive plant infestations. See Section 3.3 Treatment Effectiveness for an in-depth discussion of invasive plant spread under Alternative 1. Invasive plant populations in and of themselves would not have a bearing on whether land could be designated as wilderness or roadless, however invasive plants can change the characteristics and attributes of the areas. For example characteristics such as high quality soil, diversity of plant and animal communities, habitat for TES, and natural appearing landscapes with high scenic quality can all be affected by invasive plants.

Proposed treatments in Alternatives 2 and 3 are similar except for herbicide application method and distance to water. Alternative 3 would affect the Little Montana, Sparks Lake, Cardinal Bridge, and Fly Creek blocks, as no herbicide would be allowed within 10’ of water. The other blocks are either away from water, or propose manual and cultural treatment, and are therefore the same between alternatives.

Crooked River National Grassland Summary

None of the blocks meet PWA criteria or Unroaded/Undeveloped attributes because the area’s physical terrain and vegetation allows for easy access, and old road prisms are readily recognizable. The proposed project area unit (PAU) on Wychus Creek is contained within the Deschutes/Steelhead Inventoried Roadless Area, which was designated as such before the Forest Plan. The Forest Plan allows road construction within the area where invasive plant treatments are proposed. This area actually has many roads within the IRA and was farmed at one time. The PAU includes the canyon, a small and isolated part of the IRA. Proposed herbicide and manual treatments would not alter the character of any of the above areas. No roads are being built, no trees are being cut, no developments are proposed; activities would be short-term, and the character of the area will not be affected.

Ochoco National Forest Summary

None of the blocks meet the PWA criteria or Unroaded/Undeveloped attributes because the area’s physical terrain and vegetation allows for easy access, and old road prisms and other forest activities are readily recognizable. Proposed herbicide and manual treatments would not alter the character of any of the above areas. No roads are being built, no trees are being cut, no developments proposed; activities would be short-term, and the character of the area would not be affected.

Deschutes National Forest Summary

The area south of FS 60 road (Big Marsh block) may have potential wilderness quality because it is within the Oregon Cascades Recreation Area, which abuts the Mt. Thielsen Wilderness Area. Although there are primitive roads running along side the marsh, these could be decommissioned, making the size and character of the area feasible for an extension of the Mt. Thielsen Wilderness Area. Proposed cultural treatments of reed canarygrass would have a short-term effect on the scenic quality of the area

while plastic is down suppressing vegetation. Proposed revegetation using native vegetation (seeding and plugs) would help the area recover quickly, especially in these moist habitats. There would be a long-term benefit to the wilderness quality by restoring native plant communities. None of the proposed invasive plant treatments would alter or jeopardize the character of the area.

All other blocks do not meet PWA criteria or Unroaded/Undeveloped attributes because the area's physical terrain and vegetation allows for easy access, and old road prisms are readily recognizable. Sparks Lake, although surrounded by Wilderness, RNA and Roadless, has been developed for recreation opportunities, and designated as Intensive Recreation in the LRMP. It is a very popular lake with a paved road, campground, and trailhead. Proposed herbicide and manual treatments would not alter the character of any of the above areas. Disturbance may occur to recreationists during treatments, and visitors may see dead vegetation for one growing season. No roads are being built, no trees are being cut, and no developments proposed; activities would be short-term, and the character of the area will not be permanently altered or affected.

Cumulative Effects - All Alternatives

The overall impact of this project on recreation and scenic resources is beneficial. Effects to invasive plants on wildlife, fish, and native plants are discussed throughout Chapter 3. Impacts to these resources ultimately effects the scenic beauty and recreation opportunities on public lands. As explained above the effects of the proposed invasive plant treatments on recreation and scenic resources, are considered to be limited, localized, and short-term, there is very low chance the effects would accumulate with effects brought on by past and future activities such as timber harvest and grazing, as these are not activities that generally occur in areas visited by most members of the public.

Current and proposed treatments of weed infestations are generally very small (less than one acre, and in most cases less than 0.1 acre) with patches widely dispersed across the landscape. Seventy percent of the treatment areas are along major road corridors, which further limit the scenic and recreation impact on the forest user. Repeated treatments would occur at different times and would be unlikely to affect the same individual, but would increase the overall potential for worker/visitor overlap. Duration of herbicide treatments would be less than manual efforts. If repeated herbicide treatments are necessary it is usually a result of missed plants during the first herbicide application and herbicide label rates would not be exceeded, or result in a cumulative effect.

Forseeable actions such as proposed OHV trail designation projects (Ochoco Summit and Lava Rock) have the potential to introduce invasive plants by bringing seeds and plant parts in on dirty vehicles. Under Alternative 1, herbicide control of new infestations would not be feasible on most of the proposed trails. Herbicide is the most economical and efficient way to control populations (see Section 3.3), and therefore it is expected that invasive plants would continue to expand under this alternative, affecting the recreation experience, and further spreading invasive plants to new areas. Alternatives 2 and 3 incorporate a rapid response strategy to be able to control new infestations along trails and staging areas without having to wait years for new NEPA analysis. This is expected to benefit all resources and habitats, ultimately improving the recreation and scenic opportunities on the Forests and Grassland. The basis for cumulative effects regarding herbicide use in surrounding areas is discussed in section 3.1.3, and cumulative effects to humans are analyzed in section 3.8.

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. Natural vectors include wind, water, wildlife, and wild horses. Invasive plants adversely affect wilderness values because they disrupt natural processes.

According to the R6 2005 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 (USDA Forest Service 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 114).

Table 114. 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, houndstongue	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 areas included in these sites are already being treated with herbicides under the 1998 Deschutes NF Noxious Weed Control EA. Monitoring shows that weed density has decreased, for example Highway 242 has a few plants that are now occasionally handpulled (FACTS database).

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 any treatment of sites within the Wilderness Areas listed in Table 114 above; and it would also 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. On-going herbicide treatments near the Wilderness, such as along Cascade Lakes Highway, have 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. There are known sites of medusahead adjacent along the South Fork Road, and also in the Murderer's Creek drainage on BLM land. These infestations have been treated with a variety of methods for many years. 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 114); 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. An analysis according to Section 18 of the 1909.15 Forest Service NEPA Handbook would be warranted if the treatment prescription was not similar to any analyzed in this FSEIS, and additional NEPA may be required.

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. 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 and houndstongue within Project Area Unit 71-57 in the Mill Creek Wilderness. The proposed manual treatment would help reduce the spread of knapweed by cattle by removing the plants before seed development. Other management activities within wilderness areas are limited, and include things like trail maintenance, weed inventory, and stream inventories.

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. There are no other actions proposed or occurring in wilderness.

3.14.2 Oregon Cascades Recreation Area – Deschutes National Forest

Affected Environment

The goal 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" (USDA Forest Service 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. Grazing was terminated in the 1990s, and has not been grazed since. This grass is spread throughout the marsh; spotted and diffuse knapweeds, Canada thistle, and bull thistle also occur within this project unit (16.6 acres) 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 Action 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. The primary treatments would 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 (less than 5 years) effects to the recreation experience in Big Marsh will be visual impact of plastic covering on patches of reed canarygrass (see also section 3.14.3 below). 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. See section 3.1.3 in this Chapter for a thorough discussion of cumulative effects. There are no other projects that overlap proposed invasive treatments in the Big Marsh area.

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 condition and water

quality 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 115. For rivers found to be eligible for inclusion in the national system of wild and scentic rivers (Table 115), management must ensure that those values for which the river is found to be eligible (including free flowing condition and water quality) are maintained. Table 116 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 115. Outstandingly Remarkable Values (ORVs) for the Wild and Scenic Rivers on the Deschutes & Ochoco NFs and CRNG

ORV	Upper Deschutes	Crooked River	N. Fork Crooked	Metolius River	Whychus Creek	Little Deschutes	Crescent Creek	Big Marsh Creek
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			

* Historic and prehistoric values, and traditional uses

Table 116. 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, 11-68, 11-69, 11-70, 11-71	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
Crooked River	75-10	CEBI2, CEDI3, TACA8, ONAC	Chemical Chemical/manual	Quarry
North Fork Crooked River	71-08, 71-25, 71-75, 72-03,72-21, 72-67	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, IRPS CIAR4, PHARP	Chemical/manual/cultural Chemical/manual/biological Chemical/manual Manual Mechanical	Road Stream
Whychus Creek*	15-03	CEBI2, CEDI3	Manual	Road

River Segment	Project Area Units	Species	Treatment Methods	Site Types
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 Cultural	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

Environmental Consequences

Direct, Indirect, and Cumulative Effects

Effects of Alternative 1 - 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 recreation.

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). One example of where native vegetation along the riverbank is being displaced by invasive plants is ribbongrass along the Metolius River. The Water Resources section 3.6 states “There is potential for water quality to degrade as ribbongrass continues to create a monoculture that replaces the diverse native riparian vegetation, and may change the form and function of the Metolius River. Island formation from colonization of

logs in the river, can influence the dynamics and morphology of the river." If left unchecked, these influences could affect the geology/hydrology ORV of the Metolius River in the long-term.

In addition, loss of species diversity and richness could have a direct effect on the vegetation and ecology ORVs of the Upper Deschutes, North Fork Crooked, Metolius, Little Deschutes, Crescent and Big Marsh Creeks. These creeks were designated as part of the wild and scenic river system based, in part, on their outstandingly remarkable ecological and vegetation values. The WSRA requires that management actions protect and enhance the free flowing condition, water quality, and outstandingly remarkable values, of designated rivers. Controlling invasive introduced species would promote the protection and enhancement of native plant populations that contribute to these ORVs.

The Upper Deschutes and Metolius Rivers have outstandingly remarkable fisheries and fish habitat. 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 condition of the Forests and Grassland wild and scenic rivers may be at risk from several invasive plant species listed in Table 116, 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 one acre each, and occur along roadways and rock pits, treatment of which would not affect ORVs within the wild and scenic river corridors. The exception is the invasive emergent grass infestations described above, affecting the Upper Deschutes (2 acres), Metolius (one acre scattered within 119 ac.), and Big Marsh Creek (3 acres) wild and scenic rivers. This grass is also found on 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. Solarization techniques (in Big Marsh for example) would have a longer term effect on scenery, as plastic tarps laid over the reed canarygrass would stay on for several years,

after which time native plants would be planted. The overall timeframe for visual effects of this treatment is expected to be 3-4 years before native vegetation is established.

Controlling invasive plants in these corridors would be beneficial to native vegetation, and would have negligible effects to other outstandingly remarkable values (see 3.4 Non-Target Vegetation, 3.6 Water Resources; 3.7 Fisheries and Aquatic Oganisims). 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-flowing condition or water quality 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, Table 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. Alternative 3 would not allow herbicides to control emergent vegetation (reed canarygrass, ribbongrass, and yellow-flag iris) along the perennial streams listed in Table 116. Manual control of these rhizomatous species is difficult and is not as effective as herbicide. It is estimated that in the long-term (20 to 50 yrs) monocultures may form along the banks and islands of wild and scenic rivers, changing the hydrology, shifting towards multiple braided channels, and increasing the number of islands present (see Alternative 3 in the Water Resources Section 3.6). In turn, this may have a long-term effect on the ORVs listed in Table 115.

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 (the lands ability to absorb alteration yet retain its visual integrity) of the wild and scenic river corridors is great enough to tolerate herbicide, manual and mechanical treatments.

Cumulative Effects

The treatment of invasive plants in all alternatives is consistent with wild and scenic river management plans and will not have an adverse effect on the area. 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-flowing nature of the rivers, and ORVs except scenery. There would be a minor short-term effect on scenery. The cumulative effects to water quality, scenery, fish and wildlife are discussed in detail in their sections; all which report little to no cumulative effects.

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.

There are other established and proposed RNAs on the two Forests, including Mokst Butte, Pringle Falls, Torrey-Charlton, Haystack Butte, Many Lakes, and Wechee Butte that currently do not have known invasive plant populations within or adjacent to the boundary. It is possible that these RNAs may have invasive plant infestation in the future that would be treated under EDRR.

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 117). In addition, there is multiple project area units listed in Table 117 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 117 also shows the native plant communities at risk to invasion by invasive species.

Table 117. Research Natural Areas with overlapping or adjacent project area units

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/needle grass
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 plant 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	71-16, 71-32	Road/ General	ARMI2, CEBI2, CYOF,	Chemical/manual	Grand fir Ponderosa pine

Research Natural Area	Project Area Units	Site Type	Species	Treatment Methods	Native Plant Communities Potentially at Risk
(established)		Forest	TACA8, COAR4		
Grassland Island RNA (established)	75-47	General Forest	TACA8	Manual	Sagebrush/steppe

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 117 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 71-32) 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 crosses the southeast corner of 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. A total of 21 acres is proposed for chemical control in both Alternatives. 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 (approximately 3.5 acres on NFS land). 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 containing the 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.

Early Detection Rapid Response

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 is no grazing or timber harvest within RNAs. Prescribed burning has occurred in the Metolius RNA since the 1980s with no resulting invasive plant sites. There are no proposed invasive plant treatments, and there are no effects to RNAs from other management activities on the Deschutes NF, and therefore no cumulative effects. On the Ochoco NF and CRNG, no management activities occur 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. The treatment of invasive plants in all alternatives is consistent with research natural area management plans.

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) (USDA Forest Service 1994b, p 1).

Affected Environment

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.

Table 118. 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

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. PAU 11-01 is the 18 Road, a major access road through the monument. There are small scattered knapweed populations that have been treated with herbicide since 1998. These populations have declined, but new species and new sites have been introduced. Alternatives 2 and 3 would continue treatment of these small infestations along the road shoulders. Bull thistle within the Project Area Units will receive manual and mechanical treatment methods, as this species is a biennial and is easy to control. The reed canarygrass in PAU 11-33 would be cut back with a gas-powered trimmer (weed-wacker) and then herbicide would be applied by hand in Alternative 2. Cutting back the foliage reduces the amount of herbicide required to kill the plants. There would be short-term (< 1 year) browning of plants as they die, and signs of revegetation with native

plants. Treatment would occur in the fall after the peak tourist season as required by PDF 32 to reduce disruption to visitors. Herbicide treatment of reed canarygrass under Alternative 3 would not occur; control would be done by manual or cultural methods such as covering the plants with tarps. The duration of effects would be longer in this Alternative. Manual control is not as effective on this rhizomatous plant, therefore would require years of digging the plants out of the bank, causing some amount of siltation in the water (see a complete discussion in the soil and water sections). Tarps need to remain on the site several years to successfully kill the plants.

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. Herbicide use is compatible with the management plan, which states "*Take action to eliminate or control existing populations of undesirable exotic plant species within the Monument. Where feasible and effective, choose methods that mimic natural processes (such as prescribed fire). Other treatments that may be used where appropriate include mechanical and herbicide treatments. Establish priorities for treatment based on rate of spread, threats to native populations, etc"* (USDA Forest Service 1994b p.35).

Cumulative Effects

The treatment of invasive plants in all alternatives is consistent with volcanic monument area management plans. Other activities occur within the Monument, including timber harvest, prescribed burning, firewood collection and recreation. Invasive plant treatments along the major roadways through the Monument are not expected to overlap in time or spatial area for an additive effect as treatment consists of spot spraying individual plants along road shoulders, expected timeframe is one to two days annually. The reed canarygrass treatment would not overlap other management activities because they would not occur on the shoreline of Paulina Lake. Recreation use would overlap with reed canarygrass treatment. Recreation pressure near the sites at the boat launch and near the resort would continue during treatment, although after the peak season is over. The effect is expected to be minimal under both Alternatives 2 and 3 with minor amounts of sediment resulting from either manual efforts on the shoreline or bare areas until native vegetation is restored.

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. Also see Section 3.13.3 Recreation and Scenery for a discussion on potential wilderness, roadless/undeveloped characteristics.

Affected Environment

There are approximately 198,000 acres of IRA across the Deschutes and Ochoco NFs and Grassland, of which 8,000 acres are administered by the Malheur National Forest (and is not part of the project area). The breakdown of acres for the two Forests is 137,000 acres on the Deschutes NF and 53,000 acres on the Ochoco NF and Grassland. The majority of PAUs listed in the table below are along major access routes that bisect the roadless areas.

Environmental Consequences

Effects of No Action

Invasive plants are known to occur in several IRAs (Table 119). Some sites were addressed in the 1998 Noxious Weed EAs, including 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. 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 119. Where not already covered, or without effective treatment, these sites are likely to expand 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 7 meters in a single season (Mazzu 2005); where these canes root new daughter plants can develop. Without treatment it could spread rapidly.

Table 119. Project Area Units that overlap or are adjacent to Inventoried Roadless Areas

Inventoried Roadless Area	Project Area Units	Project Area Unit Description	Treatment Methods*
Bearwallows	15-03, 15-13	Road plus adjacent disturbed area; spotted and diffuse knapweed spreading along road.	Manual
Bend Watershed	11-06,11-07, 11-17	Knapweed, Canada thistle and 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; tansy ragwort and bull thistle	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, 15-14, 15-17	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	11-33, 11-38,11-43	Canada thistle at ponds created by geothermal test drilling.	Chemical, manual
Deschutes/Steelhead Canyon	75-43, 75-56, 75-42	Road, General Forest, Stream. Large knapweed & medusahead sites.	Chemical, manual
Green Mountain	71-48	Eleven species on primary access route to the west end of the district.	Chemical, manual, biological
Lookout Mountain	71-18, 71-39	Spotted knapweed, diffuse knapweed, yellow toadflax, and med sage along the 42 Road. Spotted knapweed on the 42-173 and 42-152 roads	Chemical, manual
Rock Creek	72-49, 72-70	Diffuse knapweed on major access road and within material source.	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.

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. Manual methods are used where allowed, but depending on the species, is often not effective due to the rhizomatous nature of the root system (Russian knapweed, Dalmatian toadflax, reed canarygrass, etc). 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 second choice herbicide 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 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 1,100 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.

The material source within the Rock Creek IRA, along road 38, is currently designated open for OHV use in the 2011 Motor Vehicle Use Map. The knapweed population has been reduced down to a few plants germinating every year by herbicide control approved by the 1998 Ochoco NF Noxious Weed EA. Designating OHV use in this material source may increase use, which in turn is expected disturb the seedbank causing increased germination of knapweed seed. This may increase the amount of herbicide used at this site in the long-term (> 5 years).

Prescribed burning, approximately 16,000 acres, is planned in the Lookout Mountain Roadless Area on the Lookout Mountain Ranger District in the near future. Burning has the potential to create bare soil, which can be colonized by invasive plants. There are few known invasive plant sites within this IRA, which decreases the risk of introduction of weeds to exposed soil. Two small infestations occur on the north side of Lookout Mountain, lesser burdock (0.1 acres) and yellow toadflax (less than 0.25 acre). Design Features would be implemented at the project level during planning that would prevent burning conditions and techniques from promoting the spread of these two populations, which would not cause a cumulative effect for treatment. For example, the South Bend and Canyon Fuels Projects flagged known weed sites and did not allow operations within the area (see Appendix G for more details of site-specific prevention examples used on the Forests).

3.14.7 Experimental Forest

The Pringle Falls Experimental Forest is diverse field laboratory within the Deschutes National Forest. It was the first experimental forest to be established in the Pacific Northwest in 1931 as center for silviculture forest management and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range.

Affected Environment

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.

Environmental Consequences - No Action and Alternatives 2 and 3

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). The entire Project Area Unit (Road 43) is 219 acres with 1.6 acres currently occupied by invasive plants. The portion of the PAU that occurs within the Experimental Forest boundary equals about 121 acres. 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.

Cumulative Effects

The EXF Vegetation Management Project (Bend/Ft. Rock Ranger District) within the Lookout Mountain block of the Experimental Forest is currently being implemented. The project proposes roughly 2,500 acres of commercial timber thinning, mowing and underburning. The activities in the Lookout Mountain block do not overlap with Burgess Road (PAU 11-11); therefore there are no cumulative effects. Timber haul occurred during the Extra Timber Sale on Burgess Road and haul may also occur with the Bind Timber Sale. This increased traffic may contribute to the risk of additional invasive plant introduction, or spread existing infestations. Alternatives 2 and 3 would control any increase in infestations. Herbicide treatment of some species is also occurring along Burgess Road under Alternative 1.

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 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.

Wilderness:
Alternative 1 – There is no current herbicide use in wilderness. This alternative has the greatest risk of introduction and spread of invasives into wilderness areas.

Alternatives 2 and 3 - Herbicide use is not proposed within wilderness. This alternative would control invasives at trailheads and surrounding areas using all treatment methods, providing the most effective means to avoid spread into wilderness.

Oregon Cascades Recreation Area:
Alternative 1 - Reed canarygrass and other species would continue to spread within Big Marsh, and this Alternative poses the greatest threat to the goals established for the area, and its unique values.

Alternatives 2 and 3 - Cultural and manual methods are prescribed to treat invasive plants, having short-term effects to the recreation experience from reed canarygrass solarization control techniques and resulting dead patches of vegetation.

Wild and Scenic Rivers:
Alternative 1 - This alternative has the greatest long-term risk of affecting the Outstanding and Remarkable Values (ORV) for all Wild and Scenic Rivers in the project area, from continued spread of invasive plants.

Alternative 2 - Herbicide treatments would have short-term effects to the scenery ORVs. The alternative has the most long-term benefit to native plant communities and associated ORVs.

Alternative 3 - This alternative has slightly less long-term benefit due to the restriction of less effective treatment methods within 10 feet of Wild and Scenic Rivers.

Research Natural Areas:
Alternative 1 - Invasive plants would continue to spread within the Ochoco Divide & The Island RNAs, despite on-going manual treatment

Alternatives 2 and 3 - Herbicide use is proposed within one RNA - Ochoco Divide. There would be minor, short-term effects to native vegetation from herbicide use. The greatest long-term benefit to

maintaining natural conditions within RNAs is by controlling weeds on adjacent roads, and by implementing EDRR.

Newberry National Volcanic Monument:
Alternative 1 - Herbicide treatment along Highway 97 would continue. Other invasive plant sites, including reed canarygrass on Paulina Lake, would continue to spread throughout the lake shoreline in the Monument.

Alternatives 2 and 3 - Herbicide use proposed along major access roads to the Monument, and the sno-park, would have short-term visual effects. Chemical, cultural, and manual methods are proposed for reed canarygrass at Paulina Lake. This provides flexibility of site-specific methods for different patches of the grass. Small patches could be covered with fabric (solarization); this would have a somewhat longer visual effect than chemical or manual removal. The fabric needs to stay on the ground for several years to completely kill the vegetation below. Revegetation with natives would most likely be needed in this situation. Chemical treatment using wiping would have a short-term impact to visuals.

Inventoried Roadless Areas:
Alternative 1 - Current herbicide treatment would continue on roads adjacent to 5 Roadless Areas. Continued spread of invasives adjacent to and within all 13 IRAs

Alternative 2 - PDFs minimize or eliminate short-term effects to native vegetation from herbicide treatments. Highest protection to native plant habitats.

Alternative 3 - Control of reed canarygrass at Lava Lake would be less effective due to 10-foot no herbicide buffer. Somewhat less effective control of Himalayan blackberry due to second-choice herbicide.

Experimental Forest:
Alternative 1 - Does not allow treatment of site 1-11, so is the highest risk for spread of knapweed and toadflax into Pringle Falls Experimental Forest

Alternatives 2 and 3 - Allows roadside herbicide treatment of site 1-11 and EDRR to prevent sprea

3.15 Forest Plan Amendments

Alternatives 2 and 3 in this Final SEIS 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.[20] 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 (USDA Forest Service 2005b). The proposed changes are described on pages 18-21. 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.

This plan amendment is being prepared under the 2000 rule as amended with transition wording at 36 CFR 219.35 that allows the use of the 1982 rule procedures. (See 65 FR 67568, Nov. 9, 2000, as amended at 66 FR 1865, Jan. 10, 2001; 66 FR 27554, May 17, 2001; 67 FR 35434, May 20, 2002; 68 FR 53297, Sept. 10, 2003; 69 FR 58057, Sept. 29, 2004). The 1982 rule and the 2000 rule as amended are available online at http://www.fs.fed.us/emc/nfma/2000_planning_rule.html.

[20] 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).

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 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 (USDA Forest Service 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.

3.16 Other Disclosures

Federal Water Pollution Control Act Amendments of 1972

(Pub.L. 92-500, 86 Stat. 816, 33 U.S.C. 1251). This Act revises and reenacts previous Federal Water Pollution Control Acts of 1970, 1965, 1956, and 1948. The objective is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Current goals include eliminating pollutant discharges into waters of the United States and providing surface water suitable for uses.

The act charges each State with primary responsibility for point source (section 402) and nonpoint source (section 208) pollution control. It specifies that effluent limits be set for point source discharges and that nonpoint sources of pollution be identified as appropriate and procedures be set forth to control them to the extent feasible.

Section 404 of this act provides for a permit program to regulate discharge from dredge and fill activities. This is administered by the Corps of Engineers. Portions of this regulatory program may be delegated to States.

Section 313 requires Federal agencies to comply with State and local requirements related to control and allotment of pollution to the extent that any person is subjected to such requirements.

Clean Water Act of 1977

(33 U.S.C. 1251, 1254, 1323, 1324, 1329, 1342, 1344; 91 Stat. 1566). This act amends the Federal Water Pollution Control Act of 1972. Section 313 is strengthened to stress Federal agency compliance with Federal, State and local substantive and procedural requirements related to the control and abatement of pollution to the same extent as required of nongovernmental entities.

Activities that may be exempt from 404 permits or that are covered under the general permit are identified. These include normal silviculture, forest roads using best management practices, and streambank erosion control.

Section 404t was added to reinforce the States role in controlling discharge of dredge and fill material in navigable waters under their jurisdiction, including any Federal activity.

Additional Congressional Action, Guidance, and Impacts of Recent Court Rulings

On January 9, 2012, Forest Service national guidance was issued regarding point source discharges from pesticide applications. Due to a recent court decision, the Forest Service must meet new requirements under the Clean Water Act. Point source discharges from pesticide applications to “waters of the United States” whether intentional or inadvertent, are now required to have permit coverage under the National Pollutant Discharge Elimination System (NPDES). NPDES requirements for pesticide applications are not uniform nationwide. The State of Oregon is authorized to issue NPDES permits for pesticide applications and the Deschutes and Ochoco National Forest and Crooked River National Grassland personnel will obtain the necessary permits to implement pesticide applications consistent with national and regional direction.

However, in December of 2011, Congress subsequently exempted pest control operations from CWA permitting requirements until September 30, 2012, by including in the Consolidated Appropriations Act of 2012 a provision that states: SEC. 429. From the date of enactment of this Act until September 30, 2012, the Administrator of the Environmental Protection Agency shall not require a permit under section 402 of the Federal Water Pollution Control Act (33 U.S.C. 1342), nor shall the Administrator directly or indirectly require any State to require a permit, for discharges of stormwater runoff from roads, the construction, use, or maintenance of which are associated with silvicultural activities, or from other silvicultural activities involving nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, *pest* and fire control, harvesting operations, or surface drainage.

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

Civil rights legislations, especially the Civil Rights Act (CR) of 1964, Title VI, prohibits discrimination in Forest Service program delivery. The underlying principal behind the Civil Rights Act is that no activity shall negatively affect minorities, woman, or persons with disabilities by virtue of their race, color, sex, national origin, religion, age, disability, or material or familial status. Executive Order 12898 (Environmental Justice), demands the fair treatment and meaningful involvement of all people. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from the execution of our actions.

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.

This project would not result in disparate or disproportionately effects, or too discriminate or negatively impact any individual or subset of the populations described above. This invasive plant treatment decision applies equally to all members of the public, and therefore is not discriminatory to any person or group.

In order to make the determination that a civil rights impact analysis and a statement of findings were not needed, we scoped with more than 700 individuals, organizations, tribes, and other agencies as part of the NEPA process. One organization suggested that implementation of this project may affect Hispanic forest workers and American Indians dispropotionately. The FSEIS discusses the potential impacts of this project on these groups (FSEIS Chapter 3.8). With the implementation of any of the alternatives, there is the potential for some impact to Hispanic, Asian, and American Indian communities. Tribal rights (ceded lands) and Tribal traditional uses were covered earlier in Chapter 3, and all of the alternatives would not have any measurable impacts on Tribal interest. The project is not located in a minority community nor would it affect residents of low or moderate income. Forestry workers, usually disproportionately Hispanic, will have more exposure to the proposed herbicides than the population at large. Also, harvesters of non-timber forest products tend to come from Asian, Hispanic, and American Indian communities. These groups could be exposed to herbicide treatments in areas available for picking or collecting their products. However, Implementation Planning (FSEIS 2.3), and the PDFs (FSEIS 2.4), particularly PDFs number 1, 6, and 9 through 41, eliminate any potential impact to human health.

The two Forests would continue to consult often with Oregon Tribal Governents for herbicide treatments within cultural plant collection areas as required by PDF 41.

In addition, the types of employment opportunities provided by the alternatives, including the No Action Alternative, from site restoration, manual treatment, etc., would have positive effects on the categories of individuals and population groups these laws and regulations are intended to protect.

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 (USDA Forest Service 2005b) and Project Design Features (Chapter 2 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 as amended, except where Forest Plan Amendments are described in Chapter 2 (Table 13). 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.

A determination of Likely to Adversely Effect in a Biological Assessment for fish species can be made while complying with management direction associated with the Aquatic Conservation Strategy and PACFISH/INFISH. A low risk of adverse impacts on protected fish species exists in the short term; risks will be minimized through PDFs and buffers. In the long term, this project will maintain and restore fish habitat.

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 2005 ROD.

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. 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.
- This project will maintain or restore aquatic and riparian habitats; long term beneficial impacts to these habitats outweigh the minimized risk of adverse effects at any one site, watershed or PAU. The PDFs and buffers eliminate adverse effect to the degree possible, and minimize risks that cannot be avoided.

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 FSEIS.

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 (Fults pers. comm. 2009). Because Alternatives 2 and 3 would comply with the Clean Water Act and State water quality standards for toxic substances, NWFP ACS objectives, PACFISH, and INFISH RMOs, this information is not essential to a reasoned choice among the alternatives.

The best available science is considered in preparation of this FSEIS. However, what constitutes best available science might vary over time and across scientific disciplines as new science is brought into play. We show consideration of the best available science when we insure the scientific integrity of the discussions and analyses in the project NEPA document. Specifically, this FSEIS and the accompanying project record identifies methods used, references reliable scientific sources, discusses responsible opposing views, and discloses incomplete or unavailable information, scientific uncertainty, and risk (See 40 CFR, 1502.9 (b), 1502.22, 1502.24). 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 2005 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 32, the Botany Report, and 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 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.

Formal consultation was conducted with USFWS for bull trout, and the designation of bull trout critical habitat. The Level I team was presented the proposed action and affected environment; conversations with the Level One Team has continued throughout the analysis stages. The USFWS Biological Opinion states: "…it is the Service's biological opinion that the action as proposed is not likely to jeopardize the continued existence of the Columbia River Basin DPS of bull trout or result in adverse modification of designated bull trout critical habitat."

Formal consultation was conducted with National Marine Fisheries Service on listed anadromous fish species and essential fish habitat that occur within or near the proposed invasive plant treatment areas. The NMFS biological opinion concludes: "that the proposed action is not likely to jeopardize the continued existence of Middle Columbia River steelhead, or result in the destruction or adverse modification of designated critical habitat for Middle Columbia River steelhead."

The consultation process with the USFWS and National Marine Fisheries on the FSEIS satisfies terms of the National Pollutent Discharge Elimination System permit.

The Forest Service will follow terms and conditions in both Biological Opinions to minimize "taking" of any threatened species. Table 120 includes specific actions required as a result of consultation that are **in addition** to the project design of this action (treatment caps, PDFs, prevention, monitoring, etc).

Table 120. Additional requirements as a result of consultation

Required Action	US Fish and Wildlife Service	National Marine Fisheries Service
Reporting prior to implementation	By April 1 of each year	By May 1 of each year (use electronic system, CIRS, when available)
EDRR reporting	By November 1 each year using Project Consistency Evaluation Forms (PCEF)	N/A
Post-application reporting	By January 31 each year using PCEF	By February 28 each year
Monitoring	By January 31 each year using PCEF	By February 28 each year, including that required by the R6 2005 ROD
Herbicide use	No broadcast of picloram, non-aquatic triclopyr, non-aquatic glyphosate, or sethoxydim to roads that have a high risk of delivery to water.	No application of herbicides in riparian areas or ditches when soil is saturated.

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 Tribes 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, Jefferson, 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 Final Supplemental 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 FSEIS 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 SEIS 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 FSEIS is also in this chapter.

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Carolyn Close (retired) - District Botanist and Weed Coordinator, USDA Forest Service, Deschutes National Forest, Crescent Ranger District

Maret Pajutee – District Ecologist and Weed Coordinator, USDA Forest Service, Deschutes National Forest, Sisters Ranger District

Rick Dewey – Assistant Forest Botanist, Deschutes and Ochoco National Forests.

Charmane Powers – District Botanist/Ecologist and Weed Coordinator, USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District

Kev Alexanian – Crook County Weed Management Specialist, Prineville, Oregon

Dave Langland –Oregon Department of Agriculture Weed Specialist, Redmond, Oregon

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Kevin Keown – Wildlife Program Manager, USDA Forest Service, Ochoco National Forest

Daniel Rife – Fishery Program Manager, USDA Forest Service, Deschutes/Ochoco NF

Marcy (Boehme) Anderson – NEPA Coordinator, Ochoco National Forest. Former Wildlife Biologist, USDA Forest Service, Deschutes National Forest, Crescent Ranger District.

Mike Riehle – Fishery Biologist, USDA Forest Service, Deschutes National Forest, Sisters Ranger District

Gery Ferguson – NEPA Planner, USDA Forest Service, Deschutes National Forest.

4.3 Distribution of the Environmental Impact Statement

The Final 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 Ochoco and Deschutes Forests Website http://www.fs.usda.gov/centraloregon 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 June 2009 Draft SEIS and the Forest Service responses are available on the web site.

Paper of Record: The Bulletin, Bend, Oregon

Received FSEIS or Notified of FSEIS 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

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
Oregon State Snowmobile Association
Oregon Equestrian Trails, Central Oregon ChapterBusinesses
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

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Bob and Diane Siebert
Robert Ervin
Bill and Gloria Gibbs
Mark Dohrmann
Tyler Groo
Charles and Helen McDonald
Allen Greendale
James Baird
Eunice and Dean Richardson
Greg Bedortha
Loy Helmly
Charles Hedges
Brenda Pace
Al and Sharon Sahonchik
Bob and June Hill
Jim and Janet Crates
David Kruse
Paul Smoland
Warren Pavlat
Violet Johnson
Stan Kunzman
Kathryn Venator
William Padgham
Bruce Kassab
Peter Schay
Dave Molony
Michele Penner
Kent Gill
Pieter and Diane Van Gelderen
Luann Danforth
Dave Lynn
Chuck Tolboe
Matt Mahoney
Vera Riser
Ken Roadman
Wally Buckman
Lee Fischer
Gary Pankey
Margie Gregory

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[21] - 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.

[21] 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.

Agent - Any substance, force, radiation, organism, or influence that affects the body. The effects may be beneficial or injurious.

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.

Aquatic influence zone - Land adjacent to perennial and intermittent streams, rivers, ponds, lakes, springs, and wetlands that have a direct or potentially direct influence on the water body and its function where herbicides may enter surface waters. This zone has a default width of 100 feet, realizing that in some areas it may be wider or narrower pending a site-specific review.

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.

Bankfull - The incipient elevation on the bank where flooding begins. This is the point where water begins to overflow onto the floodplain. The bankfull stage and a steams discharge at this stage serve to form and maintain channel dimensions. Bankfull discharge is associated with a momentary maximum flow which on average has a recurrence interval of 1.5 years as determined by using a flood frequency analysis (Rosgen 1996).

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.

Cation Exchange Capacity - 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.

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.

Half-life or halftime - The time required for the concentration of the chemical to decrease by one-half. For example if the half-life of a chemical is 10 days, half the product would be broken down 10 days after application; after 10 more days, half of that half of the product is broken down, etc.

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.

Impurity – A chemical compound found in herbicides as a result of the synthesis or production process.

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.

Manage Known Sites – To maintain the habitat elements needed to provide for persistence of the Survey and Manage species at the site. 'Manage' may range from maintaining one or more habitat components such as down logs or canopy cover, up to complete exclusion from disturbance for many acres, and may permit loss of some individuals, area, or elements not affecting continued site occupancy.

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)

Metabolite - A compound formed as a result of the metabolism or biochemical change of another compound.

Microorganisms - A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, protozoans and some fungi.

Minimal – very small in amount or degree. Also refers to definition of minimal risk level in the R6 2005 FEIS, which is defined as "an exposure level that is not likely to be associated with adverse effects in the general population, including sensitive subgroups."

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.

National Pollutant Discharge Elimination System (NPDES) - As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. An NPDES permit is required for herbicide use into water or adjacent conveyances with a hydrologic surface connection to water at the time of application.

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.

Rare Species – A species is considered to be rare when: there are low number of extant known sites with low numbers of individuals present at each site and populations are not well-distributed within its natural range. "Low" numbers and "not well distributed" are relative terms that must be considered in the context of other criteria such as distribution of habitat, fecundity, and so forth.

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.

Survey and Manage – mitigation measure adopted as a standard and guideline within the Northwest Forest Plan Record of Decision that is intended to mitigate impacts of land management efforts on those species that are closely associated with late-successional or old-growth forests whose long-term persistence is a concern. These measures apply to all land allocations and require land managers to take certain actions relative to species of plants and animals, particularly some amphibians, bryophytes, lichens, mollusks, vascular plants, fungi, and arthropods, which are rare or about which little is known. These actions include: (1) manage known sites; (2) survey prior to ground-disturbing activities; (3) conduct extensive and general regional (strategic) surveys.

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).

Uncommon species – A species that does not meet the definition of a rare species, but where concerns for its persistence remain.

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.

Waterbody – All perennial, intermittent and ephemeral streams, wetlands, and springs.

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.

References

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Guidance manual for the assessment of joint toxic action of chemical mixtures. Available from U.S. Department of Health and Human Services, Public Health Service, ATSDR, Division of Toxicology.

Adams, M.J., D.E. Schindler, B.R. Bury. 2001. Association of amphibians with attenuation of ultraviolet-b radiation in montane ponds. Oecologia 128 (4): 519-525.

Apfelbaum, S.I. and Charles E. Sams. 1987. Ecology and Control of Reed Canary Grass (Phalaris arundinaceae L.). Natural Areas Journal.

Ahlenslager, Kathy. 2006. *Personal* c*ommunication*. Forest Botanist, Colville National Forest, Colville, Washington.

Alexanian, Kev. 2006. *Personal communication*. Weed Management Specialist, Crook County, Prineville, Oregon.

Allaby, M., ed., 1996. The Concise Oxford Dictionary of Botany, Oxford University Press, Oxford, Great Britain.

Allison, S.D. and P.M. Vitousek. 2004. Rapid nutrient cycling in leaf litter from invasive plants in Hawai'i. Oecologia 141: 612-619.

Altman, B. 2000a. Conservation strategy for landbirds of the east-slope of the Cascade Mountains in Oregon and Washington. Version 1.0. June. Oregon-Washington Partners in Flight. 128pp.

Altman, B. 2000b. Conservation strategy for landbirds in the northern Rocky Mountains of eastern Oregon and Washington. Version 1.0. May. Oregon-Washington Partners in Flight. 121pp.

Altman, B. and A. Holmes. 2000. Conservation strategy for landbirds in the Columbia Plateau of eastern Oregon and Washington. Version 1.0. March. Oregon-Washington Partners in Flight. 131pp.

Alvarez et al., 2009. Determining herbicide risk to bull trout using a Polar Organic Chemical Integrative Sampler (POCIS). USGS Columbia Environmental Research Center, Columbia, MO.

Anonymous. 1999. Are "Inert" Ingredients in Pesticides really benign. J. Journal of Pesticide Reform 19(2):1

Anonymous. 2009. The bees are back in town. The Economist 390(8621): 85-86. March 7th, 2009.

Apfelbaum, S.I. and Charles E. Sams. 1987. Ecology and Control of Reed Canarygrass (*Phalaris arundinaceae* L.). Natural Areas Journal.

Archer, A.J. 2001. Taeniatherum caput-medusae [Web Page]. Located at: http://www.fs.fed.us/database/feis. Accessed 2003 Aug 11.

Asher, J. 2000. War on weeds: wining it for wildlife. Paper presented at North American Wildlife and Natural Resources conference. Rosemont, Illinois. March 27. 17 pp.

Asher, J. and S. Dewey. 2005. White paper on Estimated Annual Rates of Weed Spread on Western Federal Wildlands.

Aubry, K.B., and J.C. Lewis. 2003. Extirpation and reintroduction of fishers (Martes pennanti) in Oregon: implications for their conservation in the Pacific States. Biological Conservation 114: 79-90.

Aubry, K.B. and C.M. Raley. 2002. The pileated woodpecker as a keystone habitat modifier in the Pacific Northwest. USDA Forest Service, Gen. Tech. Rep. PSW-GTR-181.

Aubry, K.B.; S. Wisely; C. Raley; and S.W. Buskirk. 2005. Zoogeography, spacing patterns, and dispersal in fishers: insight gained from combining field and genetic data. Pp. 201-220 In D.J. Harrison, A.K. Fuller, G. Proulx (eds.). Martens and fishers (*Martes*) in human-altered environments: an international perspective. Springer and Business Media, Inc. electronic book. 275+ pp.

Baarschers WH; Donnelly JG; Heitland HS.1988. Microbial toxicity of triclopyr and related herbicides. Tox. Assess. 3 (2):127-136.

Baker, M.B., 1988. Hydrologic and Water Quality Effects of Fire. Proceedings: Effects of Fire in Management of Southwestern Natural Resources (Tucson, AZ, November 14-17, 1988). p 31-42.

Bakke, D. 2002. Analysis of issues surrounding the use of spray adjuvants with herbicides. Unpublished report by the Forest Service Pacific Southwest Regional Pesticide Use Specialist.

Bakke, D. 2003. Human and ecological risk assessments of nonylphenol polyethoxylate-based (NPE) surfactants in the Forest Service herbicide applications. Unpublished report by the Forest Service Pacific Southwest Regional Pesticide Use Specialist.

Bakke, D. 2007. Revised Analysis of issues surrounding the use of spray adjuvants with herbicides. Unpublished report by the Forest Service Pacific Southwest Regional Pesticide Use Specialist.

Banci, V. 1994. Wolverine. Pp. 99-127 *In* Ruggiero, L.F.; K.B. Aubry; S.W. Buskirk; L.J. Lyon; W.J. Zielinski (eds). The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States, RM-GTR-254. Fort Collins, Colorado. USDA Forest Service, Rocky Mountain Research Station. 184 pp.

Barnett, J.K. and J.A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. Journal of Range Management 47: 114-118.

Barrows, C.W. 1996. Tamarisk control and common sense. Proceedings: California Exotic Pest Plant Council San Diego, CA.

Battaglin, W.A., E.M. Thurman, D.W. Kolpin, E.A. Scribner, M.W. Sanstrom, and K.M. Kuivila. 2003. Work plan for determining the occurrence of glyphosate, its transformation product AMPA, other herbicide compounds, and antibiotics in Midwestern United States streams, 2002. USGS Open-File Report 03-69. 24p.

Battaglin, W. and J. Fairchild. 2002. Potential toxicity of pesticides measured in Midwestern streams to aquatic organisms. Watershed Science and Technology. 45(9): 95-103.

Bautista, Shawna. 2008. Climate change and Invasive Plants: Information for PNW Invasive Plant NEPA (Sept. 10, 2008). U.S. Dept. of Agriculture, Forest Service, Region 6. http://www.fs.fed.us/r6/invasiveplant-eis/Region6-Inv-Plant-Toolbox/.

Bautista, Shawna. 2006. Personal communication. Invasive Plant Biologist, Pacific Northwest Regional Office, Portland, Oregon.

Bautista, S.L. and S.P. Bulkin. 2006. Herbicide information summary and PDC crosswalk April 14, 2006 working document. US Forest Service. Pacific Northwest Region, Portland, OR

Bautista, Shawna. 2005. Personal communication. Invasive Plant Biologist, Pacific Northwest Regional Office, Portland, Oregon.

Bautista, Shawna. 1995. Personal observation. Zone Biologist, Angeles National Forest. Saugus, California.

BC Mushrooms; Website. http://bcmushrooms.forrex.org/ntfp/pages/sustainableharvest.html

Bedunah, D., and Carpenter, J. 1989. Plant community response following spotted knapweed (*Centaurea maculosa*) control on three elk winter ranges in western Montana Plant &Soil Department and Extension Service/ Montana State University. 1998 - Knapweed Symposium Bozeman, Montana.

Beedy, E.C. and W.J. Hamilton, III. 1999. Tricolored Blackbird (*Agelaius tricolor*). *In* A. Poole and F. Gill(eds.), The Birds of North America, No. 423. Philadelphia, PA: The Birds of North America, Inc

Belnap, Jayne, Roger Rosentreter, Steve Leonard, Julie H. Kaltenecker, John Williams, and David Eldridge. 2001a. Biological Soil Crusts: Ecology and Management. USDI Bureau of Land Management, Denver Colorado, Technical Reference 1730-2.

Belnap, J., and S. L. Phillips. 2001b. Soil biota in an ungrazed grassland: response to annual grass (Bromus tectorum) invasion. Ecol. Appl. 11:1261–1275.

Benoit, et al., 1998. Biosorption Characterization of Herbicides, 2, 4-D and Atrazine, and Two Chlorophenols on Fungal Mycelium. *Chemosphere,* Vol. 31, No. 7, pp. 1271-1282, 1998.

Berg, N. 2004. Assessment of herbicide best management practices: Status of our knowledge of BMP effectiveness. Pacific Southwest Research Station. USDA Forest Service. Albany, CA.

Berger, L., R. Speare, and A.D. Hyatt. 1999. Chytrid fungi and amphibian delines: overview, implications and future directions. Pp. 23-33 In A. Campbell, ed. Declines and disappearances of Australian frogs. Environment Australia. Canberra.

Berger, L., R. Speare, P. Daszak, D.E. Green, A.A. Cunningham, C.L. Goggin, R. Slocombe, M.A. Ragan, A.D. Hyatt, K.R. McDonald, H.B. Hines, K.R. Lips, G. Marantelli, H. Parks. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. Proceedings of the National Academy of Science USA 95: 9031-9036.

Berrill, M., S., Bertram, and B., Pauli. 1997. Effects of Pesticides on Amphibian Embryos and Larvae. Herpetological Conservation 1:233-45.

Berrill, M., S., Bertram, L., McGillivray, M., Kolohon, and B., Pauli . 1994. Effects of low concentrations of forest-use pesticides on frog embryos and tadpoles. Environmental Toxicol. and Chemistry 13(4):657-64.

Beschta, R. L. 1997. Riparian Shade and Stream Temperature: An Alternative Perspective. Rangelands Vol. 19, No. 2 (Apr., 1997), pp. 25-28

Bishop, C.A., Brooks, R.J., Carey, J.H., Ng, P., Norstrom, R.J. and others. 1991. The Case for a Cause Effect Linkage Between Environmental Contamination and Development in Eggs of the Common Snapping Turtle *(Chelydra S. Serpentina)* from Ontario, Canada. Journal of Toxicology and Environmental Health 33:521-47.

Blakesley, J.A., Franklin, A.B., and R.J. Gutierrez. 1992. Spotted owl roost and nest site selection in northwestern California. 1992. Journal of Wildlife Management, 56(2): 388-392.

Blaustein, A.R., Edmond, B., Kiesecker, J.M., Beatty, J.J., Hokit, D.G. 1995. Ambient ultraviolet radiation causes mortality in salamander eggs. Ecological Applications 5: 740 743

Blaustein, A.R., L.K. Belden, D.H. Olson, D.M. Green, T.L. Root, J. M. Kiesecker. 2001. Amphibian breeding and climate change. Conservation Biology 15 (6): 1804-1809.

Blossey, B. 1999. Before, during, and after: the need for long-term monitoring in invasive plant species management. Biological Invasions 1:301-311.

Blus, L.J., C.S. Staley, C.J. Henny, G.W. Pendleton, T.H. Craig, E.H. Craig, and K.K. Halford. 1989. Effects of organophosphorus insecticides on sage grouse in southeastern Idaho. Journal of Wildlife Management 53: 1139-1146.

Bornschein S; Hausteiner C; Römmelt H; Nowak D; Förstl H; Zilker T. 2008a. Double-blind placebo-controlled provocation study in patients with subjective Multiple Chemical Sensitivity (MCS) and matched control subjects. Clin Toxicol (Phila). 46(5): 443-9.

Bornschein S; Hausteiner C; Pohl C; Jahn T; Angerer J; Foerstl H; Zilker T. 2008b. Pest controllers: a high-risk group for Multiple Chemical Sensitivity Clin Toxicol (Phila). 46(3): 193-200.

Borrecco, J.E., and Neisess, J. 1991. Risk Assessment for the Impurities, 2-Butoxyethanol and 1, 4-Dioxane Found In Garlon 4 and Roundup Herbicide Formulations. Forest Pest Management, Pacific Southwest Region Report No. R91-2:1-33.

Bradley, BA, Blumenthal, DM, Wilcove, DS. 2009. Climate change and plant invasions: restoration opportunities ahead?. Global Change Biology, 15: 1511–1521.

Bradley, BA, Blumenthal, DM, Wilcove, DS, et al. 2010. Predicting plant invasions in an era of global change. Trends Ecol Evol 25:310-318.

Brady, N.C., and R.R. Weil. 1999. The nature and properties of soils. 12th Edition. 881 pp. Upper Saddle River, NJ: Prentice Hall.

Branum, Wayne. 2005. Personal Communication. Wildlife Biologist Technician, Crescent Ranger District, Deschutes National Forest.

Braun, C.E. 1987. Current issues in sage grouse management. Proceedings of the Western Association of Fish and Wildlife Agencies 67: 134-144.

Braun, C.E. 1998. Sage grouse declines in western North America: what are the problems? Proceedings of the Western Association of Fish and Wildlife Agencies 78: 139-156.

Bridges, C.M. and R.D. Semlitsch. 2000. Variation in pesticide tolerance of tadpoles among and within species of Ranidae and patterns of amphibian decline. Conservation Biology 14 (5): 1490-1499.

Brotherson, J. D., and Field, D. 1987. *Tamarix*: impacts of a successful weed. Rangelands 9:110-2.

Brown, Melissa L., Celestine A. Duncan, and Mary B. Halstvedt. 2001. Cost and Efficacy of Spotted Knapweed Management with Integrated Methods. TechLine, Weed Management Resource Library, Granby, Colorado, May 2001.

Bryan, T. and E.D. Forsman. 1987. Distribution, abundance and habitat of great gray owls in southcentral Oregon. The Murrelet 68(2):45-49.

Buchanan, D.V., M.L. Hanson, and R.M. Hooton. 1997. Status of Oregon's Bull Trout. Oregon Department of Fish and Wildlife, Portland, Oregon.

Bulkin, Steve. 2006. Personal Communication. Pacific Northwest Region Invasive Plant Implementation Team Member.

Bull, E.L.; A.A. Clark; and J.F. Shepard. 2005. Short-term effects of fuel reduction on pileated woodpeckers in northeastern Oregon – a pilot study. USDA Forest Service, Pacific Northwest Research Station. Research paper PNW-RP-564. Portland, Oregon. 17 pp.

Bull, E.L. and M.P. Hayes. 2001. Post-breeding season movements of Columbia spotted frogs (*Rana luteiventris*) in northeastern Oregon. Western North American Naturalist 61(1): 119-123.

Bull, E.L.; R.S. Holthausen; and M.G. Henjum. 1990. Techniques for monitoring pileated woodpeckers. Gen. Tech. Rep. PNW-GTR-269. USDA Forest Service, Pacific Northwest Research Station. Porltand, Oregon. 13 p.

Bull., E.L., and M.G. Henjum. 1990. Ecology of the Great Gray Owl. General Technical Report PNW-GTR-265. USDA Forest Service.

Bull, Evelyn L.; Henjum, Mark G.; Rohweder, Ron S. 1988a. Home range and dispersal of great gray owls in northeastern Oregon. Journal of Raptor Research. 22: 101-106.

Bull, Evelyn L.; Henjum, Mark G.; Rohweder, Ron S. 1988b. Nesting and foraging habitat of great gray owls. Journal of Wildlife Management. 53: 47-50.

Burford, L.S. and M.J. Lacki. 1998. Moths consumed by *Corynorhinus townsendii virginianus* in Eastern Kentucky. American Midland Naturalist 129 (1):141-146.

Burke, T.E; J.S. Applegarth; and T.R. Weasma. 1999. Management recommendations for Survey and Manage terrestrial mollusks. Duncan, N. Ed. USDI Bureau of Land Management, Oregon and Washington.

Burtelow, Amy and Heidi Suna. 2004. B&B Complex Fire: Year Two BAER Weed Monitoring Report. Sisters District, Deschutes National Forest, Sisters, Oregon.

Busse, M. et al., 2001. Glyphosate toxicity and the effects of long-term vegetation control on microbial communities. Soil Biology and Biochemistry 33 (2001) 1777-1789.

Busse, et al., 2003. Ectomycorrhizal Formations in Herbicide-Treated Soils of Differing Clay and Organic Matter Content. In: Water, Air and Soil Pollution 152: 23-34, 2004.

Busse, Matt, Gary Fiddler, and Nancy Gillette. 2003. Are Herbicides Detrimental to Ectomycorrhizae? In: Proceedings of the Twenty-Fourth Annual Forest Vegetation Management Conference, January 14-16, 2003, Redding, California.

Busse, M. 2005. *Personal Communication.* Research Scientist, USDA Pacific Southwest Research Lab, Redding/Davis, California.

Caltrans. 2005. First Flush Phenomenon Characterization. California Department of Transportation Division of Environmental Analysis. Sacramento, CA.

Carey, C.G. 2003. Golden eagle *Aquila chrysaetos*. Pp. 160-162 *In* Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 752 pp.

Castellano, M.A., E. Cazares, B. Fondrick, and T. Dreisbach. 2003. Handbook to Additional Fungal Species of Special Concern in the Northwest Forest Plan. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-572.

Cameron, S.A. et al., 2011. Patterns of widespread decline in North American bumble bees. Proceedings of the National Academy of Sciences of the United States of America, Vol. 108, No. 2. Pages 662-667.

CCD Steering Committee. 2007. Colony collapse disorder action plan. USDA Agricultural Research Service. Downloaded on June 16, 2008 from:http://www.ars.usda.gov/is/br/ccd/ccd_actionplan.pdf.

Chakravarty, P., and S. S. Sidhu. 1987. Effect of glyphosate, hexazinone and triclopyr on in vitro growth of five species of ectomycorrhizal fungi. Eur. J. For. Path. 17:204-210.

Chapman, D., A. Giorgi, T. Hilman, D. Deppert, M. Erho, S. Hays, C. Peven, B. Suzumoto, and R. Klinge. 1994. Status of summer/fall Chinook salmon in the Mid-Columbia region. Don Chapman Consultants Inc., Boise, Idaho.

Cheney, Byron. 2006. *Personal Communication.* Invasive Plant Program Manager, Deschutes & Ochoco NFs and Crooked River NG. 6/13/2006.

Chew, F.S. 1981. Coexistence and local extinction in two Pieris butterflies. American Naturalist 118: p.655-72.

Chitwood, L. 1998. *Personal Communication.* Forest Geologist, Deschutes National Forest. Bend, Oregon.

Choudhury, H.; J. Cogliano; R. Hertzberg; D. Mukerjee; G. Rice; L. Teuschler; E. Doyle; and R. Schoeny. 2000. Supplementary guidance for conducting Health Risk Assessment of chemical mixtures. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. 143 pp. + appendices.

Chornesky, E.A.; A.M. Bartuska; G.H. Aplet; K.O. Britton; J. Cummings-Carlson; F.W. Davis; J. Eskow; D.R. Gordon; K.W. Gottschalk; and R.A. Haack. 2005. Science priorities for reducing the threat of invasive species to sustainable forestry. BioScience 55(4): 335-348.

Christensen, J.R. 1981. A Field Guide to the Butterflies of the Pacific Northwest. A Northwest Naturalist Book. The University Press of Idaho, Moscow, Idaho. 116 pp.

Cipollini, M.L., B.G. Drake, and D. Whigham. 1993. Effects of elevated CO_2 on growth and carbon/nutrient balance in the deciduous wood shrub *Lindera benzoin* (L.) Blume (Lauraceae). Oecologia 96: 339-346.

Clark, B.S., D.M. Leslie, Jr., and T.S. Carter. 1993. Foraging activity of adult female Ozark big-eared bats (*Plecotus townsendii ingens*) in summer. Journal of Mammalogy 74(2):422-427.

Clerck-Floate, RD. 1997. *Cattle as dispersers of hound's-tongue on rangelands in southeastern British Columbia, May 1997.* Journal of Range Management 50:239-243.

Climate Change Science Program. 2008. Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Julius, S.H.; J.M. West (eds.), J.S. Baron, B. Griffith, L.A. Joyce, P. Kareiva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scot (Authors)]. U.S. Environmental Protection Agency, Washington, D.C. 873 pp.

Clinnic, P.F. 1985. Buffer strip management in forest operations: a review. Australian Forestry Vol. 48(1) p.34-45.

Clowers, Gary. 2004. Wickiup Reservoir Final Report 2004. A report on bald eagle use of Wickiup Reservoir prepared under contract for the Bend Office of the Northwest Region of the Bureau of Reclamation, Bend, Oregon. Unpublished.

Colborn, T. 1991. Epidemiology of Great Lakes Bald Eagles. Journal of Toxicology and Environmental Health 33:395-453.

Colborn, T., vom Saal, F.S., Soto, A.M. 1993. Developmental Effects of Endocrine-Disrupting Chemicals in Wildlife and Humans. Environmental Health Perspectives 101(5):378-84.

Connelly, J.W. and O.D. Markham. 1983. Movements and radio nuclide concentrations of sage grouse in southeastern Idaho. Journal of Wildlife Management 47:169-177.

Comerford, N., Mansell, R. and D. Neary. 1992. The effectiveness of buffer strips for ameliorating offsite transportation of sediment, nutrients, and pesticides from silvicultural operations. Tech. Bull. 631, National Council of the Paper Industry for Air and Stream Improvement. New York, NY. June 1992. 48p.

Confederated Tribes of Warm Springs and USDI, Bureau of Indian Affairs. 2005. Vegetation Management Noxious Weed Control Plan and Assessment. Oregon.

Connelly J.W., H.W. Browers, R.J. Gates. 1988. Seasonal movements of sage grouse in southeastern Idaho. J. Wildl. Manage. 52:116–122.

Connelly, J. W., M. A. Schroeder, A. R. Sands, C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28(4): 967-985.

Connelly, J.W.; M.A. Schroeder; A.R. Sands; and C.E. Braun. 1991. Sage grouse use of nest sites in southeastern Idaho. Journal of Wildlife Management 55: 521-524.

Council for Agricultural Science and Technology (CAST). 2002. Environmental impacts of livestock on U. S. grazing lands. Task force report, No. 22:1-16.

Council on Environmental Quality. 2011. Memorandum for Heads of Federal Departments and Agencies: Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact. January 14, 2011. 20 pp.

Courtney, S.P., J.A. Blakesley, M.L. Bigley (et al). 2004. Scientific evaluation of the status of the northern spotted owl. Portland OR: Sustainable Ecosystems Institute. 508 pp.

Cox, C. 1999. Inert ingredients in pesticides: who's keeping secrets? J. Pesticide Reform 19(3):2-7.

Cox, C. 2003. Imazapic - Herbicide Factsheet. Journal of pesticide reform. 23 (3) 10-14.

Cox, G.W. 1999. Alien Invasion in North America and Hawaii: Impacts on Natural Ecosystems. Island Press.

Cox-Foster, D.L.; S. Conlan; E.C. Holmes; G. Palacios; J.D. Evans, et al. 2007. A Metagenomic survey of microbes in honey bee colony collapse disorder. Science 318: 283-287.

Craigg, T. 2000. Herbicide Sampling for the Grass Control Demonstration Project. White paper summary of herbicide residue sampling on the Deschutes National Forest.

Crawford J. A. 1982. History of Sage Grouse in Oregon. Oregon Wildlife. 37(3):3–6.

Crawford, J.A., and R.S. Lutz. 1985. Sage grouse population trends in Oregon, 1941-1983. Murrelet 66 (3): 69-74.

Crawford, J.A.; R.A. Olson; N.E. West; J.C. Mosley; M.A. Schroeder; T.D. Whitson; R.F. Miller; M.A. Gregg; and C.S. Boyd. 2004. Ecology and management of sage-grouse and sage-grouse habitat. Journal of Range Management 57: 2-19.

Croft, Lisa, Wayne R. Owen, and J. Stephen Shelly. 1997. Interior Columbia Basin Ecosystem Management Project Analysis of Vascular Plants. USDA Forest Service and USDI Bureau of Land Management, http://www.icbemp.gov/

Crump, M.L. 2005. Why are some species in decline but others not? Pp. 7-9 In M. Lannoo, ed. Amphibian Declines: the conservation status of United States species. Univ. of California Press. Berkely. 1094p.

Csuti, B.; T.A. O'Neil; M.M. shaughnessy; E.P. Gaines; J.C. Hak. 2001. Atlas of Oregon Wildlife: Distribution, Habitat, and Natural History. Oregon State University Press. Corvallis, OR 524 pp.

Cude, C.G.. 1996. *Oregon Water Quality Index Report for the Deschutes and Hood Basins: Water Years 1986-1995*. Oregon Department of Environmental Quality Laboratory. Portland, Or.

Curtis, P.S., B.G. Drake, and D.F. Whigham. 1989. Nitrogen and carbon dynamics in C_3 and C_4 estuarine marsh plants grown under elevated CO_2 in situ. Oecologia 78: 297-301.

Cushman, K.A. and C.A. Pearl. 2007. A conservation assessment for the Oregon spotted frog (*Rana pretiosa*). USDA Forest Service, Region 6; USDI Bureau of Land Management, Oregon and Washington. 46 pp.

Cushman, K. and R. Huff. 2007. Conservation Assessment for Fungi included in the Forest Service Regions 5 and 6 Sensitive and BLM California, Oregon and Washington Special Status Species Programs. Portland, Oregon.

D'Antonio, C.M., and P. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecological Systems 23:63-87.

Dachtler, N. 1997. Big Marsh Creek level II stream inventory. Crescent Ranger District. Deschutes National Forest. Crescent, OR.

Dachtler, N. 1998. Fly Creek Level II Stream Inventory. Sisters Ranger District. Deschutes National Forest. Sisters, OR.

Dachtler, N. 2000. Metolius River Level II Stream Inventory. Sisters Ranger District. Deschutes National Forest. Sisters, OR.

Dachtler, N. 2003. Summary of 2003 bull trout presence absence surveys in the Odell/Davis Lakes basin. Deschutes National Forest. Bend, OR.

Dachtler, N. 2004. Fish surveys on the Crescent Ranger District. Summer, 2004. Deschutes National Forest. Bend, OR.

Dachtler, N. 2009. Fisheries Report, Deschutes & Ochoco NF and Crooked River National Grassland Invasive Plant Treatment Project.

Das-Munshi J; Rubin GJ; Wessely S. 2006. Multiple chemical sensitivities: A systematic review of provocation studies. J Allergy Clin Immunol. 118(6): 1257-64.

Das-Munshi J; Rubin GJ; Wessely S, 2007. Multiple chemical sensitivities: review. Curr Opin Otolaryngol Head Neck Surg. 15(4): 274-80.

Davies, J., Honegger, J.L., Tencalla F.G., Meregalli, G., Brian, P., Newman, J.R., and H.F. Pitchford. 2003. Herbicide risk assesment for non target aquatic plants: sulfosulfuron – a case study. Pest Management Science. 59:231-237.

De Snoo, G.R., and P.J. De Wit, 1998. Buffer zones for reducing pesticide drift to ditches and risks to aquatic organisms, Ecotoxicol Environ Saf 41 (1998), pp. 112-118.

Descalzo, R., Zamir K., et al. (1997). Glyphosate treatment of bean seedlings causes short-term increases in Pythium populations and damping off potential in soils. Centre for Pest Management, Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada, V5A 1S6

Desser, Rochelle. 2008. Forest Service Region Six, Source and Effectiveness of Project Design Features/Criteria for Herbicide Use in Invasive Plant Treatment Projects.

Desser, Rochelle. 2012. Personal Communication. Risk assessment results for the 2011 Glyphosate SERA Report TR-052-22-03b. US Forest Service, Pacific Northwest Region, Portland, OR.

Dewey, Rick. 2006a. *Personal Communication*. Bryophyte expert, Deschutes National Forest, Bend, Oregon.

Dewey, Rick. 2006b. Survey Recommendations for Survey and Manage Vascular Plants, Bryophytes, Lichens and Fungi on the Deschutes National Forest (for Category A and C species). Deschutes National Forest, Bend, Oregon.

Dewey, Rick. 2007. Draft Conservation Strategy for *Calochortus longebarbatus* var. *peckii*. Ochoco National Forest, Prineville, Oregon.

Dibyendu N.R., Konar, S.K., Banerjee, S., Charles, D.A., Thompson, D.G. and R. Prasad. 1989. Persistance, movement and degradation of glyphosate in selected Canadian boreal forest soils. J. Agric. Food Chem. 37(2): 437-440.

DiTomaso, J.M. 2000. Invasive weeds in rangelands: Species, impacts and management. Weed Science 48:255-265.

Dixon, R.D. 1995. Density, nest-site and roost-site characteristics, home range, habitat use, and behavior of white-headed woodpeckers: Deschutes and Winema National Forests, Oregon. Non-game Project 93-3-01, Oregon Department of Fish and Wildlife.

Dobkin, D.S., R.G. Gettinger, and M.G. Gerdes. 1995. Springtime movements, roost use, and foraging activity of Townsend's big-eared bat (*Plecotus townsendii*) in central Oregon. Great Basin Naturalist 55(4):315-321.

Donaldson, S.G. 1997. Flood-borne noxious weeds: impacts on riparian areas and wetlands. California Exotic Pest Plant Council. 1997 Symposium Proceedings.

Drost, C.A. and G.M. Fellers. 1996. Collapse of a regional frog fauna in the Yosemite area of the California Sierra Nevada, USA. Conservation Biology 10 (2): 414-425.

Dudley, T.L. 2000. Management of Invasive Plant Species: *Arundo Donax*. Pp. 53-58 *in:* Bossard, C.C., Randall, J.M., and Hoshousky, MC, eds. Invasive plants of California wildlands. Berkeley, CA: Univ. of California Press. p.53-8.

Dukes, J.S. and H.A. Mooney. 1999. Does global change increase the success of biological invaders? TREE 14(4): 135-139.

Dunbar, D. L., B. P. Booth, E. D. Forsman, A. E. Hetherington, and D. J. Wilson. 1991. Status of the spotted owl, *Strix occidentalis*, and barred owl, *Strix varia*, in southwestern British Columbia. Canadian field-naturalist 105(4). pp. 464-468.

Duncan, Nancy, Tom Burke, Steve Dowlan, and Paul Hohenlohe. 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan. Version 3.0. IM OR 2003-44. www.or.blm.gov/surveyandmanage/sp.htm

Duncan, N., D. Gowan and T.E. Burke. 2004. Conservation Assessment for *Pristiloma arcticum crateris*, Crater Lake Tightcoil. Originally issued as Management Recommendations October 1999 and reconfigured September 2004 by Nancy Duncan.

Durfey, Dan. 2006. Personal communication. Umatilla County Weed Supervisor, Pendleton, Oregon.

Durkin and Durkin, 2005. A Note on Plausible Initial Pesticide Residues on Selected Mushrooms: Hen of the Wood, Shiitake, and Portabello. Unpublished Internal Forest Service review of residues on mushrooms and associated health risks.

Easton, S.W. 1995. Northern Waterthrush (Seiurus noveboracensis). In A. Poole and F. Gill, editors. The Birds of North America. No 182. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union. Washington, D.C. 20 pp.

Eaton, S. W. 1995. Northern Waterthrush (Parkesia noveboracensis), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/182

Ehrenfeld, J.G. 2003. Effects of exotic plant invasions on soil nutrient cycling processes. Ecosystems 6: 503-523.

Ehrenfeld, J. G., P. Kourtev, et al. 2001. Changes in soil functions following invasions of exotic understory plants in deciduous forests. Ecological Applications 11(5): 1287-1300.

Eiswerth, M.E. et al. 2005. Input-output modeling, recreation, and the economic impact of noxious weeds. Weed Science 53:130-137, 2005.

El-ghamry et al. 2000. Changes in Soil Biological Properties with the addition of Metsulfuron Methyl Herbicide. ISSN 1009-3095 Journal of Zhejiang University (SCIENCE) V.1, No. 4, P. 442-447, Oct. - Dec., 2000.

Ellison, L.E., T.J. O'Shea, M.A. Bogan, A.L. Everette, and D.M. Schnieider. 2003. Existing data on colonies of bats in the United States: Summary and analysis of the U.S. Geological Survey's bat population database. Pages 127-237 *In* O'Shea,T.J. and M.A. Bogan, eds. Monitoring Trends in bat populations of the United States and territories: problems and prospects. U.S. Geological Survey, Biological Resources Discipline, Information and Technology Report, USGS/BRD/1TR-2003-0003, 274pp.

Environmental Consultants, Inc. 1991. Determination of the effects of herbicide buffer zones in protecting water quality in New York power line rights-of-way. Research Report EP 89-44. Final Report. August 1991.

Erickson, Vickie J., et al. 2003. Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest.

Estok, D., B. Freedman, and D. Boyle. 1989. Effects of the Herbicides 2,4-D, Glyphosate, Hexazinone, and Triclopyr on the Growth of Three Species of Ectomycorrhizal Fungi. Bulletin of Environmental Contamination and Toxicology 42: 835-839.

Evans, D. G. and Miller, M. H. 1988. Vesicular-arbuscular mycorrhizas and the soil — disturbance induced reduction of nutrients absorption in maize. I. Casual relations. New Phytol. 110: 67–74.

Evans, D. G. and Miller, M. H. 1990. The role of external mycelial network in the effect of soil disturbance upon vesiculararbuscular colonization of maize. New Phytol. 114: 65–71.

Evans, J.O and D.R. Duseja . 1973. Herbicide Contamination of Surface Runoff Waters. Environmental Protection Agency, Technology Series Report, EPA-R2-73-266. pgs 99.

Executive Order 13112 Invasive Species. 1999. Federal Register: Feb 8, 1999 (Volume 64, Number 25; 6183 - 6186).

Facemire, C.F., Gross, T.S., Guilette Jr, L.J. 1995. Reproductive Impairment in the Florida Panther: Nature or Nurture? Environmental Health Perspectives Supplements 103(S4):12.

Fairchild, J. F., Feltz, K. P., Sappington L. C., Allert, A. L., Nelson, K. J. and J. Valle. 2008. An Ecological Risk Assessment of the Acute and Chronic Toxicity of the Herbicide Picloram to the Threatened Bull Trout (Salvelinus confluentus) and the Rainbow Trout (Onchorhyncus mykiss). Arch Environ Contam Toxicol. DOI 10.1007/s00244-008-9227-1.

Feiger, Michael. 2006. Personal communication. Wildlife Biologist, Ochoco National Forest. Prineville, Oregon.

Feiger, Michael. 2007. Personal communication. Wildlife Biologist, Ochoco National Forest. Prineville, Oregon.

Feng, J.C., D.G. Thompson and P.E. Reynolds, 1989. Fate of glyphosate in a forest stream ecosystem. Proceedings of the Carnation Creek Herbicide Workshop, pages 45-64. P.E. Reynolds, ed. Forest Pest Management Institute, Forestry Canada, Sault Ste. Marie, Ontario.

Ferguson, L. M., L. Wilson, and K. Launchbaugh. 2001. Phenological Effects of Simulated Grazing on Centaurea Sostitialis in Northern Idaho, University of Idaho. Society of Range management 56th Annual meeting Abstracts, February 2 – 6, 2003.

Fiedler, C. 2005. Personal observation. Fisheries Biologist, Columbia River Gorge National Scenic Area, US Forest Service. Hood River, Oregon.

Fierke, M.K. and J. Boone Kauffman. 2006. Invasive Species Influence Riparian Plant Diversity Along a Successional Gradient, Willamette River, Oregon. Natural Areas Journal. Vol. 26, Issue 4.

Fischer, R.A.; K.P. Reese; and J.W. Connelly. 1996. Influence of vegetal moisture content and nest fate on timing of female sage grouse migration. Condor 98: 868-872.

Fitzgerald, S. 2009. Unpublished data from Oregon Extension Service/US Forest Service plots on the Fort Rock District of the Deschutes National Forest.

Forsman, E.D., E.C. Meslow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.

Fox, G.A., Collins, B., Hayakawa, E., Weseloh, D.V., Ludwig, J.P. and others. 1991a. Reproductive Outcomes in Colonial Fish-Eating Birds: A Biomarker for Developmental Toxicants in Great Lakes Food Chains. Journal of Great Lakes Research 17(2):158-67.

Fox, G.A., Gilbertson, M., Gilman, A.P., Kubiak, T.J. 1991b. A Rationale for the Use of Colonial Fish-Eating Birds to Monitor the Presence of Developmental Toxicants in Great Lakes Fish. Journal of Great Lakes Research 17(2):151-2.

Fox, G.A., Gilman, A.P., Peakall, ..D.B., Anderka, F.W. 1978. Behavioal Abnormalities of Nesting Lake Ontario Herring Gulls. Journal of Wildlife Managemement 42(3):477-83.

Franklin, A. B., K .P. Burnham, G. C. White, R. J. Anthony, E. D. Forsman, C. Schwarz, J. D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. U.S. Geological Survey, Colorado and Oregon Cooperative Fish and Wildlife Research Units, Fort Collins, CO and Corvallis, OR. 71 pp.

Fry, D.M. 1995. Reproductive Effects in Birds Exposed to Pesticides and Industrial Chemicals. Environmental Health Perspectives 103(Supplement 7):165-71.

Fry, D.M., and Toone, C.K. 1981. DDT-Induced Feminization of Gull Embryos. Science 213(August):922-4.

Fry, M.D., Toone, C.K., Speich, S.M., Peard, R.J. 1987. Sex Ratio Skew and Breeding Patterns of Gulls: Demographic and Toxological Considerations. Studies in Avian Biology 10:26-43.

Fryrear, D. W. 2000. Wind Erosion. Handbook of Soil Science, Editor Malcom E Sumner, G-195 to G-216. Boca Raton: CRC Press.

Fults, Janet. 2009. Personal communication. Program Manager, Pesticides Division Registration-Certification, Salem, Oregon.

Garbaye, J. and G.D. Bowen, 1989. Stimulation of ectomycorrhizal infection of Pinus radiata by some microorganisms associated with the mantle of ectomycorrhizas. New Phytol. (1989), 112, 383-388.

Gardner, SC., Grue CE. 1996. Effects of Rodeo and Garlon 3A on nontarget wetland species in central Washington. Environ Toxicol Chem. 15(4): 441-451.

Geiser, Linda. 2006. Personal communication. Lichen Expert/Ecologist, Pacific Northwest Region Air Program, Corvallis, Oregon.

Germaine, S.S., Rosenstock, S.S., Schweinsburg, R.E, and Richardson, W.S. 1998. Relationships among breeding birds, habitat, and residential development in greater Tucson, Arizona. Ecological Applications.

Gibson, Steve. 2006. Personal communication. Range Vegetation Specialist, Crooked River National Grassland, Madras, Oregon.

Gilbertson, M., Kubiak, T., Ludwig, J., Fox, G. 1991. Great Lakes Embryo Mortality, Edema, and Deformities Syndrome (GLEMEDS) in Colonial Fish-Eating Birds: Similarity to Chick-Edema Disease. Journal of Toxicology and Environmental Health 33(455):520.

Giudice, B.D., A. Massoudieh and T.M. Young. 2007. Evaluating management decisions to reduce environmental risk of roadside-applied herbicides. Transportation Research Board: Journal of the Transportation Research Board. Washington D.C. No:1991.

Goetz, F.A. 1989. Biology of the bull trout, Salvelinus confluentus: a literature review. Willamette National Forest, Eugene, Oregon.

Goggans, R., R.D. Dixon, and L.C. Seminara. 1989. Habitat use by three-toed and black-backed woodpeckers, Deschutes National Forest, Oregon. Oregon Department of Fish and Wildlife, Nongame Wildlife Program, Tech. Rep. 87-3-02. 43pp.

Goggans, Rebecca; Platt, Melissa. 1992. Breeding season observations of great gray owls on the Willamette National Forest, Oregon. Oregon Birds. 18(2).

Goldsborough, L.G. and L.E. Beck, 1989. Rapid dissipation of glyphosate in small forest ponds. Archives of Environmental Contamination and Toxicology. Vol. 18, nbr. 4/Jul 1989. p 537-544.

Goodman, S. 2009. Pathogen linked to bee colonies' collapse – study. E&E Publishing, online news service. April 16, 2009.

Green, D.M., T.F. Sharbel, J. Kearsley and H. Kaiser. 1996. Postglacial range fluctuation, genetic subdivision and speciation in the western North American spotted frog complex, *Rana pretiosa* . Evolution 50:374-390.

Gregg, M. 2011. *Personal Communication*. Wildlife Biologist, Sisters, Deschutes National Forest.

Gregory, S.V., F.J. Swanson, W.A. McKee, K.W. Cummins. 1991. An ecosystem perspective of riparian zones. BioScience. 41(8):540-550.

Grenier, Katie. 2002. Deschutes National Forest Noxious Weed Monitoring Report. Deschutes National Forest, Bend, Oregon.

Guillette, L.J., Gross, T.S., Gross, D.A., Rooney, A.A., Percival, H.F. 1995. Gonadal Steroidogenesis *in Vitro* from Juvenile Alligators Obtained from Contaminated or Control Lakes. Environmental Health Perspectives 103:31-6

Guillette Jr., Louis J., Gross, Timothy S., Masson, Greg R., Matter, John M., Percival, H. Franklin and others. 1994. Developmental Abnormalities of the Gonad and Abnormal Sex Hormone Concentrations in Juvenile Alligators from Contaminated and Contorl Lakes in Florida. Environmental Health Perspectives 102(8):680-8.

Haag KH. 1986. Effects of herbicide application on mortality and dispersive behavior of the water hyacinth weevils neochetina-eichhorniae and neochetina-bruchi coleoptera curculionidae. Environ Entomol; 15 (6) 1986 1192-1198.

Hall, Frederick C. 1998. Pacific Northwest Ecoclass Codes for Seral and Potential Natural Communities. U.S. Department of Agriculture Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-418, April 1998.

Halliday, T. 2005. Diverse phenomena influencing amphibian population declines. Pp. 3-6 In M. Lannoo, ed. Amphibian Declines: the conservation status of United States species. Univ. of California Press. Berkely. 1094p.

Hamer, T. E., D.L. Hays, S.M. Senger, and E.D. Forsman. 2001. Diets of northern barred owls and northern spotted owls in an area of sympatry. J. Raptor Res 35(3): 221-227.

Hamer, T.E., S.G. Seim, and K.R. Dixon.1989. Northern spotted owl and northern barred owl habitat use and home range size in Washington: preliminary report. Washington Department of Wildlife, Olympia, Washington.

Hampson, P.S., Treece Jr., M.W., Johnson, G.C., Ahlstedt, S.A., and Connell, J.F. 2000. Water Quality in the Upper Tennessee River Basin, Tennessee, North Carolina, Virginaia, and Georgia 1994-98. U.S. Geological Survey Circular 1205, 32p.

Hanf J.M., P.A. Schmidt, E.B. Groshend. 1994. Sage grouse in the high desert of Central Oregon: results of a study, 1988–1993. U.S.D.I.-Bur. Land Manage., Series P-SG-01, Prineville, Ore.

Hann, W.J., Jones, J.L., Karl, M.G., Hessburg, P.F., Keane, R.E. and others. 1997. Landscape dynamics of the basin. in: Quigley, T.M., and Arbelbide, S.J., eds., An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Volume 2. p 337-1055.

Harvey, S.J. and R.M. Nowierski. 1989. Spotted knapweed: allelopathy or nutrient depletion? In Proceedings of the 1989 Knapweed Symposium, Montana State University. Bozeman, MT 59717.

Haupt, H.F. and W.J. Kidd, 1965. Good logging practices reduce sedimentation in central Idaho. Journal of Forestry. 63:664-670.

Hayes, M.P. 1997. Status of the Oregon spotted frog (*Rana pretiosa* sensu stricto) in the Deschutes Basin and selected other systems in Oregon and northeastern California with a rangewide synopsis of the species status. Final report prepared for The Nature Conservancy under contract to the U.S. Fish and Wildlife Service, Portland, Oregon. 57 p. + appendices.

Hayes, Marc P. 1995. Final Report. Status of the Spotted Frog on the Crescent Ranger District, Deschutes National Forest. Headwaters of the Deschutes River System.

Hayes, M.P. & Jennings, M.R. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology 20: 490–509.

Hayes, T.B., Hasten, K., Tsui, M., Hoang, A., Haeffele, C., and Vonk, A. 2003. Atrazine-induced hermaphroditism at 0.1 ppb in American leopard frogs. Environ. Health Perspect. 111, 568–575.

Hayes, T.B., A. Collins, M. Lee, M. Mendoza, N. Noriega, A. A. Stuart, and A. Vonk. 2002. Hermaphroditic, demasculinized frogs after exposure to the herbicide, atrazine, at low ecologically relevant doses. Proc. Nat. Acad. Sci. 99:5476-5480.

Hayes, T.B., K. Haston, M. Tsui, A. Hoang, C. Haeffele, and A. Vonk. 2002. Feminization of male frogs in the wild. Nature 419:895-896.

Hayes, T.B., P. Case, S. Chui, D. Chung, C. Haefele, K. Haston, M. Lee, V.P. Mai, Y. Marjuoa, J. Parker and M. Tsui. 2006. Pesticide mixtures, endocrine disruption, and amphibian declines: Are we underestimating the impact? Envir. Health Perspect. 114 (1): 40-50.

Heade, B.H. 1990. Vegetation strips control erosion in watersheds. Rocky Mtn. Forest and Range Experiment Station. Research Note RM-499. 5p.

Hellmann, J.J.; J.E. Byers; B.G. Bierwagen; and J.S. Dukes. 2008. Five potential consequences of climate change for invasive species. Conservation Biology 22(3): 534-543.

Helliwell, Richard. 1993. Memorandum to Ochoco National Forest Botanists to share Peck's mariposa lily (Calochortus longebarbatus var. peckii) information. On file at Lookout Mt. District, Ochoco National Forest, Prineville, Oregon.

Herter, D.R., and L.L. Hicks. 2000. Barred owl and spotted owl populations and habitat in the central Cascade Range of Washington. Journal of Raptor Research 34(4): 279-286.

Higes, M., R. Martin-Hernández, E. Garrido-Bailón, A.V. Gonzalez-Porto, Ilar Garcia-Palencia, A. Meana, M.J. del Nozal, R. Mayo, and J.L. Bernal. Honeybee colony collapse due to *Nosema ceranae* in professional apiaries. Environmental Microbiology Reports 1(2): 110-113.

Hildebrand, LD., Sullivan, DS., Sullivan, TP. 1980. Effects of roundup herbicide on populations of daphnia magna in a forest pond. Bull Environ Contam Toxicol 1980 Sep;25(3):353-7.

Hinchliff, J. 1994. An atlas of Washington butterflies. The Evergreen Aurelians. The Oregon State University Bookstore, Inc, Corvallis, OR. 162p.

Hobbie, SE. 1992. Effects of plant species on nutrient cycling. T.R.E.E. 7:336–339.

Holes, Ray. 2005. Presentation: turning vegetation into dollars. 34th PNW Range management Short Course, February 23 – 25, 2005.

Hook, P.B. 2003. Sediment retention in rangeland riparian buffers. Journal of Environmental Quality. 32:1130-1137 (2003).

Horner, N.J. 1978. Survival, densities and behavior of salmonid fry in streams in relation to fish predation. M.S. Thesis, University of Idaho. Moscow, Idaho.

Horton, J.S. 1977. The development and perpetuation of the permanent tamarisk type in the phreatophyte zone of the Southwest. U.S. Department of Agriculture, Forest Service, Gen. Tech. Rep., Rocky Mountain Forestry and Range Experiment Station 43: p.124-127.

Howard, Cheryl. 2007. Personal communication. Deschutes County Weed Advisory Board Member and organizer of "Let's Pull Together" weed pull event in Central Oregon.

Howell, P.K., D.S. Jones, L. Lavoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of anadromous salmonids, Volume II. Final report to Bonneville Power Administration, U.S. Department of Energy. Portland, Oregon.

Houslet, B.S. and M.D. Riehle. 1998. Draft Report: Trends in bull trout abundance and thermal habitat use in tributaries to the Metolius River. Deschutes National Forest. Sisters Ranger District. Sisters, OR.

Houslet, B. and J. Lovtang. 1996. Candle Creek Level II Stream Inventory. Sisters Ranger District. Deschutes National Forest. Sisters, OR.

Houslet, B.S. and M.D. Riehle. 1998. Inland redband trout spawning survey of the upper Metolius River subbasin. USDA Forest Service, Sisters Ranger District, Sisters, Oregon.

Huang, X., T. Pedersen, M. Fischer, R. White, and T.M. Young. 2004. Herbicide runoff along highways. 1. Field observations. Environmental Science and Technology. 38 (12):3262-3271.

Hupp, J.W. and C.E. Braun. 1989. topographic distribution of sage grouse foraging in winter. Journal of Wildlife Management 53: 823-829.

Hurd, Signe. 2005. Noxious Weed Site Revegetation Project Executive Summary. Deschutes National Forest, Bend, Oregon.

Interior Columbia Basin Ecosystem Management Project. 2000. USDA Forest Service and USDI Bureau of Land Management, http://www.icbemp.gov/

Jackman, S.M.; Scott, J.M. 1975. Literature review of twenty-three selected forest birds of the Pacific Northwest. Portland, OR: U.S. Department of Agriculture, Forest Service: 339-353.

Jacobs, J. Sharlene Sing, Monica Pokorny and Roger Sheley. 2006. Presentation: The interaction of competitive grass and biological control to manage spotted knapweed. 59th Society for Range Management Annual Meeting, Vancouver B.C., February 12 – 17, 2006.

Jakle, M.D., and Gatz, T.A. 1985. Herpetofaunal use of four habitats of the Middle Gila River drainage, Arizona. Paper presented at the North American Riparian Conference, April 16-18, 1985, Tucson, AZ.

Jakober, M. 1992. Influence of stream size and morphology on the seasonal distribution and habitat use of resident bull trout and west slope cutthroat trout in Western Montana. Progress Report, USDA Forest Service, Intermountain Research Station, Fort Collins, Colorado.

Jeffries, Shane and Dave Zalunardo. 2003. Forest Wildlife Biologists for the Deschutes and Ochoco National Forests and Crooked River National Grasslands. White paper on historical lynx occurrence in Central Oregon and defining lynx habitat based on current definitions. Bend, Oregon.

Johnsen, TN and Warskow, WL. 1980. Picloram Dissipation in a Small Southwest Stream. Weed Science, vol. 28, no 5, September 1980. p 612-615.

Johnson, H.B., H.W. Polley, and H.S. Mayeux. 1993. Increasing CO_2 and plant-plant interactions: effects on natural vegetation. Vegetatio 104/105: 157-170.

Jones, D., N. Singhasemanon, D. Tran, J. Hsu, J. Hernandez, and H. Feng. 2000. Surface Water Monitoring for Pesticides in the Hupa and Karuk Territories. State of California, Department of Pesticide Regulation, Sacramento, CA. 14 pp. plus appendices. [Webpage] Located at: http://www.cdpr.ca.gov/docs/empm/pubs/tribal/reports.htm.

Joyce, L.A.; G.M. Blate; J.S. Littell; S.G. McNulty; C.I. Millar; S.C. Moser; R.P. Neilson; K. O'Halloran; and D.L. Peterson. 2008. National Forests. Pp. 3-1 to 3-127 In Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Julius, S.H.; J.M. West (eds.), J.S. Baron, B. Griffith, L.A. Joyce, P. Kareiva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scot (Authors)]. U.S. Environmental Protection Agency, Washington, D.C. 873 pp.

Kaltenecker, Julienne H., Marcia C. Wicklow-Howard, and Mike Pellant. 1999. Biological soil crusts: natural barriers to *Bromus tectorum* L. establishment in the northern Great Basin, USA. *In*: Eldridge, David and David Freudenberger, editors, Proceedings of the VI International Rangeland Congress, Townsville, Queensland, Australia, July 19-23, 1999.

Kaplan, J.K. 2008. Colony collapse disorder: a complex buzz. Agric. Research (May-June 2008): 8-11.

Kats, L.B. and R.P. Ferrer. 2003. Alien predators and amphibian declines: review of two decades of science and the transition to conservation. Diversity and Distributions (9): 99-110

Kenaga, E.E. 1973. Factors to be considered in the evaluation of the toxicity of pesticides to birds in their environment. Pp. 166-181 In Environmental quality and safety: Global aspects of chemistry, toxicology, and technology as applied to the environment, Vol. II. Academic Press, Inc. New York, NY.

Kirk, J. J. 1988. Western spotted frog (*Rana pretiosa*) mortality following forest spraying of DDT. Herpetological Review 19: 51–53.

Kittrell, J. 2006. Personal communication. Wildlife biologist. Deschutes National Forest.

Kiviat, E. 1996. Short Communications: American Goldfinch nests in purple loosestrife. Wilson Bulletin 108(1): p.182-6.

Klimek, M. et al. 2001. Metabolism of the phosphonate herbice glyphosate by a non-nitrate-utilizing strain of Penicillium chrysogenum. Pest Management Science. Vol.57(9):815-21.

Knapp, R.A., and K.R. Matthews. 2000. Non-native fish introductions and the dcline of the mountain yellow-legged frog from within protected areas. Conservation Biology 14 (2): 428-438.

Knight, A.P., and R.G. Walter. 2003. A Guide to Plant Poisoning of Animals in North America, 2001. Teton NewMedia.

Knight, H. 1997. Hidden toxic "inerts": a tragicomedy of errors. J. Pesticide Reform 17(2):19pp.

Knight, H. and C., Cox. (Northwest Coalition of Alternatives to Pesticides). 1998. Eugene, Oregon: Northwest Coalition for Alternatives to Pesticides.

Knisel, W.G., and F.M. Davis. 2000. Groundwater loading effects of agricultural management systems, user manual version 3.0. http://sacs.cpes.peachnet.edu/sewrl/Gleams/gleams.htm

Kremer, R.G., E. Raymond Hunt, Jr, Steven W. Running & Joseph C. Coughlan 1994. Simulating vegetational and hydrologic responses to natural climatic variation and GCM-predicted climate change in a semi-arid ecosystem in Washington, U.S.A. Journal of Arid Environments (1996) 33: 23–38

Krutz, L.J., S.A. Senseman, R.M. Zablorowicz, and M.A. Matocha. 2005. Reducing herbicide runoff from agricultural fields with vegetative filter strips: a review. Weed Science. 53:353-367.

Kubiak, T.J., Harris, H.J., Smith, L.M., Schwartz, T.R., Stalling D.L., Trick and others. 1989. Microcontaminants and Reproductive Impairment of the Forster's Tern on Green Bay, Lake Michigan - 1983. Archives of Environmental Contamination and Toxicology 18:706-27.

KY Water Watch. 2005. Water Quality Parameters. www.state.ky.us/nrepc/water/wcparint.htm

Lacey, J.R., C.B. Marlow and J.R. Lane. 1989. Influence of spotted knapweed (*Centaurea maculosa*) on surface water runoff and sediment yield. Weed Technology 3: 627-631.

Lacey, J. R., Olson, B. E. 1991. Environmental and economic impacts of noxious range weeds. Noxious Range Weeds James, L. F., Evans, J. O., Ralphs, M. H., & Child, R. D., editors (Westview Press).

Lacey, J.R., C.B. Marlow & J.R. Lane. 1998. Influence of spotted knapweed (Centaurea maculosa) on surface runoff and sediment yield. Weed Technology 3: 627-631.

Lahaye, W.S., and R.J. Gutierrez. 1999. Nest sites and nesting habitat of the northern spotted owl in northwestern California. Condor 101: 324-330.

Lamb, Bonnie. 2007. *Personal Communication.* Oregon Department of Environmental Quality, Bend, Oregon.

Langland, Dave. 2005a. Deschutes National Forest Herbicide Treatment Monitoring Report. Oregon Department of Agriculture, Redmond, Oregon.

Langland, Dave. 2005b. *Personal Communication*. Weed Specialist, Oregon Department of Agriculture, Redmond, Oregon.

Langland, Dave. 2006. *Personal Communication*. Weed Specialist, Oregon Department of Agriculture, Redmond, Oregon.

Larsen, D.M. 1976. Deschutes National Forest Soil Resource Inventory. USDA Forest Service Pacific Northwest Region.

Larsen, E.M., E. Rodrick, et al. 1995. Management Recommendations for Washington's Priority Species, Volume I. 42-46 pp.

Lauenroth, W.K., D.G. Milchunas, J.L. Dodd, R.H. Hart, R.K. Heitschmidt, and L.R. Rittenhouse . 1994 . Effects of grazing on ecosystems of the Great Plains . Pages 69 - 100 *in* Vavra, M., W.A. Laycock, and R.D. Pieper Editor(s). Ecological implications of livestock herbivory in the West. Society for Range Management, Denver, CO.

Lavergne, S. and Molofsky, Jane. 2004. Reed Canary Grass (Phalaris arundinacea) as a Biological Model in the Study of Plant Invasions. Critical Reviews in Plant Sciences,23:5,415 — 429.

Leatherland, J.F. 1993. Field Observations on Reproductive and Developmental Dysfunction in Introduced and Native Salmonids from the Great Lakes. Journal of Great Lakes Research 19(4):737-51.

LeBlanc, G.A. 1995. Are Environmental Sentinels Signaling? Environmental Health Perspectives 103(10):888-90.

Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. In T.M. Quigley and S. J. Arbelbide eds “An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III.” U.S. Department of Agriculture, USDA Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen Tech Rep PNW-GTR-405).

Lefcort, H.; R.A. Meguire; L.H. Wilson; and W.F. Ettinger. 1998. Heavy metals alter the survival, groth, metamorphosis, and antipredatory behavior of Columbia spotted frog (*Rana luteiventris*) tadpoles. Archives of Environmental Contamination and Toxicology 35: 447-456.

Leitch, C. and P. Fagg. 1985. Clopyralid herbicide residue in stream water after ariel spraying of a Pinus radiata plantation. New Zealand Journal of Forestry Science. 15(2) 195-206.

Leonard, D.L., Jr. 2001. Three-toed Woodpecker (Picoides tridactylys). In The Birds of North America. No. 588 (A. Poole and F. Gill, editors). The Birds of North America, Inc., Philadelphia, PA. 24 pp.

Lesko, Mark. 2006. History of Yellow Starthistle Infestation at Northside Timber Sale Area. Monitoring notes, Lookout Mountain District, Ochoco National Forest.

Leskiw, T., and R.J. Gutiérrez. 1998. Possible predation of a Spotted Owl by a Barred Owl. Western Birds 29:225–226.

Liu, L., Z. K. Punja and J. E. Rahe, 1997. Altered root exudation and suppression of induced lignification as mechanisms of predisposition by glyphosate of bean roots (Phaseolus

vulgarisL.) to colonization byPythiumspp. Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada, V5A 1S6

Lindsay, R.B., B.C. Johasson, R.K. Schroeder and B.C. Cates. 1989. Spring Chinook salmon in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife Information Report (Fish) 89-4, Portland, Oregon.

Lippert, Jenny. 2006. Personal communication. Botanist, Willamette national Forest, Eugene, Oregon.

Lips, K. 1999. Mass mortality and population declines of Anurans at an upland site in western Panama. Conservation Biology 13 (1): 117-125

Lips, K. 1999. Mass mortality and population declines of Anurans at an upland site in western Panama. Conservation Biology 13 (1): 117-125.

Lor, S.K. 1999. Habitat use and population status of marsh birds in western New York. M.S. thesis. Department of Natural Resources, Cornell University, Ithica New York. 135.

Lorz, Harold W. and others. 1979. Effects of selected herbicides on smolting of coho salmon. EPA-600/3-79-071. Corvallis, OR: U.S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory. 103 pg.

Lovtang, J. C. 2005. Distribution, habitat use, and growth of juvenile spring chinook salmon in the Metolius River basin, Oregon. Masters Thesis, Department of Fisheries and Wildlife, Oregon State University. Corvallis, Oregon. Reprinted with permission from Portland General Electric. Portland, Oregon.

Lyman, W.J. 1995. Transport and transformation processes. In: Fundamentals of Aquatic Toxicology. Rand, G.M., editor. Second edition. Taylor and Francis, Philadelphia, PA.

Lynch, J.A., E.S. Corbett, and K. Mussallem. 1985. Best management practices for controlling Nonpoint-course pollution on forested watersheds. Journal of Soil and Water Conservation, 40:164-167.

Mac, M.J., Edsall, C.C. 1991. Environmental Contaminants and the Reproductive Success of Lake Trout in the Great Lakes: An Epidemiological Approach. Journal of Toxicology Anf Environmental Health 33:375-94.

Mac, M.J., Schwartz, T.R., Edsall, C.C., Frank, A.M. 1993. Polychlorinated Biphenyls in Great Lakes Lake Trout and Their Eggs: Relations to Survival and Congener Composition 1979-1988. Journal of Great Lakes Research 19(4):752-65.

Mack, R.N. 1981. Invasion of *Bromus tectorum* L. into Western North America: an ecological chronicle. Agro-Ecosystems: 7: p.145-65.

Mack R.N. and J.N. Thompson. 1982. Evolution in steppe with few large, hooved mammals. American Midland Naturalist 119: 757-773.

Mafera, D. 2006. *Personal Communication*. Botanist, Paulina Ranger District, Ochoco National Forest.

Mafera, D. 2008. *Personal Communication*. Botanist, Paulina Ranger District, Ochoco National Forest. Timber sale survey results from 2003 to 2008.

Mafera, D. 2010. *Personal Communication*. Botanist/Invasive Plant Program Manager, Deschutes and Ochoco National Forests.

Mann, R. and J., Bidwell. 2000. Application of the FETAX protocol to assess the development toxicity of nonylphenol ethoxylate to Xenopus laevis and two Australian frogs. Aquatic Toxicology 51:19-29.

Mann/R.M., and J.R., Bidwell. 2001. The acute toxicity of agricultural surfactants to the tadpoles of four Australian and two exotic frogs. Environmental Pollution 114:195-205.

Mann, R.M. and J.R. Bidwell. 1999. The toxicity of glyphosate and several glyphosate formulations to four species of southwestern Australian frogs. Archives of Environmental Contamination and Toxicology 26: 193-199.

Marco, A.; C. Quilchano; and A.R. Blaustein. 1999. Sensitivity to nitrate and nitrite in pond-breeding amphibians from the Pacific Northwest, USA. Environmental Toxicology and Chemistry 18: 2836-2839.

Marquardt, S., H., Knight, C., Cox. Toxic secrets: "inert" ingredients in pesticides 1987-1997: Northwest Coalition for Alternatives to Pesticides (NCAP).

Marrs, R.H., C.T. Williams, A.J. Frost, and R.A. Plant. 1989. Assessment of the Effects of Herbicide Spray Drift on a Range of Plant Species of Conservation Interest. Environmental Pollution 59:71-86.

Marshall, D.B. 1997. Status of the White-headed woodpecker in Oregon and Washington. Audubon Society of Portland. 5151 N.W. Cornell Road, Portland, OR 97210. 20 pp.

Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2006. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR.

Martin, N.S. 1970. Sagebrush control related to habitat and sage grouse occurrence. Journal of Wildlife Management 34: 313-320.

Maser, C. B.R. Mate, J. F. Franklin, C.T. Dyrness. 1981. Natural history of Oregon coast mammals. Gen. Tech. Report PNW-133. USDA Forest Service, Pacific Northwest Range and Experiment Station, Portland, OR. 496pp

Mazurek, M.J. 2004. A maternity roost of Townsend's big-eared bats (*Corynorhinus townsendii*) in coast redwood basal hollows in northeastern California. Northwestern Naturalist 85:60-62.

Mazzu, Linda. 2004. A compilation of documents giving extra detail on the discussions provided in the Draft Preventing and Managing Invasive Plants EIS. Specialist report on file at U.S. Forest Service Pacific Northwest Region (Region 6) office, Portland, Oregon.

Mazzu, Linda. 2005. Common Control Measures for Pacific Northwest Invasive Plants. Available on the Forest Service Region Six Invasive Plants website: www.fs.fed.us/r6/invasiveplant-eis

McAdoo, J.K.; S.R. Swanson; B.W. Schultz; and P.F. Brussard. 2004. Vegetation management for sagebrush-associated wildlife species. P. 189-193 in USDA Forest Service Proceedings RMRS-P-31.

McArthur, E. D., and J. E. Ott. 1996. Potential natural vegetation in the 17 conterminous Western United States. Pages 16–28 in J. R. Barrow, E. D. McArthur, R. E. Tausch, and J. Robin, editors. Proceedings of the Symposium on Shrubland Ecosystem Dynamics in a Changing Environment. U.S. Forest Service, Intermountain Research Station Technical Report INT-GTR-338.

McCarthy, J.J. and J.D. Kobriger. 2005. Management plan and conservation strategies for greater sage-grouse in North Dakota. North Dakota Game and Fish Dept. 30 pp.

McCune, B. and L. Geiser. 2009. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, Oregon.

McDowell, S.C. 2002. Photosynthetic Characteristics of Invasive and Noninvasive Species of Rubus (Rosaceae). American Journal of Botany 89(9): 1431–1438. 2002.

McIntosh, B.A., Sedell, J.R., Smith, J.E., Wissmar, R.C., Clarke, S.E., Reeves, G.H., and Brown,

L.A., 1994. Management History of Eastside Ecosystems: Changes in Fish Habitat Over 50 years, 1935 to 1992. Eastside Forest Ecosystem Health Assessment, Vol III, USFS Gen. Tech. Rept. PNWGTR- 321, Portland, OR.

McPhail, J.D. and C.B. Murray. 1979. The early life-history and ecology of Dolly Varden, Salvelinus malma, in the Upper Arrow Lakes. Department of Zoology and Institute of Animal Resources, Vancouver.

Mehta, S.V., R.G. Haight, F.R. Homans, S. Polasky, and R.C. Venette. 2007. Optimal detection and control strategies for invasive species management. Ecological Economics 61:237-245.

Meyer, J.S., Irwin, L.L., and M.S. Boyce. 1998. Influence of habitat abundance and fragmentation on northern spotted owls in western Oregon. Wildlife Monographs 139: 1-51.

Michael, J.L. and D.G. Neary. 1993. Herbicide dissipation studies in southern forest ecosystems. Environ. Toxicol. and Chem. 12: 405-410.

Michael, J.L. 2000. Pesticides (Chapter 13) In: Drinking water from forests and grasslands, a sythesis of scientific literature. G.E. Dissmeyer, editor. USDA Forest Service. Southern Research Station. GTR SRS-39.

Michael, J.L. 2004. Best management practices for silvicultural chemicals and the science behind them. Water, Air and Soil Pollution: Focus. 4: 95-117.

Michael, J.L. and S.S. Ruiz-Cordova. 2006. Physical, chemical, and biological impacts of intensive forest management on streams draining watersheds in the coastal plain of Alabama. In: Proceedings 2006 IUFRO Forest Plantations Meeting. 10-13 October 2006 at the DoubleTree Guest Suites in Charleston, SC.

Miller, T.W. et al. 2008. Managing Reed Canarygrass (Phalaris arundinacea) to Aid in Revegetation of Riparian Buffers. Weed Technology 2008 22:507-513.

Mills, G.S., Dunning, J. B. Jr., and Bates, J. M. 1989. Effects of urbanization on breeding bird community structure in southwestern desert habitats. *Condor* (91): p.416-28.

Minnesota Department of Natural Resources. 2006. White and yellow sweet clover (*Melilotus alba*; *M. officinalis*). Available on: http://www.dnr.state.mn.us/invasives/terrestrialplants/herbaceous/whitesweetclover.html

Molina, Randy, David Pilz, Jane Smith, Susie Dunham, Tina Dreisbach, Thomas O'Dell, and Michael Castellano. 2001. Conservation and Management of Forest Fungi in the Pacific Northwestern United States: an Integrated Ecosystem Approach. *In* Moore, D., M.M. Nauta, S.E. Evans and M. Rotheroe, editors. Fungal Conservation – Issues and Solutions. Cambridge University Press, Cambridge, UK. Pages 19-63.

Moore, Kevin R. and C.J. Henny. 1983. Nest Site Characteristics of Three Coexisting Accipiter Hawks in Northeastern Oregon. Raptor Research 17(3):65-76

Morse, R.A. and N.W. Calderone. 2000. The value of honey bees as pollinators of U.S. crops in 2000. Bee Culture Magazine 128: 1-14.

Moser, L. and D. Crisp. 2000. Mediterranean sage, *Salvia aethiopis*. San Francisco Peaks Weed Management Area fact sheet on Salvia aethiopis. Coconino National Forest. Available online at http://www.usgs.nau.edu/swepic/factsheets/saaesf_info.pdf.

Mote, P.W. 2004. How and why is Northwest climate changing? Pp. 11-22 In D.L Peterson, J.L. Innes, and K. Obrian (eds.). Climate change, carbon, and forestry in Northwestern North America: Proceedings of a Workshop. November 14-15, 2001. Orcas Island, Washington. USDA Forest Service, Pacific Northwest Research Station, Gen. Tech. Rept. PNW-GTR-614.

Mote, P.W. and 18 co-authors. 1999. Impacts of climate variability and change: Pacific Northwest. A report of the Pacific Northwest Regional Assessment Group for the U.S. Global Change Research Program. JISAO/SMA Climate Impacts Group, University of Washington, Seattle.

Mullan, J.W., K. Williams, G. Rhodus, T. Hillman, and J. McIntyre. 1992. Production and habitat of salmonids in mid-Columbia River tributary streams. U. S. Fish and Wildlife Service. Monograph 1.

Muths, E., P.S. Corn, A.P. Pessier, and D.E. Green. 2003. Evidence for disease-related amphibian decline in Colorado. Biological Conservation 110: 357-365.

NCASI 2000. Riparian vegetation effectiveness. National Council for Air and Stream Improvement. Technical Bulletin No 799

National Park Service. 1999. Humminbirds succumb to vegetative "Velcro". Park Science – Integrating Research and Resource Management. Vol. 19, Number 1. February 1999. USDI National Park Service, Washington, D.C.

National Research Center. 1996. Risk Assessment in the Federal Government: Managing the Process. 13th (1996) ed. Washington DC: National Academy Press.

National Assessment Synthesis Team. 2000. Climate change impacts on the United States: The potential consequences of climate variability and change. US Global Change Research Program. Washington, D.C. 154pp.

NatureServe. 2003. Nature Serve Explorer: An online encyclopedia of life [web application]. Version 1.8. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: December 19, 2003).

NatureServe. 2003. Coturnicops noveboracensis. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

NatureServe. 2006. *Bartramia longicauda*. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

NatureServe. 2011. Nature Serve Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Neary, DG and others. 1985. Picloram Movement in an Appalachian Hardwood Forest Watershed. Journal of Environmental Quality, vol. 14, no. 4, October-December 1985. p 585-592.

Neary, D.G., Michael, J.L. 1989. Appendix C Effects of Herbicides on Soil Productivity and Water Quality. In: USDA Forest Service. Draft Environmental Impact Statement, Vegetation Management in the Ozark/Ouachita Mountains. Southern Region Management Bulletin R8-MB-23, Atlanta, GA, 842 pp.

Neitzel, D.A., and T.J. Frest. 1992. Survey of Columbia River Basin Streams for Giant Columbia River Spire Snail *Fluminicola columbiana* and Great Columbia River Limpet *Fisherolla nuttalli*. PNL-7103, Pacific Northwest Laboratory, Richland, Washington.

Nehlsen, W. 1995. Historical salmon and steelhead runs of the upper Deschutes River and their environments. Portland General Electric Company, Hydro Licensing Department. Portland, Oregon.

Nelson, T.K. 2000. Trout Creek 2000 Summer Steelhead Outmigrant Trapping Results. Oregon Department of Fish and Wildlife, Madras, Oregon.

Newmaster, Steven G., F. Wayne Bell, and Dale H. Vitt. 1999. The effects of glyphosate and triclopyr on common bryophytes and lichens in northwestern Ontario. Canadian Journal of Forest Research 29: 1101-1111.

Norris, L.A., H.W. Lorz, and S.V. Gregory. 1983. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America. USDA Forest Service General Technical Report PNW-149. 95 pg.

Norris, Logan A. 1983. Monitoring streams for herbicide residues from brush control operations on BPA powerline rights-of-way: a rationale and protocol. Corvallis, Oregon: Oregon State University, School of Forestry. 60 pg.

Norris, L.A., Lorz, H.W., and Gregory, S.V. 1991. Forest Chemicals. *American Fisheries Society Special Publication* 19:207-296.

North American Pollinator Protection Campaign. 2006. Fact Sheet available on-line at www.NAPPC.org or www.coevolution.org.

Olsen E.A., P.M.P. Beamesderfer, M.L. McLean, and E.S. Tinus. 1992. Salmon and steelhead stock summaries for the Deschutes River Basin: an interim report. Columbia River Coordination Program, Oregon Department of Fish and Wildlife, Portland, Oregon. Contract DE-FC79-89BP94402, Project 88-108. Prepared for Bonneville Power Administration, Portland, Oregon.

Olson, B.E. and R.G. Kelsey. 1997. Effect of Centaurea maculosa on Sheep Rumen Microbial Activity and Mass in Vitro. Journal of Chemical Ecology, Vol 23, Number 4.

Olson, Bret E. 1999. Impacts of Noxious Weeds on Ecologic and Economic Systems. *In:* Sheley, Roger L. and Janet K. Petroff, editors. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis, Oregon.

O'Neil, Cynthia. 1992. Species Conservation Strategy for Peck's Penstemon (*Penstemon peckii*). Deschutes National Forest, Bend, Oregon.

Oregon Biodiversity Information Center. 2010. Updated list of Rare, Threatened or Endangered Species. Available on: http://orbic.pdx.edu/

Oregon Department of Agriculture. 2005. Summary report on herbicide acres and usage on the Deschutes National Forest, 2000-2005. On file at Deschutes National Forest Supervisor's Office, Bend, Oregon.

Oregon Department of Agriculture. 2008. Pesticide Use Reporting System. 2007 Annual Report.

Oregon Department of Environmental Quality (ODEQ). 1999. Upper Deschutes River Basin R-EMAP: 1997-1998 Water Chemistry Summary. Oregon Department of Environmental Quality, Laboratory Division, Biomonitoring Section. Tech. Rpt. BIO99-04.

Oregon Department of Fish and Wildlife. 1996. Deschutes River Subbasin Fish Management Plan. High Desert Region, Bend District, Bend, Oregon.

Oregon Dept. of Fish and Wildlife. 2000a. Oregon guidelines for timing of in-water work to protect fish and wildlife resources. http://www.dfw.state.or.us/lands/0600_inwtrguide.pdf

Oregon Dept. of Fish and Wildlife. 2000b. Redd Count Data in the Trout Creek Watershed. Unpublished data, Madras, Oregon.

Oregon Dept. of Fish and Wildlife. 2003. Deep Creek redband trout migration study: 2003 Progress report. Oregon Department of Fish and Wildlife. Prineville, OR.

Oregon Dept. of Forestry. 2000. Final Report – Aerial Pesticide Application Monitoring. Forest Practices Monitoring Program. Technical Report 7, March 2000.

Oregon State University. 2009. The Economics of Invasive Species. Prepared for the Oregon Invasive Species Council. http://seagrant.oregonstate.edu/sgpubs/onlinepubs.html.

Pagel, J. Unpublished data. Peregrine falcon nest site data, 1983-2006, 1983-2004 US Forest Service, Regional Peregrine Falcon Specialist; data collected for PNW Interagency Peregrine Falcon Program, Ashland OR; 2004-2006, US Fish and Wildlife Service, Carlsbad, CA.

Pajutee, M. 2006b. Personal Communication. Sisters Ranger District Ecologist.

Pajutee, M. 2007. Personal Communication. Sisters Ranger District Ecologist.

Pajutee, M. 2008. Ribbongrass Removal Demonstration. An unpublished report by Sisters Ranger District.

Pajutee, Maret. 2009. Species Conservation Strategy Update for Peck's Penstemon (*Penstemon peckii*). Deschutes National Forest, Sisters, Oregon.

Pang, L., Close, M.E., Watt, J.P.C., and K.W. Vincent, 2000. Simulation of picloram, atrazine, and simazine leaching through two New Zealand soils and into groundwater using HYDRUS-2D. Journal of Contaminant Hydrology. Vol. 44, Issue 1, June 2000, pp. 19-46.

Parker, P.E. and Christensen, G.F. 1964. Guides for controlling sediment from secondary logging roads. USDA Forest Service Inter Mountain Forest and Range Experiment Station, Ogden, UT, and Northern Region, Missoula MT.

Parks, et. al. 2005. Natural and land use history of Northwest Mountain Ecoregions in relation to patterns of plant invasions. Perspectives in Plant Ecology, Evolution and Systematics 7 (2005) 137-158.

Parks, C.G. Wisdom, M.J. and John G. Kie. 2005. The Influence of Ungulates on Non-native Plant Invasions in Forests and Rangelands: A Review. Unpublished paper, PNW Causal Paper – Ungulates, Appendix D of the R6 2005 FEIS.

Patten, K. 2003. Persistence and non target impacts of imazapyr associated with smooth cordgrass control in an estuary. Journal of Aquatic Plant Management. 41:1-6.

Paulsen, D.J. 1977. Ochoco National Forest Soil Resource Inventory. USDA Forest Service Pacific Northwest Region.

Peakall, David B., Fox, Glen A. 1987. Toxicological Investigations of Pollutant-related Effects in Great Lake Gulls. Environmental Health Perspectives 71:187-93.

Pearl, C. A. and M. P. Hayes. 2002. Predation by Oregon spotted frogs (*Rana pretiosa*) on western toads (*Bufo boreas*) in Oregon. American Midland Naturalist 147: 145-152.

Pearl C.A., Hayes MP. 2005. *Rana pretiosa*, Oregon spotted frog. Pp. 577-580 *In*: Lannoo MJ, editor. Amphibian declines: status and conservation of United States Amphibians. University of California Press, Berkeley, CA.1094 pp.

Pearl C.A., M.J. Adams, R.B. Bury, B. McCreary. 2004. Asymmetrical effects of introduced bullfrogs (*Rana catesbeiana*) on native Ranid frogs in Oregon. Copeia 2004 (1): 11–20.

Pearl, C.A. (US Geological Survey) and R. Roninger (Bureau of Land Management), pers. comm., May 2007

Pearson, R.R., and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. J. Raptor Res., 37(4): 265-276.

Pearson, D.E., Mckelvey, K.S., Ruggiero, L.F. 2000. Non-target effects of an introduced Biological control agent on Deer Mouse Ecology. Oecologia 122:121-8.

Pechmann, J.H.K., D.E. Scott, R.D. Semlitsch, J.P. Caldwell, L.J. Vitt, J.W. Gibbons. 1991. Declining amphibian populations: the problem of separating human impacts from natural fluctuations. Science 253: 892- 895.

Pellant, M. 1990. The cheatgrass-wildfire cycle – are there any solutions? In. McArther, E. Durant, E.M. Romney, S.D. Smith, P.T. Tueller. Proceedings of the Symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management: 1989 april 5-7. Las Vegas, NV. USDA Forest Service Gen. Tech. Rep. INT-276. Ogden, UT.

Perkins, P.J., J.H. Boermans, G.R. Stephenson. 2000. Toxicity of glyphosate and triclopyr using the frog embryo teratogenesis assay-*Xenopus*. Environmental Toxicology and Chemistry 19: 940-945.

Peterson, J.G. 1970. The food habits and summer distribution of juvenile sage grouse in central Montana. Journal of Wildlife Management 34: 147-155.

Pettis, J., Vanengelsdorp, D., Cox-Foster, D. 2007. Colony collapse disorder working group pathogen sub-group progress report. *Amer.Bee J.*. 147:595-597.

Pierson, E.D. 1988. Preliminary Results: *P.t. townsendii* in Coastal California 1987-1988. *In* The Status of Townsend's Big-Eared Bat (*Plecotus Townsendii*) in California. Report to the Nongame Bird and Mammal Section, California Department of Fish and Game. Sacramento, CA.

Pierson, E.D., et al. 1999. Species conservation assessment and strategy for Townsend's big-eared bat (*Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallescens*). Idaho Department of Fish and Game, Boise, Idaho.

Pilz, David and Randy Molina. 2001. Commercial harvests of edible mushrooms from the forests of the Pacific Northwest United States: issues, management, and monitoring for sustainability. Forest Ecology and Management 5593 (2001) 1-14.

Pilz, David. 2006. *Personal communication*. Forest mycologist, Oregon State University, Corvallis, Oregon.

Ponzetti J., B. Youtie, D. Salzer, and T. Kimes. 1998. The effects of fire and herbicides on microbiotic crust dynamics in high desert ecosystems: final report. Submitted to the Forest and Rangeland Ecosystem Science Center, Biological Resources Division, U.S.G.S. by The Nature Conservancy of Oregon, Portland.

Powell, R.A., and W.J. Zielinski. 1994. Pp. 38-73 *In* Ruggiero, L.F.; K.B. Aubry; S.W. Buskirk; L.J. Lyon; W.J. Zielinski (eds). The Scientific Basis for Conserving Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States, RM-GTR-254. Fort Collins, Colorado. USDA Forest Service, Rocky Mountain Research Station. 184 pp.

Powers, Charmane. 2006a. *Personal communication*. Botanist/Ecologist, Bend/Ft. Rock District, Deschutes National Forest, Bend, Oregon.

Powers, Charmane. 2006b. Draft pumice moonwort (Botrychium pumicola) Conservation Strategy. Deschutes National Forest, Bend, Oregon.

Pratt, K.L. 1984. Habitat selection and species interactions of juvenile west slope cutthroat trout, *Salmo clarki Lewisi*, and bull trout, Salvelinus confluentus, in the upper Flathead River Basin. M.S. Thesis, University of Idaho, Moscow.

Pratt, K.L. 1991. Bull Trout scale analysis for the Metolius River Basin. Final Report, USDA Forest Service, Deschutes National Forest. Bend, Oregon.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 in P.J. Howell and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain Bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Pyke, C.R.; R. Thomas; R.D. Porter; J.J. Hellmann; J.S. Duke; D.M. Lodge; and G. Chavarria. 2008. Current practices and future opportunities for policy on climate change and invasive species. Conservation Biology 22(3): 585-592.

Pyle, R.M. 2002. The Butterflies of Cascadia. A Field Guide to all the Species of Washington, Oregon, and Surrounding Territories. Seattle Audubon Society. 420 pp.

Quigley, T.M., and Arbelbide, S.J., (eds.). 1997. An assessment of ecoystem components in the interior Columbia Basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station 3:1057-713 (656).

Quintana-Coyer, D.L. et al. 2004. Survey Protocol for the Great Gray Owl within the Range of the Northwest Forest Plan. Prepared for the USDA Forest Service and USDI Bureau of Land Management, Version 3.0.

Ragotzkie, K. E., R. L. Westman. 2000. Leafy Spurge Control in a Seasonally Flooded Riparian Environment. Society of Range management 56th Annual meeting Abstracts, February 2 – 6, 2003.

Raloff, J. 1998. Botanical 'velcro' entraps hummingbirds- burrs cause bird fatalities- brief article [Web Page]. Located at: http://www.findarticles.com/p/articles/mi_m1200/is_n16_v154/ai_21250276. Accessed 2004 Jul.

Ramwell, C.T., A.I.J. Heather, and A.J. Shepherd. 2002. Herbicide loss following application to a roadside. Pest Management Science 58: 695-701.

Randall, J.M. 1996. Weed control for the preservation of biological diversity. Weed Technology 10: p.370-83.

Ratcliff, et al. 2006. Changes in microbial community structures following herbicide (glyphosate) additions to forest soils. In: Applied Soil Ecology 34 (2006) 114-124.

Ratliff, D.E. and P.J. Howell. 1992. The status of bull trout population in Oregon. Pages 10-17 in P.J. Howell and D.V. Buchanan, eds., Proceedings of the Gearhart Mountain Bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Ratliff, D.E. 1992. Bull trout investigations in the Metolius River-Lake Billy Chinook system. Pages 37-44 in P.J. Howell and D.V. Buchanan (eds), Proceedings of the Gearhart Mountain Bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Ratliff, D.E., S.L. Thiesfeld, W.G. Weber, A.M. Stuart, M.D. Riehle, and D.V. Buchanan. 1996. Distribution, life history, abundance, harvest, habitat and limiting factors of bull trout in the Metolius River and Lake Billy Chinook, Oregon, 1934-1994. Information Report, Oregon Department of Fish and Wildlife, Portland, Oregon.

Rawinski, T.J., and Malecki, R.A. 1984. Ecological relationships among purple loosestrife, cattail and wildlife at the Montezuma National Wildlife Refuge. New York Fish and Game Journal 31(1): p.81-7.

Reaser, J.K., and D.S. Pilliod. 2005. *Rana luteiventris* Columbia spotted frog. Pp. 559-563 In Lannoo MJ, editor. Amphibian declines: status and conservation of United States Amphibians. University of California Press, Berkeley, CA. 1094 pp.

Reed, J.M. and A.R. Blaustein. 1995. Assessment of "nondeclining" amphibian populations using power analysis. Conservation Biology 9 (5): 1299-1300.

Rees, J. and P. Lee. 1990. Management of bald eagles, Haliaeetus leucocephalus, and their habitats on National Forests of the Pacific Northwest. USDA Forest Service, Portland, OR. 61 pp. + appendices.

Reichard, S.H, and P. White. 2001. Horticulture as a pathway of invasive plant introductions in the United States. *Bioscience* 51(2): 103-13.

Reisenbichler, R.R., J.D. McIntyre, M.F. Solazzi, and S.W. Landino. 1992. Genetic variation in steelhead of Oregon and Northern California. Trans. American Fish. Soc. 121:158-69.

Relyea, R.A. 2005. The lethal impacts of Roundup and predatory stress on six species of North American tadpoles. Archives of Environmental Contamination and Toxicology 48: 351-357.

Relyea, R.A. 2005b. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. Ecological Applications 15(2): 618-627.

Rashin, E.B., ClJ., Clishe, A.T. Loch, and J.M. Bell. 2006. Effectiveness of timber harvest practices for controlling sediment related water impacts. Journal of the American Water Resources Association, October 2006, p. 1307-1327.

Reynolds, R.T., R.L. Bassett, R.T. Graham, P.L. Kennedy, and M.H Reiser. 1991 Threatened, endangered and sensitive species: the northern goshawk. Proceedings of the Commission on the Arizona Environment Conference, Northern Arizona University, Flagstaff, Arizona, 5-7 June 1991.

Reynolds, Richard T., E. Charles Meslow, and Howard M. Wight. 1978. Nesting Habitat of Coexisting Accipiter In Oregon. Journal of Wildlife Management 46(1):124-138.

Rice, Peter M., J. Christopher Toney, Donald J. Beduna, and Clinton E. Carlson. 1993. Plant Biodiversity after Herbicide Applications. Paper presented at the Proceedings of the Idaho Weed Control Association meeting, February 17-18, 1993, Boise, Idaho, and published in "Knapweed", Washington State University Extension Service, August 1993, Vol. 7, No. 2.

Rice, Peter M., J. Christopher Toney, Donald J. Beduna, and Clinton E. Carlson. 1997. Plant community diversity and growth form responses to herbicide applications for control of Centaurea maculosa. Journal of Applied Ecology 34: 1397-1412.

Rice, P.M., Toney, J. C., Bedunah, D.J., and Carlson, C.E. 1997. Elk winter forage enhancement by herbicide control of spotted knapweed. Wildlife Society Bulletin 25(3): p.627-33.

Ridgely, R.S., T.F. Allnutt, T. Brooks, D.K. McNicol, D.W. Mehlman, B.E. Young, and J.R. Zook. 2003. Digital Distribution Maps of the Birds of the Western Hemisphere, version 1.0. NatureServe, Arlington, Virginia, USA.

Mike Riehle. personal communication. 2006. Sisters Ranger District. Fisheries Biologist. Sisters, OR

Riehle, M., W. Weber, A.M. Stuart, S.L. Thiesfeld, and D.E. Ratliff. 1997. Progress report of the multi-agency study of bull trout in the Metolius River System, Oregon. Pages 137-144 in W.D. Makay, M.K. Brewin, and M. Monita, eds., Friends of the bull trout conference proceedings, Bull Trout Task Force (Alberta), c/o Trout Unlimited Canada. Calgary, Alberta.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302, USDA Forest Service, Intermountain Research Station, Boise, Idaho.

Rife, Daniel. 2011. Aquatic Management Indicator Species Analysis, Invasive Plant Treatment Project, Deschutes and Ochoco National Forests and Crooked River National Grassland. Bend, Oregon.

Roberts, Anne E. Personal communication – email. Wildlife Biologist, USDA Forest Service, Crooked River National Grassland, Prineville, OR.

Rogers, Jr., H.H.; G.B. Runion; S.A. Prior; A.J. Price; H.A. Torbert III; and D.H. Gjerstad. 2008. Effects of elevated atmospheric CO2 on invasive plants: comparison of purple and yellow nutsedge (Cyperus rotundus L. and C. esculentus L.). Journal of Environmental Quality 37: 395-400.

Rogers, Jr., H.H.; D.H. Gjerstad ; G.B. Runion; S.A. Prior; A.J. Price; E. Van Santen; H.A. Torbert III. 2005. Effects of elevated atmospheric CO2 on invasive weed species in managed terrestrial ecosystems of the southeastern U.S. Southeastern Regional Center, National Institute for Global Environmental Change, Annual Report for Fiscal Year 2004. University of Alabama, Tuscaloosa, AL. 4 pp.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology. Pagosa Springs, CO.

Roslycky, E. B. 1982. Glyphosate and the response of the soil microbiota. Soil Biol. Biochem.14:87-92.

Roslycky, E. B. 1986. Microbial response to sethoxydim and its degradation in soil. Can. J. Soil Sci. 66:411-419. (referenced in Sethoxydim paper in reference research folder)

Rowland, M.M, and Wisdom, M.J. 2002. Research problem analysis for Greater Sage-grouse in Oregon. Final Report. Oregon Department of Fish and Wildlife; U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington State Office; and U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 75 p.

Ruggiero, L.F.; K.B. Aubry; S.W. Buskirk; L.J. Lyon; W.J. Zielinski. 1994. The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States, RM-GTR-254. USDA Forest Service, Rocky Mountain Range and Experiment Station.. Fort Collins, Colorado. 184 p.

Saab, V.A. and J.G. Dudley. 1998. Responses of cavity-nesting birds to stand-replacement fire and salvage logging in ponderosa pine/Douglas-fir forests of southwestern Idaho. Res. Pap. RMRS-RP-11. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 17 p.

Scheinost, P. 2008. *Ventenata dubia* Plant Guide. Natural Resource Conservation Service Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

Schmidt, K.A., and Whelan, C.J. 1999. Effects of exotic *Lonicera* and *Rhamnus* on songbird nest predation.Volume 13. 6. p 1502-6.

Schmitt, C.L. and L.H. Spiegel. 2008. Johnson's Hairstreak butterfly and dwarf mistletoe backgrounder. Report to Forest Supervisors of the Wallowa-Whitman, Umatilla, and Malheur National Forests through the Natural Resource Staff Officers.

Scholz, N.; J. Incardona; C. Stehr; and T. Linbo. 2005. Evaluating the effects of forestry herbicides on early development of fish using the zebrafish phenotypic screen. Final report submitted to USDA Forest Service, Pacific Northwest Region for FS-PIAP FY03-04. November 18, 2005. 8 p.

Schreck, C.B., H.L. Li, R.C. Hjort, and C.S. Sharpe. 1986. Identification of Columbia River Chinook and steelhead trout. Bonneville Power Administration Project 83-451, Portland, Oregon.

Schroeder M.A., J.R. Young, C.E. Braun. 1999. Sage grouse (*Centrocercus urophasianus*). p 1–28 In: A. Poole and F. Gill (eds.) The birds of North America. The Birds of North America, Inc., Philadelphia, Penn.

Schuster, M., T. Prather. 2005. Scotch Thistle. College of Agricultural and Life Sciences, University of Idaho. http://extension.ag.uidaho.edu/minidoka/ScotchThistle.htm

Scott, J.A. 1986. The butterflies of North America: a natural history and field guide. Stanford Univ. Press. Stanford: CA

Seidman, V.M. and C.J. Zabel. 2001. Bat activity along intermittent streams in northwestern California. Journal of Mammalogy 82(3):738-747.

Semlitsch, R.D. 2000. Principles for management of aquatic-breeding amphibians. Journal of Wildlife Management 64(3):615-31.

SERA (Syracuse Environmental Research Associates, Inc.). 1997. Effects of Surfactants on the Toxicity of Glyphosate, with Specific Reference to RODEO. SERA TR 97-206-1b February 6, 1997.

SERA (Syracuse Environmental Research Associates, Inc.). 1997. Use and Assessment of Marker Dyes Used With Herbicides. SERA TR 96-21-07-03b December 21, 1997.

SERA (Syracuse Environmental Research Associates, Inc.). 1998. 2,4-Dichlorophenoxyactic acid formulations - Human Health and Ecological Risk Assessment - Final Report. SERA TR 9595-21-09-01d. September 20, 1998.

SERA (Syracuse Environmental Research Associates, Inc.). 2001. Sethoxydim [Poast] -Human Health and Ecological Risk Assessment Final Report. SERA TR 01-43-01-01c. October 31, 2001

SERA (Syracuse Environmental Research Associates, Inv.). 2001a. Preparation of Environmental Documentation of Risk Assessments for the USDA/Forest Service. SERA MD 2007-01a

SERA (Syracuse Environmental Research Associates, Inc.). 2002. Neurotoxicity, Immunotoxicity, and Endocrine Disruption with Specific Commentary on Glyphosate, Triclopyr, and Hexazinone: Final Report. SERA TR 01-43-08-04a February 14, 2002.

SERA (Syracuse Environmental Research Associates Inc. 2003a. Glyphosate- Human Health and Ecological Risk Assessment Final Report.

SERA (Syracuse Environmental Research Associates, Inc.). 2003b. Picloram - Revised Human Health and Ecological Risk Assessment Final Report. SERA TR 03-43-26-01b. June 30, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003c. Sulfometuron methyl -Human Health and Ecological Risk Assessment Preliminary Draft - Introduction a Program Description. SERA TR 02-43-17-02a. October 16, 2003. References-24

SERA (Syracuse Environmental Research Associates, Inc.). 2003d. Triclopyr - Revised Human Health and Ecological Risk Assessments Final Report. SERA TR 02-43-13-03b. March 15, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003e. Documentation for Worksheets Version 2.04b - Human Health and Ecological Risk Assessments. SERA WSD 01-2.04. June 22, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Documentation for the Use of GLEAMS (Version 3) and Auxiliary Programs in Forest Service Risk Assessments (Version 2.01), SERA TD 2003-02e. Syracuse Environmental Research Associates, Inc., Fayetteville, NY. Available at www.sera-inc.com.

SERA (Syracuse Environmental Research Associates, Inc.). 2004a. Chlorsulfuron - Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-18-01c. November 21, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004b. Clopyralid - Human Health and Ecological Risk Assessment - Final Report. SERA TR 04-43-17-03c. December 5, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004c. Imazapic - Human Health and Ecological Risk Assessment - Final Report. SERA TR 04-43-17-04b. December 23, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004d. Imazapyr - Human Health and Ecological Risk Assessment – Final Report. SERA TR 04-43-17-05b. December 18, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004e. Metsulfuron methyl - Human Health and Ecological Risk Assessment Final Report. SERA TR 02-43-17-01b. December 9, 2004.

SERA (Syracuse Environmental Research Associates/Inc.). 2004f. Dicamba - Final Report. SERA TR 04-43-17-06d November 24, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004g. Documentation for the Use of GLEAMS (Version 3) and Auxiliary Programs in Forest Service Risk Assessments (Version 2.04). SERA TD 2004-02.04b February 10, 2004.

SERA (Syracuse Environmental Research Associates, Inc.). 2004h. Sulfometuron methyl - Human Health and Ecological Risk Assessment – Final Report. SERA TR 03-43-17-02c. December 14, 2004.

SERA (Syracuse Environmental Research Associates, Inc.) 2005. Documentation for Forest Service. Worksheet Program Version 4.0 -A Program for the Preparation of Worksheets Supporting Human Health and Ecological Risk Assessments.

SERA (Syracuse Environmental Research Associates, Inc.). 2007. Preparation of Environmental Documentation of Risk Assessments. SERA MD 2007-01a. January 21, 2007.

SERA (Syracuse Environmental Research Associates, Inc.). 2008. GLEAMS-Driver Program. Model developed under USDA Forest Service contract AG-3187-C-06-0010. Paul Mistretta, contracting officer representative, USDA Forest Service, Region 8, Atlanta, GA.

SERA (Syracuse Environmental Research Associates, Inc.). 2009. Control/Eradication Agents for the Gypsy Moth – Support Material for Response to Comments. Submitted to Forest Service under contract AG-3187-C-06-0010 www.sera-inc.com

SERA (Syracuse Environmental Research Associates, Inc.). 2011a. Glyphosate – Human Health and Ecological Risk Assessment Final Report. SERA TR-052-22-03b. March 25, 2011.

SERA (Syracuse Environmental Research Associates, Inc.). 2011b. Imazapyr – Human Health and Ecological Risk Assessment Final Report. SERA TR-052-29-03a. December 16, 2011.

Sheaffer, C. C. and G. C. Marten. 1995. Chapter 27: reed canarygrass. 335–343. in Barnes, R. F., D. A. Miller, and C. J. Nelson, editors. An Introduction to Grassland Agriculture in Forages: The Science of Grassland Agriculture, 5th ed., Volume 1. Ames, IA Iowa State University Press.

Sheley RL Petroff JK (editors.) 1999. Biology and Management of Noxious Rangeland Weeds. *Medusahead.* Oregon State University Press, Corvallis, Oregon.

Sheley, Roger. 2005. *Personal communication*. Research Weed Scientist, Eastern Oregon Agricultural Research Center, Burns, Oregon. Field trip to review medusahead sites on Crooked River National Grassland, August 31, 2005.

Sheley, Roger. 2004. Weed presentation given by Roger Sheley on Janurary 7, 2004 in Redmond, Oregon. Eastern Oregon Agricultural Experiment Station in Burns Oregon.

Sheley, Roger. 2005. *Personal communication*. Research Weed Scientist, Eastern Oregon Agricultural Research Center, Burns, Oregon. Field trip to review medusahead sites on Crooked River National Grassland, August 31, 2005.

Shen, Miaoqing; Xiaolong Yang; D. Cox-Foster; Liwang Cui. 2005. The Role of varroa mites in infection of Kashmir bee virus (KBV) and deformed wing virus (DMV) in honey bees. Virology 342: 141-149.

Shepard, B., K.L. Pratt, and P. Graham. 1984. Life history of west slope cutthroat and bull trout in the upper Flathead River Basin, Montana. Department of Fish, Wildlife, and Parks, Montana.

Sherwin, D. 2005. Personal communication. Deschutes County Vegetation Manager, Bend, Oregon.

Sherwin, D. 2006. Personal communication. Deschutes County Vegetation Manager, Bend, Oregon.

Shunk Stephen and Shelley Borchert. 2001. Birds in Forested Landscapes: 2001 recreation study. Unpublished report for the Deschutes National Forest in partnership with Cornell Laboratory of Ornithology. 7 p. with maps and tables.

Sibley, D.A. 2000. National Audubon Society The Sibley Guide to Birds. 543 pp.

Siemers, J. 2002. A survey of Colorado's caves for bats. Colorado Division of Wildlife.

Simmons, J. 2003. Northern flicker. Pp. 370-372 In D.B. Marshall, M.G. Hunter, and A.L. Contreras, (eds.). Birds of Oregon. Oregon State University Press. Corvallis, Oregon. 752pp.

Simpson, Mike. 2005. *Personal communication*. Ecologist, Deschutes and Ochoco National Forests, Bend, Oregon.

Smith, G.R. 2001. Effects of Acute Exposure to a Commercial Formulation of Glyphosate on the Tadpoles of Two Species of Anurans. Bull. Environ. Contam. Toxicol. 67:483-8.

Smith A.E. and A.J. Aubin. 1989. Persistance studies with the herbicide clopyralid in prairie soils at different temperatures. Bulletin of Environmental Toxicology. 42: 670-675.

Smith, S.D.; T.E. Huxman; S.F. Zitzer; T.N. Charlet; D.C. Housman; J.S. Coleman; L.K. Fenstermaker; J.R. Seemann; and R.S. Nowak. 2000. Elevated CO_2 increases productivity and invasive species success in an arid ecosystem. Nature 408:79-82.

Spencer, K. 2003. Red-necked grebe. Pp. 31-32 In D.B. Marshall, M.G. Hunter, and A.L. Contreras, (eds.). Birds of Oregon. Oregon State University Press. Corvallis, Oregon. 752pp.

Spuher, D.R. 1994. Low plant diversity found in communities dominated by reed canary grass (Phalaris arundinacea). p. 43–47. In D.C. Hartnett (ed.) Proc. of the 14th North American Prairie Conf.: Prairie Biodiversity. 12–16 July 1994. Kansas State Univ., Manhattan.

Stalmaster, M.B. 1987. The Bald Eagle. Universe Books. New York, New York.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. J. Wildl. Manage. 43:506-513.

Starnes, S.M.; C.A. Kennedy, and J.W. Petranka. 2000. Sensitivity of embryos of southern Appalachian amphibians to ambient solar UV-B radiation. Conservation Biology 14 (1): 277-282.

Steele, Dede. 2006. Personal communication. Wildlife biologist. Ochoco National Forest. Prineville, Oregon.

Stehr, C.M., Linbo, T.L., Bladwin, D.H., Sholz, N.L. and J.P. Incardona. 2009. Evaluating the effects of forestry herbicides on fish development using rapid phenotypic screens. North American Journal of Fisheries Management. 29:975-984.

Stern, M.A. 2003. Upland sandpiper. Pp. 222-223 *In* Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 752 pp.

Stern, M.A. and K.J. Popper. 2003. Yellow rail. Pp. 190-192 *In* Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 752 pp.

Stevens County Noxious Weed Control Board. 2006. Common teasel (*Dipsacus fullonum*). Colville, Washington. Available at: http://www.co.stevens.wa.us/weedboard/

Stuart, A., Grover D. and S. Thiesfeld. 1996. Redband trout investigations in the Crooked River Basin. Oregon Department of Fish and Wildlife. Prineville, OR.

Stuart, A.M., S.L. Thiesfeld, D.E. Ratliff, T. Fies, and B.M. Hooton. 1997. Changes in management of bull trout in the Metolius River from trash fish to trophy. Proceedings of the Friends of the Bull Trout Conference, Calgary, Alberta.

Stuart, A.M., D. Grover, T.K. Nelson, S.L. Thiesfeld. 2002. Draft report: Redband Trout investigations in the Crooked River Basin. Oregon Department of Fish and Wildlife. High Dessert Region, Prineville, Oregon.

Stuart, A.M., S.L. Thiesfeld, D.E. Ratliff, T. Fies, and B.M. Hooton. 1997. Changes in management of bull trout in the Metolius River from trash fish to trophy. Proceedings of the Friends of the Bull Trout Conference, Calgary, Alberta.

Surber, L., Rodney Knott, James Moore, Brent Roeder and Gary Hewitt. 2006. Presentation: Noxious weed utilization by sheep grazing Montana native range. 59th Society for Range Management Annual Meeting, Vancouver B.C., February 12 – 17, 2006.

Sussmann, P. 2006. Deschutes, Ochoco and Crooked River National Grasslands Invasive Plants EIS Draft Soils Resource Report 8/29/06. Deschutes National Forest. Bend, OR.

Sussmann, P. 2011. Metolius Ribbongrass Demonstration Project Monitoring Report: Dodd Fischer Property. Unpublished report, Deschutes National Forest.

Sveum, C.M.; J.A. Crawford, and W.D. edge. 1998. Use and selection of brood-rearing habitat by sage grouse in south central Washington. Great Basin Naturalist 58: 344-351.

Swenson, J.E.; C.A. Simmons, and C.D. Eustace. 1987. Decrease of sage grouse *Centrocercus urophasianus* after ploughing of sagebrush steppe. Biological Conservation 41: 125-132.

Sylvia D.M. and A.G. Jarstfer. 1997. Distribution of mycorrhiza on competing pines and weeds in a southern pine plantation. Soil Sci. Soc. Am. J. 61: 139-144.

Tausch, R.J. 2008. Invasive plants and climate change. (May 20, 2008). U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. http://www.fs.fed.us/ccrc/topics/invasive-plants.shtml

Taylor, K., and C. Potvin. 1997. Understanding the long-term effect of CO_2 enrichment on a pasture: the importance of disturbance. Canadian Journal of Botany 75(10): 1621-1627.

Taylor, D.M. and C.D. Littlefield. 1986. Willow flycatcher and yellow warbler response to cattle grazing. American Birds 40(5): 1169-1173.

The Nature Conservancy. 1987. Element Stewardship Abstract for *Melilotus officinalis* (sweetclover). Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds/udcavis.edu

The Nature Conservancy. 1988. Element Stewardship Abstract for Taeniatherum caput-medusae. Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu/esadocs/taencapu.html

The Nature Conservancy. 1998a. Element Stewardship Abstract for *Acroptilon repens* (Russian knapweed). Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu/

The Nature Conservancy. 1998b. Element Stewardship Abstract for *Convolvulus arvensis* L. (Field Bindweed). Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu

The Nature Conservancy. 1999. Weed Notes: *Salsola kali*. Compiled by TunjyLee Morisawa. Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu

The Nature Conservancy. 2003. Element Stewardship Abstract for Iris pseudacorus L. (Yellow flag iris, water flag). Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu

The Nature Conservancy. 2004. Element Stewardship Abstract for *Potentilla recta* L. (Sulfur cinquefoil). Available on The Nature Conservancy's Global Invasive Species Initiative website: http://tncweeds.ucdavis.edu

The Research Group. 2000. Economic Analysis of containment Programs, Damages, and Production Losses from Noxious Weeds in Oregon. In Radtke, Hans D. and Shannon W. Davis. Oregon Department of Agriculture Plant Division, Noxious Weed Control Program. http://www.oregon.gov/ODA/PLANT/weed_economicassess.shtml

Thomas, J.W., E.D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Unpublished interagency document.

Thomas, J.W.; C. Maser; and J.E. Rodiek. 1979. Wildlife habitats in managed rangelands - the Great Basin of southeastern Oregon: Riparian Zones. USDA Forest Service. Portland, Oregon. Gen. Tech. Rep. PNW-80. 18 pp.

Thompson, D., et al. 2000. Comparative fate of glyphosate and triclopyr herbicides in the forest floor and mineral soil of an Acadian forest regeneration site. Canadian Journal of Forest Research. Vol. 30. p.1808-1816, 2000.

Thompson, D.Q., Stuckey, R.L., and Thompson, E.B. 1987. Spread, impact, and control of purple loosestrife (*Lythrum salicaria)* in North American wetlands. Fish and Wildlife Research 2. USDI Fish and Wildlife Service, Washinton DC. 55p.

Tiedeman, A.R., Helvey, J.D., and Anderson, T.D. 1978. Stream chemistry and watershed economy following wildfire and fertilization. Journal Environ. Quality, Vol. 7, no. 4. p 580-589.

Tierney, K.B., P.S. Ross, H.E. Jarrard, K.R. Delaney and C.J. Kennedy. 2006. Changes in juvenile coho salmon elctro-olfacatogram during and after short term exposure to curren-use pesticides. Environmental Toxicology and Chemistry. 25(10):2809-2817.

Tisdall, J.M. and Oades, J.M. 1982. Organic matter and water-stable aggregates in soils. Journal of Soil Science 33: 141-163.

Tobalske, B.W. 1997. Lewis's Woodpecker (Melanerpes lewis), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/284

Torri, D., and L. Borselli. 2000. Water erosion. p. G171–G194. In M. Sumner (ed.). Handbook of soil science. CRC Press, Boca Raton, FL.

Trammell, M.A., and Butler, J.L. 1995. Effects of exotic plants on native ungulate use of habitat. Journal of Wildlife Management 59((4)): p.808-16.

Tu, C.M. 1994. Effects of herbicides and fumigants on microbial activities in soil. Bulletin of Environmental Contamination and Toxicology. 53 (1):12-17.

Tu, M., Callie Hurd, and John M. Randall. 2001. Weed Control Methods Handbook, The Nature Conservancy, http://tncweeds.ucdavis.edu, Version: April 2001.

Tu, Mandy. 2004. Reed Canarygrass (*Phalaris arundinacea* L.) Control and Management in the Pacific Northwest. The Nature Conservancy, Oregon Field Office, Portland, Oregon.

Tu, Mandy. 2005. *Personal communication*. Invasive Species Ecologist, The Nature Conservancy, Oregon Field Office, Portland, Oregon. Field trip to review Ribbongrass along Metolius River, Camp Sherman, Oregon, July 27, 2005.

Turner, Lauri. 2010a. Wildlife Report for Management Indicator Species, Species of Concern from the Northwest Forest Plan, and Landbirds – Travel Management Project FEIS, Deschutes National Forest.

Turner, Lauri. 2010b. Biological Evaluation of Threatened, Endangered, and Sensitive Wildlife – Travel Management Project FEIS, Deschutes National Forest.

Tyser, R.W 1992. Vegetation associated with two alien plant species in a fescue grassland in Glacier National Park, Montana. *Great Basin Naturalist 52,* 189-93.

University of California. 2006. Ecology and Management of Medusahead. University of California at Davis, Davis, California, http://californiarangeland.ucdavis.edu/water_quality/MEDUSA.HTM

University of Idaho. 2005. Scotch thistle. http://extension.ag.uidaho.edu/minidoka/ScotchThistle.htm

United States Department of Agriculture, Forest Service; United States Department of the Interior, Bureau of Land Management. 1994a. Record of Decision and Final Environmental Impact Statement for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Washington, D.C.: U.S. Government Printing Office. (*also referred to as the Northwest Forest Plan).*

United States Department of Agriculture, Forest Service, United States Department of the Interior, Bureau of Land Management. 1995. Environmental Assessment, Decision Notice, and Finding of No Significant Impact for the Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH).

United States Department of Agriculture, Forest Service, United States Department of the Interior, Bureau of Land Management. 1995a. Environmental Assessment, Decision Notice and Finding of No Significant Impact for the Inland Native Fish Strategy (INFISH).

United States Department of Agriculture, Forest Service, United States Department of the Interior, Bureau of Land Management. 2001a. Record of Decision, Standards and Guidelines and FSEIS for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standard and Guidelines. Portland, Oregon.

USDA Forest Service and United States Department of the Interior, Bureau of Land Management. 2006a. Memo re: Equivalent Effort Surveys for Survey and Manage Category B Species. Pacific Northwest Regional Office, Portland, Oregon. Dated April 3, 2006.

United States Department of Agriculture, Forest Service and United States Department of the Interior, Bureau of Land Management. 2006b. Joint aquatic and terrestrial programmatic biological assessment for lands within the Deschutes Basin administered by the Bureau of Land Management Prineville Office and the Deschutes and Ochoco National Forests: August 2006 – August 2009. 129 pp + appendices.

United States Department of Agriculture, Forest Service and United States Department of the Interior, Bureau of Land Management. 2012. Cladonia norvegica Species Fact Sheet. Interagency Special Status Sensitive Species Program website:

United States Department of Agriculture, Natural Resource Conservation Service. 1999. Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys, Second Edition.

United States Department of the Interior, Bureau of Land Management. 1996. Lower John Day River Integrated Weed Management. EA Number: OR-053-3-063. p 41-43.

United States Department of the Interior, BLM, Fish and Wildlife Service, United States Department of Agriculture, Forest Service, Oregon Dept. of Fish and Wildlife, Oregon Dept. of State Lands. 2000. Greater sage-grouse and sagebrush-steppe ecosystems: management guidelines. Unpublished document. 27 pp.

United States Deptartment of Commerce and NOAA 1973. National Weather Service Precipitation frequency atlas of the Western United States. Silver Springs, MD.

United States Department of Commerce. 2005. Endangered Species Act – section 7 consultation biological and conference opinion and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat consultation. National Marine Fisheries Service, Northwest Region. Seattle, WA.

United States Department of Commerce. 2008. Endangered Species Act – section 7 consultation biological and conference opinion and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat consultation. Fish Habitat Restoration Activities in Oregon and Washington CY2007-CY2012. National Marine Fisheries Service, Northwest Region. Seattle, WA.

United States Department of Commerce. 2012. Endangered Species Act Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Invasive Plant Treatment Project on Deschutes National Forest, Ochoco National Forest and Crooked River National Grassland, Oregon. National Marine Fisheries Service, Northwest Region. Seattle, WA.

United States Environmental Protection Agency. 1993. Wildlife Exposures Handbook, Vol.1. U.S. Environmental Protection Agency, Office of Research and Development. Washington, D.C. 572pp.

United States Environmental Protection Agency. 1997. Special Report on Environmental Endocrine Disruption: An Effects Assessment and Analysis. Washington D.C.: U.S. Environmental Protection Agency, Risk Assessment Forum Technical Panel. EPA Publication No. 630/R-96/012.

United States Environmental Protection Agency. 2000a. Lists of Other (Inert) Pesticide Ingredients. Office of Pesticide Programs. Washington, DC. Available at: http://www.epa.gov/opprd001/inerts/lists.html

United States Environmental Protection Agency. 2000b. Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures. Washington D.C.: U.S. Environmental Protection Agency, Risk Assessment Forum Technical Panel. EPA Publication No. 630/R-00/002.

United States Environmental Protection Agency, Office of Pesticide Programs. 2004. Overview of the Ecological Risk Assessment process in the Office of Pesticide Programs, U.S. Environmental Protection Agency; Endangered and Threatened Species Effects Determinations. Office of Prevention, Pesticides, and Toxic Substances; Office of Pesticide Programs, Washington, D.C. 92 pp.

United States Environmental Protection Agency. 2011. Pesticide General Permit. Office of Water and Office of Wastewater Management Water Permits Division. Washington, DC. Available at: http://www.deq.state.or.us/wq/wqpermit/indinfo.htm

United States Department of the Interior, Fish and Wildlife Service. 1981. Bald Eagle Management Guidelines Oregon-Washington. U.S. Fish and Wildlife Service, Portland, Oregon. 10pp.

United States Department of the Interior, Fish and Wildlife Service. 1986. Recovery plan for the Pacific Bald Eagle. U.S. Fish and Wildlife Service, Portland, Oregon. 160pp.

United States Department of the Interior, Fish and Wildlife Service. 1987. The northern spotted owl status review. U.S. Fish and Wildlife Service, Portland, OR.

United States Department of the Interior, Fish and Wildlife Service. 1989. The northern spotted owl; a status review supplement. U.S. Fish and Wildlife Service, Portland, OR.

United States Department of the Interior, Fish and Wildlife Service. 1990a. Final rule listing: listing of threatened status for northern spotted owl (*Strix occidentalis caurina*). Federal Register 55:26114-26194.

United States Department of the Interior, Fish and Wildlife Service. 1990b. 1990 status review: northern spotted owl; *Strix occidentalis caurina*. Report to the Fish and Wildlife Service, Portland, OR.

United States Department of the Interior, Fish and Wildlife Service. 1992a. Final Draft Recovery Plan for the Northern Spotted Owl. Unpublished Report. U.S. Department of Interior, Washington, D.C.

United States Department of the Interior, Fish and Wildlife Service. 1992b. Final rule: designate critical habitat for northern spotted owl (Strix occidentalis caurina). Federal Register 57:1796-1838.

United States Department of the Interior, Fish and Wildlife Service. 1995. Final rule: reclassify endangered to threatened for bird (*Haliaeetus leucocephalus*). Federal Register 60:35999-36010.

United States Department of the Interior, Fish and Wildlife Service. 1999. Proposed rule: delist bald eagle (*Haliaeetus leucocephalus*) in the lower 48 states. Federal Register 64:36453-36464.

United States Department of the Interior, Fish and Wildlife Service. 2002. Birds of Conservation Concern. U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, VA. 99 p.

United States Department of the Interior, Fish and Wildlife Service. 2003a. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the western sage grouse. February 7, 2003. Federal Register 68(26): 6500-6504.

United States Department of the Interior, Fish and Wildlife Service. 2003b. Endangered and threatened wildlife and plants; 90-day finding for a petition to list as endangered or threatened wolverine in the contiguous United States. Federal Register 68(203): 60112-60115.

United States Department of the Interior, Fish and Wildlife Service. 2004a. Endangered and threatened wildlife and plants; 12-month finding for a petition to list the West Coast Distinct Population Segment of the fisher (Martes pennanti); Proposed Rule. April 8, 2004. Federal Register 69(68): 18770-18792.

United States Department of the Interior, Fish and Wildlife Service. 2004b. Recovery outline for the Columbia Basin Distinct Population Segment of the pygmy rabbit (Brachylagus idahoensis). U.S. Fish and Wildlife Service, Upper Columbia Fish and Wildlife Office, Spokane, Washington. 25pp.

United States Department of the Interior, Fish and Wildlife Service. 2004c. Species assessment and listing priority assignment from: *Rana pretiosa*, Oregon spotted frog. U.S. Fish and Wildlife Service, Western Washington Field Office, Lacey, WA. 36p.

United States Department of the Interior, Fish and Wildlife Service. 2005a. Biological Opinion, Concurrence, and Conference Report on the Effects to 23 Species and 4 Critical Habitats from the U.S. Forest Service Pacific Northwest Region Invasive Plant Program (USFWS Reference Number 1-7-05-7-0653). Portland, OR.

United States Department of the Interior, Fish and Wildlife Service. 2005b. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the Pygmy Rabbit as Threatened or Endangered. Federal Register 70(97): 29253 -29265. March 20, 2005.

United States Department of the Interior, Fish and Wildlife Service. 2006. Post-delisting monitoring results for the American peregrine falcon (*Falco peregrinus anatum*), 2003. Federal Register 71(198): 60563.

United States Department of the Interior, Fish and Wildlife Service. 2006a. Endangered and threatened wildlife and plants; Review of native species that are candidates or proposed for listing as endangered or threatened; annual notice of findings on resubmitted petitions; annual

descriptions of progress on listing actions. September 12, 2006. Federal Register 71 (176): 53756-53835.

United States Department of the Interior, Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. U.S. Fish and Wildlife Service. 23 p.

United States Department of the Interior, Fish and Wildlife Service. 2011. Invasive Plant Program Biological Opinion and Concurrence for Deschutes and Ochoco National Forests and Crooked River National Grassland FY 2012-2027. U.S. Fish and Wildlife Service. 80 p.

United States Department of Agriculture, Forest Service. 1974. Standards established by the Visual Quality Objectives in the Visual Management System Handbook AH-462, Volume 2, Chapter 1.

United States Department of Agriculture, Forest Service. 1980. Region 6, Water Quality Guides for Pesticide Detection. R6-WS-040-1980

United States Department of Agriculture, Forest Service. 1988a. Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation in the Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1988b. Managing Competing and Unwanted Vegetation: Treatment Methods. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1988c. General Water Quality Best Management Practices. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1989. Land and Resource Management Plan, Part 1 – Ochoco National Forest and Part 2 - Crooked River National Grassland. Prineville, Oregon.

United States Department of Agriculture, Forest Service. 1990a. Forest Service Manual (FSM) 2600, Wildlife, Fish and Sensitive Plant Habitat Management. Washington Office Amendment 2600-90-1, effective 6/1/90.

United States Department of Agriculture, Forest Service. 1990b. The Pacific Northwest Region Recreational Opportunity Spectrum, R6-REC-021-90)

United States Department of Agriculture, Forest Service. 1990c. Land and Resource Management Plan, Deschutes National Forest. Bend, Oregon.

United States Department of Agriculture, Forest Service. 1990d. Bald Eagle Species Management Guide for Region 6. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1992. “Mediated Agreement”- Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation, Amendment to 1988 Record Of Decision. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1994a. Categorical Exclusion for Manual and Biological Control Treatments, Deschutes National Forest, Bend, Oregon.

United States Department of Agriculture, Forest Service. 1994b. Newberry National Volcanic Monument Comprehensive Management Plan. Pacific Northwest Region, Deschutes National Forest. Pp 184 + appendices.

United States Department of Agriculture, Forest Service. 1995a. Noxious Weed Management. Forest Service Manual 2080, Washington, D.C. (http://www.fs.fed.us/im/directives/fsm/2000/2080.txt).

United States Department of Agriculture, Forest Service. 1995b. Forest Service Manual (FSM) 2600, Wildlife, Fish and Sensitive Plant Habitat Management. R-6 Supplement 2600-95-3, effective 6/29/95.

United States Department of Agriculture, Forest Service. 1995c. Forest Service Manual (FSM) 2600, Wildlife, Fish and Sensitive Plant Habitat Management. R-6 Supplement 2600-95-3, effective 6/29/95.

United States Department of Agriculture, Forest Service. 1995d. The concepts and principles set by the current Landscape Aesthetic, a Handbook for Scenery Management, number 701.

United States Department of Agriculture, Forest Service. 1995e. Trout Creek Watershed Analysis. Ochoco National Forest. Prineville, Oregon.

United States Department of Agriculture, Forest Service. 1995f. Integrated Weed Management Environmental Assessment and Decision Notice, Ochoco National Forest and Crooked River National Grassland, Prineville, Oregon.

United States Department of Agriculture, Forest Service. 1996. Herbicide Information Profile - Triclopyr, Pacific Northwest Region.

United States Department of Agriculture, Forest Service. 1997. Herbicide Information Profile - Glyphosate, Pacific Northwest Region.

United States Department of Agriculture, Forest Service. 1997b. Big Marsh Watershed Analysis. Deschutes National Forest, Crescent Ranger District. Crescent, Oregon.

United States Department of Agriculture, Forest Service. 1998a. Noxious Weed Control Environmental Assessment. Deschutes National Forest.

United States Department of Agriculture, Forest Service. 1998b. Integrated Noxious Weed Management Environmental Analysis and Decision Notice. Ochoco National Forest and Crooked River National Grasslands.

United States Department of Agriculture, Forest Service. 1998c. Stemming the Invasive Tide: Forest Service Strategy for Noxious and Nonnative Invasive Plant Management. National Office, Washington, D.C.

United States Department of Agriculture, Forest Service. 1998d. Whychus (formerly Squaw) Watershed Analysis. Deschutes National Forest Sisters Ranger District. Sisters, Oregon.

United States Department of Agriculture, Forest Service. 1999a. Stemming the invasive tide: Forest Service strategy for noxious and nonnative invasive plant management. Washington Office. Washington, D.C.

United States Department of Agriculture, Forest Service. 1999b. Herbicide Information Profile - Dicamba, Pacific Northwest Region.

United States Department of Agriculture, Forest Service. 1999c. Mt. Baker-Snoqualmie National Forest. Environmental Assessment for Forest-Wide Noxious Weed Management.

United States Department of Agriculture, Forest Service. 1999d. Willamette National Forest. Environmental Assessment for Integrated Weed Management.

United States Department of Agriculture, Forest Service. 1999e. Forest-wide Roads Analysis, Deschutes and Ochoco National Forests.

United States Department of Agriculture, Forest Service. 1999f. Noxious Weed Strategy. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 1999g. Odell Watershed Analysis. Deschutes National Forest Crescent Ranger District. Crescent, Oregon.

United States Department of Agriculture, Forest Service. 2000. Herbicide Information Profile – Picloram, Pacific Northwest Region.

United States Department of Agriculture, Forest Service. 2001a. Guide to Noxious Weed Prevention Practices. July 5, 2001.

United States Department of Agriculture, Forest Service. 2003a. B & B Complex Burned Area Emergency Response Report. Deschutes National Forest, Sisters, Oregon.

United States Department of Agriculture, Forest Service. 2003b. Herger Feinstein Quincy Library Group Supplemental Environmental Impact Statement. USDA Forest Service Pacific Southwest Region. Valejo, CA. http://www.fed.us/r5/hfqlg/documents/HFQLG_SEIS/readers_guide.pdf.

United States Department of Agriculture, Forest Service. 2003c. Human and Ecological Risk Assessment of NPE Surfactants in Forest Service Herbicide Applications, 2003. David Bakke. Pacific Southwest Region. Vallejo, California.

United States Department of Agriculture, Forest Service. 2004a. Implementing the National Fire Plan Using Livestock Grazing to Manage Vegetation (Official Letter), August 30, 2004.

United States Department of Agriculture, Forest Service. 2004b. Update to the Regional Forester's Sensitive Species List. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 2004c. Regional Policy for Invasive Plant Prevention. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 2004d. Cache Mountain/Link Fire Weed Monitoring Report. Sisters Ranger District, Deschutes National Forest.

United States Department of Agriculture, Forest Service. 2004e. Crooked River National Grassland Vegetation Management / Grazing Final Environmental Impact Statement. Crooked River National Grassland and Ochoco National Forest, Prineville, Oregon.

United States Department of Agriculture, Forest Service. 2004f. Metolius Watershed Analysis Update. Sisters Ranger District, Deschutes National Forest.

United States Department of Agriculture, Forest Service. 2005a. Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement. USDA Forest Service, Pacific Northwest Region. R6-NR-FHP-PR-02-05.

United States Department of Agriculture, Forest Service. 2005b. Pacific Northwest Region Invasive Plant Program Record of Decision. Portland, OR. USDA Forest Service, Pacific Northwest Region. R6-NR-FHP-PR-02-05.

United States Department of Agriculture, Forest Service. 2005c. Turnpike Pit Medusahead Control, Environmental Assessment and Decision Notice (2005). Paulina Ranger District, Ochoco National Forest.

United States Department of Agriculture, Forest Service. 2005d. Biological Assessment for the USDA Forest Service Pacific Northwest Region Invasive Plant Program. USDA Forest Service, Pacific Northwest Region, Portland, OR. June 17, 2005. 425 pp + appendices.

United States Department of Agriculture, Forest Service. 2005e. Westside Allotments Environmental Analysis. Paulina Ranger District, Ochoco National Forest.

U United States Department of Agriculture, SDA Forest Service. 2005f. 12/2/2005 NRIS Weed Sites and Treatment Areas Data. Deschutes National Forest, Bend, Oregon.

United States Department of Agriculture, Forest Service. 2006a. Whychus Creek Wild and Scenic River Resource Assessment (DRAFT). Sisters Ranger District, Deschutes National Forest.

United States Department of Agriculture, Forest Service. 2006b. Site Specific Invasive Plant Treatments for Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, Including Forest Plan Amendment 16. USDA Forest Service, Sandy, Oregon.

United States Department of Agriculture, Forest Service. 2006c. Olympic National Forest Draft Environmental Impact Statement, Beyond Prevention: Site-Specific Invasive Plant Treatment Project. Olympic National Forest, Olympia, Washington.

United States Department of Agriculture, Forest Service. 2006d. 18 Fire Competing Vegetation Management Environmental Assessment. Bend/Ft. Rock District, Deschutes National Forest, Bend, Oregon.

United States Department of Agriculture, Forest Service. 2006e. Snow Lakes Watershed Analysis. Deschutes National Forest, Bend/Ft. Rock District, Bend, Oregon.

United States Department of Agriculture, Forest Service. 2006f. Joint Aquatic and Terrestrial Programmatic Biological Assessment for Federal Land within the Deschutes and John Day River Basin's Administered by the Deschutes and Ochoco National Forests. August 2006-August 2009.

United States Department of Agriculture, Forest Service. 2008. Update to the Regional Forester's Sensitive Species List. Pacific Northwest Region, Portland, Oregon. http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/

United States Department of Agriculture, Forest Service. 2009. Fisheries Biological Assessment for the Invasive Plant Treatment Project Deschutes National Forest and Ochoco National Forest and The Crooked River National Grassland. May 2009. Deschutes National Forest. Bend, OR.

United States Department of Agriculture, Forest Service. 2010. Joint aquatic and terrestrial programmatic biological assessment August 2010 – August 2013 for federal lands within the

Deschutes and John Day River Basins administered by the Deschutes and Ochoco National Forests. Bend, OR.

United States Department of Agriculture, Forest Service. 2011. Update to the Regional Forester's Sensitive Species List. Pacific Northwest Region, Portland, Oregon.

United States Department of Agriculture, Forest Service. 2011b. Forest Activity Tracking System database (FACTS) for invasive species treatment data management and reporting. Office of the Chief, Washington, DC.

United States Department of Agriculture, Forest Service. 2011c. Travel Management Project Record of Decision for the Deschutes National Forest, Ochoco National Forest and Crooked River National Grassland.

United States Department of Agriculture, Forest Service. 2011d. Invasive Plant Monitoring Plan and Cover Letter. Pacific Northwest Region, Portland, Oregon.

U.S. Geological Survey. 1998. Investigations of Endocrine Disruption in Aquatic Systems Associated with the National Water Qualtiy Assessment (NAWQA) Program. Portland, OregonPortland, Oregon: US Geological Society. USGS Fact Sheet FS-081-98.

U.S. Geological Survey. 2000. Pesticide National Synthesis Project. http://ca.water.usgs.gov/pnsp/pesticide _use_maps_1997/

U.S. Geological Survey. 2001. Herbicide Use in the Management of Roadside Vegetation, Western Oregon, 1999-2000: Effects on Water Quality of Nearby Streams. Water-Resource Investigations Rpt. 01-4065, 27 pp.

U.S. Geological Survey. 2001a. Ground-water hydrology of the Upper Deschutes Basin, Oregon. Water Resources Investigations Rpt. 00-4162, 73 pp.

U.S. Geological Survey. 2006. The Quality of Our Nations Waters, Pesticides in the Nations Streams and Ground Water, 1992-2001. U.S. Geological Survey Circular 1291. http://ca.water.usgs.gov/pnsp/pubs/circ1291/

Van der Putten, W. 1997. Die-back of *Phragmites australis* in European wetlands: an overview of the European research program on reed die-back and progression (1993-1994). *Aquatic Botany* 59: 263-275.

Van Wyk, D.B., 1982. Influence of prescribed burning on nutrient budgets on mountain fynbos catchments in S. W. Cape Rep. of South Africa. Gen. Tech. Rep. PSW-58. Berkeley, CA: Southwest Forest and Range Experiment Station, Forest Service, USDA.

Vogue, P.A., E.A. Kerle, and J.J. Jenkins. 1994. OSU Extension Pesticide Properties Database. Oregon State University. http://npic.orst.edu/ppdmove.htm

Wagner, Dave. 1999. Report on *Marsupella emarginata* var. *aquatica* from Waldo Lake outlet stream. Sponsored by the Willamette National Forest, Contract 53-04-R4-8-9800.

Walker, A. and S. J. Welch. 1989. The relative movement and persistence in soil of chlorsulfuron, metsulfuron-methyl and triasulfuron. *Weed Res.* , 29: 375-83.

Wallestad R.O. and D..B. Pyrah. 1974. Movement and nesting os sage grouse hens in central Montana. Journal of Wildlife Management 38: 129-136.

Wallestad, R.O. 1971. Summer movements and habitat use by sage grouse broods in central Montana. Journal of Wildlife Management 35: 129-136.

Wills, Barton. 2011. *Personal Communication*. Geologist, Deschutes National Forest, Bend, Oregon.

WSNF (Warm Springs National Fish Hatchery) 1992-1996. Operational Plan. U.S. Fish and Wildlife Service.

Wan MT; Watts RG; Moul DJ. 1989. Effects of different dilution water types on the acute toxicity to juvenile Pacific salmonids and rainbow trout of glyphosate and its formulated products. Bull Environ Contam Toxicol. 43(3): 378-385.

Warren, A.D. 2005. Butterflies of Oregon: Their Taxonomy, Distribution, and Biology. Lepidoptera of North America 6. Contributions of the C.P. Gillette Museum of Arthropod Diversity. Colorado State University, Fort Collins, CO. 408 pp.

Washington DOH, 1995. Wellhead protection program guidance document. Washington State Department of Health. DOH Publication 331-018. April 1995.

Washington Department of Agriculture. 2009. Summary of Aquatic Acute Toxicity Data for Spray Adjuvants Allowed for Use on Aquatic Sites in Washington, rev. 5/18/2009.

Washington Department of Fish and Wildlife. 2003. Game Management Plan: July 2003-June 2009.

Weihe, P.E., and Neely, R.K. 1997. The effects of shading on competition between purple loosestrife and broad-leaved cattail. Aquatic Botany 59: p.127-38.

Weiher, E., Wisheu, I.C., Keddy, P.A., and Moore, D.R.J. 1996. Establishment, Persistence, and Management Implications of Experimental Wetland Plant Communities. Wetlands 16(2): p.208-18.

Weiss, N.T. and B.J. Verts. 1984. Habitat and distribution of the pygmy rabbit (*Sylvilagus idahoensis*) in Oregon. Great Basin Naturalist 44: 563-571.

Wente, W.H., M.J. Adams, and C.A. Pearl. 2005. Evidence of decline for *Bufo boreas* and *Rana luteiventris* in and around the northern Great Basin, western USA. Alytes 22:95-108.

Wiemeyer, S.N., C.M. Bunck, and C.J. Stafford. 1993. Environmental contaminants in bald eagle eggs – 1980-84 and further interpretations of relationships to productivity and shell thickness. Archives of Environ. Contam. and Toxicol. 24:214-227.

Wilde, S.B., T.M. Murphy, C.P. Hope, S.K. Habrun, J. Kempton, A. Birrenkott, F. Wiley, W.W. Bowerman, A.J. Lewitus. 2005. Avian vacuolar myelinopathy linked to exotic aquatic plants and a novel cyanobacterial species. Environmental Toxicology 20 (3): 348-353.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, M.R. Eames. 2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: broad-scale trends and management implications. Gen. Tech. Rep. PNW-GTR-485. Portland, OR. USDA Forest Service, Pacific Northwest Research Station. 3 Vol.

Wise, T. 2008. Metolius Basin Bull Trout Redd Surveys 1986 - 2007. Oregon Department of Fish and Wildlife. Bend, Oregon. Tab 20 *in* Pelton Round Butte 2008 Fisheries Workshop Binder. Portland General Electric Company. Portland, Oregon.

Whisenant, S.G. 1990. Changing fire frequencies on Idaho's Snake river pants: ecolgoical and management implications. In. Symposium on Cheatgrass Shrub Die-off and Other Aspects of Shrub Biology and Management. Las Vegas, NV.

White, R., Jobling, S., Hoare, A., Sumpter, J.P., Parker, M.G. 1994. Environmentally Persistent//Alkylphenolic Compounds are Estrogenic . Endocrinology 135(1):175-82.

Williams, Shannon. 2004. Management of Goats for Controlling Noxious Weeds: A Primer. CIS 1121, University of Idaho Extension, Idaho Agricultural Experiment Station, November, 2004.

Wills, Bart. 2012. Personal communication. Forest Geologist, Deschutes National Forest. Groundwater dependent ecosystem survey results.

Wilson, L.M.; M. Schwarzlaender; B. Blossey; and C.B. Randall. 2004. Biology and biological control of purple loosestrife. Forest Health Technology Enterprise Team, USDA Forest Service. FHTET-2004-12. 78 PP.

Wilson, L., Karen Launchbaugh and John Wallace. 2006. Presentation: The effects of prescribed grazing on yellow starthistle (Centaurea solstitialis, L.) phonological development and resource allocation. 59th Society for Range Management Annual Meeting, Vancouver B.C., February 12 – 17, 2006.

Winfree, R.; N.M. Williams; J. Dushoff; and C. Kremen. 2007. Native bees provide insurance against ongoing honey bee losses. Ecology Letters 10: 1105-1113.

Wisdom, M.J., Warren, N.M., Wales, B.C. 2002. Vertebrates of conservation concern in the interior northwest: priorities for research. Northwest Science 76(1):90-4.

Wissmar, R.C., J.E. Smith, B.A. McIntosh, H.W. Li, G.H. Reeves, and J.R. Sedell. 1994.Ecological health of river basins in forested regions of eastern Washington and Oregon. General Technical Report PNW-GTR-326. U.S. Department of Agriculture, USFS, Pacific Northwest Research Station. Portland, Oregon.

Wood, J.A., and D.H.A. Anthony, 1997. Herbicide contamination of prairie springs at ultra trace levels of detection. American Society of Agronomy in Journal of Environmental Quality 26:1308-1318.

Wren, C.D. 1991. Cause-Effect Linkages Between Chemicals and Populations of Mink (Mustella vision) and Otter (Lutra canadensis) in the Great Lakes Basin. Journal of Toxicology and Environmental Health 33:549-85.

WSNF (Warm Springs National Fish Hatchery). 1992-1996. Operational Plan. U.S. Fish and Wildlife Service.

Youtie, Berta, Jeanne Ponzetti, and Dan Salzer. 1999. Fire and herbicides for exotic annual grass control: effects on native plants ad microbiotic soil organisms. In: Eldridge, David and David Freudenberger, editors, Proceedings of the VI International Rangeland Congress, Townsville, Queensland, Australia, July 19-23, 1999.

Zaady, et al. 2004. Application of the Herbicide, Simazine, and its Effect on Soil Surface Parameters and Vegetation in a Patchy Desert Landscape. Arid Land Research and Management 18:397-410, 2004.

Zalunardo, D. 2006. Personal Communication. Forest Wildlife Biologist, Ochoco National Forest. Prineville, Oregon.

Zavaleta E. 2000. Valuing Ecosystem Services Lost to Tamarix Invasion in the United States. Pp.261-300 In H. A. Mooney, and R.J. Hobbs, eds. Invasive Species in a Changing World. Island Press. Washington D.C.

Zeise, L., Wilson, R., and Crouch, E. 1984. Use of Acute Toxicity to Estimate Carcinogenic Risk. Risk Analysis Vol. 4//No. 3:187-99.

Zhang et al. 2006. Growth and Development of ponderosa pine on sites of contrasting productivities: relative importance of stand density and shrub competition effects. Canadian Journal of Forest Research, 36: 2426-2438.

Zika, P.R., R. Brainer, and B. Newhouse. 1995. Grapeferns and moonworts (Botrychium, Ophioglossaceae) in the Columbia Basin. Report submitted to the Eastside Ecosystem Management Project, U.S. Forest Service, Walla Walla, Washington.

Zimmerman, C.E. and G.H. Reeves. 1996. Steelhead and rainbow trout early life history and habitat use in the Deschutes River, Oregon. 1995 annual report. USDA Forest Service, Pacific Northwest Research Station, Project No. 656107. Portland General Electric, Portland, Oregon.

Ziska, L.H. 2003. Evaluation of the growth response of six invasive species to past, present and future atmospheric carbon dioxide. Journal of Experimental Botany 54(381): 395-404.

Ziska, L.H., S. Faulkner, and J. Lydon. 2004. Changes in biomass and root:shoot ration of field-grown Canada thistle (*Cirsium arvense*), a noxious, invasive weed, with elevated CO_2: implications for control with glyphosate. Weed Science 52:584-588.

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