United States
Department of
Agriculture

Forest
Service

PNW
Research
Station

September 2009

Draft Environmental Impact Statement

EXF Thinning, Fuels Reduction, and Research Project

Bend/Ft. Rock Ranger District, Deschutes National Forest
Deschutes County, Oregon

T. 20 S., R 9 E., Sections 28-33; T. 21 S., R. 9 E., Sections 4-6
Willamette Meridian

Draft Environmental Impact Statement
Deschutes National Forest
Deschutes County, Oregon

Lead Agency: **USDA Forest Service**

Responsible Officials: **John Allen, Supervisor, Deschutes National Forest**
Bov Eav, Station Director, Pacific Northwest Research Station

For Information Contact: **Beth Peer, Environmental Coordinator**
1230 N.E. 3rd St., Suite A-262
Bend, OR 97701
(541) 383-4769

Abstract: This Draft Environmental Impact Statement (DEIS) contains the Forest Service's proposal for vegetation management across approximately 2,554 acres of the Lookout Mountain Unit of the Pringle Falls Experimental Forest. The proposed action integrates the research goals of the Pacific Northwest Research Station with the need to reduce stand densities to lower susceptibility to insects and disease and reduce hazardous fuels to lower risk of uncharacteristic crown fire. Treatments are proposed in such a way that pertinent research questions regarding long-term sustainability of ponderosa pine and mixed conifer forests in the changing climate can be answered.

Three alternatives were analyzed in this DEIS:

1. Alternative 1, No Action.
2. Alternative 2 (preferred), the Proposed Action.
3. Alternative 3, developed to respond to the issue of maintaining spotted owl habitat.

Comments: This DEIS is made available for a 45-day Comment Period, under the provisions of the National Environmental Policy Act (40 CFR 1500-1508), and Notice, Comment, and Appeal Procedures for National Forest System Projects and Activities, (36 CFR 215). The Forest Service will accept comments as provided in §215.6(a)(4), beginning on the day following the date of publication of the Notice of Availability (NOA) in the Federal Register. The official comment period timelines will be posted in the Federal Register, and on the Deschutes National Forests' Web site http://www.fs.fed.us/r6/centraloregon/projects/units/bendrock/index.shtml.

Mail Comments to: **John Allen, Forest Supervisor**
c/o Shane Jeffries, District Ranger
1230 N.E. 3rd St., Suite A-262
Bend, OR 97701

E-mail Comments to: **comments-pacificnorthwest-deschutes-bend-ftrock@fs.fed.us**

Fax: **541-383-4700**

Date Comments Must Be Received: 45 days following Federal Register Notice which is estimated to be September 21, 2009.

Important Notice: Comments received in response to this solicitation, including names and addresses of those who comment, will be considered part of the public record on this proposed action and will be available for public inspection. Comments submitted anonymously will be accepted and considered; however, those who only comment anonymously will not have standing to appeal the subsequent decision under 36 CFR Part 215. Reviewers must provide the Forest Service with their comments during the review period of this Draft Environmental Impact Statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewer's position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. City of Angoon, v. Hodel (9th Circuit, 1986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Reader's Guide

This Draft Environmental Impact Statement (DEIS) contains information about a project proposal that will address forest health issues in the Lookout Mountain Unit of the Pringle Falls Experimental Forest.

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

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

Executive Summary: The summary of the Draft EIS provides a concise 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 and figures are also included.

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

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

Chapter 3 – The Affected Environment and Environmental Consequences: Chapter 3 describes current physical, biological, and social and economic environments within the area of influence of the Proposed Action (termed the Project Area Units). This information provides the baseline for assessing and comparing the potential impacts of the action alternatives. In addition, this chapter provides a comprehensive scientific and analytical comparison of the potential environmental impacts of the action alternatives 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 DEIS. It also discloses the distribution of the document including Federal Agencies, federally recognized tribes, State and local governments and organizations representing a wide range of views. The references, glossary, and index are in the last part of this chapter.

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

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

Appendix A – Past & Ongoing Research within the Experimental Forest

Appendix B – Study Plan

Appendix C – Consistency with Current Laws and Management Direction

Appendix D – Data used in Fire Behavior Analysis

Acronyms used in this Document:

BA	Biological Assessment
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BE	Biological Evaluation
BMP	Best Management Practices
BO	Biological Opinion
CEQ	Council on Environmental Quality
CHU	Critical Habitat Unit
DEQ	Oregon Department of Environmental Quality
DBH	Diameter at Breast Height
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
FS	Forest Service
FSH	Forest Service Handbook
FSM	Forest Service Manual
FVS	Forest Vegetation Simulator
HRV	Historic Range of Variability
INFISH	Inland Native Fish Strategy
LAA	Likely to Adversely Affect
LOS	Late and Old Structure
LRMP	Deschutes National Forest Land and Resource Management Plan (1990)
LSOG	Late Successional/Old Growth
LSR	Late Successional Reserve
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
MOU	Memorandum of Understanding
MSA	Management Strategy Area
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NLAA	May Affect, but Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NWFP	Northwest Forest Plan
ODFW	Oregon Department of Fish and Wildlife
OSHA	Occupational Safety and Health Association

PAG	Plant Association Group
PDC	Project Design Criteria from the 2006-2009 Programmatic Biological Assessment
PNWRS	Pacific Northwest Research Station
RNA	Research Natural Area
SDI	Stand Density Index
UMZ	Upper Management Zone
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

Table of Contents

Table of Tables

Table of Figures

Appendices

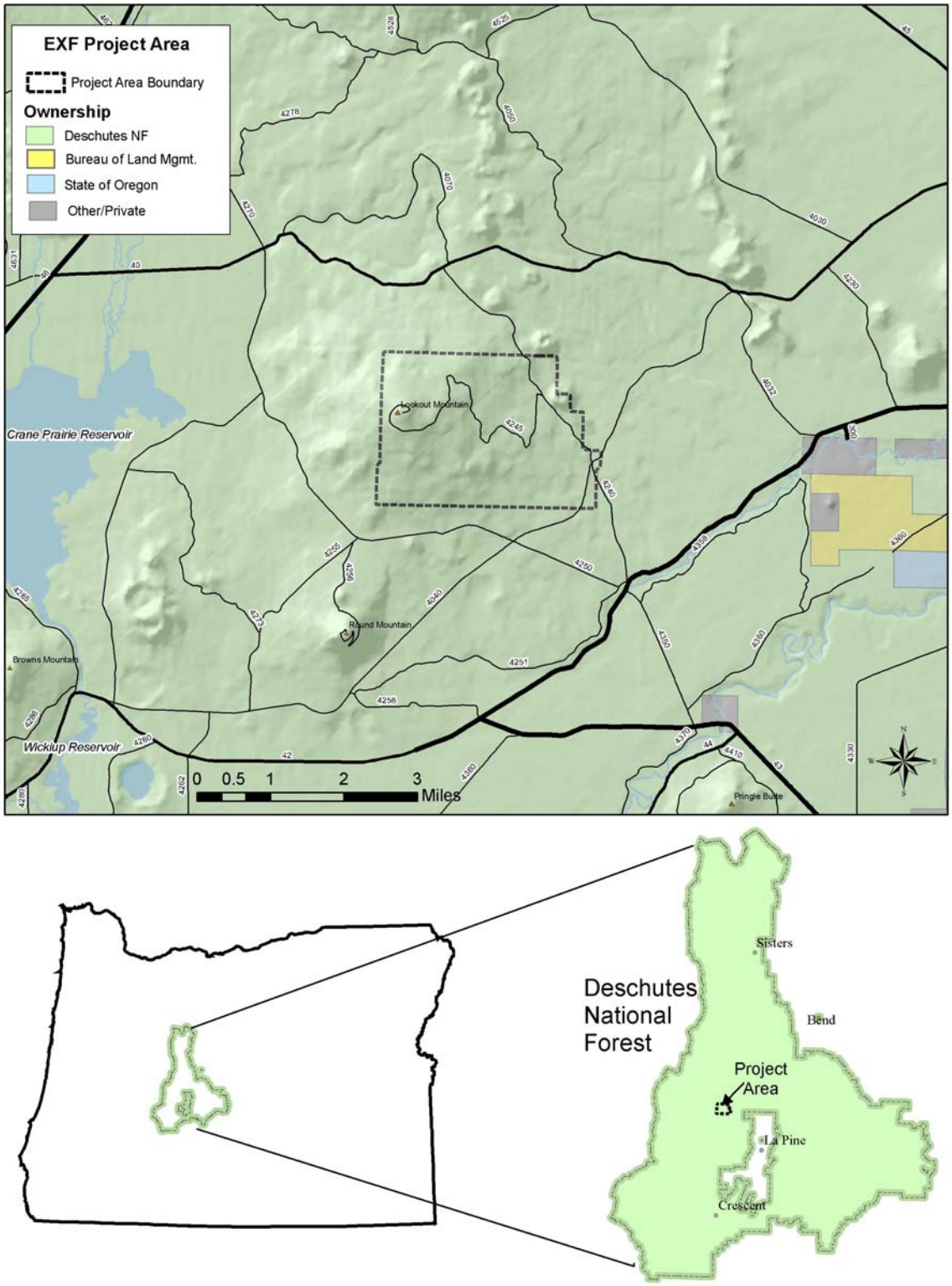


Figure 1. Project Area Vicinity

Executive Summary

This Draft Environmental Impact Statement (DEIS) discloses the effects of implementing vegetation management and fuels reduction within the Lookout Mountain Unit of the Pringle Falls Experimental Forest. The layout of thinning, mowing, and underburning is based on the design of a research study plan written by the Pacific Northwest Research Station.

Stands in this area of the experimental forest are overstocked and need to be thinned to prevent major disturbance from wildfire or insects and disease. Because this area was specifically established for silvicultural research in ponderosa pine, the need for forest management and the need to conduct research coincide, providing a unique opportunity to address pertinent questions about forest management.

The proposed action responds to two needs: 1) to address the risk of severe insect epidemic or catastrophic fire; and 2) to provide operational scale research opportunities through a series of thinning and fuel reduction treatments applied across the landscape. The final approved Study Plan entitled "Forest Dynamics after Thinning and Fuels Reduction in Dry Forests" (Appendix B) is the origin of the proposed action. The proposed action involves thinning and fuels reduction on 2,554 acres in order to reduce stand density below the upper management zone (UMZ), lower flame lengths and crown fire potential, and address the research questions posed in the stud plan.

There are three alternatives analyzed: 1) the No Action alternative ; 2) Alternative 2, the Proposed Action which treats across 2,554 acres; and 3) Alternative 3, that avoids activities within spotted owl habitat and Late Successional Reserve, treating across 2,178 acres. The third alternative responds to the key issue of treating within spotted owl habitat. Alternative 2 is the preferred alternative.

Table ES-1. Comparison of the alternatives.

Actions	Alternative 1 (No Action)	Alternative 2	Alternative 3
Thin to UMZ*	0	714 acres	701 acres
Thin to 75% UMZ	0	806 acres	540 acres
Thin to 50% UMZ	0	681 acres	586 acres
Thin to 75% UMZ and Create Small Openings	0	353 acres	351 acres
Total Thinning	**0**	**2,554 acres**	**2,178 acres**
Mow and Underburn	0	2,554 acres	2,178 acres
Control – No Treat Areas	0	342 acres	342 acres
Temp Roads	0	1 mile	0.5 mile

*Upper Management Zone (UMZ) is the level of density in a stand at which trees exhibit reduced vigor and bark beetle activity can be expected to increase dramatically. Where stands are denser than the UMZ, there is imminent risk of catastrophic loss of overstory trees to bark beetles.

Each action alternative includes project design features and mitigation to reduce or eliminate unwanted effects. Each action alternative also includes two Forest Plan amendments: the first amends the Eastside Screens because trees over 21" DBH will need to be removed in order to meet target basal

areas and the second one also amends the Eastside Screens because a small amount of the area east of the owl line that will be harvested is within an LOS type that is below the historic range of variability.

The analysis in Chapter 3 discloses the existing conditions and anticipated effects of the alternatives to forest vegetation and forest health, fuels and fire behavior, wildlife, soils, cultural resources, and the economy. The following summarizes basic conclusions related to the key issue and purpose/need.

Spotted Owls: The No Action alternative results in the least amount of NRF acres impacted as opposed to the Action Alternatives. Alternative 2 will directly reduce NRF habitat on 211 acres. Alternative 3 does not treat within NRF habitat, but stands treated around the NRF may influence the suitability or utilization (either increasing or decreasing) of the NRF. Alternative 3 best meets the Recovery Plan management intent to provide spotted owl habitat in dry forests landscapes. Alternative 3 protects existing habitat, while reducing risks around NRF habitat. Treatments may provide spotted owl dispersal habitat in the long-term, and a measure of protection for NRF habitat immediately surrounding the Lookout Mt Unit.

Forested Vegetation and Research: Under the No Action alternative, the entire project area remains at risk of loss from density-related insect, disease, or fire. Under Alternative 2, stand density is reduced to levels at or below the Upper Management Zone (UMZ) on 2,554 acres. This reduces the risk of bark beetle-caused mortality to large trees. The area treated is about 370 acres less under Alternative 3. These untreated areas remain at risk. Beetle-related tree mortality at or above the UMZ stand density index on the treated acres will not be a concern for at least 30 years. Density reduction through thinning retains the largest trees on site. Compared to the No Action alternative, the action alternatives increase the average size of trees in the project area. Tree vigor will improve in the treated stands, which will result in accelerated diameter growth and the number of large trees will increase sooner over time than the no action.

No new research would be conducted under Alternative 1. The Study Plan (Appendix B) can be effectively implemented under Alternative 2. Under Alternative 3, some of the treatment blocks are not sufficiently represented.

Fire/Fuels: The project area is currently at risk because a wildfire would produce moderate to high flame lengths, torching, and spotting over at least half of the area. The action alternatives increase the area where flame lengths would be low – a condition that makes direct attack of a wildfire possible. The potential for crown fire is reduced under the action alternatives. The difference between Alternative 2 and 3 are the amount of acres over which treatments reduce flame lengths and crown fire potential. Both action alternatives substantially change fire behavior so that direct attack of a wildfire with hand crews is possible over most of the area. Both action alternatives would also reduce the crown fire potential on all acres treated.

Chapter 1
Purpose and Need

1.1 Introduction

The Bend/Ft. Rock Ranger District of the Deschutes National Forest is proposing to thin and underburn about 2,554 acres of ponderosa pine and mixed conifer within the Pringle Falls Experimental Forest, located about 25 miles southwest of Bend (Figure 1). The project is designed to reduce stand density and fuels in a forest that is currently susceptible to uncharacteristic wildfire and insect and disease attacks, while addressing questions about vegetation dynamics and the impacts of climate change on forest sustainability.

The Pringle Falls Experimental Forest is a diverse field laboratory within the Deschutes National Forest. It was the first experimental forest to be established in the Pacific Northwest in 1931, as a center for silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range. It is divided into two units: Lookout Mountain Unit and Pringle Falls Unit. The Lookout Mountain unit, where the current project is located, was added to the Experimental Forest in 1937.

1.2 Background

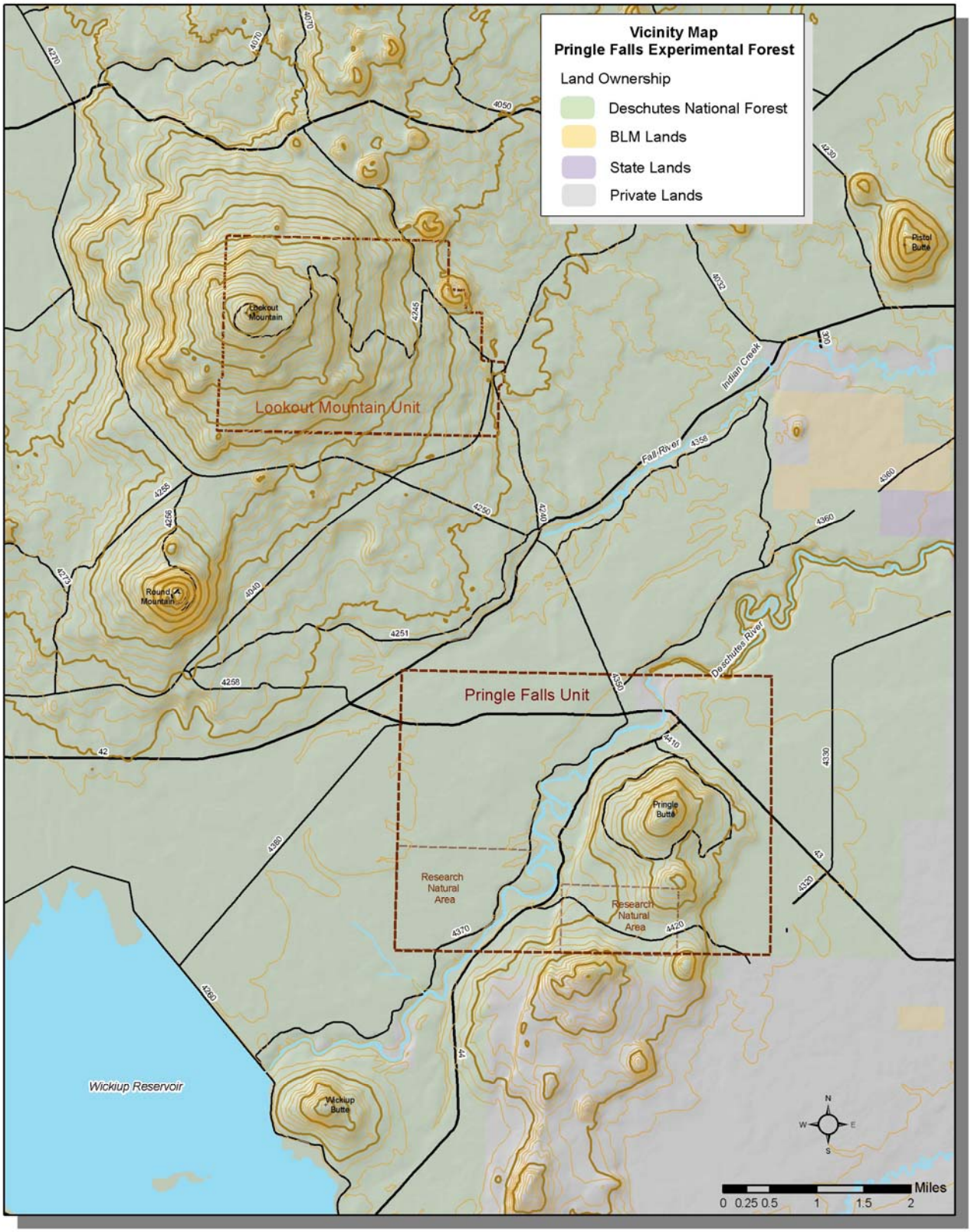
Experimental Forests

Experimental forests have a rich legacy of providing information to guide forest management activities. Pringle Falls Experimental Forest, located in central Oregon within the Deschutes National Forest, is one of 81 experimental areas in a national network of experimental forests and ranges. These areas represent important forest and range types and provide opportunities for short- and long-term field research and education in ecosystem structure and function, and demonstration of forest management techniques. Pringle Falls Experimental Forest was formally established in 1931 as a 7,520-acre center for silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range. The site was the first experimental forest to be officially established in the Pacific Northwest and was home to some of the earliest forest management and silviculture research in the region. The 3,535-acre Lookout Mountain Unit, site of the EXF Project, was added to the Pringle Falls Experimental Forest in 1937. The Pringle Falls Experimental Forest is maintained and administered by the Pacific Northwest Research Station in cooperation with the Deschutes National Forest. Figure 2 on the next page displays the entire Pringle Falls Experimental Forest.

> *"A tract of 3,536 acres of young, even-aged ponderosa pine, named the Lookout Mountain Unit, was added to the Pringle Falls Experimental Forest. This area…is especially well-suited for experiments in thinning and pruning and for studies of growth and site factors."*
>
> -1938 Annual Report of the Pacific Northwest Forest Experiment Station for the year 1937.

The Forest and Rangeland Renewable Resource Research Act of 1978 (16 USC 1643, as amended) authorizes the Secretary of Agriculture to designate experimental forests and ranges. The responsibility for establishment and administration is delegated to the Chief of the Forest Service under regulations (7 CFR 2.60(a)). The McSweeney-McNary Act of 1928 was further implemented by Regulation L-20 in 1930, directing the Chief to define experimental forests as dedicated to and used for research, and to make them permanently available. Research use was reaffirmed under the Forest and Rangeland Renewable Resources Research Act of 1978.

Figure 2. The Pringle Falls Experimental Forest is divided into two units: Lookout Mountain and Pringle Falls. It also includes two Research Natural Areas.



Past and Ongoing Research Activities at Pringle Falls Experimental Forest

Much of the knowledge on which current eastside ponderosa pine silviculture is based was developed at Pringle Falls Experimental Forest. For example, the *Lookout Mountain Levels-of-Growing-Stock Study* has demonstrated long-term stand development in single-cohort ponderosa pine and provides numerous implications for current resource management objectives. See Chapter 3.3.1 for more discussion of past research findings. Appendix A of this DEIS lists the publications that have resulted from past and ongoing research activities in the Lookout Mountain Unit and displays the location of long-term research plots that need protection from wildfire and insect outbreaks. Current research is designed to increase understanding of the processes that influence healthy and productive forest ecosystems.

Existing Condition of the Lookout Mountain Unit

Within the Lookout Mountain Unit is a relatively large block of closed-canopy forest that has undergone only minor disturbance since about 1845 when a single stand-replacement fire resulted in the establishment of dense ponderosa pine at lower elevations and Douglas-fir, grand fir, sugar pine, western white pine, and mountain hemlock at higher elevations. The 163-year old cohort of ponderosa pine has grown exceptionally well and it is known that within this portion of the western distribution of ponderosa pine, individual trees could survive for 600 years (Youngblood et al. 2004). However, the trees here have declined in radial growth over the past decade, and have structural characteristics that indicate they are at imminent risk of catastrophic loss to bark beetles and high risk of loss to wildfire.

There have been management activities within the experimental forest, including vegetation management, since the road system was built in the 1960s. Forest records show that much of the Lookout Mountain unit was thinned in the 1970s and 80s. In the last century, one large wildfire has occurred within the unit: the 1914 Lookout Mountain Eastside Fire covered 323 acres. Fire exclusion has contributed to high stand density and allowed elevated fuel accumulation.

The forest is at risk of major disturbance from multiple threats, including wildfire and insects. Because of stand density, average diameter, and availability of host species and fuels, there is a high and increasing probability that ponderosa pine across the Lookout Mountain unit will support a landscape-scale western pine or mountain pine beetle outbreak, or a large stand-replacing event. This important site could be lost if stand densities are not reduced. Such disturbance would mean the loss of existing high-value, long-term studies and eliminate most future research opportunities. See the Forested Vegetation section in Chapter 3 for more details on the existing conditions.

Research Study Plan

The Pacific Northwest Research Station's proposal to conduct operational-scale research in the Lookout Mountain unit is documented in a study plan titled "Forest Dynamics after Thinning and Fuels Reduction in Dry Forests" (SP-PNW-4577-X). Preparation of the study plan followed Forest Service Manual direction at FSM 4072.3. It has been peer-reviewed for experimental and statistical rigor and for appropriateness and compliance with Station direction by Pacific Northwest Research Station personnel. It was also the subject of a double-blind review process with seven reviewers external to the Research Station. The study plan was approved on March 3, 2009 and is included in this document as Appendix B.

The Proposed Action described in Chapter 2.3 will establish the new stand structure within which specific measurements will be made over time to assess the six specific research questions from the study plan. The broad goal of the project is to refine management options for restoring resiliency in forest ecosystems. This work is expected to have wide applicability in stands of similar structure throughout the Deschutes and Fremont-Winema National Forests.

The project will also serve as a foundation for additional studies. For example, there is interest in studies involving pine-associated wildlife.

1.3 Purpose and Need

The primary purpose of the proposed project is to reduce risk to the site by reducing stand densities, and lowering susceptibility to catastrophic loss to insects, disease, and fire. By integrating the need to reduce risk to the site with the research goals of the PNW Research Station, treatments would be implemented in such a way that pertinent research questions regarding long-term sustainability of ponderosa pine and mixed conifer forests in a changing climate can be answered.

There is a need to address the risk of a severe insect epidemic or catastrophic fire. The purpose of the project is to reduce stand densities and surface fuels in stands of ponderosa pine and mixed conifer plant associations dominated by ponderosa pine to maintain high growth rates and reduce susceptibility to catastrophic loss to insects, disease, or fire. Reducing risk of loss will protect long-term studies and keep large blocks of homogenous structure to maintain options for future research opportunities.

There is a need to provide operational scale research opportunities through a series of thinning and fuel reduction treatments applied across the landscape. This need comes generally from the establishment record for the Experimental Forest, and specifically from the study plan. The project will provide a platform for research addressed in the Pacific Northwest Research Station's study plan titled "Vegetation Dynamics after Thinning and Fuels Reduction in Dry Forests." The project is designed to address the following specific research questions:

1. What set of fuel reduction treatments best accelerates the development of large trees while over the long-term reintroduces natural disturbance processes that provide greater ecosystem resiliency?
2. What is the long-term influence of climate change interacting with a set of fuel reduction treatments on vegetation dynamics and forest structure?
3. Can single cohort stands be readily converted to multi-cohort stands?
4. Do multi-cohort stands share the same risks of multiple, interacting stresses as single-cohort stands?
5. How does the dominant shrub, giant chinquapin, respond in the near term to a set of fuel reduction treatments?
6. How does the residual stand structure resulting from a set of fuel reduction treatments interact locally and in the near-term with wind to cause additional structural changes?

The proposed action will also further the mission of the Managing Disturbance Regimes Research, Development, and Application Program[1] which is: *to provide new insights and scientific knowledge about the role of natural and human-caused disturbances as agents of change in ecosystems, and the degree to which they can be effectively managed to achieve or sustain desired ecologic conditions, functions, and socioeconomic values of forest and rangeland ecosystems*.

1.4 Proposed Action

The research to be conducted was the basis for the Study Plan; the final approved Study Plan is the origin of the proposed action. The Forest Service proposes to address the purpose and need by treating approximately 2,554 acres as shown in Table 1.

[1] Research at the Pacific Northwest Research Station is divided into seven Research Programs, each with a program mission. See http://www.fs.fed.us/pnw/research/index.shtml for more information on these programs.

While addressing the significant threat of insects, disease, and fire in the experimental forest, the proposed activities will also provide a platform for a suite of new studies that address the Pacific Northwest (PNW) Research Station's goals for climate change and vegetation dynamics research. Scientists at the PNW Research Station have identified numerous research goals with this proposal. The study plan is included in this document as Appendix C. The proposed work also establishes a framework for other studies that may be conducted concurrently or subsequently that use treatments established by the study plan. The proposed action requires two Forest Plan amendments in order to be implemented: to allow removal of trees > 21" DBH east of the owl line, and to harvest within late-old structure stands that are below the Historic Range of Variability (HRV).

Table 1. Treatments Considered in the Proposed Action.

Thinning Type	Surface Fuel Reduction	Acres
1. Thin to UMZ*	Mow & Underburn	714
2. Thin to 75% UMZ	Mow & Underburn	806
3. Thin to 50% UMZ	Mow & Underburn	681
4. Thin to 75% UMZ & Create small openings	Mow & Underburn	353
5. Control – no treat	Control – no treat	
	Total	**2,554**

*UMZ – Upper Management Zone – See definition page 15.

Since the scoping period in April 2008, the proposed action was adjusted by removing a small portion of Unit 33 that went around a small cinder butte east of the 4240 road. Refer to Chapter 2.2.2 for more details on this proposal and Figure 6 for locations of Alternative 2 units.

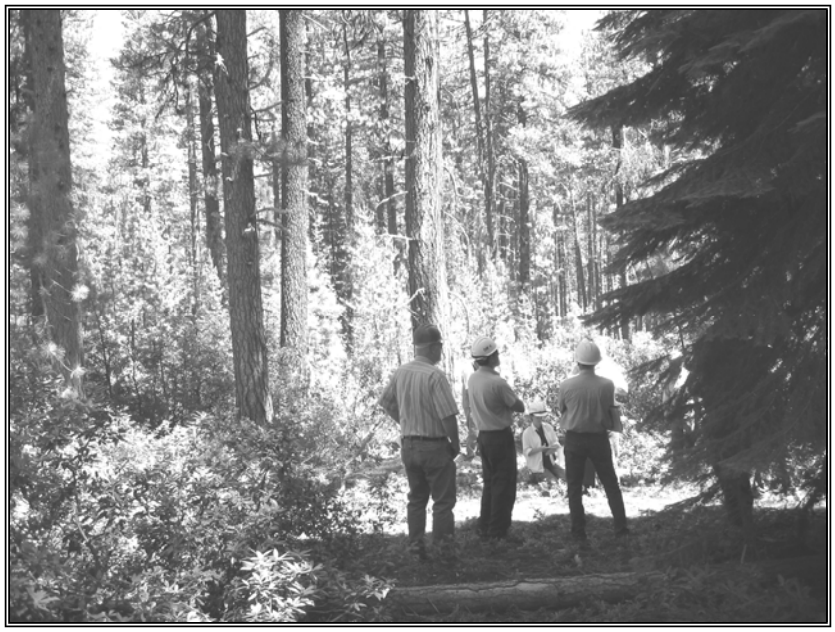
Figure 3. Treatment unit in the EXF project area.

1.5 Public Involvement

Scoping

The EXF project was announced in the Fall 2007 issue of the *Schedule of Proposed Actions for the Deschutes & Ochoco National Forests and Prineville District BLM*. A Notice of Intent to prepare an environmental impact statement was published in the Federal Register on April 11, 2008 (Vol. 73, No. 71, p. 19805). The proposed action was presented in a letter April 4, 2008 to 112 individuals, organizations, agencies, and Tribes. The NOI and scoping letter were also posted to the Forest Service web site.

The scoping letter resulted in responses from 11 individuals, organizations, and agencies. All comments were considered and categorized as either a key issue, analysis issue, or a non-significant issue that will not be considered further. This categorization is located in the project file.



A field trip was held on August 19, 2008 for some conservation groups who were interested in discussing the proposed project with the project proponents from the Pacific Northwest Research Station (PNW). Representatives of the League of Wilderness Defenders-Blue Mountains Biodiversity Project, Oregon Wild, and Sierra Club joined Deschutes National Forest and Pacific Northwest Research Station employees in the field to tour and discuss the various treatments proposed as well as the research objectives.

An additional scoping effort was made in March 2009, when more details of the project were developed. A mailing went out to an updated mailing list of 118 individuals, agencies, and organizations, describing the project and the alternatives that were being considered for analyzing in the DEIS.

A second field trip was held on July 1, 2009. Representatives of the PNW Research Station and the Deschutes National Forest hosted several individuals interested in the research.

Coordination has also occurred with federal, state, and local government officials. Coordination with the U.S. Fish and Wildlife Service began on April 29, 2008. The Environmental Protection Agency provided comments listing their concerns for air and water quality and habitat impacts and provided a list of elements that should be analyzed in the EIS.

1.6 Planning Issues

Key Issues

Key issues are those that represent a point of debate or concern that cannot be resolved without consideration of the trade-offs involved. These issues spur the design of alternatives to the proposed

action that provide a different path to achieve project objectives. Trade-offs can be more clearly understood by developing alternatives and displaying the relative impacts of these alternatives weighed against the proposed action.

Key Issue #1 – Northern spotted owl: The EXF project proposes to thin stands and reduce surface fuels across about 2,554 acres. Most of the project area is within the range of the northern spotted owl, and there is some spotted owl nesting, roosting, and foraging (NRF) habitat that would be impacted by proposed treatments. There is no Critical Habitat in the project area. The silvicultural and fuels treatments proposed would reduce stem density, may reduce overall canopy cover, and may reduce the amount of down wood that provides prey base habitat. These activities may reduce the quality, effectiveness, and the distribution of habitat available to the northern spotted owl in the planning area. Consequences of active management may have a negative effect on the northern spotted owl and its ability to establish and maintain breeding territories, provide sufficient prey base habitat, and disperse across the landscape.

This issue is addressed by the development of an alternative that excludes the NRF habitat and the LSR from treatment. The effects of these two action alternatives are then analyzed in detail and compared to the No Action. The effects to the northern spotted owl will be measured using the following attributes and measures:

- Acres of Nesting, Roosting, and Foraging (NRF) habitat treated by alternative, as compared to the existing condition.
- Acres of northern spotted owl dispersal habitat actively managed in the project area.

Analysis Issues

In addition to the key issue, other environmental components will be considered in the Effects section in Chapter 3 as a way to compare the alternatives, though they did not result in differing design elements between alternatives. These issues are important for providing the Responsible Official with complete information about the effects of the project.

Forest Vegetation – The proposed actions are expected to make the treated stands less susceptible to loss from insects, disease, or wildfire. The threat of losing a large portion of the experimental forest to insect and disease is a primary purpose for thinning. The alternatives will be assessed for the amount of high-risk stands that are put into more sustainable conditions and how well they meet the purpose and need described earlier in this chapter. The alternatives will also be compared for their ability to implement the study plan and answer the specific research questions.

Fuels and Fire Behavior – Part of the purpose of the proposed action is to reduce the amount of surface and ladder fuels, reduce high stocking levels, which is expected to lower the project area's susceptibility to higher severity fires. Attributes used for displaying effects and comparing the alternatives will be the expected fire behavior, the crown fire potential, the amount of area on which fire hazard is effectively lowered, and production of particulate matter.

Wildlife – In addition to the key issue related to the northern spotted owl, the following were analyzed and compared by alternative: Federally Threatened, Endangered, and Candidate Species; Regional Forester's Sensitive Species; Deschutes Forest Plan Management Indicator Species; Landbird Focal Species; Snags & Down Wood Habitat.

Soil Quality – The proposed use of ground-based equipment can potentially increase the amount and distribution of detrimental soil conditions within the areas proposed for mechanical thinning, mowing, and piling. The removal of trees can also potentially cause adverse changes in organic matter levels.

Alternatives are compared by analyzing changes in soil productivity, measured in extent of detrimental soil conditions and amount of coarse woody debris and surface organic matter to be retained.

Water Quality and Watershed Condition– There is no surface water in the EXF project area. The closest waterbody, or riparian area is over 2 miles from the project area boundary. The project's relationship to Aquatic Conservation Strategy Objectives of the Northwest Forest Plan is discussed in Chapter 3.3.8.

Fisheries – There will be no effect to Essential Fish Habitat, and no effect to any threatened, endangered, proposed, or candidate fish species. A Biological Evaluation has been prepared and is summarized in Chapter 3.

Air Quality – Compliance with air quality standards during burning operations is assessed for each alternative.

Botanical Resources – Potential effects to Proposed, Endangered, Threatened, and Sensitive (PETS) plant species were considered and no PETS plants were found in the project area. The EIS includes the conclusions of the biological evaluation completed for the project area.

Invasive Species – There are no known invasive plant sites within the project area. Proposed management activities have the potential to spread invasive plants or create disturbed ground that could allow the introduction of invasive plants. For that reason, the project is designed to comply with Forest Plan standards and guides for preventing the introduction and spread of invasive plants. A noxious weed risk assessment was completed for the project and is discussed in Chapter 3.

Cultural Resources – Project activities have the potential to impact cultural resources. The project area has been assessed for the presence of cultural resources; any known sites will be avoided.

Economics – Consideration must be given to the financial efficiency of the proposed action and alternatives. Alternatives will be compared by their benefit/cost ratio and effects on local economy, such as jobs created or maintained and timber volume produced. A timber sale that accomplishes the objectives outlined for the project while being as economically efficient as possible and avoiding excessive damage to the area is desirable.

Other Issues Addressed during Alternative Development

Some issues and concerns raised by the public were used by the interdisciplinary (ID) team when considering potential alternatives. For example, some public comments expressed opposition to conducting commercial harvest within the Experimental Forest. These are discussed under Chapter 2.6 Alternatives Not Considered in Detail.

Resources not Carried Forward in Analysis

Recreation – There are no designated trails or developed recreation sites within the EXF project area. The closest recreation sites are about three miles to the west at Crane Prairie Reservoir, or one mile to the southeast at Fall River. Recreation was not an issue raised during scoping. The recreation resource will not be discussed further in the EIS.

Scenery Management – There are no Scenic Views Management Areas within the EXF project area. Project design features were incorporated into the action alternatives that address the scenic views allocation adjacent to Units 21 and 22.

Inventoried Roadless Areas and Wilderness – There are no Inventoried Roadless Areas or Wilderness within or near the project area. Neither of these will be discussed further in the EIS.

1.7 Planning Framework

The Forest and Rangeland Renewable Resources Research Act of 1978 is the statutory authority for planning and conducting forestry research. The Act authorizes the Secretary of Agriculture "*to conduct, support, and cooperate in investigations, experiments, tests, and other activities the Secretary deems necessary to obtain, analyze, develop, demonstrate, and disseminate scientific information about protecting, managing, and utilizing forest and rangeland renewable resources in rural, suburban, and urban areas.*" [16 U.S.C. 1642]

Development of this Environmental Impact Statement follows implementing regulations of the National Forest Management Act (NFMA); Title 36, Code of Federal Regulations, Part 219 (36 CFR 219); Title 36, Code of Federal Regulations, Part 220 (36 CFR 220); Council of Environmental Quality, Title 40; CFR, Parts 1500-1508, National Environmental Policy Act (NEPA).

Many federal and state laws, including the Forest and Rangeland Renewable Resources Act (RPA), Endangered Species Act, Clean Air Act, and Clean Water Act also guide the planning and analysis. Appendix C has a brief explanation of each of these laws and their relation to the current project planning effort, as well as discussion of compliance with applicable laws, regulations, and management direction.

Deschutes National Forest Land and Resource Management Plan

The 1990 Deschutes National Forest Land and Resource Management Plan (LRMP), as amended, guides all natural resource management activities and provides standards and guidelines for the Deschutes National Forest. The project area is entirely within the Experimental Forest (MA-16) (See Figure 3). See Appendix C for standards and guidelines that were used in the project design. The goal in this management area is:

> "To provide an area where field research activities are conducted while considering other resource values. Administrative coordination between the National Forest System and Research within the Forest Service will provide for long-term protection of the Forest Environment to assure future research needs are met." (LRMP 4-152).

The allocation is unique for land management, as this section of Forest does not have a management objective that drives the need for a certain kind of recreational use, habitat type, visual quality, or commodity. The goal of providing for long-term research needs is so that knowledge can then be applied in other areas where it can inform management options depending on the area's objectives.

Northwest Forest Plan

The project falls primarily within an Administratively Withdrawn Area (AWA) under the Northwest Forest Plan (NWFP) which amended the LRMP in 1994 (See Figure 4). AWAs are areas where existing Forest Plan direction would preclude scheduled timber harvest. Deschutes Forest Plan standards and guidelines for the Experimental Forests Management Area (MA-16) apply where they are more restrictive or provide greater benefits to late-successional forest related species than other provisions of the NWFP standards and guidelines (NWFP C-2).

The northeast corner of the project area (160 acres) falls within the Sheridan Mountain Late Successional Reserve (LSR). An LSR Assessment was completed for the area in 1996 (USFS 1996). The proposed treatments are consistent with the management recommendations in the LSR Assessment. There is no Critical Habitat Unit within the project area.

The project area is not within a Key Watershed, and there are no Riparian Reserves.

Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales (Eastside Screens)

Approximately 370 acres in the southwest corner of the project area lies east of the spotted owl range, and is subject to this amendment, also known as the Eastside Screens. The Eastside Screens amendment was the result of a large-scale planning effort to determine the best approach for maintaining future options concerning wildlife habitat associated with late and old structural stages, fish habitat, and old forest abundance. The Eastside Screens contain guidelines for management of timber sales in late-old structure (LOS) relative to the Historic Range of Variability (HRV), wildlife corridors, snags, coarse woody debris, and goshawk management. Although intended as interim direction in 1995, it remains an applicable amendment to our LRMP. The Regional Forester has encouraged the consideration of Forest Plan amendments in cases where the proposed treatments would move landscape conditions towards HRV.

Area Assessments

Late Successional Reserve Assessment – The *Cultus Mountain / Sheridan Mountain Late Successional Reserve Assessment* (LSRA), completed in 1996 provides a description of two LSRs and identifies important conditions and processes, disturbance regimes, historic and current uses, and their implications for management. Plant and animal species of interest or concern and connectivity within and between LSRs are also addressed. The LSRA provides sideboards for treatment in specific vegetation conditions; treatments are then further refined by the goals and objectives of Management Strategy Areas. Unit 33 of the EXF project falls partially within what the LSRA has defined as Management Strategy Areas B, C, and J representing the mixed conifer wet, mixed conifer dry, and ponderosa pine wet/dry groups respectively. According to the LSRA, thinning and fuels reduction are immediate (0-10 yrs) old growth protection strategies for these MSAs. Similarly, commercial thinning is an acceptable strategy for late-successional old growth habitat acceleration in these types of MSAs.

1.8 Decision to be Made

The Forest Supervisor of the Deschutes National Forest and the Director of the Pacific Northwest Research Station are the officials responsible for deciding the type and extent of management activities in the EXF project area. The responsible officials can decide on several courses of action ranging from no action, to one of the action alternatives or combinations of treatment options. The responsible officials will also determine whether Forest Plan amendments are implemented for the area east of the owl line and will identify which mitigation measures will apply to project implementation.

The responsible official will consider the following factors in making his decision:

How well the alternative meets the project's purpose and need.

Will the density of stands be reduced enough to improve health and vigor of the residual forest and decrease susceptibility to epidemic outbreaks of insect and disease?

Will the density of stands be modified enough to decrease susceptibility to stand-replacing wildfire?

Can the Study Plan be successfully implemented so that the goals and objectives for research of the Pacific Northwest Research Station are met?

2. How well does the alternative respond to the issues; and have public comments been considered during the analysis?

3. What are the likely environmental effects of the proposed actions, and in particular, the short and long-term effects and benefits to the habitat of federally-listed threatened and endangered species?

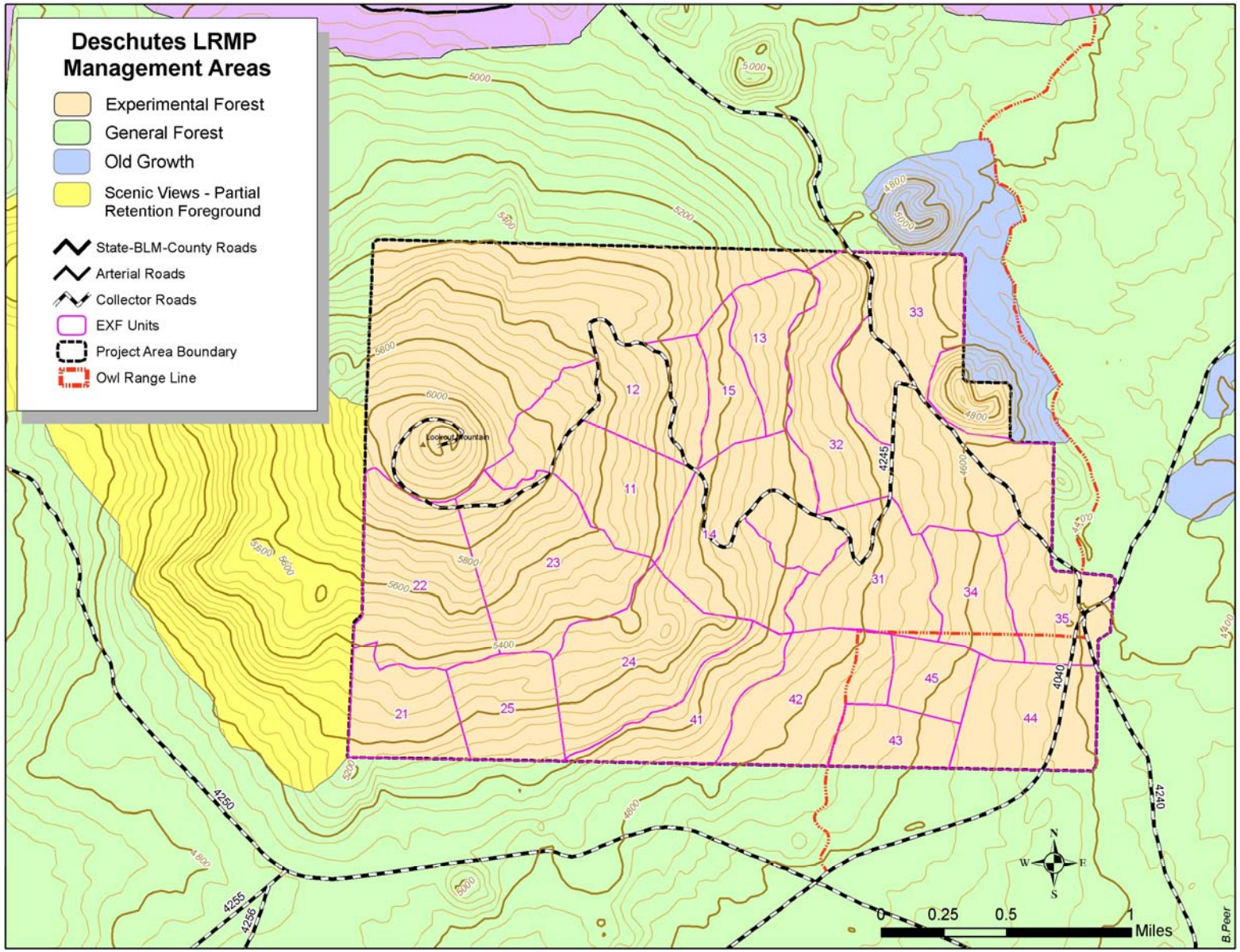


Figure 4. Deschutes National Forest LRMP Management Areas.

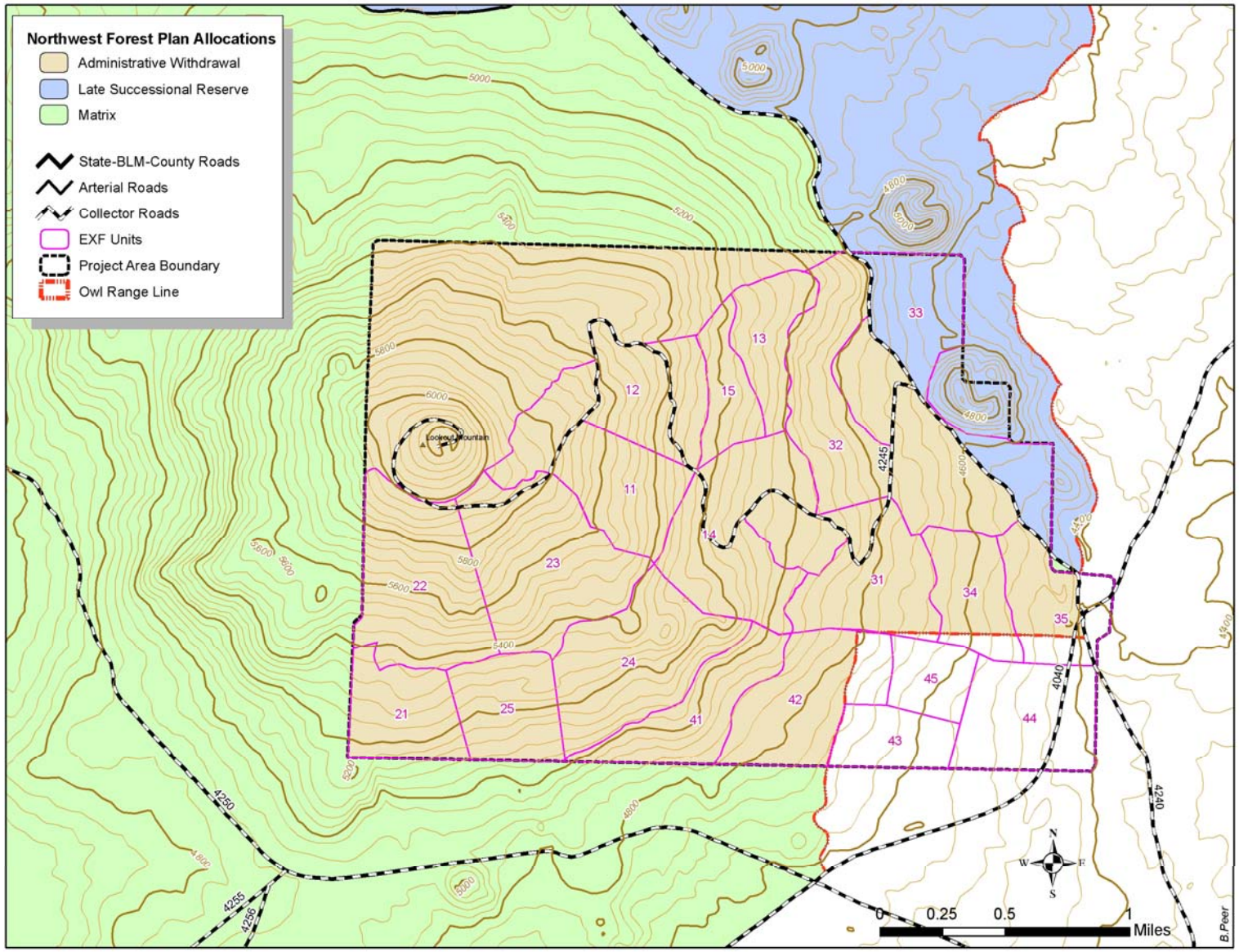


Figure 5. Northwest Forest Plan Allocations.

Chapter 2
Alternatives

Alternatives, Including the Proposed Action

2.1 Introduction

This chapter describes and compares the alternatives considered for the EXF Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, defining the differences between each alternative in order to provide a clear basis for choice by the decision maker. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental effects of implementing each alternative.

> *"Much of the knowledge on which current eastside ponderosa pine silviculture is based was developed at Pringle Falls Experimental Forest."*
>
> -Experimental Ranges and Forests of the USDA Forest Service, GTR NE-321

2.2 Alternatives Considered in Detail

The Forest Service developed one alternative to the Proposed Action, for a total of two action alternatives plus the No Action alternative. The No Action Alternative is used as a baseline to display consequences of a passive management scenario. Other alternatives were considered, but eliminated from detailed analysis (see Chapter 2.4).

2.2.1 Alternative 1 (No Action)

Under the No Action alternative, current management plans would continue to guide management of the project area. No additional thinning or fuels treatments would be implemented to accomplish project goals. The Study Plan would not be implemented; the proposed research would not be undertaken. Custodial activity would continue, such as routine maintenance of roads and timber plantations. Response to environmental emergencies, such as suppressing a wildfire, would continue.

2.2.2 Alternative 2 (Proposed Action; Preferred Alternative)

The proposed action is the Study Plan as designed by the Pacific Northwest Research Station (see Appendix B). Four treatment blocks with relatively homogeneous elevation, aspect, and plant association were delineated using, where possible, existing roads. Treatment units were then delineated within each block, also based on topography and roads. Each unit was randomly assigned one of four levels of treatment or no treatment (i.e. control). Any future entry into the control units would require additional NEPA analysis. See Appendix B for more information on the experimental design.

The intensity of proposed thinning uses the Stand Density Index (SDI), which is a relative tree density measurement of each stand. At a certain SDI the trees in a stand exhibit reduced vigor due to excessive density and bark beetle activity can be expected to increase dramatically. This is called the upper management zone (UMZ). Below the upper management zone bark beetle activity still occurs but at endemic levels. Where stands are more dense than the UMZ, there is imminent risk of catastrophic loss of overstory trees to bark beetles. Treatments closer to UMZ (e.g. 75% of UMZ) are less intensive treatments; those further from UMZ (e.g. 50% of UMZ) are more intensive treatments.

The following change was made to the proposed action since it was first made public: an area of about 49 acres surrounding the small cinder butte in the northeast section of the project area was removed from Unit 33 east of the 4240 road. This change resulted from discussions in the field on August 18, 2008.

The proposed action includes vegetation management activities across approximately 2,554 acres, and would result in the harvest of approximately 27 to 29 million board feet of timber. About 1 mile of temporary road construction would be needed for access to units 11, 14, 21, and 23. Refer to Figure 6 for locations of Alternative 2 units. This alternative also includes a Forest Plan amendment (see page 18).

Table 2. Alternative 2 Units with Silviculture and Fuels Prescriptions and Forest Plan Management Area.

Unit No.	Acres	Silv. Rx	Fuels Rx	Mgmt.
11	118	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
12	192	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
13	83	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
14	194	Thin to UMZ	Mow/Underburn	Experimental Forest
15	64	No Treat	No Treat	
21	106	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
22	206	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
23	225	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
24	196	Thin to UMZ	Mow/Underburn	Experimental Forest
25	108	No Treat	No Treat	
31	148	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
32	164	Thin to UMZ	Mow/Underburn	Experimental Forest
33	335	Thin to 75% UMZ	Mow/Underburn	Experimental Forest / LSR
34	94	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
35	109	No Treat	No Treat	
41	116	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
42	160	Thin to UMZ	Mow/Underburn	Experimental Forest
43	70	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
44	147	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
45	61	No Treat	No Treat	

Acres are approximate. Actual acres treated would be slightly reduced to account for such things as avoidance of sensitive areas (e.g. where slopes exceed 30%). The control units (No Treatment) are included in the table because they are an important component of the research design, and the acres of no treatment will be tracked through analysis. Any future entry into the control units would require additional NEPA analysis.

Table 3. Summary of Actions for Alternative 2

Thinning Type	Acres
1- Thin to UMZ	714
2- Thin to 75% UMZ	806
3- Thin to 50% UMZ	681
4- Thin to 75% UMZ & Create small openings	353
Total	**2,554**
5- No Treat (Control Units)	342

Description of Activities Common to Alternatives 2 and 3

Thinning

Thinning will be conducted with ground-based machinery. For treatment types 1, 2, and 3 thinning is from below: to reduce stand density by removing trees from the lower crown classes or smaller diameters to improve growth and overall forest health of trees in the upper crown classes or the larger trees. Larger trees are retained. Treatment type 4 (thin to 75% UMZ with small openings up to about ¼ acre in size) will be a free thin across the entire diameter distribution to begin transition to an all-aged stand structure (i.e. multi-cohort). Target basal area and trees per acre are applied as an average across a unit.

For all treatment types, species preference for cutting is as follows: 1) lodgepole pine, 2) grand/white fir, 3) small-diameter ponderosa pine, 4) small-diameter mountain hemlock, 5) small diameter Douglas-fir. This preference is intended to be flexible, with the intent of moving towards greater resilience. As diameters increase, retention of trees having more vigor will be emphasized.

Slash and Smaller Material Treatment

Trees with commercial value (usually greater than 7" or 8" DBH) will be whole-tree yarded, with limbs and tops attached to the landings, thereby reducing the need for slash piling within the units. Tops and limbs will be utilized as biomass as market conditions allow, otherwise they will be burned at the landings. Smaller material (generally < 7" DBH) will be felled by hand and will also be utilized as biomass as market conditions allow. If it cannot be utilized, the lighter concentrations will be lopped and scattered and heavier concentrations grapple piled and burned. Assuming no market for smaller material, approximately one-half of the units will have heavier concentrations of small material piled and burned. This assumption is used in the analysis.

Mechanical Shrub Treatment (Mowing)

Thinning and slash treatment will be followed by mechanical shrub treatment, also known as mowing. This involves the use of mechanized equipment to mow, cut, chop, grind or otherwise reduce shrub or ground fuel vertical structure to a height of about 8 inches.

Underburning

Following thinning, slash treatment, and mowing, prescribed fire is planned for most areas. This is considered a landscape-scale burning operation where fire will be applied when conditions are conducive to meeting the burning objectives.

Fire lines are used to control the fire during prescribed burning operations. Existing roads will be used as much as possible. Line construction will be necessary at the project perimeter, around control units, and around the plantation in the middle of the project area. Lines will be built with an ASV (a rubber tracked "All Surface Vehicle" commonly used to place fireline on slopes of less than 30%), and will be approximately 3 to 4 feet wide. Handline will be constructed where necessary, such as with steeper slopes.

Maintenance of desired structure may be needed as early as 40 years on some treatment blocks. \Any future maintenance work will be assessed under a new NEPA process.

Connected Actions Common to Alternatives 2 and 3

Temporary road construction: Harvest operations are expected to require approximately 1 mile of temporary road to be developed for access to units 11, 14, 21, and 23. Temporary roads are built to facilitate ground-based harvest systems for the purpose of removing forest products from a treated stand. These roads are short, averaging less than 0.2 miles. Temporary roads will be built to low specifications that would allow equipment access to landing sites. These temporary roads will be built on slopes less than 10 percent and will be constructed to the lowest possible standard capable of supporting log haul in order to minimize ground disturbance. These temp roads will be restored after use.

Road maintenance: Approximately 35 miles of existing roads in the project area will require maintenance prior to use for timber haul. Maintenance is blading and shaping of the roadbed and brush removal.

Gating: A Forest Service gate will be placed on the 4245 road at the intersection of the 4240 and 4245 roads. This will prevent public vehicle access on the main road through the Experimental Forest. The gate will be closed year-round. Access for administrative use and for research purposes will be provided.

Danger tree removal: Federal and State of Oregon safety regulations require that danger trees along project area travel routes be felled prior to activities taking place. Roadside danger trees will be felled along these travel routes and where activity units border the road system.

Forest Plan Amendments

During evaluation of the proposed action against current management direction, it was found that two Forest Plan amendments are necessary to proceed with either action alternative. The amendments are specific to the Interim Wildlife standard from the Regional Forester's Forest Plan Amendment #2 (the Eastside Screens), and therefore apply only to the portion of the project area east of the owl range line. See Chapter 3.3.13 for an analysis of these amendments.

- *Harvest in LOS:* East of the owl line, the following Interim Wildlife Standard would not apply to the implementation of the EXF project: 6.d. "…there should be no net loss of LOS from that biophysical environment. Do not allow timber sale harvest activities to occur within LOS stages that are below HRV." Within unit 43, harvest of LOS will take place across the 70-acre unit. See Chapter 3.3.1 for HRV analysis and 3.3.13 for forest plan amendment analysis.
- *Harvest of trees > 21" DBH:* East of the owl line (units 31, 34, 42, 43, and 44), the following Interim Wildlife Standard (p. 10 of the Screens) would not apply to the implementation of the EXF project: 6.d.2.a. "Maintain all remnant late and old seral and/or structural live trees ≥ 21" DBH that currently exist within stands proposed for harvest activities." In order to reach the target basal area, trees over 21 inches would need to be removed across these five units.

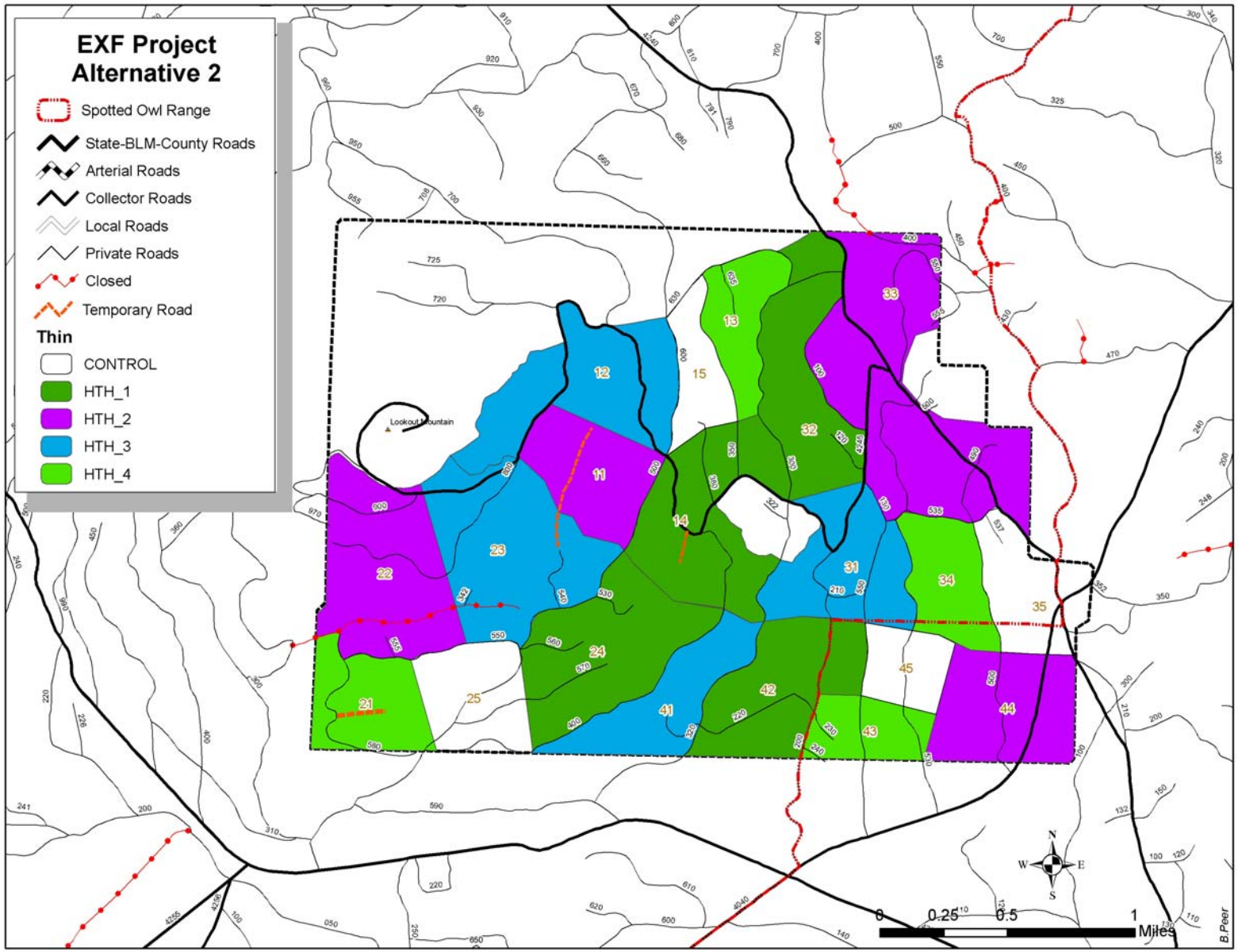


Figure 6. Map of Alternative 2.

2.2.3 Alternative 3

This alternative was developed to address the issue of northern spotted owl habitat. Portions of the project area totaling about 211 acres are mapped and field-verified as suitable Nesting, Roosting, and Foraging (NRF) habitat for the northern spotted owl. In Alternative 3, these areas are removed from the units and deferred from treatment (affects units 11, 22, 23, 32). Also, the portion of unit 33 that lies within the Sheridan Late Successional Reserve (165 acres east of the 4240 road) is removed from Alternative 3 and deferred from treatment. Because the NRF will be excluded from underburning, more fireline will be needed around the perimeter of it. Approximately 0.5 mile of temporary road will be needed for accessing Units 11.1, 11.2, 14, 21, and 23. All other activities are the same as described for Alternative 2, including the Forest Plan Amendment to allow the cutting and removal of trees over 21" DBH in units 34, 42, 43, and 44, east of the owl line. This alternative would result in harvest of approximately 23-25 million board feet of timber.

Table 4. Alternative 3 Units with Silviculture and Fuels Prescription and Management Area.

Unit	Acres	Silv. Rx	Fuels Rx	Mgmt.
11.1	22	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
11.2	27	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
12	155	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
13	81	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
14	194	Thin to UMZ	Mow/Underburn	Experimental Forest
15	64	No Treat	No Treat	Experimental Forest
21	106	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
22	170	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
23	167	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
24	196	Thin to UMZ	Mow/Underburn	Experimental Forest
25	108	No Treat	No Treat	Experimental Forest
31	148	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
32	151	Thin to UMZ	Mow/Underburn	Experimental Forest
33	174	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
34	94	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
35	109	No Treat	No Treat	Experimental Forest
41	116	Thin to 50% UMZ	Mow/Underburn	Experimental Forest
42	160	Thin to UMZ	Mow/Underburn	Experimental Forest
43	70	Thin to 75% UMZ w/ small openings	Mow/Underburn	Experimental Forest
44	147	Thin to 75% UMZ	Mow/Underburn	Experimental Forest
45	61	No Treat	No Treat	Experimental Forest

Acres are approximate. Actual acres treated would be reduced slightly to account for such things as avoidance of sensitive areas (e.g. where slopes exceed 30%). The control units (No Treatment) are included in the table because they are an important component of the research design, and the acres of no treatment will be tracked through the analysis. Any future entry into the control units would require additional NEPA analysis.

Table 5. Summary of Actions for Alternative 3.

Thinning Type	Acres
1 - Thin to UMZ	701
2 - Thin to 75% UMZ	540
3 - Thin to 50% UMZ	586
4 - Thin to 75% UMZ & Create Small Openings	351
Total	**2,178**
5 – No Treat (Control Units)	342

There are 370 fewer acres treated under Alternative 3 than Alternative 2. However, these are not part of the "control" units identified in the research design, so are not included in the acres of control units.

Figure 7. EXF Project Unit 32.

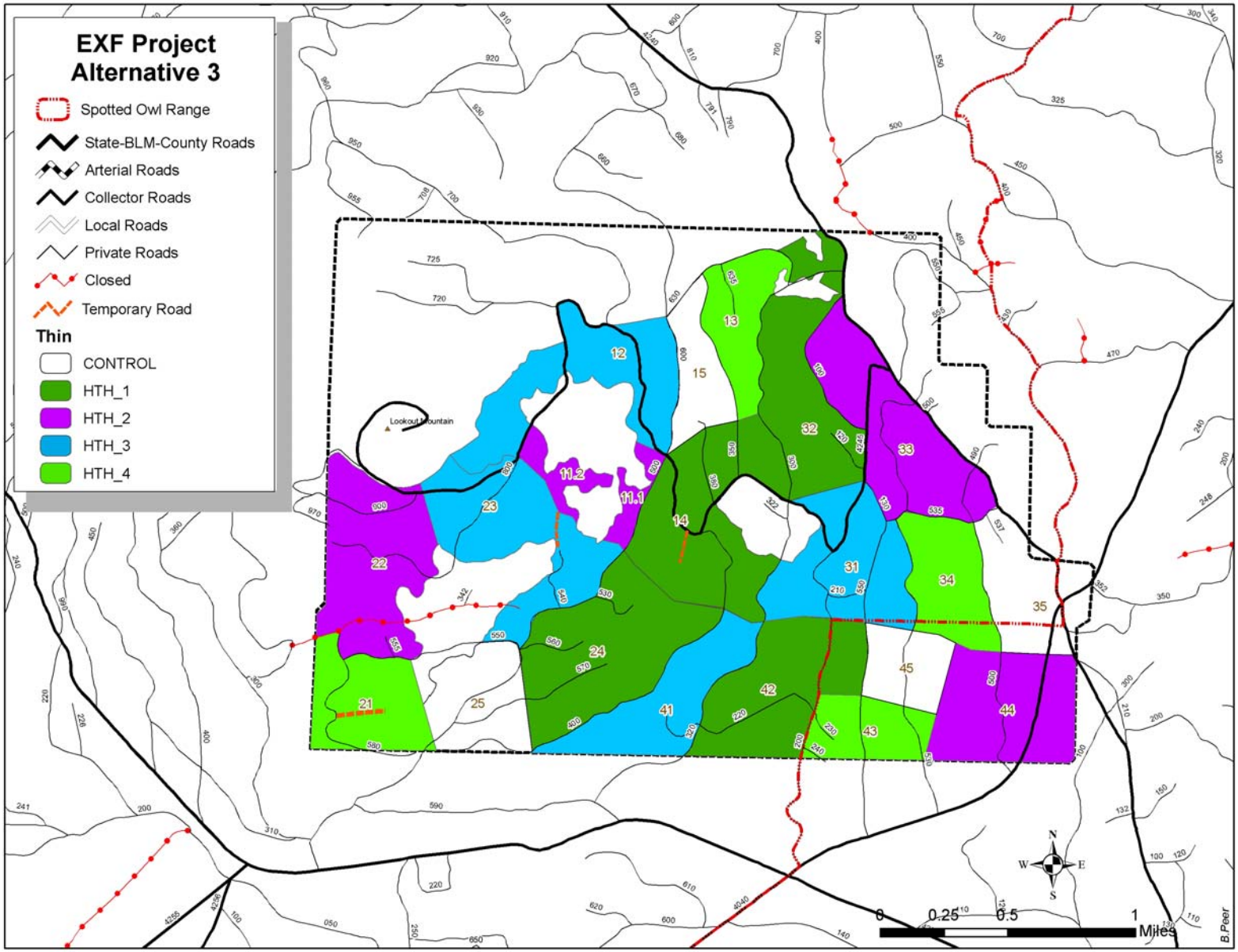


Figure 8. Map of Alternative 3.

2.2.4 Resource Protection Measures Common to Both Action Alternatives

All of the Alternatives would meet direction in relevant laws and policies, and the standards and guidelines in the Deschutes National Forest Land and Resource Management Plan as amended by the Northwest Forest Plan, except where noted on page 18 (Forest Plan Amendments). In addition, the Alternatives either comply with the project design criteria for the Deschutes and Ochoco National Forests Programmatic Biological Assessment (2006 – 2009), or, if there are proposed deviations from the Biological Assessment, were consulted on by US Fish and Wildlife Service.

The difference between the project design features (PDFs) and mitigation measures is that PDFs are considered routine, have been used on numerous similar projects, and are either incorporated into contract provisions or accomplished between appropriate resource specialists, and have proven to be effective. Mitigation measures are site-specific, are usually assigned to specific units, and are used to avoid, minimize, rectify, reduce, or compensate an impact (40 CFR 1508.20). For example, a PDF may include a seasonal closure for unknown nest sites (to be applied if discovered); a mitigation measure would place a seasonal closure on a known nest site specific to a unit. PDFs and mitigation measures are used as a basis for determining and disclosing effects in the Environmental Consequences discussions.

The sources of the PDFs and mitigation measures include but are not limited to: Forest Plan goals, objectives, or standards & guidelines; Project Design Criteria from the Programmatic BA; Best Management Practices; conservation strategies; Invasive Plant Prevention Practices.

Purpose		**Comments**
To protect existing research installations from project activities		
1.	No direct ignition of prescribed fire within a 120-foot buffer around plots within the Levels of Growing Stock study area. Areas to avoid will be flagged. Units: 24, 41, 42	Tree height buffer used in previous projects.
To ensure prescribed fire activities are implemented appropriately		
2.	Conduct prescribed fire in compliance with National Ambient Air Quality Standards, Oregon Department of Environmental Quality regulations and restrictions, and under the Oregon Smoke Management Plan regulations and restrictions.	Federal and state regulation.
3.	Prescribed burning will be conducted under favorable smoke dispersal conditions, to avoid impacts to urban areas and Class I airsheds. Inversion conditions, which would increase the potential for smoke pooling in valleys and drainages, would be avoided during burning operations.	Federal and state regulation.
To protect soil		
4.	In all proposed activity areas, locations for new yarding and transportation systems would be designated prior to logging operations. This includes all log landings, and primary (main) skid trail networks.	LRMP SL-1 & SL-3; Timber Management BMP T-11, T-14 & T-16
5.	*Surface Drainage on Temporary Roads* – minimize the erosive effects of concentrated water through the proper design and construction of temporary roads.	Road BMP R-7

6.	*Road Maintenance* – conduct regular preventive maintenance to avoid deterioration of the road surface and minimize the effects of soil.	Road BMP R-18, R-19
	Prescribed Burn Operations	
7.	A burn plan addressing compliance with all applicable LRMP standards and guidelines and Best Management Practices will be completed before the initiation of prescribed fire treatments in planned activity areas. Prescribed burn plans need to include soil moisture guidelines to minimize the risk of intense fire and adverse impacts to the soil resource.	LRMP SL-1 & SL-3; Timber BMP T-2, T-3 & T-13; Fuels Management BMP F-2, F-3
	Coarse Woody Debris/Down Wood	
8.	Retain adequate supplies of coarse woody debris (greater than 3-inches in diameter) to provide organic matter reservoirs for nutrient cycling following the completion of all project activities. It is recommended that a minimum of 5 to 10 tons per acre of CWD be retained on Ponderosa Pine sites, and 10 to 15 tons of CWD per acre should be retained on mixed conifer and lodgepole pine sites to help maintain long-term site productivity. These amounts are less than the recommended levels for wildlife habitat objectives.	LRMP SL-1
	Maintaining Duff Layer	
9.	Strive to maintain fine organic matter (organic materials less than 3-inches in diameter; commonly referred to as the duff layer) over at least 65 percent of an activity area (pertains to both harvesting and post-harvest operations). If the potential natural plant community (i.e., site) is not capable of producing fine organic matter over 65 percent of the area, adjust minimum amounts to reflect potential vegetation site capabilities.	LRMP SL-6; Fuels Management BMP F-2; Timber Management BMP T-13
	Minimize the extent of new soil disturbance from mechanical treatments	
10.	Implement appropriate design elements for avoiding or reducing detrimental soil impacts from project activities. ***Options include using some or all of the following:*** ▪ Use existing log landings and skid trail networks (whenever possible) or designate locations for new skid trails and log landings. ▪ Maintain spacing of 100 to 150 feet for all primary (main) skid trail routes, except where converging at landings. Closer spacing due to complex terrain must be approved in advance by the Timber Sale Administrator. Main skid trails spaced an average of 100 feet apart limit soil impacts to 11 % of the unit area. For the larger activity areas (greater than 40 acres) that can accommodate wider spacing distances, it is recommended that distance between main skid trials be increased to an average of 150 feet to reduce the amount of detrimentally disturbed soil to 7 percent of the unit area (Froehlich, 1981, Garland, 1983). This would reduce the amount of surface area where restoration treatments, such as subsoiling, would be required to mitigate impacts to achieve soil management objectives.	

- Restrict grapple skidders to designated areas (i.e., roads, landings, designated skid trails) at all times, and limit the amount of traffic from other specialized equipment off designated areas. The use of harvester machines will be authorized to make no more than two equipment passes on any site-specific area to accumulate materials.
- Avoid equipment operations during times of the year when soils are extremely dry and subject to excessive soil displacement.
- Avoid equipment operations during periods of high soil moisture, as evidenced by equipment tracks that sink deeper than during dry or frozen conditions.
- Operate equipment over frozen ground or a sufficient amount of compacted snow to protect mineral soil. Equipment operations should be discontinued when frozen ground begins to thaw or when there is too little compacted snow and equipment begins to cause soil puddling damage (rutting).

11. Prevent additional soil impacts in random locations of activity areas, between skid trails and away from landings, by machine piling and burning logging slash on existing roads and logging facilities that already have detrimental soil conditions.

12. Restrict mechanical disturbance to existing roads and skid trails at all times on portions of activity areas that contain slopes greater than 30 percent. Prohibit any new development of temporary roads and/or designated skid trails on sensitive soils with steep slopes. Require operators to winch logs to skidders with at least 75 feet of bull line. Hand felled trees shall be directionally felled toward pre-approved skid trails, and the leading end of logs shall be suspended while skidding. Exceptions for areas that make up less than 10 percent of an activity area would be subject to Forest Service approval. On slopes steeper than 30 percent, existing skid trails (used by the purchaser) shall be reclaimed by applying appropriate rehabilitation treatments (see *Mitigation* below).

    The following activity areas are proposed for mechanical treatment and contain slopes over 30 percent:

    Alternative 2: Units 11, 12, 14, 22, 23, 24, 32, and 41.
    Alternative 3: Units 11.1, 14, 22, 23, 24, 32, and 41.
    Sustained slopes longer than 200 feet within these EA units would be excluded from mechanized harvest and mowing activities.

13. Reclaim all temporary roads and some of the log landings and primary (main) skid trails by applying appropriate rehabilitation treatments in activity areas where detrimental soil conditions are expected to exceed the Regional Policy guidelines. Decommission (obliterate) logging facilities that will not be needed for future management. Options for mitigating the effects of project activities include the use of subsoiling equipment to loosen compacted soils on log landings and designated skid trails, redistributing humus-enriched topsoil in areas of soil displacement damage, and pulling available slash and woody materials over the treated surface to establish

effective ground cover protection.

Reclaim all temporary roads and some of the logging facilities in portions of the following activity areas:

Alternative 2 Units: 13, 14, 21, 22, 23, 24, 31, 32, 33, 34, 41, 42, 43, and 44.
Alternative 3 Units: 13, 14, 21, 22, 23, 24, 31, 32, 33, 34, 41, 42, 43, and 44.

14. Under both action alternatives, reclaim all machine-built fire lines by redistributing displaced topsoil and unburned woody debris over the disturbed surface.

Wildlife

Spotted Owl

To prevent disturbance to nesting birds during breeding season

15. Should a new spotted owl nest site or activity center be discovered during surveys, disruptive work activities will not take place within ¼ mile of nest sites or activity centers of all known pairs or resident singles between March 1 and September 30.

Programmatic BA Project Design Criteria

16. Prescribed fire managers need to use smoke management forecasts in order to minimize smoke entering into suitable habitat and to ensure that dissipation would be adequate.

Programmatic BA Project Design Criteria

Raptors

To prevent disturbance to nesting birds during breeding season

17. Any active raptor nest stands found during management activities will be protected from disturbing activities within ¼ mile of the nest by restricting site disturbing operations during the following periods:

LRMP WL-3, WL-33, WL-28.

Sharp-shinned hawk	April 15 – August 31
Northern goshawk	March 1 – August 31
Red-tailed hawk	March 1 – August 31
Osprey	April 1 – August 31
Great-grey owl	March 1 – June 30

18. The goshawk nest site in Unit 15 will require a seasonal restriction on disturbing operations during the period of March 1 – August 31.

Units 12, 13, 14, 15.

Snags

19. All existing snags would remain except where snags must be felled for roads, log landings, or occupational safety (including safety during logging and burning operations). Timber Sale Administrators would design harvest operations to avoid snags by locating skid trails and landings away from them, where possible. If snags need to be felled, they are to be retained for down wood. Felled snags may be moved off roads and

landings, but not removed from the site.

To Prevent the Introduction and Spread of Invasive Plants		
20.	Use clean-equipment contract clauses (local and regional) to minimize risk of introduction and spread of invasive plant species by contractors, for actions that operate outside the limits of the road prism (i.e. bulldozers, skidders, other logging equipment) prior to entering National Forest System Lands.	LRMP standard (Invasive Plant ROD 2005)
21.	Any fill materials should be gathered only at weed-free quarries or other weed-free source sites.	LRMP standard (Invasive Plant ROD 2005)
22.	Minimize soil disturbance and retain native vegetation, in and around project activity areas, to the extent possible consistent with project objectives.	Standard prevention practice
To Preserve Visual Quality		
*The following design features apply to **Units 21 and 22**, which lie adjacent to the Scenic Views Management Area (Partial Retention Foreground), just to the west of the EXF project boundary.*		
23.	Design fuel and vegetation units to minimize ground disturbance and damage to vegetation in units adjacent to partial retention foreground areas (first 150 feet of western boundary).	These measures will ensure the scenery management objectives for views from nearby recreation sites, such as Crane Prairie Reservoir are met by minimizing visual changes at the boundary.
24.	Flush cut stumps to less than 6 inches in height within the first 150 feet of western boundary in units adjacent to partial retention foreground areas.	
25.	Clean-up activities in units adjacent to partial retention foreground areas, including landings, skid trails, and slash piles, should be completed within two years post-treatment.	
26.	Locate slash piles for burning in units that will minimize scorching adjacent to partial retention foreground areas. Limit live crown scorch to < 1/3 tree height. Locate grapple piles on logging facilities.	
27.	Remove visible flagging when unit activities are completed.	
To Protect Cultural Resources		
28.	Coordinate with District Archaeologist during implementation so that project activities avoid the known cultural resource site.	Avoidance per Regional Programmatic Agreement
29.	In the event that previously unknown sites or artifacts are found during project implementation, they will be flagged and operations in the area avoided until an archaeologist is consulted	

2.2.5 Monitoring Common to Both Action Alternatives

Large Tree/ Snag/ Log Retention

This monitoring is proposed in order to assess the validity of some assumptions made about effects of prescribed fire on large live ponderosa pine, snag, and logs. There has been considerable discussions as to the effects of thinning, prescribed burning and the combination on the ultimate creation or removal of these stand elements; most recently in Harrod et al. (2009) showing large tree mortality (snag creation), and loss of existing snags (falling over to become logs) occurring most often in a combination thinning and prescribed burning (spring burning) treatment.

Although past local practices have not shown this type of direct correlation, there is the opportunity under this project to gather local data on this topic. In 2007, pre-treatment plots were established that recorded the number, species, and size (diameter) of the live trees, snags and logs within the project area. These same plots would be examined post-treatments to determine large tree, snag and log retention.

Monitoring Element: Number, species, and size of individual trees, snags, and logs on tenth of an acres plots established within the various treatment blocks.

Type of Monitoring: Implementation Monitoring/Validation Monitoring

Methods/Thresholds: Stand exam procedures used during the establishment and data gathering pre-treatment. Comparisons of data would then be made.

Frequency/Duration/Required action: Once after the completion of all treatments.

Responsibility: Silviculturist, Wildlife Biologist, Fuels Planner

Unintended OHV Use

This monitoring is proposed in order to assess the potential that creation of firelines and temporary roads would attract OHV use post-project implementation. Although the temporary roads would be obliterated, the "footprint" of these roads, as well as the ASV-created firelines would remain possibly attracting OHV use in the particular area that it is not currently occurring.

Monitoring Element: Presence/absence of OHV evidence (e.g. tire tracks, newly churned soil)

Type of Monitoring: Implementation Monitoring

Methods/Thresholds: Visual examination of firelines and temporary roads post-project implementation. Evidence of use may warrant signage and patrol to ensure compliance with Access and Travel Management Plan, and Experimental Forest goals and objectives.

Frequency/Duration/Required action: Two to three years after the completion of all treatments.

Responsibility: Roads Manager, Recreation/OHV specialist, Wildlife Biologist, Fuels Planner.

Soils

Monitoring is proposed to ensure the selected alternative, including mitigation measures, are properly implemented on the ground as designed and achieve the desired results.

Soil Quality Objective: To determine if post-project subsoiling mitigation was effectively accomplished and reduced the extent of detrimentally compacted soil in a representative sample of EIS Units.

Monitoring Elements: Surface area treated on temporary roads and primary logging facilities.

Area of Consideration: Individual activity areas (EIS Units).

Suggested Methodology: Combination of visual survey and shovel probing.

2.3 Comparison of the Alternatives

This section provides a comparison of the three alternatives. Table 6 displays the number of acres of each action to occur by alternative. Alternative 2 allows for more thinning, mowing, and underburning to occur because it does not avoid spotted owl habitat. Alternative 2 includes approximately 0.5 mile more of temporary road construction than alternative 3. Because Alternative 3 avoids treatments in spotted owl habitat and LSR, it requires the construction of more fire line to protect those areas during underburning.

Table 6. Comparison of the alternatives

Actions	Alternative 1 (No Action)	Alternative 2	Alternative 3
Thin to UMZ	0	714 acres	701 acres
Thin to 75% UMZ	0	806 acres	540 acres
Thin to 50% UMZ	0	681 acres	586 acres
Thin to 75% UMZ and Create Small Openings	0	353 acres	351 acres
Total Thinning	**0**	**2,554 acres**	**2,178 acres**
Mow and Underburn	0	2,554 acres	2,178 acres
Control – No Treat Areas	0	342 acres	342 acres
Temp Roads	0	1 mile	0.5 mile

Table 7. Comparison of how the alternatives meet the purpose and need

Purpose and Need	Alternative 1 (No Action)	Alternative 2	Alternative 3
Reduce risk of loss due to insects and disease and fire; protect existing and future research	No density reduction, no fuels treatment. Risk of loss remains high across experimental forest because stand density remains above UMZ. Low flame lengths predicted on 50% of project area. 47% of area would support a passive crown fire, increasing over time.	Reduces beetle risk on 2,554 acres (72% of the Lookout Mountain Unit) by reducing stand density to levels at or below UMZ and treating fuels. Highest degree of risk reduction among alternatives considered. Low flame lengths predicted on 85% of project area. 577 acres would support a passive crown fire.	Reduces beetle risk on 2,178 acres (62% of the Lookout Mountain Unit) by reducing stand density to levels at or below UMZ and treating fuels. Intermediate degree of risk reduction among alternatives considered. Low flame lengths predicted on 81% of area. 733 acres would support a passive crown fire.

Purpose and Need	Alternative 1 (No Action)	Alternative 2	Alternative 3
Provide operational-scale research and address research questions in study plan "Forest Dynamics after Thinning and Fuel Reduction in Dry Forests"	No new research would be conducted. Existing research would remain at risk.	Provides new research opportunities on 2,554 acres. Enables full and proper implementation of peer-reviewed/approved research design; full pursuit of research objectives; and attainment of scientifically-valid research results.	Provides new research opportunities on 2,178 acres. Prevents full and proper implementation of research design; compromises full pursuit of research objectives and attainment of scientifically valid research results.

Table 8. Comparison of how the alternatives address the Key Issue – Spotted Owl Habitat

Element of Key Issue	Alternative 1 (No Action)	Alternative 2	Alternative 3
Spotted Owl Critical Habitat	No impact to Critical Habitat	No impact to Critical Habitat	No impact to Critical Habitat
Spotted owl Nesting, Roosting, and Foraging (NRF) habitat	0 acres treated	Approximately 211 acres NRF removed through thinning and fuel treatments – 0.25% of NRF on Deschutes NF.	0 acres of NRF treated.
Spotted owl dispersal habitat	0 acres treated	1,935 acres dispersal treated; 1,594 acres degraded and 533 acres removed.	1,718 acres dispersal treated; 1,436 acres degraded and 283 acres removed.
Treatment within Late Successional Reserve	0 acres treated. Current risk to wildfire remains high.	Best addresses the objectives of the LSR Assessment by thinning and treating fuels on 165 acres, promoting habitat conditions for the focal species.	0 acres treated. Current risk to wildfire remains high.

2.4 Alternatives Considered but not Analyzed in Detail

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action expressed concerns they had with the proposed action and in some cases provided suggestions for a different course of action. Some of these alternatives may have duplicated the alternatives considered in detail or were determined to be unable to meet the project's Purpose and Need. Alternatives that were considered but dismissed from detailed consideration are summarized below.

Conduct a different kind of research

Wouldn't it be more valuable to study natural processes in the Lookout Mountain Unit rather than manipulated forest?

Some members of the public feel that the Lookout Mountain unit of the Pringle Falls Experimental Forest is more valuable for studying natural processes because it provides a natural, landscape-scale area to observe. However, the Pringle Falls Experimental Forest was established for the express purpose of silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range. The Forest and Rangeland Renewable Resources Research Act of 1978 authorizes the Secretary of Agriculture to conduct renewable resources research activities on national forest and rangelands. Additionally, research at the Lookout Mountain Unit is not limited to the current study. A variety of research opportunities could be overlaid on the research platform created with the study plan of "Forest Dynamics after Thinning and Fuel Reduction in Dry Forests."

Natural processes are better studied at Research Natural Areas. Within the National Forest System and the Bureau of Land Management, RNAs are managed to maintain the natural features for which they were established, and to maintain natural processes. Non-manipulative research and monitoring activities are encouraged in RNAs and can be compared with manipulative studies conducted in other similar ecoregions. There are five RNAs on the Deschutes National Forest, including one within the Pringle Falls Experimental Forest (see Figure 2, page 2). An environmental assessment is currently being prepared for the establishment of four additional RNAs on the Deschutes National Forest (see Scheduled of Proposed Actions).

Conduct the research in another area of the Forest

Can the research questions be addressed by collecting data in other areas of the Forest that are undergoing active management?

It was suggested by some members of the public that the proposed research could be conducted in other areas of the Forest, such as where there is ongoing thinning that is similar to that proposed here. This alternative was not considered in detail in the EIS because: 1) the Experimental Forest is the appropriate place to conduct research because it allows for long-term data collection, and for us to learn how forests change over time as climate and other factors change; and because the Experimental Forest was established for the purpose of conducting research; and 2) the need to thin the area due to overly-dense stands within the Lookout Mountain unit, making it reasonable to conduct the research there.

Limit the Treatments to what is needed to protect existing research

Some commenters felt that the proposed action exceeds what is necessary to meet the objective of protecting existing research and want to see an alternative that reduces the area treated to just that necessary to protect existing research plots from fire.

The interdisciplinary team (IDT) conducted a preliminary analysis to determine the placement of treatments in strategic locations (according to the Treatment Optimization Model) to determine if those locations would be sufficient to meet the stated purpose and need of density reduction and research. The model identifies major fire travel routes and attempts to block them efficiently with fuel treatments. The IDT considered the initial results of the strategic placement of treatments analysis. The results show about 1,500 acres (assuming the maximum benefit of 30% of the area treated) of treatment would be placed primarily along the perimeter of the Experimental Forest boundary, including the northwest section that does not fall into the study area. The forest type in the northwest corner of the Experimental Forest is mountain hemlock and lodgepole pine; these species do not lend themselves to the study objectives, which are focused on ponderosa pine. The current project, however, does not preclude future proposals to reduce fuels in that part of the Forest.

This alternative was not developed in detail because it would essentially result in an alternative that would not meet the purpose and need of implementing the study plan, and would not meet the purpose and need of density reduction across the experimental forest. Alternative 3, which eliminates certain habitat components (spotted owl NRF and Late Successional Reserve) from treatment, treats 2,178 acres of the Experimental Forest, which is roughly 700 acres more than the treatment optimization model initially predicts is necessary for full protection from fire alone. The treatment optimization alternative would be similar in scale to Alternative 3, but would include some of the NRF and the LSR and the units would not be situated on the landscape as needed for the experimental design which ensures homogeneity in elevation and aspect.

Some individuals also pointed out their concerns that the scale of the EXF project is much larger than previous research that has occurred in the Lookout Mountain Unit.[2] It is not uncommon for silvicultural experiments to occur at operational scale (i.e. units are large enough that the results can be directly related to management information needs without having to scale up research results from smaller experimental plots). For examples of large-scale silvicultural experiments, see http://www.fs.fed.us/pnw/research/lsse/index.shtml. The scale of treatments proposed in this project, however, is due to the need for thinning across a large area to reduce the risk of beetle attack. It is also important for the size of blocks to remain large because larger blocks of relatively homogenous forest will best maintain options for future research.

No timber harvest in the Experimental Forest

As discussed earlier in this section, the opinion that the experimental forest should be maintained in a natural condition without manipulation was also brought forward. Some members of the public are opposed to harvest operations in the Experimental Forest. To address this concern, the IDT considered an alternative that would involve only ground fuel reduction without any thinning. This alternative would have treated fuels through mowing and underburning to provide short-term fire risk reduction; no thinning would occur. The no-harvest alternative would respond to public concerns about timber harvesting in the experimental forest while allowing some limited fuels reduction treatments. This alternative was not analyzed in detail because it would not meet the purpose and need for action which is to reduce stand density to maintain high growth rates and reduce susceptibility to catastrophic loss to insects, disease, or

[2] Appendix A lists past and ongoing research in the Lookout Mountain Unit. In addition to the research treatments, there have also been past treatments within the Lookout Mtn. Unit that were not specifically designed for experiments. Both of these kinds of past activities are listed at the beginning of Chapter 3, under Basis for Cumulative Effects Analysis.

fire, and to implement the research study plan. The modification of fire behavior would be short-term; and the fuel treatments do not address overly-dense stands or the research objectives. The long-term effects of not thinning the project area will be displayed under the No Action alternative analysis.

Diameter Limits

Some commenters suggested that diameter limits should be applied to the project design because it is less controversial and improves the ability to achieve project goals. An alternative was considered that involved only thinning trees < 21" DBH and smaller.

This alternative was eliminated from detailed study because modeling of the vegetation indicated that only thinning trees smaller than 21" DBH would not reach the target basal area for the stands. Retaining all trees 21" and larger does not reduce the tree density to residual levels called for in the study plan on 2,078 acres under Alternative 2 and 1,784 acres under Alternative 3.

The thinning prescriptions call for thinning from below, which means that the largest trees in any given area will be retained.

2.5 Sale Area Improvement Projects

Money may be collected from the timber sales to complete certain projects such as required mitigation, and enhancement and restoration projects in the vicinity of the timber sale areas. Required mitigation measures (M) have the highest priority for funding, but may be funded by other means such as appropriated funds to insure that requirements are accomplished. Items marked with an (E) are considered enhancement.

This list is intended to serve as an overall guide for the analysis area. As timber sales are defined, specific priorities may be adjusted to meet the needs for each sale area. This priority setting should be documented briefly in the implementation file for each timber sale.

Some projects listed here were not analyzed as part of this project and would require documentation through a separate NEPA process.

1. Subsoiling (M)
2. Subsoiling (E)
3. Road gating (E)
4. Repair of existing gates (E)
5. Experimental Forest Boundary signing (E)
6. Flagging removal (E)
7. ATV damage repair (E)
8. Trash removal (E)
9. Road closures and signing (E)

Chapter 3
Affected Environment and Environmental Consequences

Affected Environment and Environmental Consequences

This section of the environmental assessment considers the environmental consequences of implementation of the various alternatives. The following discussion of effects follows CEQ guidance for scope (40 CFR 1508.25(c)) by categorizing the effects as direct, indirect, and cumulative. The focus is on cause and consequences. For this analysis, in general, direct and indirect effects have been discussed in the context that most readers are accustomed to: those consequences which are caused by the action and either occur at the same time and place, or are later in time or farther removed in distance but are still reasonably foreseeable (40 CFR 1508.8). 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).

Measures to mitigate or reduce adverse effects caused by the implementation of any of the actions proposed are addressed in Chapter 2, Resource Protection Measures. Effective mitigation avoids, minimizes, rectifies, reduces, or compensates for potential effects of actions. After mitigation is applied, any unavoidable adverse effect to each resource area is addressed in the section titled "Other Disclosures" in this chapter of the EIS. The temporal and spatial scale of the analysis is variable depending upon the resource concern being evaluated, particularly for cumulative effects. The landscape within the EXF project area boundary is the focus of this EIS, but adjacent lands are considered in portions of this analysis process.

3.1 Basis for Effects Analysis

3.1.2 Project Record

The interdisciplinary team (IDT) includes Forest specialists for each discipline (see Chapter 4.3 for team members and their qualifications). Specialists on the IDT prepared technical reports to address the affected environment and environmental consequences of the EXF project. All reports are maintained in the project file, located at the Bend/Ft. Rock Ranger District office in Bend, Oregon. In some cases, this chapter provides a summary of the report and may only reference technical data upon which conclusions were based.

3.1.3 Role of Science

Science information improves the ability to estimate consequences and risks of decision alternatives. The effects of each alternative are predicted based on science literature and the experience of the IDT. The conclusions of the IDT are based on the best available science and current understanding. Relevant and available scientific information is incorporated by reference and a complete bibliography is included at the end of this DEIS.

The research and development (R&D) arm of the U.S. Department of Agriculture (USDA) Forest Service works at the forefront of science to improve the health and use of our Nation's forests and grasslands. Research has been part of the Forest Service mission since the agency's inception in 1905.

All treatment units are subject to and will benefit from thinning and fuels reduction; however, there will be variation in the relative benefits between the thinning types. These variations are the subject of the research to be conducted. For example, the study plan hypothesizes that removing more small trees should allow the residual trees to grow to larger diameters faster, so the trees left in units thinned to 50% UMZ should grow more each year

and/or for a longer period o time than in units that are thinned to 75 or 100% UMZ. This hypothesis has only been tested on smaller pole-size stands of ponderosa pine.

This project will improve and expand our knowledge concerning forest management. In addition to improving understanding of forest vegetation dynamics, the research will also produce information pertinent to fuels management/fire risk and forest insect/disease issues and may indirectly and over the longer term address herbivory and wildlife habitat and climate change issues.

3.1.4 Cumulative Effects

The Environmental Consequences disclosures in this DEIS include discussion of cumulative effects. Where there is an overlapping zone of influence, or an additive effect, this information is disclosed. In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects. Most of these actions and natural events are displayed in Table 9.

The cumulative effects analysis in this DEIS does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one can not reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions.

By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. Finally, the Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The cumulative effects analysis in this EIS is also consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> "CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. 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)

The following table lists the groups of actions that have contributed to the existing conditions within the project area. The effects analysis throughout this Chapter considers these past actions as contributing to the current condition. For example, the discussion of existing soil conditions (p. 169) and table 59 which shows existing detrimental soil conditions are based on the information in Table 9. The project record contains maps and data on past activities.

Table 9. Past actions and events that have contributed to the current conditions in the project area.

Type of Action	General Description	Status / Timing
Past Veg. Mgmt., Including for Research		
PNW-sponsored silviculture studies	Various small-scale thinning or regeneration cutting within the experimental forest boundary. Some geographic overlap of units where research plots will be protected. Some contribution to the vegetation conditions. Studies listed in Appendix A.	Completed 1950s through 1990s; some ongoing
Fire Salvage	Salvage cutting in 1985 Lookout Mtn. Fire area. About 1 acres within the project area.	Completed 24 years ago
Thinning	Low thinning across multiple acres.	1970s and 80s.
Road Construction		
The road network was established within the experimental Forest.	About 35 miles of road were built in the Lookout Mtn. unit. Contributes to current road density and provides access.	Completed 40 years ago in the 1960s
Wildfires		
1845 Wildfire	Stand replacement wildfire covering much of the project area, followed by establishment of current stand structure, density and species composition in the Fall and Crane Prairie watersheds.	165 years ago
1914 Lookout Mtn. Eastside Fire	321 acre fire in the central eastern portion of EXF. Contributed to current vegetation in the project area and Fall watershed.	95 years ago
1985 Lookout Mtn. Fire	533 acre fire to west of EXF boundary; 1 acres overlap with project area; contributed to current veg. condition in Crane Prairie watershed.	14 years ago
Other		
Communication Site	Forest Service Communication site installed at top of Lookout Mountain. Within project area; covers approximately 1 acre.	Ongoing

Table 10. Ongoing or Reasonably foreseeable future actions in the project area and in the Crane Prairie and Fall River 6th field watersheds (see Figure 7) that may contribute to cumulative effects.

Type of Action	General Description	Status / Timing
Programmatic		
Travel Management Rule & Deschutes Travel Management EIS	Motorized travel in central Oregon will be restricted to designated trails, only. Off-road or cross-country travel will not be permitted within the EXF project area. Current off-road use will be subject to enforcement.	Planning; implementation expected in 2010

Type of Action	General Description	Status / Timing
PNW Invasive Plant Program, Preventing and Managing Invasive Plants Record of Decision (2005)	The ROD provides Standards and Guidelines for treatment and prevention of invasive plant species. Currently, there are no known invasive plant sites in the project area. Measures to prevent invasive plant introduction and spread are included in the EXF project design.	Implementation Ongoing
Silviculture/Fuels Reduction		
Long-Term Research Projects	Some studies listed in Appendix A are long-term ongoing studies that may involve rethinning in small plots and data collection.	Ongoing / Recurring
Snow Fuels Reduction	Not in project area; Approx. 3,000 acres in watershed.	Currently Implementing Sales
SIBUN Commercial Firewood	Not in project area; Approx. 20 acres in watershed	
EXF Biomass Study	Approx. 10 acres in project area. About 29 trees were removed from along major roads	Completed 2008
Charlie Brown Project	Not in project area; Approx. 11,492 acres in watershed. Prescribed burning and precommercial thinning.	Post-sale work ongoing
Fall Project	Not in project area; Approx. 3,169 acres in watershed. Prescribed burning.	Post-sale work ongoing
Transportation System		
Highway 42 Reconstruction	Not in project area; Approx. 5 miles in watershed	Ongoing
County Roads ROW maintenance	Not in project area; Approx. 20 miles in watershed	Ongoing / Recurring
MISC.		
Midstate Electric Powerline Maintenance	Not in project area; Approx. 1 acre of vegetation clearing along powerline.	Ongoing / Recurring
Crane Prairie Resort and developed recreation site maintenance	Not in project area; Approx. 10 acres in watershed.	Ongoing / Recurring
Irrigation District Improvements and Reservoir level maintenance	Not in project area; Located at Crane Prairie Reservoir in watershed.	Ongoing / Recurring

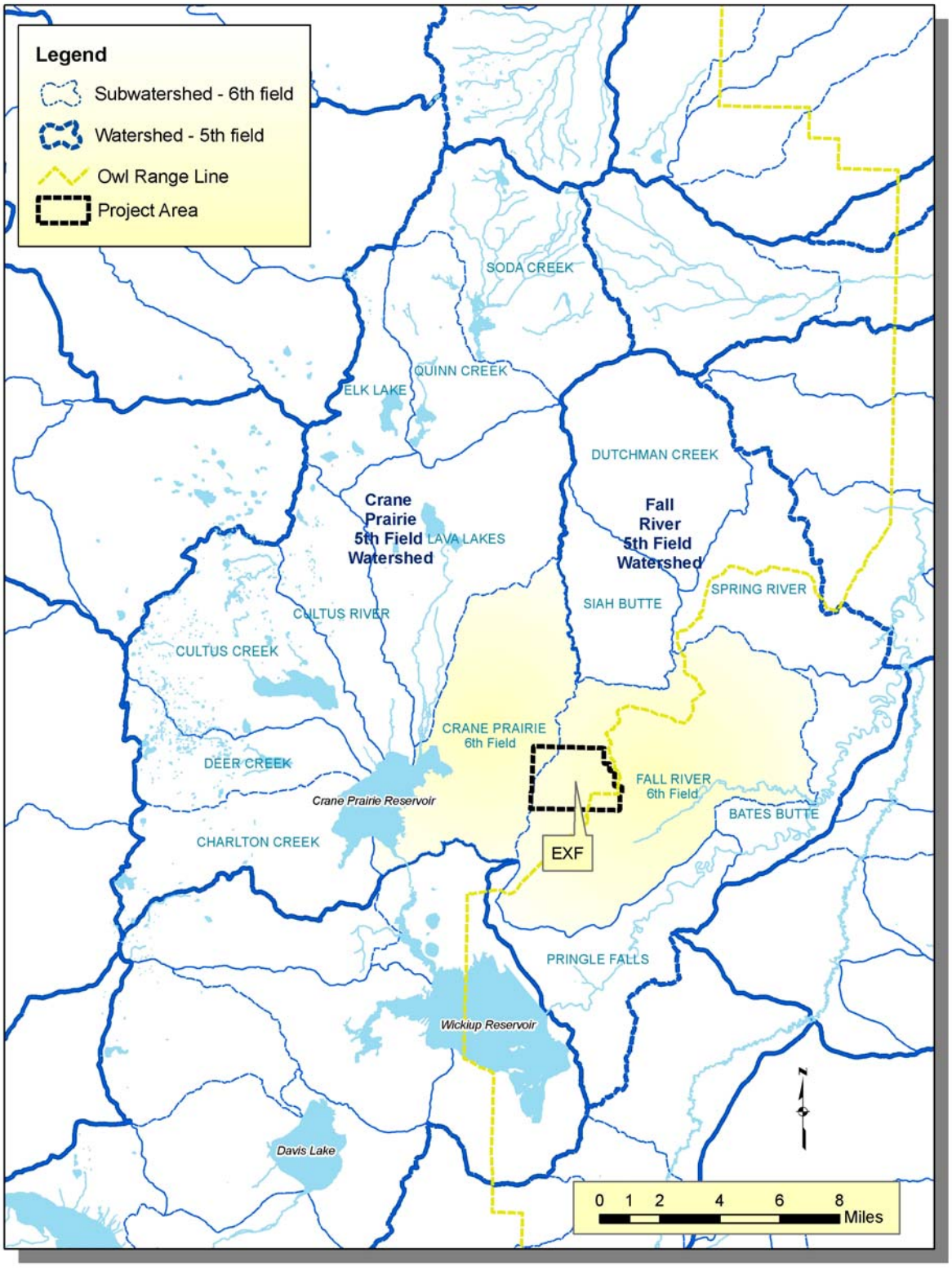


Figure 9. Location of the EXF Project in the Crane Prairie and Fall River 5th and 6th Field Watersheds.

3.2 Discussion of Effects – Key Issue

Key Issue #1 – Northern Spotted Owl Habitat

Federal Threatened, MIS

Introduction

During initial scoping for this project, some members of the public wanted to see that northern spotted owl habitat is protected from the thinning activities. Some expressed concerns that the proposed activities would be in conflict with recovery plan objectives. The Lookout Mountain unit of the experimental forest contains 221 acres of nesting, roosting, and foraging (NRF) habitat. Alternative 3 was developed to address the issue of protecting this kind of habitat. The 221 acres of NRF would not be treated and would be protected from underburning by fire line. There is also 160 acres of Late Successional Reserve overlapping the experimental forest that are deferred from treatment under Alternative 3. This section compares the alternatives' effects to the spotted owl.

Affected Environment

The USFWS listed the northern spotted owl (NSO) as a threatened species in Washington, Oregon, and California on June 26, 1990 (55 Federal Register [FR] 26114). A final draft recovery plan was released in January 1992 but was not finalized. A new draft recovery plan was released in April 2007 (72 FR 20865) and the final recovery plan was released on May 16, 2008 (USFWS 2008). Critical habitat primary constituent elements include forested lands that are used or potentially used for nesting, roosting, foraging, and dispersing. Critical habitat on 6,887,000 acres was designated on January 15, 1992 (57 FR 1796) and revised on August 12, 2008 to include 5,312,300 acres (73 FR 47325). Current threats to NSO include previous and ongoing loss of suitable habitat and competition with barred owls (*Strix varia*) (55 FR 26114).

The northern spotted owl inhabits mature to old-growth mixed coniferous habitats (USFWS 1990). They will occupy second-growth forests if key components of mature forests are present; however, population density and reproductive success are usually lower than in old-growth forests (USFWS 1989). Major roosting and nesting areas are generally dispersed throughout a territory and their use varies seasonally (Forsman et al. 1984).

Functional nesting, roosting, and foraging (NRF) habitat for the NSO occurs in mixed conifer stands and riparian areas with multi-storied canopies. The canopy cover is typically greater than or equal to 40% with an overstory comprised of at least five percent of trees greater than 21 inches diameter breast height (DBH). Habitat that meets nesting and roosting requirements also provides foraging habitat, although a wider array of forest types are used for foraging, including more open and fragmented habitat.

Prey species on the drier East Cascades forests include a mix of arboreal and terrestrial rodents including northern flying squirrels, woodrats, voles, and deer mice, with birds and insects as secondary prey. Mixed conifer stands provide the best habitat for northern flying squirrel while lodgepole pine stands provide habitat for woodrats and deer mice.

Spotted owls primarily use cavities in the boles of dead or live trees for nesting structure. They will sometimes build platform nests in abandoned raptor nests, broken treetops, mistletoe brooms, and squirrel nests. Large diameter trees with the ability to produce large limb structure or epicormic branching also provide good nesting structure. Relatively heavy canopy habitat with a semi-open understory is essential for effective hunting and movement. Nest trees on the Forest are predominately Douglas-fir, with ponderosa pine and white fir used less often.

Courtship behavior usually begins in February or March, and females typically lay eggs in late March or April. After they leave the nest in late May or June, juvenile spotted owls depend on their parents until they are able to hunt on their own. By late summer, the adults are rarely found roosting with their young and usually only visit the juveniles to feed them at night (Forsman et al. 1984). Parental feeding may continue into September after chicks fledge (Forsman et al. 1984). Natal dispersal of spotted owls typically begins in September and October with a few individuals dispersing in November and December (Miller et al. 1997, Forsman et al. 2002). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Forsman et al. 2002).

Activities involving chainsaws, heavy equipment, aircraft, or blasting in specified distances during the breeding season (March 1 to September 30) have the potential to disrupt breeding, feeding, or sheltering which may lead spotted owls to flush from the nest, abort a feeding, or postpone a feeding (Damiami et al. 2007, USFWS 2003, Delaney et al. 1999). The sensitivity of an individual owl to disturbance is likely related to the baseline level of disturbance to which the individual is accustomed, the level and proximity of the disturbance, and the timing of the disturbance in the nesting cycle and nightly activity period. Spotted owls are likely most sensitive to disturbance during the earlier months of their breeding season (March-early July). Recent research on this subject has suggested that noise disturbance within 195 ft (60 m) of a nest will likely cause failure (USFWS, pers. comm. 3/11/09).

Nesting, Roosting, and Foraging Habitat

A majority (2,589 ac of 3,535 ac Lookout Mt. Unit) of the project area lies within the range of the northern spotted owl and under management of the Northwest Forest Plan (NWFP). Another 370 acres of the project area lies east of the range of the northern spotted owl and under management of the Interim Management Direction – Regional Forester's Forest Plan Amendment #2 or "Eastside Screens." Approximately 160 acres of the 31,004 acre Sheridan Mountain Late Successional Reserve (LSR) are within the project area. There are no Critical Habitat Units within the project area.

Mapped suitable NRF habitat was field verified in 2008 and the baseline data updated (see Biological Assessment p. 9-10). The amount of NRF within the project area is displayed in Table 11. Assessments of NRF habitat do not separate out nesting, roosting, and foraging into different habitat classifications. The stands within the project area that met better roosting and foraging quality, but lacked immediate nest tree availability, were still classified as NRF because it is anticipated that nest trees (e.g. large Douglas-fir or true first with large cavities) could develop within these stand types.

Table 11. Spotted Owl Nesting, Roosting, and Foraging Habitat by Allocation.

Allocation	Acres within the EXF Project Area	NRF Acres within the Lookout Mtn. Unit	NRF Acres within Treatment Units	Percent of NRF within Lookout Mtn. Unit also within Treatment Unit
Late Successional Reserve / Experimental Forest	160	0	0	0%
Administratively Withdrawn / Experimental Forest	3,005	250	221	88%
Eastside Screens / Experimental Forest	370	N/A	N/A	N/A
Total	**3,535**	**250**	**221**	**88%**

Dispersal Habitat and Connectivity

Dispersal habitat is important for spotted owl young to move from one territory to another, away from natal areas, or away from adults. The Programmatic BA defines dispersal habitat as a minimum of 30% canopy closure regardless of plant association, and a minimum average diameter of 7 inch DBH for lodgepole pine stands, and 11 inch DBH for mountain hemlock, ponderosa pine and mixed conifer stands (Table 12).

Table 12. Dispersal habitat definitions (items in bold are PAGs found within the EXF Project Area)

Plant Association Group (PAG)	Stand Criteria Average DBH, Percent Canopy Cover
Mixed Conifer Wet	**11" DBH, 40% CC**
Mixed Conifer Dry	**11" DBH, 30% CC**
Ponderosa Pine	**11" DBH, 30% CC**
Lodgepole Pine	7" DBH, 30% CC
Mountain Hemlock	7" DBH, 30% CC

Approximately 18,392 acres of the 6th field watersheds are NSO dispersal habitat using the above criteria. There is approximately 2,250 acres of dispersal habitat within the Experimental forest and it is well-distributed. The project area provides dispersal habitat in all directions. The Charlie Brown project (Bend/Ft. Rock Ranger District EA 2002) had supported the mapping of connectivity corridors between LSRs in the Crane Prairie and Fall River watersheds that had been established under the Browns/Wickiup Watershed Analysis and Browns/Round Mountain Late-Successional reserve Assessment (1997). These corridors were to be managed for late-seral characteristics and encompassed the best habitat currently meeting these characteristics. One of these corridors runs through the EXF Project area and encompasses suitable NRF habitat as well as dispersal habitat. The Fall River planning efforts (Bend/Ft. Rock Ranger District EA 2004) also designated corridors under the Eastside Screens that connect to the other corridors from the Charlie Brown project. These corridors are to be managed for late-seral characteristics such as higher canopy closures and larger trees. These corridors ensure dispersal habitat is maintained in the watersheds.

Dispersal habitat is generally available throughout the area. Miller et al. (1997) found dispersing owls favored old growth structure for dispersal, but utilized many types of forest. Use of open sapling stands during dispersal decreased the probability of mortality, where use of clearcuts increased the probability of mortality. Miller et al. (1997) tied the increase of survival in sapling stands to availability of prey. The SEI report (Courtney et al. 2004) noted that owls did not disperse across large unforested valleys but did disperse between areas through forested foothills.

Critical Habitat and Late Successional Reserve

Critical Habitat Units (CHU) were established by the U. S. Fish and Wildlife Service because 1) spotted owl habitat is continually decreasing and becoming more fragmented, 2) the resultant increased threat of isolation of spotted owl populations, and 3) the exacerbation of poor habitat conditions for dispersing spotted owls. There are no CHUs within the project area. The closest CHU is approximately 7 air miles to the west (Cultus Mountain).

The Sheridan Mountain Late Successional Reserve (LSR) is 31,004 acres and approximately 160 acres are within the EXF Project area. This LSR has 1,393 acres of mapped NRF habitat, none of which is within the EXF Project area or has been field verified. A decline in habitat has likely occurred in the LSR due to insects and disease, but this also has not been field verified.

The Northwest Forest Plan established the LSR network designed to protect late-successional forest species. The purpose of the LSR is to provide distribution, quantity, and quality of late successional and old growth forest habitats sufficient to avoid foreclosure of future management options. The objective of LSRs is to "protect and enhance the condition of late-successional/old growth forest ecosystems, which serve as habitat for dependent or old growth associated species including the northern spotted owl." (USDA 1994a).

The Deschutes National Forest Late Successional Reserve Overview (USDA 1995b) recognized that late successional reserves east of the Cascade crest function differently as well as identifying the major risks to each. "Climatic conditions on the eastern flank of the Cascade Range are much drier then conditions west of the crest. These drier climatic conditions in combination with the exclusion of fire and past timber harvest activities have created over stocked and stressed stands that are and have been susceptible to large scale insect and disease epidemics, and catastrophic fires. Within Region 6, some of the Deschutes National Forest LSRs provide habitat for species which rely on late structured stands maintained by frequent, low intensity fire regimes. These "fire climax" late successional and old growth stands provide habitats and an array of late successional and old growth related species not usually associated with the "climatic climax" stands on the Deschutes Forest or Province. Because of this mix of "westside" and "eastside" vegetation types and conditions, management efforts should focus on maintaining the dynamic balance of all the vegetative series, to include both climatic climax and fire climax ecosystems. This will provide opportunities for ecosystem maintenance and restoration for existing and potential natural vegetation." (USDA 1995b).

As required by the NWFP, a Late Successional Reserve Assessment (LSRA) was completed to determine what management activities would be appropriate within the LSR. The LSRA was reviewed by the Regional Ecosystem Office (REO) and determined to be consistent by letter January 27, 1997 (USDA 1997). The REO found the Sheridan Mountain LSRA provided sufficient framework and context for future activities within the LSR and was consistent with the direction found in the Record of Decision for the NWFP.

Specifically the objectives of any proposed management within the LSRA are 1) to prevent the loss of current late-successional and old-growth habitat due to large scale disturbances; and 2) to accelerate the development of late-seral old growth forest characteristics (e.g. snags, logs, large trees, canopy gaps).

The LSRA defined Management Strategy Areas (MSA) throughout the LSRs based on plant association groups and recommended treatments to reduce the risk of insect, disease, and fire. The LSRA included management options in which to reduce these risks and identified priority areas. The intent of the LSRA was to take a proactive approach before a stand-replacing event could occur. Therefore, it is intended that treatments will occur to reduce the effect of a wildfire in order to forego this type of event all together.

The portion of the Sheridan Mt LSR that overlaps the EXF project area contains the MSAs B, C, and J representing the mixed conifer wet, mixed conifer dry, and ponderosa pine wet/dry groups respectively. According to the LSRA, thinning and fuels reduction needs are immediate and projects that address these needs were recommended within the first 10 years of the assessment. Similarly, commercial thinning is an acceptable strategy for late-successional old growth habitat acceleration in these types of MSAs.

Common wildlife indicator species across these three MSAs include pileated woodpecker, northern goshawk, and flammulated owl. Other indicator species for the MSAs in this portion of the LSR include northern spotted owl, black-backed woodpecker, and white-headed woodpecker. Many of these species have been observed in the watershed.

Hessburg et al. (1994 in Courtney et al. 2004) concluded that a century of fire protection has promoted a steady shift away from open ponderosa pine forests toward denser late-seral fir forests. Lehmkuhl et al.

(1994) documented forests in eastern Oregon and Washington became more dense in vertical and horizontal canopy structure as understory structure increased with regeneration of mostly shade-tolerant species. These changes in the mixed conifer community resulted in habitat conducive to the spotted owl but have also resulted in a shift toward greater instability (Maffei and Tandy 2002). Much of this newly developed spotted owl habitat is relatively short-lived as habitat because replacement Douglas-fir and ponderosa pine nest trees are unlikely to develop given successional pathways. This was the case with most suitable habitat within the Sheridan Mt. LSR and eastern portion of the Crane Prairie/western portion of the Fall River watershed.

Recovery Plan for the Northern Spotted Owl (USFWS 2008)

The final recovery plan devotes an entire appendix (Appendix E) to managing sustainable spotted owl habitat in dry eastern Cascades forests, of which the EXF project is a part. In this section of the recovery plan, it is recognized in the dry eastside forest environments large, old, widely-spaced ponderosa pine, western larch, or Douglas-fir dominated the overstory. These large, fire-tolerant trees could survive low and mixed severity fire but large snags and logs were generally sparse. This is different than spotted owl habitat on the west-side of the Cascades that have infrequent fire return intervals, supporting higher densities of large snags and logs. Spotted owl habitat in eastside forests generally occur in Douglas-fir, white fir and grand fir vegetation series embedded in larger landscapes of forest vegetation series that are more indicative of high fire return intervals (e.g. ponderosa pine, dry mixed conifer: 5-10 yr fire return interval). This picture of a landscape of dry and moist mixed conifer patches in a landscape of more fire-tolerant ponderosa pine closely describes the spotted owl habitat in the EXF project area and the adjacent portions of the Crane Prairie and Fall River Watersheds (especially the Sheridan Mt. LSR). Management of these habitats for spotted owl habitat would include identifying high quality NRF habitat (e.g. patches of mixed conifer with large Douglas-fir or white/grand fir and large dead wood) and placing risk reduction treatments around these key habitats. Total area of owl habitat patches or clusters should strive to average 30-35% of the overall landscape where applicable; with the larger percentages being in landscapes dominated by moist forest habitats.

Specifically, Recovery Actions #6 and #7 include: "Identify, maintain, and restore approximately 30-35% of the total dry forest (ponderosa pine, Douglas-fir, and dry grand fir plant association group) habitat-capable area as spatially dynamic high-quality spotted owl habitat patches, and approximately 50-75% of the total moist forests (moist grand fir, western hemlock, and Pacific silver fir) habitat-capable areas as spatially dynamic high-quality spotted owl habitat patches." and "Manage lands outside of high-quality habitat patches to restore ecological processes and functions and to reduce the potential for significant losses by stand replacement fires, insects, and disease." Although there is not a process in place to consistently identify high quality habitat, the field verification of mapped NRF conducted in 2007 and 2008 and the subsequent determination of NRF amounts within the project area fulfills this management need of identifying high quality NRF habitat for this project area.

Therefore, there is a need to balance the management for the spotted owl with other habitat conditions on the landscape. Where development of suitable spotted owl habitat best fits the landscape, additional measures will be incorporated to ensure that components of habitat are being managed for (i.e. prey species habitat requirements, dispersal, large trees, etc.).

Northern Spotted Owl Presence in Project Area

One known spotted owl home range lies partially within the Experimental Forest (Three Trappers Buttes); but not within any project unit. A majority of the Three Trappers Buttes home range lies outside of the Experimental Forest. Surveys conducted according to the R-6 protocol (USDA 1993) have occurred throughout the project area since 2007; this initial survey found this known spotted owl home range but did not locate any nest tree. Mousing attempts to determine if this pair had young proved inconclusive, as the pair ate every mouse it was offered. The EXF Project area was surveyed again in 2008 and 2009. All suitable habitat, in addition to this new activity center, has been surveyed

to determine occupancy and use. In 2008, the only detection was an auditory detection of a male calling. This owl was not visually located and did not respond again on any further location attempts. The pair detected in 2007 has not been relocated to date. There were no spotted owl detections (visual or auditory) during the 2009 field season. None of the survey efforts have detected or observed barred owls.

Approximately 5 miles to the north is the home range circle for the Sheridan Mt Pair (1005). This site was first found to be active in 1989 with only a resident male observed until 1995. In 2006 a single female was heard, and this was the last observation made of any spotted owls in this home range. Reproduction for this pair was never confirmed nor inferred (i.e. no young seen).

Environmental Consequences

The following evaluation criteria will be used to evaluate the effects of planned activities:

- **NRF Habitat:** Acres of suitable habitat treated.
- **Dispersal Habitat:** Acres of current dispersal habitat treated, and acres of dispersal habitat treated within established corridors.

In addition, snag and down wood levels will be discussed as they relate to spotted owl habitat. However, a more in-depth discussion on snags and down wood can be found in the Wildlife Section 3.3.3.

Effects Common to All Alternatives, Including No Action

CHU

There will be no effects to any CHUs. The closest CHU is on the western border of the Bend/Ft. Rock Ranger District, whereas the EXF project area lies on the eastern edge of the spotted owl's range. Spotted owl dispersal to the CHU via the LSRs is discussed under dispersal habitat.

Dispersal Habitat

Considering dispersal habitat, an action common to all alternatives will be to monitor and fall trees that pose a hazard to public safety on open roads or within harvest units when identified as an imminent hazard. These typically occur outside suitable habitat or areas managed for the development of suitable habitat. However, where danger trees are identified in suitable habitat, trees are to be cut and left to provide additional downed wood. Hazard trees within NRF habitat in the EXF area should be rare since these stands are still green. Removal of danger trees outside of NRF habitat will reduce snag and down wood levels, however this will be minor in scope and will be contained to the road prism and area immediately adjacent. Adequate snag and downed wood levels will still remain across the project area.

Alternative 1 – No Action

Direct and Indirect Effects (Ecological Trends)

NRF Habitat

This alternative allows for processes to follow natural succession. There would be no removal of wood other than danger trees. Large portions of the project area would remain a mix of ponderosa pine stands and mixed conifer stands where large ponderosa pine are co-dominant with Douglas-fir, with white fir in the understory. Existing habitat would be at risk to insect and wildfire mortality due to fuel loadings within and adjacent to the stand.

In the short-term, the current levels of NRF habitat would remain, but in the long-term there would be little to no development of ponderosa pine and Douglas-fir forests across the area because these are early seral species that would die out as true firs develop into the understory. The habitat currently used by the Three Trappers Butte owls is an inclusion of large diameter Douglas-fir and true fir surrounded by lodgepole pine. It is apparent that the stand is a remnant that survived wildfires in the past. With current fuel loadings in the area, it is uncertain whether a stand such as this would survive a future wildfire with the possibility that future spotted owl habitat may become even more limited.

Dispersal

The current 2,250 acres of dispersal habitat would remain. The current function of the established corridors would remain intact.

Alternative 2

Direct and Indirect Effects

NRF Habitat

This alternative would result in the removal of 211 acres of NRF habitat. Light thinning would likely degrade the NRF habitat (13 ac), whereas heavier thinning and thinning across all age cohorts, in combination with fuels treatments, will likely remove NRF habitat (198 acres). Light thinning may remove some canopy components, but not necessarily the dominant canopy. The stand is expected to have large trees and $\leq$ 30% canopy closure; thinning from below will reduce the multi-storied aspect of the stand that is conducive as spotted owl habitat and prey habitat. Thus the stand may still function as NRF, but more for roosting and foraging rather than nesting. Heavy thinning and thinning across all age cohorts have these same effects but effects are more exaggerated. In these treatments, canopy closure, multi-storied structure and larger trees (in the case of thinning across age cohorts) would be reduced and cause the entire stand to no longer function as NRF (e.g. reduce average tree DBH in the stand and reduce the canopy closure below 30%).

Prescribed burning and mowing can limit the sustainability of existing down large woody debris and snags that are habitat for spotted owl prey. This effect is less precise because many factors determine the amount of dead consumed and created. A prescribed fire can consume large logs and snags. However, it can also create large snags and logs by causing existing snags to fall (creating large logs), or by killing large trees (creating large snags). It is assumed that in order to attain research objectives, mortality of live trees would be prevented by mowing to reduce fuel loads, and burning under spring-like conditions. Because the prescribed burning is to be designed to result in small fuel consumption, and it has been shown in the Pringle Falls Unit of this Experimental Forest that prescribed burning can retain snags and logs, it is not expected that this action would contribute to the degradation of spotted owl habitat or its prey habitat.

The effects of these activities within NRF habitat (i.e. degradation and removal of habitat) will adversely affect northern spotted owls by further limiting available habitat within the watersheds. Owl habitat on the eastern edge of the species' range adds to the diversity of the species and its ability to persist (McCullough 1996). The objective of the research is to investigate treatments for ponderosa pine growth and protect existing research. There is not a spotted owl research component to the proposal, and ponderosa pine types are generally not managed for spotted owl habitat. The beneficial effects to spotted owl habitat from the reduced fuel loadings and thinning that retains Douglas-fir are secondary to the proposed research within the project area. The treatments may eventually promote better roosting and foraging opportunities rather than nesting due to the increased health and spacing of the trees within the stand.

One temporary road will be constructed through existing, unoccupied NRF habitat. It will be approximately 0.5 miles in length and will be closed (the roadbed will be subsoiled) after thinning is complete. The construction of this temporary road will contribute to the loss of NRF habitat already anticipated by the thinning. The closing of this temporary road may reduce future disturbance.

The removal of danger trees from the haul routes is expected to have minimal effects to NRF habitat. Generally these trees would be close to the roads and not favorable for spotted owl nesting. Any effects of this aspect of the proposed action would act in conjunction with the thinning, mowing, and burning.

Dispersal

1,935 acres of dispersal habitat will be treated. Of these acres, 533 acres will not meet dispersal guidelines outlined in the Programmatic BA or the Sheridan LSRA after treatment. The affected dispersal acres occur within mixed conifer vegetation types and would receive the heavy thin prescription; specifically Units 12, 41 and 23 which occur within the connectivity corridors analyzed under the Charlie Brown analysis effort (2000) and established under the Browns/Wickiup Watershed Analysis and Browns/Round Mountain Late-Successional Reserve Assessment (1997). The corridor "CC#2" was designated to address dispersal and movement needs of a variety of species, past fragmentation between the LSRs and the literature then on risks to NSO from predators associated with edges. The goal was to provide connected dispersal habitat within a corridor that was a minimum of 1,000 ft. wide, and an average 30% canopy closure through time (Charlie Brown Biological Evaluation and associated USFWS Letter of concurrence, 2000). Treatments within Units 12, 41 and 23 would narrow this corridor to the minimum 1,000 ft. width. Loss of dispersal habitat can adversely affect spotted owls because it limits the ability of young to successfully move throughout the landscape and establish a new territory. Loss of dispersal in conjunction with a loss of NRF habitat can prevent new pairs of owls becoming established and being able to rear young, thus recovering the population.

The 533 acres removed represents approximately 24% of the current dispersal habitat in the project area and 3% of the dispersal habitat in the watersheds. It is unlikely that the loss of 533 acres of dispersal habitat will form a barrier to movement; especially since other stands of habitat are still distributed throughout the area (e.g. control units, and other non-treated portions of the experimental forest). The proposed actions narrow the suitable areas for dispersal and can increase the risk of predation as an owl moves through the area.

The one mile of temporary road construction in three segments would take place within this "CC#2." This construction contributes to the degradation and loss of dispersal habitat because it would require the removal of trees and brush within the road bed. Because the temporary roads would be built within the proposed units, the dispersal habitat degraded and removed has already been accounted for in the discussion of the effects of thinning.

Table 13. Unit Specific Effects to Dispersal Habitat.

Unit	Trtmt	PAG	% Canopy Cover - LSRA	Current - BA	Target - BA	Dispersal BA	Current - TPA	Dispersal TPA	Currently Dispersal	Will Meet Dispersal After?	In Connectivity Corridor?	Acres
11	**2**	MCD	40	138	76	70	103	95	Y	Y	Y	118
12	**3**	MCD	40	138	51	70	103	95	Y	Y	Y	155
13	**4**	MCD	40	138	76	70	103	95	Y	Y	Y	83
14	**1**	MCD	40	138	101	70	103	95	Y	Y	Y	194
15	**5**	MCD	40	138	138	70	103	95	Y	Y	Y	64
21	**4**	MCD	40	174	83	70	85	95	Y	Likely	Y	106
22	**2**	MCD	40	174	83	70	85	95	Y	Likely	Y	206
23	**3**	MCD	40	174	56	70	85	95	Y	No	Y	167
24	**1**	MCD	40	174	111	70	85	95	Y	Likely	Y	196
25	**5**	MCD	40	174	174	70	85	95	Y	Likely	Y	108
31	**3**	MCD	40	184	70	70	101	95	N/A	Y	Y - Eastside Screens	148
32	**1**	MCD/ MCW	40	184	140	70	101	95-100	Y	Y	Y	164
33	**2**	MCD	40	184	105	70	101	95	Y	Y	N	335
34	**4**	MCD	40	184	105	70	101	95	N/A	Y	Y - Eastside Screens	94
35	**5**	PPD/PPW	30-35	184	184	80-85	101	140-155	N/A	Y	Y - Eastside Screens	109
41	**3**	MCD	40	154	35	70	99	95	Y	No	Y	116
42	**1**	MCD/ MCW	40	154	70	70	99	95-100	N/A	Y	Y - Eastside Screens	160
43	**4**	MCW/ PPD	30-40	154	53	70-80	99	100-140	N/A	No	Outside Owl Line	70
44	**2**	PPW/ PPD	30-35	154	53	80-85	99	140-155	N/A	No	Y - Eastside Screens	147
45	**5**	MCW	40	154	154	70	99	100	N/A	Y	Y - Eastside Screens	61

LSR

Treatments are proposed within the Sheridan Mt LSR. This portion of the LSR is part of proposed Unit 33 of the EXF Project. Unit 33 is proposed to be treated with a "moderate thinning" strategy whereby the stand will be thinned from below to within 75% of the Upper Management Zone (UMZ) for ponderosa pine. This means that understory and co-dominant trees will be removed from the stand (i.e. unit) resulting in a less dense stand (e.g. a stand density index or SDI that is currently 267 trees per acre will be 152 trees per acre). The thinning will target lodgepole pine first, then grand fir/white fir, small diameter ponderosa pine, and lastly small diameter Douglas-fir. Unit 33 is a mature mixed conifer stand dominated by ponderosa pine and white fir. The largest trees are ponderosa pine and the desired condition is to reduce the existing tree density per acre while retaining these larger ponderosa pine and having a co-dominant canopy of Douglas-fir.

The LSRA defined Management Strategy Areas (MSA) throughout the LSR based on plant association groups. Unit 33 contains MSAs B, C, and J representing the mixed conifer wet, mixed conifer dry, and ponderosa pine wet/dry groups respectively. According to the LSRA, thinning and fuels reduction needs are immediate and should occur within the first 0-10 years after the assessment was written and adopted (1997) in order to help protect old growth habitat. Similarly, according to the LSRA, commercial thinning is an acceptable strategy or treatment in order to develop late-successional old growth habitat in these types of MSAs. Common wildlife indicator species for these three MSAs include pileated woodpecker, northern goshawk, white-headed woodpecker, and flammulated owl. The

proposed actions for Unit 33 would likely promote habitat conditions for these species. For other wildlife indicator species within MSAs B and C (northern spotted owl and black-backed woodpeckers) the activities would not necessarily provide short-term habitat for these species. The thinning would reduce the multi-storied/structural diversity in the stands that often are a component of spotted owl habitat. Thinning would also improve the health of the stand and make it less susceptible to the insect attacks upon which black-backed woodpeckers often capitalize.

To summarize, the proposed actions within the LSR are compatible with the LSRA completed and adopted in 1997. These proposed actions will help protect existing habitat as well as aid in the development of new habitat for the focal species: pileated woodpecker, white-headed woodpecker, northern goshawk, and flammulated owl. Although the proposed actions may help protect habitat for the spotted owl and black-backed woodpeckers (both focal species) elsewhere in the LSR; they will not necessarily help in the development of new habitat.

Disturbance-related Effects

Because the proposed actions have the likelihood of occurring during the spotted owl nesting season, disturbance to spotted owls may occur. There are no proposed actions within the 1.2 mile home range of a known pair; and disturbance is generally found within 0.25 mile of an individual or nest, therefore there would be no disturbance effects to owls within known home ranges. There are proposed activities within 0.25 miles of NRF habitat that is otherwise outside of a unit. These NRF patches are small (<10 acres) and are unlikely to contain a nest. Potential for disturbance in these patches is low.

The proposed actions would occur within the breeding season within the LSR. Although there is no NRF habitat within the LSR, there may be disturbance effects to other species utilizing the LSR.

Cumulative Effects

Activities identified in Table 10 in Chapter 3.1.2 and Table A-1 in Appendix A were reviewed to assess whether in combination with the likely impacts of the EXF Project, there would be any cumulative effects to spotted owls. Table A-1 in Appendix A lists the types of research that has occurred within the EXF project area, the type of activity that was used for the research, author, and the papers published. For a complete description of the study and its methods, one can refer to the publication listed. Table 10 lists the ongoing and reasonably foreseeable projects occurring in the 6th field watersheds. Effects of past actions will not be discounted, but to the contrary, are analyzed in the description of the existing conditions. It is assumed the effects of past actions are best put into proper context when considered in the existing conditions (e.g. habitat conditions).

Cumulative effects to spotted owls will be addressed at the 6th field watershed scale –the Crane Prairie and Fall River watersheds (see Figure 9) because it is a large area that can cover a variety of spotted owl habitat conditions and the connectivity of the habitats. Based on that review, the potential interrelated or independent actions or effects are discussed.

Crane Prairie Watershed

The majority of nest sites within the watershed are located within the mixed conifer plant association groups (PAGs). The dry mixed conifer PAGs often have an overstory of ponderosa pine and Douglas-fir that have survived past fire events, with a co-dominant overstory formed by white fir that has developed within more recent times with aggressive fire suppression. This condition most likely had the greatest influence on spotted owl habitat across the district due to the development of nesting, roosting, foraging stand characteristics, but in areas where climatically the climax association would be more open stands. This is to say, spotted owl habitat developed in areas where it is difficult to sustain such habitat due to the existing fire regimes and climate.

Activities proposed under the Snow Fuels Reduction project did not impact spotted owl habitat since suitable NRF habitat was avoided. Measures were incorporated to retain suitable nesting habitat, strategically place units to protect suitable habitat as well as reduce the risk of fire in mixed conifer stands by reducing ladder fuels. Under the remaining Charlie Brown treatment units, fuels treatments (e.g. piling and burning slash, underburning) will further provide areas that may slow a wildfire's progression towards spotted owl habitat in the EXF project area. Overall, treatments proposed will improve spotted owl habitat conditions by promoting the development of large structure and reducing the risk of loss of existing habitat to the east from other large-scale disturbances.

Danger trees were removed from within the Cultus Mt LSR and CHU. Although some of the trees removed were of the size of spotted owl nest trees, they were within ~150 ft. of the road where there is increased disturbance. This makes it unlikely they would ever be used for nest trees. This project would not have interrelated and interdependent effects with the EXF project.

Maintenance activities within developed recreation sites will have no cumulative effects in association with the proposed action and no action alternatives.

Fall River Watershed

Most of this watershed lies east of spotted owl's range. There are two home ranges (Sheridan Mt and Three Trapper's Butte) within the western half and these occur within mixed conifer PAGs. Mixed conifer PAGs form a relatively thin band of potential and suitable spotted owl habitat within this watershed, as it quickly becomes ponderosa pine and lodgepole pine PAGs (not potential or suitable spotted owl habitat).

NRF habitat in this watershed has experienced some of the same ecological effects as habitat in the Crane Prairie Watershed. The habitat in the Fall River watershed is at greater risk to wildfire because it lies east of the majority of the insect mortality and high fuel concentrations that exist in the adjacent Crane Prairie watershed (e.g. Mt. Bachelor Roadless Area) and fires tend start in the Three Sisters Wilderness and move in a east/southeasterly direction (pers. communication. T. Bisby, former Assistant Fire Management Officer, Cascade Division, Bend-Ft Rock RD, 2008).

NRF habitat in this watershed closely resembles "late-successional forest structure embedded in a matrix of more fire-tolerant forest structures" described in the 2008 Recovery Plan (Appendix E page 105). That is, the NRF habitat tends to be relatively small stands of large Douglas-fir and white fir embedded in larger areas of ponderosa pine and lodgepole pine stands. Appendix B from the programmatic Biological Assessment was updated March 2008. This table also accounts for all previous losses of NRF habitat from other activities as well (e.g. timber harvest).

Table 14. Changes in Spotted Owl Baseline Habitat

Ranger District	May 2006 Baseline (App B)	NRF Lost (Field Verification, Fire or <2 ac slivers)	March 2008 Baseline (App B)	Acres of NRF Habitat Lost by the EXF Project
Crescent	26,427	0	26,441	0
Sisters	36,935	3,60	33,075	0
Bend-Ft. Rock	24,787	556	24,183	211
Forest Total	**88,149**	**4,416**	**83,699**	**83,501**

Implementation of Alternative 2 will have further additive effects to spotted owls. Alternative 2 will remove 211 acres of NRF habitat. As maintenance of treatments and protection of research plots continues, degraded habitat will likely stay marginal for the long-term, and removed habitat will likely

not return in the short or long-term. Over the Deschutes National Forest, this project represents an approximate 0.25% decline in the amount of NRF habitat.

Conclusion

Alternative 2 will directly reduce NRF habitat. The project is not designed to develop future spotted owl NRF habitat. The founding objectives for the Lookout Mountain Unit of the Pringle Falls Experimental Forest were silvicultural and focused on ponderosa pine development and maintenance. The project is designed to protect current research and provide a platform for new research along these silvicultural objectives. Treatments however may provide spotted owl dispersal habitat in the long-term, and a measure of protection for NRF habitat immediately surrounding the Lookout Mt Unit.

Prior to the late 1980s, loss of suitable habitat was limited to timber harvest. Recent harvest activities are aimed at reducing risk to existing habitat and promoting desired species composition to develop and maintain habitat. The effect of these more recent treatments have yet to be realized in the form of spotted owl occupancy. Barred owls, an identified threat to spotted owls and a more generalist species for nesting habitat needs, may be able to more rapidly occupy the treated stands within the EXF project area. There have been no observations of barred owls within or near the Lookout Mt. Unit, although barred owls have been observed in the western portion of the Crane Prairie watershed.

There are limited plant associations that can produce NRF habitat on the eastern edge of the owl's range. Within the eastern portion of the Crane Prairie watershed and the western portion of the Fall River watershed there are the largest blocks of dry mixed conifer associations (similarly wet ponderosa pine associations) that may be able to develop large Douglas-fir trees and subsequent NRF habitat. All of the stands classified as NRF or that have had historical or recent spotted owl observations in these portions of the watershed all have contained elements of large Douglas-fir. The Experimental Forest was not established to provide for large Douglas-fir, although the thinning prescriptions proposed favor retaining Douglas-fir with the result of improving growing conditions for this species. There is a possibility that the area may support limited NRF habitat in the future, although the emphasis within the Experimental Forest will be Douglas-fir only as it is co-dominant with ponderosa pine.

Proposed actions will impact spotted owl habitat. In the long term, higher quality habitat should develop due to tree growth and preferences for fire resistant Douglas-fir; but NRF habitat would continue to be relatively scarce within this landscape on the eastern edge of the species' range. In the short term, current habitat outside of the Experimental Forest would be better protected from a wildlife perspective by the strategic placement of units. Dispersal habitat will remain throughout the watersheds, however the proposed actions will remove some dispersal and degrade the connectivity corridor established to facilitate old-growth dependent species between LSRs. Removal of dispersal habitat in the proposed action will not cause a barrier to movement. The stands will appear more open due to the thinning and may also provide better access for spotted owl predators (e.g. other birds of prey).

Implementation of **Alternative 2** (**the Proposed Action), May Effect, and is likely to Adversely Affect spotted owls** because of actions proposed that will likely further reduce available NRF habitat and degrade dispersal habitat.

There will be **No Effect to Critical Habitat Units** as a result of the proposed actions.

Alternative 3

This alternative would treat approximately 2,178 acres (~62% of the Lookout Mt unit); none of which is within NRF habitat or LSR.

Direct and Indirect Effects

NRF Habitat

There are no direct effects with the implementation of this alternative. There will be no treatment within any of the NRF habitat. Indirectly, treatments around the NRF may help protect these NRF patches from wildfire, similar to what is described in the 2008 Recovery Plan (Recovery Action #10). Sustaining these NRF stands would provide habitat for dispersing owls. Treatments would occur within ¼ mile of these stands, unless it has been determined that there are no currently nesting owls during the time of actual treatment. Treatment adjacent to the NRF stands vary from light to heavy thinning. Two of the NRF stands are over 100 acres (may provide a nesting territory) and another two are <12 acres (i.e. not likely large enough to provide a nesting territory by themselves; nor are the adjacent stands). It is uncertain if thinning around these stands would hinder new spotted owl nesting. Fireline would need to be created around these stands in order to protect them from the prescribed burning proposed in the adjacent stands. The result may be the unintentional creation of corridors for more disturbance by humans or occupation by other species that can utilize more isolated habitat (e.g. barred owls).

Dispersal

1,718 acres of dispersal habitat will be treated. Of these acres, 283 acres will not meet dispersal guidelines outlined in the Programmatic BA or the Sheridan LSRA after treatment (Table 15. The affected dispersal acres occur within mixed conifer vegetation types and would receive the heavy thin prescription; specifically Units 41 and 23 which occur within the connectivity corridors analyzed under the Charlie Brown analysis effort (2000) and established under the Browns/Wickiup Watershed Analysis and Browns/Round Mountain Late-Successional Reserve Assessment (1997). Treatments within Units 41 and 23 would narrow this corridor to the minimum 1,000 ft. width. The removal of this dispersal habitat would not form a barrier to movement through the area or between the LSRs but can adversely affect spotted owls because it narrows the ability of young to successfully move throughout the landscape and establish a new territory. Loss of dispersal in conjunction with treatment around NRF habitat may discourage new pairs of owls becoming established and being able to rear young, thus recovering the population.

Table 15. Unit specific effects to dispersal habitat

Unit	Trt mt	PAG	% Canopy Cover - LSRA	Current - BA	Target - BA	Dispersal BA	Current - TPA	Dispersal TPA	Currently Dispersal	Will Meet Dispersal After?	In Connectivity Corridor?	Acres
11	2	MCD	40	138	76	70	103	95	Y	Y	Y	118
12	3	MCD	40	138	51	70	103	95	Y	Y	Y	192
13	4	MCD	40	138	76	70	103	95	Y	Y	Y	83
14	1	MCD	40	138	101	70	103	95	Y	Y	Y	194
15	5	MCD	40	138	138	70	103	95	Y	Y	Y	64
21	4	MCD	40	174	83	70	85	95	Y	Probably	Y	106
22	2	MCD	40	174	83	70	85	95	Y	Probably	Y	206
23	3	MCD	40	174	56	70	85	95	Y	No	Y	167
24	1	MCD	40	174	111	70	85	95	Y	Probably	Y	196
25	5	MCD	40	174	174	70	85	95	Y	Probably	Y	108
31	3	MCD	40	184	70	70	101	95	N/A	Y	Y - Eastside Screens	148
32	1	MCD/ MCW	40	184	140	70	101	95-100	Y	Y	Y	164
33	2	MCD	40	184	105	70	101	95	Y	Y	N	335
34	4	MCD	40	184	105	70	101	95	N/A	Y	Y - Eastside Screens	94
35	5	PPD/PW	30-35	184	184	80-85	101	140-155	N/A	Y	Y - Eastside Screens	109
41	3	MCD	40	154	35	70	99	95	Y	No	Y	116
42	1	MCD/	40	154	70	70	99	95-100	N/A	Y	Y - Eastside	160

Unit	Trt mt	PAG	% Canopy Cover - LSRA	Current - BA	Target - BA	Dispersal BA	Current - TPA	Dispersal TPA	Currently Dispersal	Will Meet Dispersal After?	In Connectivity Corridor?	Acres
		MCW									Screens	
43	4	MCW/ PPD	30-40	154	53	70-80	99	100-140	N/A	No	Outside Owl Line	70
44	2	PPW/P PD	30-35	154	53	80-85	99	140-155	N/A	No	Y - Eastside Screens	147
45	5	MCW	40	154	154	70	99	100	N/A	Y	Y - Eastside Screens	61

Late Successional Reserve

Alternative 3 would have no direct effects to the Sheridan Mt. LSR because there would be no treatments within it. Indirectly, this SE portion of the LSR would be better protected from a fire outside of it that may start in the west and move towards the LSR due to the thinning and fuels reduction treatments planned.

This alternative would not directly address the recommended activities for the MSAs represented in this part of the Sheridan Mt. LSRA. In the short-term this may protect habitat for the various wildlife indicator species, but in the long-term habitat for white-headed woodpecker, pileated woodpecker, northern goshawk, and flammulated owl may decrease due to a lack of new source and cohort of large trees (especially ponderosa pine and Douglas-fir). Similarly, spotted owl habitat in this part of the LSR may be maintained, but there would be little recruitment of new Douglas-fir trees or increased growth in currently present Douglas-fir, while the current risk to wildfire remains high.

Cumulative Effects

A list of activities (see Table 10 in Chapter 3.1.2 and Table A-1 in Appendix A) were reviewed to assess if in combination with the likely impacts of the EXF Project, there would be any cumulative effects to spotted owls. Cumulative effects to spotted owls will be addressed at the 6th field watershed scale for both the Crane Prairie and Fall River watersheds. Based on that review, the potential cumulative effects are discussed below.

Crane Prairie Watershed

The majority of nest sites within the watershed are located within the mixed conifer plant association groups (PAGs). The dry mixed conifer PAGs often have an overstory of ponderosa pine and Douglas-fir that have survived past fire events, with a co-dominant overstory formed by white fir that has developed within more recent times with aggressive fire suppression. This condition most likely had the greatest influence on spotted owl habitat across the district due to the development of nesting, roosting, foraging stand characteristics, but in areas where climatically the climax association would be more open stands. This is to say, spotted owl habitat developed in areas where it is difficult to sustain such habitat due to the existing fire regimes and climate.

Activities proposed under the Snow Fuels Reduction project did not impact spotted owl habitat since suitable NRF habitat was avoided. Measures were incorporated to retain suitable nesting habitat, strategically place units to protect suitable habitat as well as reduce the risk of fire in mixed conifer stands by reducing ladder fuels. Under the remaining Charlie Brown treatment units, fuels treatments (e.g. piling and burning slash, underburning) will further provide areas that may slow a wildfire's progression towards spotted owl habitat in the EXF project area. Overall, treatments proposed will improve spotted owl habitat conditions by promoting the development of large structure and reducing the risk of loss of existing habitat to the east from other large-scale disturbances.

Maintenance activities within developed recreation sites will have no cumulative effects in association with the proposed action and no action alternatives.

There are no private or tribal lands within the watershed.

Fall River Watershed

Most of this watershed lies east of spotted owl's range. There are two home ranges within the western half and these occur within mixed conifer PAGs. Mixed conifer PAGs form a relatively thin band of potential and suitable spotted owl habitat within this watershed, for it quickly becomes ponderosa pine and lodgepole pine PAGs (not potential or suitable spotted owl habitat). NRF habitat in this watershed closely resembles "late-successional forest structure embedded in a matrix of more fire-tolerant forest structures" described in the 2008 Recovery Plan (Appendix E page 105). That is, the NRF habitat tends to be relatively small stands of large Douglas-fir and white fir embedded in larger areas of ponderosa pine and lodgepole pine stands.

For the spotted owl habitat that is present in the watershed, much of it lies within the Sheridan Mtn. LSR or the Experimental Forest. This project would not have additive effects to any other ongoing or reasonably foreseeable actions because there aren't any other projects impacting spotted owl habitat.

Comparison of the Alternatives

The No Action alternative results in the least amount of NRF acres impacted as opposed to the Action Alternatives. Alternative 2 will directly reduce NRF habitat. Alternative 3 does not treat within NRF habitat, but stands treated around the NRF may influence the suitability or utilization (either increasing or decreasing) of the NRF. Alternative 3 best meets the Recovery Plan management intent to provide spotted owl habitat in dry forests landscapes. Alternative 3 protects existing habitat, while reducing risks around NRF habitat.

The project is designed to protect current research and provide a platform for new research along these silvicultural objectives. Treatments however may provide spotted owl dispersal habitat in the long-term, and a measure of protection for NRF habitat immediately surrounding the Lookout Mt Unit.

Table 16. Comparison of Alternatives for Spotted Owl NRF and Dispersal Habitat

	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3
Acres of NRF Habitat Removed	0	211	0
Acres of Dispersal Habitat degraded	0	1,594	1,435
Acres of Dispersal Habitat removed	0	533	283
Acres of LSR affected	0	160	0
Home Range Affected	0	0	0
Determination	No Effect	May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect

3.3 Discussion of Effects – Analysis Issues

3.3.1 Forested Vegetation

Background

Pre-Euro-American low elevation dry conifer forests of the western United States were fundamentally shaped by frequent low- or mixed-severity disturbances such as wildfires (Agee 1993, Taylor and Skinner 1998, Everett et al. 2000, Ottmar and Sandberg 2001, Wright and Agee 2004, Youngblood et al. 2004, Hessburg et al. 2005, Arabas et al. 2006) and insect attacks (McCullough et al. 1998, Hayes and Daterman 2001) mediated by diverse environmental gradients of topography, soils, and weather.

Surface fires, ignited predominantly by lightning during the time of year when moisture content of fine fuels was lowest (Agee 1993, Rorig and Ferguson 1999), controlled regeneration of fire-intolerant species, reduced density of small-diameter stems, consumed litter and down wood, opened the stands to increased sunlight, led to vertical stratification of fuels by eliminating fuel ladders between the forest floor and the overstory canopy, and maintained relatively stable plant associations. Consequently, the structure of these low elevation dry forests generally consisted of open, predominantly widely spaced medium to large and old live trees, scattered dead trees, low levels of ground fuels, and continuous low herbaceous understory vegetation (Wickman 1992, Agee 1994, Youngblood et al. 2004, Arabas et al. 2006).

Insects are major components of forest ecosystems, representing most of the biological diversity and affecting virtually all processes and uses. Bark beetles (*Coleoptera: Curculionidae, Scolytidae*) heavily influence the structure and function of low elevation dry conifer forests by regulating certain aspects of primary production, nutrient cycling, ecological succession and the size, distribution and abundance of forest trees (Fettig et al. 2007). While we know little about pre-Euro-American arthropod abundance and their inter-specific relationships (Short and Negrón 2003), these forests likely supported many indigenous phytophagous insect species that killed trees. Phloem-boring bark beetles and cambium and wood boring beetles (Coleoptera: Buprestidae and Cerambycidae) were especially prevalent, with some preferring large, old, slow growing trees, some attacking lower boles and roots exposed after fires, some attacking the tops of trees weakened by fire, and others attacking trees with growth rates slowed by density dependent competition, drought stress, or other localized disturbances that enabled the beetles to circumvent tree defenses (de Groot and Turgeon 1998, McCullough et al. 1998). Attacks often led to mortality of individual and small groups of trees, created snags, altered the accumulation of fuels and vegetation, and created canopy gaps that provided opportunities for new seedling cohorts (Hessburg et al. 1994, Hayes and Daterman 2001).

Today, many of these same dry forests have characteristics that place them at greater risk of uncharacteristic disturbances. These features include an accumulated mass of down woody debris and continuity of the fuels mosaic at landscape scales, more small trees and fewer large trees, greater amounts of young multi-storied forests with fire-intolerant conifers in both understory and overstory strata, increased fuel ladders that contribute to greater flame lengths during fires, and new or altered forcing of regional climate on plant community structure and organization (Agee 1993, Covington and Moore 1994, Arno et al. 1997, Taylor and Skinner 1998, Harrod et al. 1999, Youngblood et al. 2004, Hessburg et al. 2005, Stephens and Gill 2005, Youngblood et al. 2006, McKenney et al. 2007). In many dry forests of the Pacific Northwest, the altered fuelbeds and shifts in forest structure and composition resulted from fire exclusion and suppression, livestock grazing, timber management activities, and changes in climate (Bergoffen 1976, Steele et al. 1986, Dolph et al. 1995, Arno et al. 1997, Richardson et al. 2007).

Increases in overall stand density over the past century have led to increased competition among trees for below-ground nutrients, water, and growing space. Increased competition among trees and reduced tree vigor increases susceptibility to attack from bark beetles and other forest insects and diseases (Mitchell 1990, Hessburg et al. 1994, Oliver 1995, Fettig et al. 2007). Mortality in ponderosa pine attributed to mountain pine beetle is positively correlated with high stand density (Sartwell and Dolph 1976, Fettig et al. 2007). Thinning has been shown to reduce the amount of ponderosa pine mortality caused by mountain pine beetle unless surrounding areas are allowed to develop epidemic population levels (Fettig et al. 2007). The mountain pine beetle often kills extensively when contiguous stands or landscapes become vulnerable. These changes have occurred more recently against a backdrop of natural and human-caused climate change that may first be manifest in the distribution of herbaceous species and woody shrubs, and may eventually result in a redistribution of tree species (McKenney et al. 2007, Richardson et al. 2007). Collectively, these altered structural conditions contribute to increased probability of multiple, interacting stresses and may lead to altered or new disturbance regimes.

Affected Environment

The EXF study area in the Lookout Mountain Unit lies is an ancient shield volcano and has an elevation ranging from 4,390 feet in the southeast corner of the planning area to 6,223 feet at the top of Lookout Mountain. Slopes are flat in the eastern portion of the planning area to greater than 30% on steeper areas. A majority of the aspects are east and south with approximately 25% of the planning area on the north side of Lookout Mountain having a north aspect. Precipitation averages 20" per year and occurs mainly as snow during the winter.

Approximately 300 acres on the upper slopes of Lookout Mountain are a complex soil type consisting of soil mapping units 84 and 85. Soil mapping units 65, 67, and 69 are the soil mapping units on the remaining 90% of the planning area. (These soils are all susceptible in varying degrees to soil displacement. (See Soils Chapter 3.3.4 for additional details).

Currently, this relatively large block of closed-canopy forest has undergone little major disturbance. The major disturbances consist of two wildfires: A single stand-replacement fire in the mid nineteenth century resulted in the establishment of dense ponderosa pine at lower elevations and Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), white fir (*Abies concolor*), sugar pine (*Pinus lambertiana*), western white pine (*Pinus monticola*), and mountain hemlock (*Tsuga mertensiana*) at higher elevations. A second fire in 1914 burned 321 acres in the eastern part of the planning area.

These closed-canopy stands have grown exceptionally well, and may represent some of the most productive ponderosa pine sites in central Oregon. However, the stands have reached a high density which slows tree growth and increases susceptibility to insect-caused mortality. Limited low thinning throughout the planning area occurred about 40 years ago when the road network was established.

The Lookout Mountain Unit of the Pringle Falls Experimental Forest lies within portions of two 6th field sub-watersheds (see Figure 9, page 39). Crane Prairie subwatershed contains 25,285 acres; the Fall River subwatershed contains 39,516 acres. Forty-three acres of the project area are in the Crane Prairie subwatershed and 2,853 acres of the project area are in the 39,516 acre Fall River subwatershed.

Plant Associations and Plant Association Groups (PAGs)

The Deschutes National Forest uses a system of vegetation plant association to group similar parts of environmental gradients. Plant associations represent units of land that respond similarly to management activities and support similar plant communities throughout different stages of development (Volland 1985). Plant associations within the Lookout Mountain Unit strongly reflect both elevation and aspect influences. Two *Pinus ponderosa/Purshia tridentate-Ceanothus velutinus* plant associations (CPS-312 and CPS-311) represent the warmest and driest plant associations in the Lookout

Mountain Unit; they occur on toe slopes and undulating slopes with east aspects at elevations up to about 4,500 feet (see Figure 10). From about 4,500 feet upslope to about 4,900 feet on east to southeast aspects is the Mixed conifer/*Ceanothus velutinus-Arctostaphylos patula* plant association (CWS-113). Ponderosa pine is the sole dominant tree species on more southerly aspects, while grand or white fir increases in prevalence on east to northeast aspects. On more southern and eastern aspects up to about 5,300 feet in elevation is the Mixed conifer/Ceanothus velutinus/Carex plant association (CWS-115). This plant association supports predominantly ponderosa pine and lodgepole pine (*Pinus contorta*) as major seral tree species, and small amounts of white/grand fir (*Abies concolor*), sugar pine (Pinus lambertiana), and Shasta red fir (*Abies magnifica shastensis*) as advance regeneration. The tall shrub *Chrysolepis chrysophylla* (giant chinquapin) occurs throughout both these plant associations. Three other plant associations occur in small amounts at higher elevations of the Lookout Mountain Unit. These are the Mixed conifer/*Arctostaphylos patula* plant association (CRS-111) that supports white-grand fir, Shasta red fir, western white pine, and Douglas-fir, the Mixed Conifer/snowbrush-chinkapin (CWH-111) plant association that supposed ponderosa pine, sugar pine and white fir and Douglas-fir, and the *Pinus contorta*/*Ceanothus velutinus-Arctostaphylos patula* (CLS-911) plant association that supports primarily lodgepole pine on cold sites. These plant associations and the Plant Association Groups (PAGs) are displayed in Figure 10.

Plant communities (or plant associations) can be classified by a variety of factors such as vegetation structure, site moisture, and overstory and understory plant species composition. Similar plant associations are aggregated and grouped by their climax species, site potential, and moisture similarities into Plant Association Groups (PAGs). Grouping plant associations helps us predict, compare, and analyze potential disturbance patterns and how the vegetation will respond to these disturbances. (Grenier unpublished paper)

There are approximately 2,500 acres of non-forested land within the two subwatersheds (cinder, meadow, riparian, rock, mesic shrub, and other ownership). No management activities are proposed on these non-forested areas. Analysis for the EXF project is based on the remaining 62,162 forested acres as shown in Table 17.

Table 17. Forested Acres by PAG (Plant Association Group) in the Fall River and Crane Prairie 6th Field Subwatersheds.

PAG Code	PAG Description	Plant Associations within Project Area	Acres of PAG in Watersheds
LPD	Lodgepole Pine Dry	CLS911	20,295
LPW	Lodgepole Pine Wet		4,464
MCD	Mixed Conifer Dry	CWS115, CRS111, CWH111	18,668
MCW	Mixed Conifer Web	CWS113	2,646
MHD	Mountain Hemlock Dry		52
PPD	Ponderosa Pine Dry	CPS312	10,609
PPW	Ponderosa Pine Wet	CPS311	5,427
Total			**62,162**

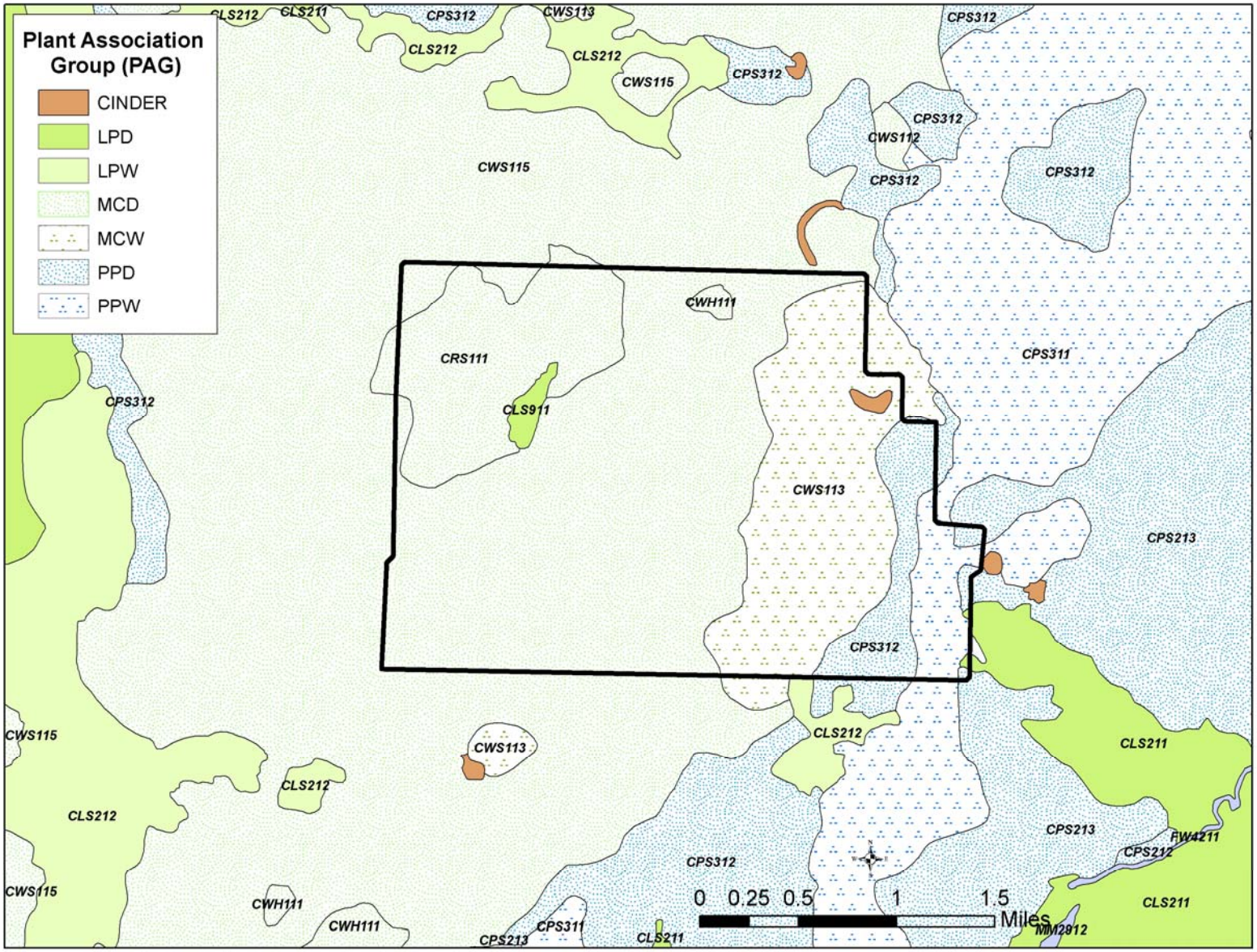


Figure 10. Plant Associations and Plant Association Groups.

Northwest Forest Plan Area (west of the spotted owl range line)

Approximately 2,527 acres of the project area (87%) lie west of the Northern Spotted Owl (NSO).

C-44 of the Northwest Forest Plan requires an assessment of the proportion of Late Successional-Old growth (LSOG) across the landscape: "Landscape areas where little late-successional forest persists should be managed to retain late successional patches. This standard and guideline will be applied in fifth field watersheds (20 to 200 square miles) in which federal forest lands are currently comprised of 15 percent or less late successional forest."

To determine the proportion of LSOG for the EXF landscape, the two affected 6th field watersheds were used (see Figure 9). This landscape was chosen because the area represents the appropriate scale and also incorporates habitat more similar to the project area than extending the analysis further west or east.

The presence of Late successional-old growth forest (LSOG) for the 62,162-acre area was determined using 2004 satellite imagery data. LSOG is determined by PAG (Table 16) as determined from the Deschutes Geographic Information System PAG layer. For any given 30 meter square pixel to be considered LSOG, the following conditions need to be satisfied:

1. Large trees are a minimum of 21" DBH
2. A minimum of 25% canopy cover is in large trees

Within the 62,162-acre landscape, 2,589 acres meet lodgepole pine LSOG criteria and 16,330 acres meet mixed conifer LSOG criteria. Total LSOG within the two subwatersheds is shown to be approximately 18,919 acres (30%) of the forested acres.

Eastside Screens Area (east of spotted owl range line)

For 369 acres of the project area east of the spotted owl range, the Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales" applies (also called Regional Forester's Amendment #2 and commonly referred to as the Eastside Screens).

Interim Ecosystem Standard of the Eastside Screens gives direction to characterize the watershed for patterns of stand structure by biophysical environment and compare to the Historic Range of Variability (HRV). Typically historic disturbance regimes are used to describe the biophysical environment.

Disturbance Regimes

The project area has land east of the owl line in the Fall River subwatershed. The following table documents the historic disturbance regimes that were dominant within the Fall River subwatershed. It is more feasible to document disturbance regimes across larger landscapes at the subwatershed level rather than try and scale them down to the project level.

Table 18. Historic Disturbance Regimes Fall River Watershed

Biophysical Environment	Dominant Disturbance Factors	Disturbance Regimes * (Agee, 1990)	Average Disturbance Patch Size Acres	Typical Landform Setting	Typical Elevation	Aspect
Non-Forest Meadow	na	na	na	na	na	Level
Lodgepole Pine	1) Fire 2) I & D	Moderate Moderate	80 – 150 10 – 1,000	Level, Rolling	4,200	Flat, Various
Ponderosa Pine	1) Fire 2) I &D	Low Low	80 – 150 1 – 20	Level, Elevated Sites	4,300	Flat, Various
Mixed Conifer	1) Fire 2) I & D	High Moderate	100 – 500 100 – 500	Elevated Sites, Buttes	5,000	NW-NE, Various

*Low severity regimes: 1-25 year return interval, 0-20% trees kill
Moderate severity regimes: 26-100 year return interval, 26-70% tree kill
High severity regimes: > 100 year return interval, 70% + tree kill

Structural Stages and Historic Range of Variability (HRV)

The following table lists and defines the structural stage classifications set out in the Eastside Screens.

Table 19. Definition of Structural Stages

Regional Forester's Amendment # 2, Structural Stage Classification	Definition	Description	Old Structural Stage Classification
Stand Initiation SS 1	Growing space is reoccupied following a stand replacing disturbance, fire, harvest etc, typically by early seral species.	Grass, forb, seedling/saplings. Scattered overstory may be present as in seed tree/open shelterwood.	Early
Stem Exclusion Open Canopy SS 2	Crowns are open growing, canopy is broken, may be a moisture limiting area or maintained by frequent underburning, density mgmt, or high water tables.	Poles to small saw logs, < 21" DBH. Crown closure of 25% or less. Scattered overstory may be present as in stage 1.	Early/Mid
Stem Exclusion Closed Canopy SS 3	Occurrence of new tree stems is mostly limited by light, stand density. Canopy is closed.	Same as stage 2 except that crown closure is 26% or greater.	Mid
Understory Re-initiation SS 4	Understory establishing under an overstory. Mortality in overstory creates growing space for new trees in the understory.	Broken overstory canopy, 2+ canopy layers. Overstory is poles, small or medium size trees. Understory is seedlings/saplings or poles.	Mid
Multi stratum w/o Large Trees (young forest multi-story) SS 5	Several canopy layers established due to influence of management, fires, insect & disease group killings. Large trees generally absent as a result of harvest or other disturbance. Large tree defined > 21" DBH.	Broken overstory canopy, 2+ layers. Large trees absent in overstory. Stands characterized by diverse distributions of trees and trees sizes. Seedlings, saplings, poles, small and medium trees present.	Mid LOS for Lodgepole Pine only
Multi stratum w/Large Trees (old forest multistory) SS 6	Multi canopy layers, multi strata stands with large, old trees.	Broken overstory canopy, 2+ canopy layers. Large trees dominant in the overstory. Stands characterized by diverse distributions of trees and tree sizes. All tree sizes maybe present.	Late/Old
Single Stratum w/Large Trees (old forest single story) SS 7	Single canopy of large, old trees.	Broken or continuous canopy of large old trees, 1 canopy layer with co-dominants. Large trees dominant in overstory. Understory absent or made up of seeds/saps, grass, forbs or shrubs.	Late/Old

East of the owl line, the existing condition of structure stages, including late and old structure (LOS) is based on interpretation of 2004 satellite imagery using the Deschutes Viable Ecosystems Model. The successional stage component of the Viable Ecosystems Model is not used for the EXF analysis. The Viable Ecosystem Model structure stage categories and their relationship to the Old Structural Stage Classification (SS) shown in the previous table are:

1. Grass, forb, shrub (Early SS)
2. Seedlings and saplings, 1" to 4.9" DBH, (Early SS)
3. Pole size, 5" to 8.9" DBH, (Mid SS)
4. Small, 9" to 20.9" DBH, (Mid SS)

5.a) Medium and Large, 21+" DBH, (Late SS Multi-strata)
5.b) Medium and Large, 21+" DBH, (Late SS Single strata)

The portion of the EXF project east of the owl line and subject to the Eastside Screens, is located within the Fall River subwatershed. There are 39,535 acres within the Fall River subwatershed with 39,033 of these acres classified as forested. The presence of LOS is assessed for the 39,033 forested acres within the Fall River subwatershed both east and west of the NSO line.

The term historic range of variability (HRV) is used by ecologists to describe the natural fluctuation of ecosystems over time. In this project, the term refers to the range of conditions and processes likely to have occurred prior to settlement by Americans of European ancestry (mid-late 1800s). The HRV serves as a reference point from which change can be measured. The HRV assumes minimal disturbance by human activities and is often used as a baseline for conditions that are assumed to have existed on the landscape more than 100 years ago. The HRV is not used to recreate precise percentages of each structural stage.

In the following three tables, the source of the HRV is the Eastside Draft Environmental Impact Statement for the Interior Columbia Basin Ecosystem Management Project (ICBEMP). The source of the current condition is satellite imagery.

Table 20. Current Condition for Lodgepole PAG in the Fall Subwatershed Compared to HRV.

Structural Stage (see Table 18 for definitions)	Current Acres	Historic Range of Variability	Current % of the PAG area	Relation to the HRV
Early (1, 2)	6,161	20-30%	35%	Above
Mid (3, 4)	6,051	50-60%	35%	Below
Late Multi-Strata 5(a)	434	10-20%	2%	Below
Late Single Strata 5(b)	4,732	5-15%	27%	Above
total	17,37			

Table 21. Current Condition for Ponderosa Dry PAG in the Fall Subwatershed Compared to HRV.

Structural Stage (see Table 18 for definitions)	Current Acres	Historic Range of Variability	Current % of the PAG area	Relation to the HRV
Early (1, 2)	2,857	10-20%	20%	Within
Mid (3, 4)	10,435	30-40%	74%	Above
Late Multi-Strata 5(a)	644	10-20%	5%	Below
Late Single Strata 5(b)	205	20-30%	1%	Below
total	14,141			

Table 22. Current Condition for Mixed Conifer Wet PAG in the Fall Subwatershed Compared to HRV.

Structural Stage (see Table 18 for definitions)	Current Acres	Historic Range of Variability	Current % of the PAG area	Relation to the HRV
Early (1, 2)	585	25-35%	8%	Below
Mid (3, 4)	5,869	40-50%	78%	Above
Late Multi-Strata 5(a)	285	25-35%	4%	Below
Late Single Strata 5(b)	775	5-10%	10%	Within
total	7,514			

For the late multi-strata category of all three PAGs within the Fall River subwatershed, the tables show existing conditions that are below HRV. The ponderosa pine PAG late single-strata category is also below HRV. Lodgepole pine PAG late single stage strata levels are above, and mixed conifer late single stage strata levels are within HRV conditions.

The largest departures from HRV are in the mid-seral structural stages which are considerably above the HRV range in the ponderosa dry and mixed conifer wet PAGs.

For the EXF project area itself, the analysis area used to determine current structural stage levels is based on only the 369 acres within the EXF project which are located east of the owl line and that are proposed for treatment.

Previous Research Findings from the Experimental Forest

Formally established in 1931, Pringle Falls Experimental Forest is the oldest Experimental Forest in the Forest Service system. It is a center for silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Cascade Range. Between 1930 and 1993, more than 100 studies have been conducted to advance knowledge in these areas. The research studies cited in this section have been compiled in "Research Publications of the Pringle Falls Experimental Forest, Central Oregon Cascade Range, 1930 to 1993" (Youngblood 1995) and illustrate some of the relevant results obtained from these on-site studies. While not all of the studies have been conducted on the Lookout Mountain block, they are referenced in this section to illustrate the range and types of research conducted on the Experimental Forest. Several silvicultural studies, such as the Lookout Mountain installation of the Levels of Growing Stock (LOGS) study, continue as long term work having both regional and national significance.

Insects

The primary insect species of concern with ponderosa pine are: mountain pine beetle (*Dendroctonus ponderosae Hopkins*), western pine beetle (*Dendroctonus brevicomis*), and the pine engraver (*Ips pini*). These have been documented and/or studied in the Pringle Falls Experimental Forest (Alosi and Robertson 1992; Barrett 1983; Barrett and Newman 1974; Greene 1992; Keen 1936; Larsson and others 1983; Sartwell 1971).

All three insect species cause ponderosa pine mortality. Although western pine beetle and pine engraver mortality can be extensive, the species capable to cause the most damage is the mountain pine beetle.

Some of the research findings in the EXF project area pertinent to mountain pine beetle are:

- Vigor decreased as basal areas and leaf area index increased. Low vigor trees were more often attacked by (mountain pine) beetles than were high vigor trees (Larsson and others 1983).
- Mortality associated with mountain pine beetle attacks was greatest in the higher growing stock levels; attacks occurring at the lower growing stock levels were on trees of low vigor only (Barrett 1983).
- The pattern of mortality during the 30 years of observation in small merchantable trees, caused by mountain pine beetle, suggests the potential to use light and frequent thinning from below to maintain the productive capacity of the stand (Barrett and Newman 1974).

Although most of the insect studies conducted in the Experimental Forest have involved the mountain pine beetle, the recommended treatment to reduce beetle caused mortality by all three species of concern is the same. Density reduction to levels below the UMZ increases tree vigor and reduces residual tree mortality caused by insects.

Root Rot

Armillaria (*Armillaria mellea*) root disease is found within the EXF project area and has been documented and/or studied in the Pringle Falls Experimental Forest (Howard, 1972, 1974; Reaves, 1985; Reaves, and others 1984, 1988, 1990).

Armillaria takes advantage of decreased host vigor when it periodically occurs from drought, defoliation, or other pest attack. Thinning may mitigate tree stress and thus, in some way, prevent infections on residual trees, should they occur, from becoming lethal. If thinning increases tree vigor and impedes fungal colonization of lateral roots and, especially the root collar or taproot, then perhaps tree mortality is delayed until other stressors occur. Also, if root or tree mortality is prevented or delayed, then disease spread to adjacent healthy trees may be further retarded as a result of confined inoculum in occluded lesions on living roots. As a general recommendation, thinning with published guidelines (Emmingham et al. 2005) for pure ponderosa pine stands in central Oregon will also prevent mortality from Armillaria root disease (Filip, Gregory M., et al. 2008).

Dwarf Mistletoe

Ponderosa pine dwarf Mistletoe (Arceuthobium campylopodum has been documented and/or studied in the Pringle Falls Experimental Forest (Barrett and Roth 1985, Beckman and Roth 1968, Knutson 1975, Koonce 1981, Koonce and Roth 1980, Roth 1953, 1966, 1971, 1974a, 1974b, Roth and Barrett 1985, Roth and Strand 1971, Scharpf and Roth 1992, Strand 1973). Reducing stand density by thinning to a relatively wide spacing is likely to slow the horizontal spread of dwarf mistletoe from infected trees to healthy trees.

Needle blight fungus

Needle blight fungus (Elytroderma deformans) of Ponderosa pine has been documented and/or studied in the Pringle Falls Experimental Forest (Roth 1959; Sikorowski 1960; Sikorowski and Roth 1962). Reducing the inoculum source by removal of infected trees is likely to reduce the spread of the fungus from infected trees to healthy.

Previous Activity

Over the last 35 years, vegetation treatment has occurred on 2,534 of the 3,535 acres within the Lookout Mountain portion of the Experimental Forest. Nearly all the treatments were implemented in conjunction with studies relative to ponderosa pine silviculture. Most treatments consisted of commercial and/or non-commercial density reduction. Reforestation activities were prescribed on approximately 120 acres while salvage of dead material occurred on less than 1% of the acres.

1,801 acres have been entered only once. Commercial size density reduction was the treatment on 1,676 (96%) of these acres. 676 acres have been entered twice with most (594 acres) of these treatments involving precommercial thinning as a follow up to commercial thinning. 57 acres have been entered three times, primarily for regeneration activities after overstory treatments and removal. See the Silviculture Report for a map of past silvicultural activities.

Forest Health

Forest stand conditions throughout the EXF planning area can best be described as being overly dense and at risk of beetle-caused mortality. Beetle-killed trees occur both individually and in groups within the planning area.

Stand density index (SDI) (Reineke 1933) is a relative density measure based on the relationship between mean tree size and number of trees per unit area in a stand, and has proved useful for quantifying relative density across a wide variety of stand conditions because it is independent of site quality and stand age (Long and Daniel 1990). While originally developed for single-cohort stands, it is equally relevant for multi-cohort stands (Shaw 2000), and can be applied to mixed species stands with consideration of individual species characteristics. Cochran and Barrett (1995) followed the development of young ponderosa pine stands in the Blue Mountains under 6 stocking levels for 24 years and determined that mean annual cubic volume growth was greatest when SDI was about 210, and high mortality from mountain pine beetle occurred when SDI was greater than 140. As part of the West-Wide Levels of Growing Stock study, Cochran and Barrett (1999) reported on the growth and development over 30 years for stands thinned to six levels, and showed that continued mortality from mountain pine beetle occurred when the SDI was above 240. Cochran et al. (1994) used the concepts underpinning SDI to set an upper management zone (UMZ) for SDI to sustain healthy stand conditions for forest stands throughout the Blue Mountains based on the dominant plant association. The same procedure was used to set UMZs for the Deschutes National Forest in central Oregon (Booser and White). Upper management zones defined specifically for the Deschutes National Forest represent the level of stocking or relative density beyond which there is imminent risk of catastrophic loss of overstory trees to bark beetles.

In central Oregon, the most widely used standard for gauging bark beetle hazard is derived from the work of P. H. Cochran (1992, 1994). Cochran (1992) and Cochran and others (1994) have developed stocking density guidelines from which we can generally predict the risk of bark beetle attack for a number of tree species in Central Oregon. The guidelines are adjusted for each plant association so that site potential (carrying capacity) can be factored into the equation, and higher stand densities can be accommodated on the better sites. Cochran describes an "Upper Management Zone" which is equal to a stocking density that allows for radial growth of 13 annual rings in 10 years and represents the threshold beyond which tree mortality begins to occur. The comparison of existing stocking levels and growth rates with the levels recommended by Cochran and others (1994) provides a useful index to describe the relative stability of a stand of trees with regard to infestation by bark beetles. The upper management zone (UMZ) radial growth rate of 13 annual rings per inch is often used as an indicator of tree vigor and susceptibility to insect caused mortality.

The slower a tree grows, the greater the number of rings per inch and the more susceptible the tree becomes to insect-caused mortality. Radial growth of 13 rings per inch is indicative of a healthy, vigorous tree that often can successfully withstand insect attacks (Eglitis, personal communication). A radial growth rate slower than 13 rings per inch indicates declining tree vigor with an increasing susceptibility to successful insect attack.

Tree radial growth rates samples in each of the potential vegetation types (PAG) represented within the EXF Project Area give an indication of relative susceptibility of the trees to bark beetles. Growth rates of 9 live trees and 5 dead trees were sampled at four locations in the EXF planning area. The trees selected for sampling were ones that appeared to be the best available for the site, ones that would likely be favored (left) after stand thinning treatments are carried out, or recent dead trees. Due to high stand densities, none of the sampled trees had been growing at the rate of 13 rings per inch. Radial growth ranged from 14 to 38 rings/inch with an average growth rate of 27 rings/inch. Ironically, two of the sample trees that had been growing the best were ones that were killed by the mountain pine beetle. Both of these ponderosa pines were very close to a lodgepole pine that had been attacked by MPB and were probably killed by spillover attacks created by the odor plume from that attack. At one of the sites three dead pines that had been killed by bark beetles were sampled in order to determine how their growth rates prior to death compared to those of living trees. The growth rings in the last inch for these trees ranged from 23 to 29, fairly comparable to other trees sampled and clearly too densely spaced for healthy growth and survival. As such, there is reason to believe that any of the remaining trees could be

infested with bark beetles and additional mortality would not be surprising (Eglitis, personal communication).

The recent dramatic effects of the mountain pine beetle within the lodgepole pine host have created concerns about the potential losses in the ponderosa host type. In lodgepole, a bark beetle infestation typically persists in a stand until all of the large-diameter trees are killed. Such is not the case in ponderosa pine, although large patches of mortality can occur. These relatively less dramatic effects in ponderosa pine can be attributed somewhat to the nature of ponderosa stands which tend to be more diverse in age structure than lodgepole stands. However, when ponderosa pine occurs in large contiguous even-aged blocks, its overall stand vulnerability might be greater than in the natural uneven-aged condition. We would nonetheless expect bark beetle-caused mortality in ponderosa pine to be less dramatic than in lodgepole pine. One issue that arises when bark beetles affect ponderosa pine stands is that a "thinning from above" is a common occurrence. The largest trees in a stand are often killed along with surrounding smaller ones in the group, and the progression to a stand dominated by large trees is delayed, not accelerated (Eglitis, personal communication).

The ponderosa pine stands in EXF could all benefit from the thinning treatments and will experience some level of tree loss to bark beetles if thinning is not done. The expected level of this mortality is difficult to predict, given the unique nature of this advanced second-growth nature of the stands in this area. A likely outcome from bark beetle infestation would be larger-than-normal patches of tree mortality and loss of some of the larger-diameter trees in the stand. (Eglitis, personal communication)

All stands in the EXF project area exceed the upper management zone SDI for the appropriate plant association and are at risk of beetle-caused mortality (Table 23). Each quadrant exceeds the upper management zone UMZ SDI by values that range from 41% to 54% with the arithmetic average value being 47%.

Table 23. Comparison of Existing SDI to Upper Management Zone SDI by Block

Quadrant	Total Acres (Includes Controls)	Management Plant Association	Current SDI / % above UMZ SDi	UMZ SDI	Alternative 2 Treatment Acres	Alternative 3 Treatment Acres
1NW	651	CWS115	212 / 36%	156	587	479
2SW	841	CWS115	245 / 57%	156	733	639
3NE	850	CWS113	266 / 32%	202	741	567
4SE	554	CPS312	229 / 125%	102	493	493
Totals	**2,896**				**2,554**	**2,178**

Another estimate of tree vigor is live crown ratio (LCR). It is relatively straightforward, and is easy to obtain. It's a measure in percent of a tree's total height occupied by green branches. In order for healthy trees to maintain relatively vigorous growth rates, trees selected for the residual stand should have a minimum 40% LCR. In several locations of the EXF project area the dominant trees which would be selected for leave in a residual stand have LCRs between 30% and 40%. The short LCRs and the high SDIs, coupled with ongoing beetle-caused mortality are all indicative of over stocked, low vigor stands. Stands growing under such overstocked conditions are not sustainable.

Environmental Consequences

Alternative 1

Direct and Indirect Effects (Ecological Trends)

In the short term, both overstory and understory vegetation density will most likely be unchanged on the Lookout Mountain unit of the Pringle Falls Experimental Forest. Without stand density reduction, tree

growth rates will remain low or continue to decrease. Tree vigor will remain poor and continue to decline. The risk of insect and disease caused mortality will remain high. Because the low vigor trees are at a relatively high susceptibility to insects, there is an increasing probability that the level of pine beetle-caused mortality will become more prevalent even in the short term. In the long term, beyond 10 years, increased levels of beetle-caused mortality will occur, and can be expected to reach epidemic levels.

Tree density, as measured by both SDI and basal area, will continue to increase and density-caused tree mortality can also be expected to increase above current levels. Tree vigor as measured by live crown ratios will continue to decrease. Lower branches will self prune and trees will be further stressed as the relative amounts of photosynthate-producing needles in tree crowns decrease over time.

Tree vigor as measured by diameter growth will also decline. Diameter growth will continue to stagnate and not increase. Development of small and medium-sized tree into larger trees will continue to be retarded. Large tree numbers will increase slowly and can be expected to decrease as a result of indiscriminate mortality caused by pine beetles in all size classes.

Existing research plots would not be protected; the opportunity to continue future research under existing studies will be lost. The opportunity to design and implement new studies at Lookout Mountain would be greatly reduced. The ability to conduct research on the management of ponderosa pine would be negatively impacted.

Alternatives 2 and 3

Direct and Indirect Effects

The types of proposed treatments under Alternative 2 and Alternative 3 are identical. Under alternative 3, LSR and NRF acres are not considered for treatment. Outside the LSR and NRF areas, impacts on each treated acre will be identical in both alternatives. Alternative 2 would treat 2,554 acres and alternative 3 would treat 2,178 acres. The silvicultural difference is that 376 more acres of LSR and NRF are proposed for density reduction under alternative 2. Trees on these additional 376 treated acres will be more resistant to insects, disease, and fire under Alternative 2.

Under both alternatives 2 and 3, twelve ½ acre plots (3 acres each including buffers) are within the project area. These are part of the western U.S. wide "Lookout Mountain Levels-of-Growing-Stock Study established in 1965. These 12 buffered plots will have densities reduced consistent with levels established for each plot under the 1965 study plan. Given the relatively small area involved, and the fact that densities will be reduced on the 36 acres involved, treatments effects are assumed to be similar to those of the two action alternatives.

Unless otherwise noted, the effects discussed in this section apply to both alternative 2 and alternative 3.

In the short term, both overstory and understory vegetation density will begin to undergo changes. The changes in tree growth will extend beyond a short term period of 10 years. With the implementation of stand density reduction under both action alternatives, live crown ratios (LCRs) and diameter growth will improve to well above current levels. The amount of improvement in LCRs and diameter growth is difficult to measure but will be positive based on tree responses to density reduction on other projects. LCRs of residual trees will gradually increase as the trees grow in height. A positive result following density reduction is that trees will retain their lower limbs longer than they would under the existing overly dense conditions, thus increasing their live crown ratios over time.

SDI Retention

Tree vigor as measured by SDI will also improve under the action alternatives; SDI is readily calculated based on tree sizes and amounts. Table 24 shows the predicted SDI response by treatment block and alternative compared to the No Action alternative.

Table 24. SDI: Existing (No Action) and Post-treatment (Alternatives 2 and 3) Comparison

Block	Treatment Acres*		Existing Average SDI by Block (Alt. 1 – No Action)	Post-Treatment Average SDI by Block*	
	Alternative 2	Alternative 3		Alternative 2	Alternative 3
1NW	587	479	221	117	120
2SW	733	639	253	115	119
3NE	741	567	274	153	152
4SE	493	493	227	79	79
Average	2,554	2,178	247	120	119

*Does not include control acres

Table 24 shows very similar block weighted averages for residual SDI in each action alternative. The main difference is that more acres are treated in alternative 2 than in alternative 3.

Basal Areas Retained

Basal areas are more easily obtained and can be readily summarized in the field using relatively simple forest measurement tools. The lower the basal area, the smaller the area occupied by trees. When comparing trees of similar sizes, a lower basal area indicates a lower stocking level of trees on an acre. This translates to more nutrient and water availability for residual trees and tree vigor would be expected to improve. Table 25 shows similar residual basal areas for the action alternatives. Again, the only measurable difference between the action alternatives is in the amount of acres treated.

Table 25. Basal Area: Existing and Post-treatment Comparison

Block	Treatment Acres*		Existing Average Basal Area by Block (Alt. 1 – No Action)	Post-Treatment Average Basal Area by Block*	
	Alternative 2	Alternative 3		Alternative 2	Alternative 3
1NW	587	479	146	88	89
2SW	733	639	181	92	94
3NE	741	567	192	120	119
4SE	493	493	155	61	61
Average	2,554	2,178	170	93	92

*Does not include control acres

Total Number of Trees Retained

The risk of insect and disease caused mortality will be reduced to below current levels. During endemic infestations there is a tendency for the beetles to select the weaker, less vigorous trees for attack, but no such selection is evident during epidemic conditions (Furniss and Carolin, 1992). Thinning from below removes lower vigor trees that are most susceptible to pine beetles under endemic conditions. Once removed, these low vigor trees can no longer serve as a brood source or infection center that would increase beetle caused mortality in adjacent, larger residual trees. Removing suppressed, overtopped trees of low vigor will reduce the likelihood of beetle caused tree mortality in larger residual, more vigorous trees during epidemic outbreaks. While trees per acre varies by individual treatment block (and treatment unit), the overall average number of trees per acre for the project area will be reduced

from nearly 100 trees per acre to approximately 30 trees per acre in each action alternative. Table 26 shows total existing trees per acre before and after treatment.

Table 26. Total Trees/Acre: Existing and Post-treatment Comparison

Block	Treatment Acres*		Existing Average Trees/acre (6"+ DBH) by Block	Post-Treatment Average Trees/acre (6"+ DBH) by Block*	
	Alt. 2	Alt. 3		Alt. 2	Alt. 3
1NW	587	479	103	34	36
2SW	733	639	85	25	27
3NE	741	567	101	35	36
4SE	493	493	99	20	20
Average	2,554	2,178	96	29	30

*Does not include control acres

Fewer trees per acre indicate more water and nutrient availability for residual trees. This translates to improved residual tree vigor so that residual trees are better able to withstand and survive beetle attacks. The average trees per acre following thinning is about ⅓ of the existing trees per acre for either alternative.

Average Tree Size Retained

Density reduction by thinning from below retains the largest trees on site while removing smaller, lower vigor trees. Larger trees have larger root systems than smaller trees. As a result of having larger root systems, larger residual trees are better able and quicker to respond than smaller trees to the increased availability of nutrients and water following density reduction.

Table 27 shows the size of residual trees for each alternative as compared to the existing average diameter.

Table 27. Tree Diameter: Existing and Post-treatment Comparison

Block	Treatment Acres*		Existing Average Quadratic Mean Diameter by Block	Post-Treatment Average Quadratic Mean Diameter by Block*	
	Alternative 2	Alternative 3		Alternative 2	Alternative 3
1NW	587	479	16.2	22.9	22.5
2SW	733	639	19.2	26.3	26.1
3NE	741	567	18.8	25.6	25.3
4SE	493	493	17.7	24.3	24.3
Average	2,554	2,178	18.3	24.9	24.7

*Does not include control acres

On average, trees to be retained are more than 6 inches larger that the current stand average. The main difference between alternatives is that alternative 2 treats 376 more acres than does alternative 3.

Large Tree Retention

In order to reach the residual target densities identified in the study plan, large trees (21"+) will be removed under either action alternative. Thinning from below removes some large trees while retaining the largest trees on site. Table 28 shows reductions in large tree numbers per acre by block.

Table 28. Large Trees/Acre: Existing and Post-treatment Comparison

Block	Treatment Acres*		Existing Average Trees/acre (21"+ DBH) by Block	Post-Treatment Average Trees/acre (21"+ DBH) by Block*	
	Alternative 2	Alternative 3		Alt. 2	Alt. 3
1NW	587	479	20	16	16
2SW	733	639	32	20	20
3NE	741	567	32	25	24
4SE	493	493	26	14	14
Average	2,554	2,178	28	19	19

*Does not include control acres

The block averages for the number of large trees removed range from 4 to 12 per acre with an overall project average of 9 large trees per acre. Alternative 1 retains all large trees on site and also means the proposed study could not be implemented. Alternative 2 retains the fewest large trees since it treats the most acres and removes an average of 9 trees on those acres. At the project level, alternative 3 retains 3,384 more large trees than alternative 2. This amount is between the levels retained under alternatives 1 and 2.

To change the number of large trees retained by leaving all, or more, of the larger trees than is proposed in the study plan would provide biased results that would be considered questionable. Implementation of alternative 3 would also prevent adequate study block replication without a complete re-design of the study plan. Without such unbiased replication, the scientific validity of the proposed study is compromised.

Time before the Next Entry to Reduce Densities

The time period before the threat of large amounts or widespread pine beetle-caused mortality becomes likely depends on the residual stocking levels achieved this entry. This time period varies from 0 years where untreated areas continue to remain at risk on up to at least 150 years where, in general, the greatest density reduction is achieved. Table 29 shows by alternative the number of acres and the length of time before the stands again become at risk of density-related, beetle-caused tree mortality.

Table 29. Alternative acres listed by the time required for stands to reach the UMZ

	Alternative 1	Alternative 2	Alternative 3
Reaches UMZ & Again at Risk in 150+ years	0	1,016	760
Reaches UMZ & Again at Risk in 70-120 years	0	471	366
Reaches UMZ & Again at Risk in 30-55 years	0	353	351
Treated to UMZ; Wide-Spread Mortality Possible in the Short Term (< 5 Years)	0	714	701
Total Acres Treated	0	2,554	2,178
Remains Both Above UMZ and at Imminent Risk of Wide-Spread Mortality	2,896	342 Controls)	342 (Controls) 376 (NRF/LSR)
Total Project Area Acres	**2,896**	**2,896**	**2,896**

Densities are effectively reduced on 363 more acres under Alternative 2 than under Alternative 3. Beetle-related tree mortality at or above the UMZ SDI on these acres will not be a concern for at least 30 years.

The density of residual trees, as measured by both SDI and basal area, can be expected to increase at relatively slow levels following treatment. Density-caused tree mortality would no longer be imminent on the acres treated to less than the UMZ by each alternative. Tree vigor as measured by live crown ratios will improve as trees grow in height and retain their lower branches longer than under current conditions. Trees will become more vigorous as live crown ratios increase and the relative amounts of photosynthate-producing needles in tree crowns increase over time.

Tree vigor as measured by diameter growth will also improve. Diameter growth will increase within 5 years and the residual trees will continue to grow more rapidly than prior to treatment. Development of small and medium sized tree into larger trees will be accelerated. As a result of thinning from below, the average tree diameter will be larger after treatment to the proposed density levels than before treatment. As a result of accelerated diameter growth, the number of large trees will also increase sooner over time than if treatment is foregone.

Brush height will be reduced through mowing and underburning this entry. The reduction in brush evapotranspiration due to reduced brush canopy cover will make available more water and nutrients to improve tree growth until some time in the future when brush again reaches its present level of site occupancy. With no additional treatments after this entry, it is estimated that this will take about 15 years. Compared to the no action alternative, as a result of density reduction tree diameters will continue to grow at an increased rate even after brush again reaches its current level of site occupancy.

Table 30. Alternative Acres and Acreage Differences by Percent of Upper Management Zone Stand Density Index (%UMZ SDI) Retained

% UMZ SDI	Block	Unit	Alt. 2 Acres	Alt. 3 Acres	Acreage Difference
50% UMZ	1NW	12	192	155	37
50% UMZ	2SW	23	225	167	58
50% UMZ	3NE	31	148	148	0
50% UMZ	4SE	41	116	116	0
50% UMZ Total Acres			681	586	95
75% UMZ	1NW	11	118	49	69
75% UMZ	2SW	22	206	170	36
75% UMZ	3NE	33	335	174	161
75% UMZ	4SE	44	147	147	0
75% UMZ Total Acres			**806**	**540**	**266**
75% UMZ Free Thin	1NW	13	83	81	2
75% UMZ Free Thin	2SW	21	106	106	0
75% UMZ Free Thin	3NE	34	94	94	0
75% UMZ Free Thin	4SE	43	70	70	0
75% UMZ Free Thin Total Acres			**353**	**351**	**2**
100% UMZ	1NW	14	194	194	0
100% UMZ	2SW	24	196	196	0
100% UMZ	3NE	32	164	151	13
100% UMZ	4SE	42	160	160	0
100% UMZ Total Acres			**714**	**701**	**13**
Subtotal Treatment Acres			2,554	2,178	376
Control	1NW	15	64	64	0

% UMZ SDI	Block	Unit	Alt. 2 Acres	Alt. 3 Acres	Acreage Difference
Control	2SW	25	108	108	0
Control	3NE	35	109	109	0
Control	4SE	45	61	61	0
Control Total Acres			342	342	0
Total Acres by Alternative			2896	2520	376

LOS East of the NSO Line

Of the 369 acres east of the NSO line in the EXF project area, approximately 263 acres are proposed for treatment. Table 31 shows acres by structural stage proposed for treatment in both action alternatives. The majority (90%) of the acres to be treated are in the mid seral structural stage category. Removing the smaller trees by thinning from below will promote more rapid development of large trees in the residual stand. While it's only one component of old growth, large tree size requires the longest time to develop. The reduced densities proposed in the action alternatives will promote more rapid development of the large trees and will move the residual stands from mid seral to late seral stages sooner.

Table 31. PAG Acres Treated by Structural Stage Alternatives 2 and 3

Structure Stage	Lodgepole PAG	Ponderosa Pine PAG	Mixed Conifer PAG	Total by Structure Stage
Early (SS1)	0	3	0	3
Mid (SS2, 3, 4,5)	1	155	82	238
LOS (SS6)	0	11	7	18
LOS (SS7)	1	3	0	4
Total by PAG	2	172	89	263

For both alternatives 2 and 3, the analysis area used to determine acres of LOS structural stages treated are based on only those LOS acres that are proposed for treatment within the EXF project which are located east of the NSO line. Treatment acres do not include the 103 acres within control blocks.

Of the 263 acres proposed for treatment east of the NSO line, 22 acres (8%) are categorized as LOS because of the number of large trees present (as determined through satellite imagery).

Table 32 shows acres of LOS to be treated by unit for areas east of the NSO line.

Table 32. Alternatives 2 and 3 LOS acres east of the NSO line proposed for treatment*

	Ponderosa pine LOS		Mixed Conifer LOS	
Unit	Multi strata acres	Single strata acres	Multi strata acres	Single strata acres
31	-	-	-	-
34	0.77	-	-	0.15
42	-	-	-	1.71
43	1.08	-	-	4.94
44	9.26	3.09	-	0.15
Totals	11.11	3.09	-	6.95

*Approximately 1 acre of lodgepole pine single strata LOS is not included above.

Single strata lodgepole pine is above HRV as is single strata mixed conifer. Harvest in LOS that is above HRV is permissible under Forest Plan Amendment 2.

Harvest in LOS that is below HRV is in conflict with Forest Plan Amendment 2 which states: "DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV." An amendment to the DRLMP is required so that harvest can take place in ponderosa pine single strata and ponderosa pine multi strata acres.

Plot data for the area east of the NSO line indicate 26 large (21"+) trees per acre. Harvest to 50% UMZ SDI on unit 43 will reduce the large trees to 9 per acre. This is less than the R6 Old Growth criteria of 10 large trees per acre. Since the proposed activity will reduce the amount of LOS in the Fall River subshed by 6 acres, a Forest Plan Amendment will also be required to implement either of the action alternatives. The large tree component for the remaining units east of the NSO line will not be reduced to less than the required 10 trees per acre minimum.

Late Successional Old Growth

Alternative 2 will treat 2,011 acres of LSOG. This is broken out by 1 acre of lodgepole pine LSOG and 2,010 acres of mixed conifer LSOG. The control units, which will not be treated, contain an additional 243 acres of LSOG. Following treatment, approximately 695 treated acres will still meet LSOG criteria of a minimum of 25% canopy cover in large trees. While the remaining 1,316 treated acres of LSOG will meet the large tree criteria, canopy cover will be reduced to less than 25%. Alternative 2 reduces LSOG within the two subwatersheds from 18,919 acres (30%) to 17,603 acres (28.3%).

Alternative 3 will treat 1,716 acres of LSOG. This is broken out by 1 acre of lodgepole pine LSOG and 1,715 acres of mixed conifer LSOG. The control units, which will not be treated, contain an additional 243 acres of LSOG. Following treatment, approximately 695 treated acres will still meet LSOG criteria of a minimum of 25% canopy cover in large trees. While the remaining 1,021 treated acres of LSOG will meet the large tree criteria, canopy cover will be reduced to less than 25%. Alternative 3 reduces LSOG within the two subwatersheds from 18,919 acres (30%) to 17,898 acres (28.7%).

Wind firmness

Future wind damage such as snapouts or blowdown is difficult to predict. Winds can be expected to be greater in exposed areas such as saddles and ridges. As previously noted, evidence of scattered blowdown and snapped out tops is present throughout the EXF project area. An indeterminate amount of wind damage following treatment can be expected to continue mainly in the more exposed, upper elevation areas. Larger, taller trees that will be retained have been more exposed to the wind than most of the smaller, shorter trees which are targeted for removal under all treatments except for the free thinning treatment which thins across all diameter classes. Due to their past wind exposure, these larger trees are expected to be more wind firm than are the smaller trees. By retaining the larger trees, wind damage will be minimized. In the free thinning treatment areas where trees are thinned across all diameter classes, the likelihood of wind damage is assumed to remain the same both before and after treatment.

Implementation of the Study Plan

Because the EXF project is driven by research described in the study plan "Vegetation Dynamics after Thinning and Fuels Reduction in Dry Forests," changes to the proposed action (such as Alternative 3) could affect the reliability of the research.

The study plan was developed with special care to ensure a block effect of elevation and aspect, with similar unit size across all four blocks except for treatments 4 and 5, which were intentionally smaller in size. Alternative 3 eliminates from treatment the spotted owl nesting, roosting, and foraging habitat as and the portion of LSR that overlap the project area. The areas affected include portions of three of the four blocks and three of the four thinning types. Units affected are: 11, 12, 22, 23, 32, and 33. Most of unit 11, proposed for treatment 2 (thin to 75% UMZ) would be left untreated under Alternative 3. The area outside of NRF is small and disjunct stands on the perimeter of the unit. These disjunct stands are

insufficient in size to meet the demands addressed in the six research questions. Under Alternative 3, treatment 2 would not be represented in one block, and the study design becomes unbalanced, is not aligned with the approved study plan, and would require a much different and more complex statistical approach. To reallocate the treatment to another block would invalidate the random selection process used to assign treatments to units, which would call into question any results from any of the component studies.

Cumulative Effects Alternatives 2 and 3

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one can not reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. Third, public scoping for this project did not identify any public interest or need for detailed information on individual past actions. Finally, the Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, “agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.

The existing conditions in the watershed are a result of past activities. These consist of natural events such as wildfires, insects, and diseases. Past activities also include vegetative management treatments, primarily natural fuels reduction and both commercial and non commercial density reduction treatments. The effects of past activities diminish with the passage of time. More recent events have a more immediate impact. Certainly, major events such as the stand replacing fire 165 years ago that initiated the present stand have played a major role in the current conditions within the planning area. However, the Lookout Mountain block has undergone relatively few, if any, recent major disturbances. Within the planning area, approximately 2,350 acres that have been previously treated within the last 30 years are proposed for treating again this entry. The proposed treatments are planned to prolong the density reduction benefits of these past activities.

The cumulative impacts of 2,347 acres of past activities within the EXF project area will have a minor effect on conditions in the 64,724 acres within the combined Fall Creek and Crane Prairie subwatersheds as a whole. The proposed activities will result in increased tree vigor and a reduction in the likelihood of widespread forest pest-caused mortality occurring. Through the use of appropriate project design criteria and any necessary mitigation measures, the cumulative effects on these areas of previous reductions in stand densities are consistent with Forest Plan standards and guides. For the EXF analysis, activities more than 30 years in the past are assumed to have a negligible effect on current

conditions. For these reasons, the analysis of past actions in this section is based on current environmental conditions.

Consistency with the Eastside Screens

The Fall watershed falls within Scenario A of the Eastside Screens because two types of LOS fall below the HRV: multi-story with large trees (PPD, MCW), and single-story with large trees (PPD); see Tables 19 - 21. Under Scenario A, the Screens state that timber harvest is not allowed in the LOS stages that are below HRV. Because the EXF project would thin within 21 acres of LOS stages that fall below HRV, a Forest Plan Amendment is required (See page 18). A Forest Plan Amendment is also required for harvesting trees larger than 21" DBH east of the owl line.

Achievement of Purpose and Need

Two purpose and needs were identified at the outset of the EXF project.

They are: 1) to Address the risk of severe insect epidemic or catastrophic fire; 2) To provide operational scale research opportunities through a series of fuel reduction treatments applied across the landscape.

As displayed in the table, alternative 2 fully best meets the risk of insect epidemic and catastrophic fire as well as provides on the greatest number of acres. Alternative 3 fully meets the risk of insect epidemic and catastrophic fire although on fewer acres. Alternative 3 does not meet the need to provide operational scale research opportunities. Alternative 1 does not meet either of the purpose and needs identified for the EXF project.

3.3.2 Fuels and Fire Hazard

Introduction

This fire and fuels analysis addresses the effects to fuels and fire behavior as a result of the no action and two action alternatives. This analysis does not address the need for research and whether or not a particular alternative meets the research objectives more than another. Analysis results are presented for the EXF project area. In cases where the analysis was conducted on a larger area, such as a watershed (in order to encompass natural disturbance events such as fire or insect outbreaks) it will be noted. The attributes used to evaluate the analysis where Fire Behavior, Burn Probability and Air Quality. The following measures were used for the analysis:

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability

Measure 2: Reduction in crown fire potential

Measure 3: Production of Particulate Matter (PM) 10 and 2.5

The scope of the analysis for this project is focused on the area bound by the EXF project. Only fire and fuels reduction activities that occurred within the project area during the preceding 15 years were considered in the analysis of cumulative effects for fire and fuels hazard reduction. District experience and field reviews have shown that vegetation management activities such as thinning followed by mowing and prescribed fire have the beneficial effect of reducing fire intensity and fire behavior for an average of 15 years, perhaps longer depending on location and treatment intensity.

Affected Environment

Condition Class and Fire Regime

This analysis considers the two 6th field Hydrologic Unit Code (HUC) which the project area overlaps, totaling 64,834 acres (see Figure 7). The Fall River 6th field HUC is 39,535 acres and includes all but 387 acres of the EXF planning area. The Crane Prairie 6th field HUC is 25,299 acres and encompasses the remaining 387 acres of the project area. The vegetation condition analysis is part of the analysis conducted by the Upper Deschutes Basin Fire Learning Network (2007).

About 76% (2,746 acres) of the EXF planning area is made up of the ponderosa pine Plant Association Groups (PAG). Ponderosa pine PAGs develop over an extremely long period covering centuries and is dominated by ponderosa pine, with a presence of lodgepole pine and white fir in areas ecotonal to the lodgepole pine or mixed conifer plant associations. Generally, in these PAGs, low-severity fires occur replacing less than 25% of the dominant overstory vegetation. However, mixed severity fires that replace up to 75% of the overstory can occur on occasion. Large stand-replacing events are rare events (200+ years). These PAGs are categorized into what is considered Fire Regime I.

The low-severity fires that typify Fire Regime I happen most frequently; the historical reference fire frequency ranges from about 7 to 38 years (Bork 1984). This short interval fire cycle would indicate that most of the Fire Regime I area would have burned more than three times without human influence and intervention since the early 1900s. An analysis of the historical large fire record that dates back to about 1904 for the Deschutes National Forest indicates that about 17% (5,851 acres) of Fire Regime I within the two subwatersheds has burned since the beginning of record. This would indicate that more than three quarters of the area has missed three or more entries of fire over the course of the last century. More definitions of Fire Regimes may be found in the Appendix to the Fire/Fuels Report.

Twenty one percent (778 acres) of the EXF planning area is made up of the dry and wet mixed conifer PAGs. These stands can be dominated by ponderosa pine, lodgepole pine and white fir. Western white pine, historically, would have been associated with these plant associations however white pine blister rust has greatly reduced tree numbers of this species. These stands were established and maintained, again assuming no human influence or intervention, with a fire return interval of about 35-100 years. Fire in these areas tends to be of mixed severity which results in heterogeneous landscapes. Within these landscapes a mix of stand ages and size classes are important characteristics; generally the landscape is not dominated by one or two age classes. Large stand replacing fires occur, but are usually rare events. Such stand-replacing fire may “reset” large areas (10,000-100,000 acres). These PAGs are categorized into what is considered Fire Regime III.

The 35-100 year fire cycle would indicate that most of the Fire Regime III area would have burned at least once, possibly up to three times, without human influence and intervention since the early 1900s. An analysis of the historical large fire record that dates back to about 1904 for the Deschutes National Forest indicates that about 22% (1579 acres) of Fire Regime III within the two HUCs has burned since the beginning of record. This would indicate that more than three quarters of the area has missed one or more entries of fire over the course of the last century.

About 33 acres (1%) of the EXF planning area is typified by the Lodgepole pine PAG. Lodgepole pine PAGs are seral communities that arise from and/or are maintained by stand-replacement fires. The small stand of Lodgepole pine lies immediately above the shorter fire return interval Ponderosa pine PAG. This is important because natural ignitions within Lodgepole pine that result in large fires may be relatively rare, so most often the fire originates lower on the slopes in the Ponderosa pine and burns uphill into the Lodgepole pine. Fires are of stand-replacing severity, since Lodgepole pine is not fire resilient, and typical fire return intervals are 35-100+ years. These PAGs are categorized into what is considered Fire Regime IV.

The 35-100 year fire cycle would indicate that most of the Fire Regime IV area would have burned at least once, possibly up to three times, without human influence and intervention since the early 1900s. An analysis of the historical large fire record that dates back to about 1904 for the Deschutes National Forest indicates that about 27% (5,468 acres) of Fire Regime III within the two HUCs has burned once since the beginning of record. This would indicate that just less than three quarters of the area has missed one or more entries of fire over the course of the last century.

The three fire regimes can be put into condition classes based on the amount of departure from the natural regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern and other disturbances. This departure is due to fire exclusion, as well as timber harvesting, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities. This departure has resulted in alterations of key ecosystem components such as species composition, structural stage and canopy closure. Condition class 1 represents areas that fall most within their natural or historical regime of characteristics. Condition class 2 and 3 represent areas that have moderate and high departures from the natural or historical regime of characteristics. The specifics for each condition class can be found in the Appendix to the Fuels Report.

In order to simplify the concepts behind condition classes within each fire regime, the three condition classes have been grouped into two descriptive categories of acres; restoration acres and maintenance acres. Restoration acres are those acres that fall into condition class 2 and 3. These acres are at an elevated risk of loss of components that define those systems as unique. Maintenance acres are assumed to be functioning within expected parameters with respect to overstory condition. Often, maintenance acres are still in need of treatment due to their surface conditions, i.e. a well developed shrub layer presenting high flame lengths and the potential for crown fire initiation. Treating these surface fuels, although they are not a factor taken into consideration when determining Condition Classes of areas, is important to decreasing fire suppression resistance and the potential for crown fire initiation. Refer to Table 33 for the summary of acres for each of the Fire Regimes now specific to the EXF project area and their current condition; maintenance or restoration.

Table 33. Fire Regime/Condition Class Summary for EXF Project Area.

PAG/Fire Regime	Description	Mainten-ance Condition Acres	% of Regime	Restoration Acres	% of Regime	Total Acres in Regime
Ponderosa Pine – Fire Regime I	0-35 yr return, low intensity	1,070	39	1,676	61	2,746
Mixed Conifer – Fire Regime III	35-100+ yr return, mixed severity	358	46	420	54	778
Lodgepole Pine – Fire Regime IV	35-100+ yr return, stand replacing severity	30	91	3	9	33
TOTAL		1,458	41	2,099	59	3,557*

*The entire EXF project area totals 3,615 acres, 58 acres are considered in the analysis as missing values or having no Fire Regime/Condition Class data.

Stand and Fire Suppression History

In 1845, an unnamed stand replacement fire across the project area resulted in the establishment of dense ponderosa pine at lower elevations and Douglas-fir, grand fir, white fir, sugar pine, western white pine and mountain hemlock at higher elevations. In 1914, the Lookout Mtn. Eastside fire burned 321 acres on the eastside of Lookout Mtn. It is not known whether suppression was taken on this 1914 fire.

A small portion (only 1 acre) of the Lookout Mtn. fire of 1985, which was actively suppressed, made its way into the project area on the western boundary. Since the establishment of the Experimental Forest in 1931, there have been commercial and non-commercial thinning treatments across the project area. Some of these treatments were research-specific, others were salvage sales from the 1970s. No known fuels treatments have taken place since establishment of the Lookout Mountain unit of the Experimental Forest in 1931.

Pre-Euro-American low elevation dry conifer forests of the western United States were fundamentally shaped by frequent low- or mixed severity disturbances such as wildfires (Bork 1984; Agee 1993; Taylor & Skinner 1998; Everett et al. 2000; Ottmar & Sandberg 2001; Wright & Agee 2004; Youngblood et al. 2004; Hessburg et al. 2005; Arabas et al. 2006) and insect attacks (McCullough et al. 1998; Hayes & Daterman 2001) mediated by diverse environmental gradients of topography, soils, and weather. Surface fires, ignited predominantly by lightning during the time of year when moisture content of fine fuels was lowest (Agee 1993; Rorig & Ferguson 1999), controlled regeneration of fire-intolerant species, reduced density of small-diameter stems consumed litter and down wood, opened the stands to increased sunlight, led to vertical stratification of fuels by eliminating fuel ladders between the forest floor and the overstory canopy, and maintained relatively stable plant associations. Consequently, the structure of these low elevation dry forests generally consisted of open, predominantly widely spaced medium to large and old live trees, scattered dead trees, low levels of surface fuels, and continuous low herbaceous understory vegetation (Wickman 1992; Agee 1994; Youngblood et al. 2004; Arabas et al. 2006).

Many of these dry forests today have characteristics that place them at greater risk of uncharacteristic disturbances. These features include an accumulated mass of down woody debris and continuity of the fuels mosaic at landscape scales, more small trees and fewer large trees, greater amounts of young multi-storied forest with fire-intolerant conifers in both understory and overstory strata, increased fuel ladders that contribute to greater flame lengths during fires, and new or altered forcing of regional climate on plant community structure and organization (Agee 1993; Covington & Moore 1994; Arno et al. 1997; Taylor & Skinner 1998; Harrod et al. 1999; Youngblood et al. 2004; Fitzgerald 2005; Hessburg et al. 2005; Stephens & Gill 2005; Youngblood et al. 2006; McKenney et al. 2007). In many dry forests of the Pacific Northwest, the altered fuelbeds and shifts in forest structure and composition resulted from fire exclusion and suppression, livestock grazing, timber management activities, and changes in climate (Bergoffen 1976; Steele et al. 1986; Dolph et al. 1995; Arno et al. 1997; Fitzgerald 2005; Richardson et al. 2007).

Increases in overall stand density over the past century have led to increased competition among trees for below-ground nutrients, water, and growing space. Increased competition among trees and reduced tree vigor increases susceptibility to attack from bark beetles and other forest insects and diseases (Mitchell, 1990, Hessburg et al. 1994; Oliver 1995; Fettig et al. 2007). Mortality in ponderosa pine attributed to mountain pine beetle is positively correlated with high stand density (Sartwell & Dolph 1976; Fettig et al. 2007). Thinning has been shown to reduce the amount of ponderosa pine mortality caused by mountain pine beetle unless surrounding areas are allowed to develop epidemic population levels (Fettig et al. 2007). The mountain pine beetle often kills extensively when contiguous stands or landscapes become vulnerable. These changes have occurred more recently against a backdrop of natural and human-caused climate change that may first be manifest in the distribution of herbaceous species and woody shrubs, and may eventually result in a redistribution of tree species (McKenney et al. 2007; Richardson et al. 2007). Collectively, these altered structural conditions contribute to increased probability of multiple, interacting stresses and may lead to altered or new disturbance regimes.

Expected Fire Behavior

Fire behavior for the existing conditions of the EXF Planning area has been predicted by using a number of state of the art tools. Remote sensing satellite imagery from 2004 was analyzed in the computer

model FlamMap under specific weather conditions. FlamMap, a fire behavior mapping and analysis program that computes fire behavior characteristics (rates of spread, flame length, crown fire potential, etc.) over an entire landscape, was used to determine the existing stand condition's potential fire behavior. The data inputs necessary for FlamMap include aspect, slope, elevation, fuel model, canopy height, canopy base height, crown bulk density, and crown class. The fuel and weather conditions used were those representing the 97th percentile weather from the Round Mountain Remote Access Weather station (RAWS). The Round Mountain RAWS is the weather station that best represents summer weather and fuel conditions for the project area, since it is within very close range of Lookout Mountain and the EXF planning area (only 2 to 3 miles). The 97th percentile fuel moisture conditions and wind conditions used can be referenced in Figure 2 of the Appendix. More information on 97th percentile weather can also be found later in the General Assumptions section. The model assumes constant weather and fuel moisture conditions for each scenario. Table 34 shows the conditions/parameters under which fire behavior would be rated low, moderate and high for flame length and fire type.

Table 34. Fire behavior condition ratings and the associated parameters by indicator

Fire Behavior Conditions	LOW	MODERATE	HIGH
Flame Length	0-4 ft	4-8 ft	8 ft +
Fire Type	Surface	Passive Crown Fire	Active Crown Fire

The fire behavior condition ratings shown in Table 34 for flame length are determined based on Fire Behavior Characteristics Charts found in Appendix B of the NWCG Fireline Handbook (2006). Fire Behavior Characteristics Charts are charts used by firefighters to determine a fire's resistance to control and spread rates. Condition ratings for fire type correspond with the potential for a crown fire. A low rating is for areas where a surface fire potential exists with no potential for either type of crown fire. A moderate rating is for areas where a passive crown fire (a surface fire with individual tree torching) may exist. A high rating is for areas where the potential for an active crown fire (a fire involving the crowns of trees with support from a surface fire) exists.

Table 35 shows the predicted fire behavior of existing conditions in acres for the EXF Planning Area using the parameters and indicators shown in Table 34.

Table 35. Existing condition predicted fire behavior.

Fire Behavior	Existing Condition					
	Low		Moderate		High	
	Acres	Percent	Acres	Percent	Acres	Percent
Flame Length (ft)	1769	50	742	21	1057	29
Fire Type	1887	53	1677	47	2	<1

*The entire EXF project area totals 3615 acres, 47 acres are considered in this analysis as missing values or having no fuel model/tree data.

Table 35 shows that the current condition within the EXF planning area varies. Under 97th percentile weather and fuel conditions, the model predicts that a wildfire would produce moderate to high flame lengths across about half the area (1,799 acres; see Figure 11). Moderate flame lengths (4-8 feet) may make direct attack of a wildfire under the stated conditions possible with a bulldozer, although the damage that bulldozers can make while fighting a fire is particularly critical in a research rich area, such as the Experimental Forest. Flame lengths of over 8 feet (High fire behavior) cannot be safely

suppressed by direct attack of ground resources. Other forms of suppression, like indirect attack, would have to be considered, and could also increase the amount of damage to the Experimental Forest.

There is a potential for a passive crown fire to occur under current fuel and stand conditions and under 97th percentile weather and fuel conditions during a wildfire for just less than half the area within EXF (1,677 acres). There are two stages to the crown-fire process: the first is torching, or movement of fire into the crown (passive crown fire), the second is active spread of the crown fire where fire moves from tree crown to tree crown through the canopy (active crown fire) (Fitzgerald, 2005). Passive crown fires, although not as intense as an active crown fire, can make suppression difficult due to high flame lengths and short and long range spotting. Damage to individual trees, to include mortality, can also be devastating in an Experimental Forest where research is dependent on particular plots and particular trees within that plot. The remaining half the area is predicted under the modeled wildfire to support a surface fire. Surface fires can still be difficult to suppress, again depending on other fire behavior conditions such as flame lengths and rates of spread.

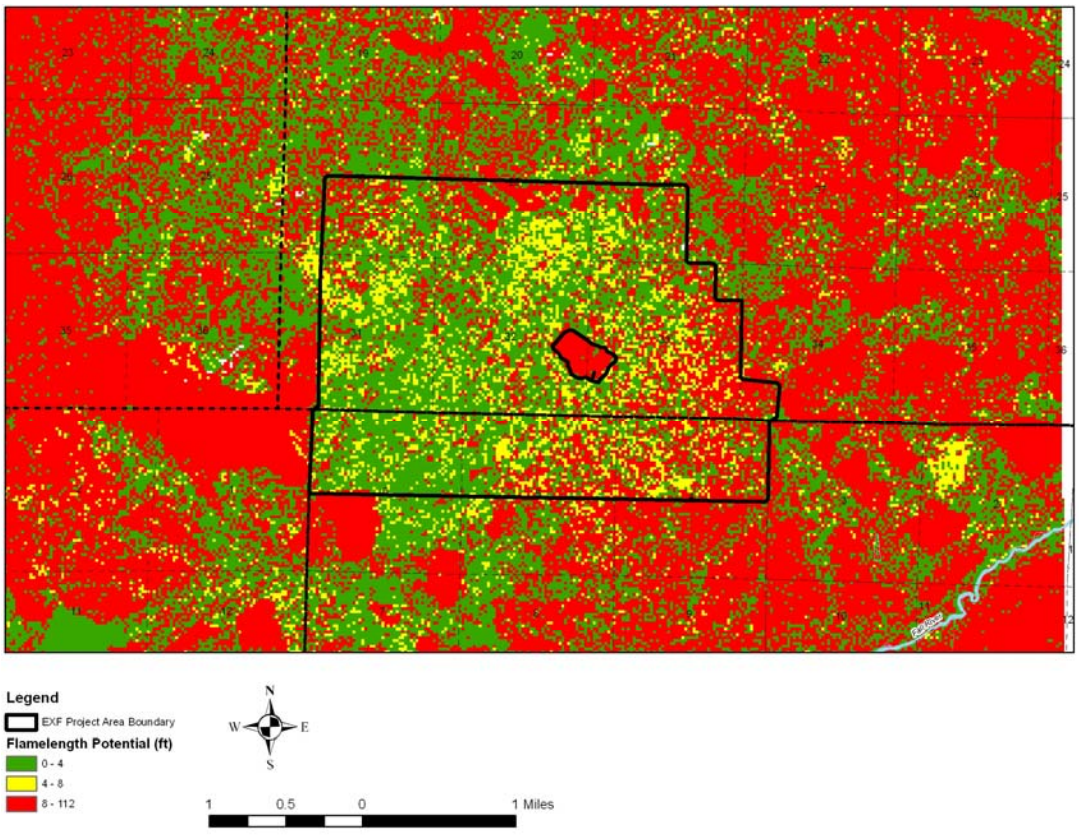


Figure 11. Flame Length Potential, Existing Condition

Burn probability is an additional output to Flammap and is a part of the minimum travel time fire growth model. Burn probability is used as an indicator of potential fire spread rates, i.e. landscape attributes, like fuel conditions, that contribute to higher spread rates and result in a higher burn probability. High burn probabilities can be related to the sizes of fires that occur on a given landscape. So under the same conditions, large fires produce higher probabilities than small fires. Since fire size is a function of the gross spread rate and duration of the fire, treatments or conditions that reduce the spread rate will lower the burn probability (Finney et al, 2006).

Burn probability was calculated within the model using the same 97th percentile weather and fuel conditions from Round Mountain RAWS, as well as with 1000 random ignitions and a 12 hour burn duration across the entire analysis area, which is approximately a 1 ½ mile buffered area surrounding EXF project area. A larger analysis area for the purpose of burn probability allows the model to consider ignitions from outside the EXF area and model that potential without bias. Burn probability is output as a decimal number between 0 and 1 for every 120 meter pixel within the project area. Those decimals were classified into 5 equal divisions and reclassified into a number from 1 to 5, 1 representing acreage with the lowest burn probability and 5 representing the highest, so that any increases or decreases in burn probability due to proposed treatments could be shown easily. Then, the outputs specific to the EXF project area were clipped from the rest of the analysis area. This is done to better show effect of any proposed treatments to burn probability within the project area. Table 36 shows the existing condition's burn probability for the project area. Figure 12 displays the existing burn probability spatially across the project area.

Table 36. Burn probability within the existing condition of the EXF project area

Burn probability classification	Amount of Acres*
1 (low)	117
2 (moderate)	1,359
3 (moderate)	2,074
4 (high)	43
5 (highest)	0

*The entire EXF project area totals 3,615 acres, 21 acres are considered in this analysis as missing values or having not enough data to complete analysis.

Table 36 shows that relative to the entire analysis area (an area that includes approximately a mile and a half around EXF), the project area itself is predicted to have moderate chances (classification of 2 or 3) for large fires across the majority of the area (3,433 acres). This is also shown in Figure 12.

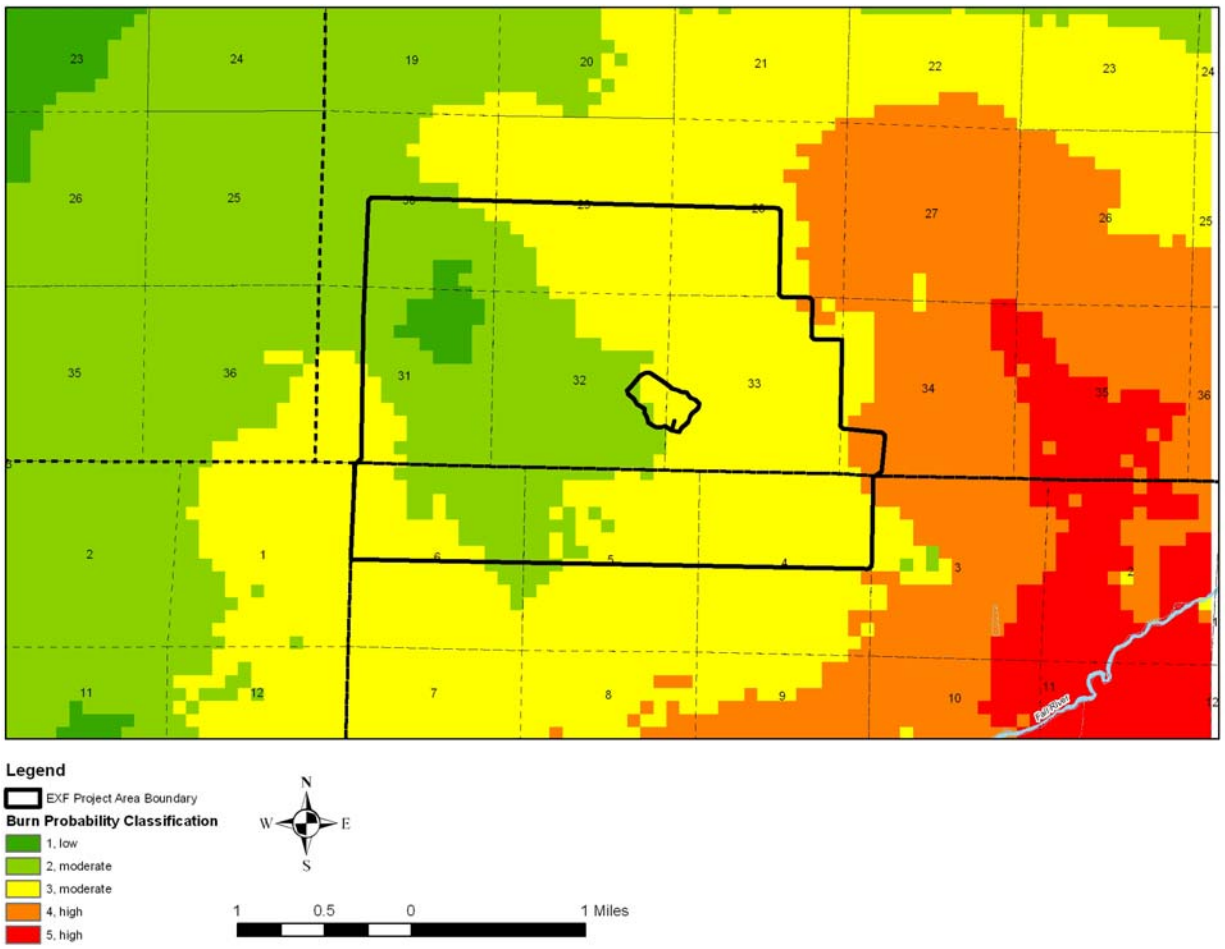


Figure 12. Burn Probability across Project Area.

Summary Affected Environment

In the EXF project area there has been only one major fire entry since the beginning of the 1900s, and that was the Lookout Mtn. Eastside fire of 1914 that totaled about 314 acres. For the rest of the area, lack of fire and/or limited treatment has resulted in denser stands, which adds to the ladder fuels already present in tall shrub layers and low canopy base heights that allow for the potential for passive crown fire. Analysis using FlamMap shows this potential to exist for just less than half the EXF project area. High flame lengths that would make direct attack by hand crews impossible, is also a concern in about half the project area according to FlamMap. The majority of the project area has a moderate chance for large fires, according to the analysis done in FlamMap.

Across the three fire regimes present in EXF, condition class shows that 59% of the ground is in a state of need for restoration and 41% of the ground is in a condition where maintenance is needed in order for stands to remain functioning within their more natural parameters. Maintenance could include reducing tree densities to encourage health and vigor of remaining trees and treating shrub densities mechanically and/or with prescribed fire in order to reduce wildfires potential within the stands.

Environmental Consequences

Agee (2002) described the Principles of Fire Resilient Forests: Reduce surface fuels; increase height to live crown; decrease crown density; retain larger trees. These principles are designed to reduce fire behavior potential, aid in suppression of wildland fire, and increase protection to valuable resources on forest land. As incorporated into the EXF project design, these principles can improve fire-resilience by: reducing surface fuels, removing ladder fuels, leaving large fire-resistant trees, and spacing tree crowns.

Where managed for reduced fire behavior potential, the desired conditions include:

- Crown bulk density and continuity of the forest canopy could not sustain a crown fire;
- Trees would have a canopy base height well enough above shrub cover in order to reduce potential for crown fire initiation;
- Shrub layer is at a height that would lower flame lengths to below the four-foot agency standard for direct attack by handline.

Where thinning is followed by sufficient treatment of surface fuels, the overall reduction in expected fire behavior and fire severity usually outweigh any changes in fire weather factors (such as surface wind speed increases or drier surface fuels) (Weatherspoon, 1996).

Elements used to Describe Effects of the Alternatives

Fire Behavior

Fire behavior is the manner in which fire reacts to topography, weather, and fuels (DeBano et al., 1998; NWCG, 1998). These three elements comprise the fire environment – the surrounding conditions, influences, and modifying forces that determine fire behavior. Modifying any one of these elements has a direct result on fire behavior, which is described by flame length and rate of spread.

The greater the fuel loading, the more intense a fire is likely to burn (DeBano et al., 1998). Conversely, a reduction in fuel loading can limit a fire's intensity. Fuel characteristics affecting fire behavior are vegetative density, species composition, amount of surface fuel, arrangement of fuels and moisture content (Rothermel 1983). Fuels contribute to the rate of spread of a fire, the intensity/flame length of the fire, how long a fire is held over in an area, and the size of the burned area (Rothermel 1983). Favorable conditions for crown fires include heavy accumulations of dead and down wood and litter, conifer reproduction and other ladder fuels like shrubs, and a continuous conifer tree forest (Rothermel 1991).

Treatments that reduce surface fuel loads have been shown to decrease fire behavior and severity (Graham et al., 1999; Pollet and Omi 1999). Van Wagtendonk (1996) found in fire simulations that a reduction in fuel loads decreased subsequent fire behavior, increased fireline control possibilities and decreased fire suppression costs.

Intensive forest management that involves the creation of activity fuels (slash) can indeed increase fire behavior conditions such as rate of spread and flame length. However, treatment of slash (i.e. burning, chipping, removal, isolation) will reduce fire behavior and fire intensity (Omi and Martinson 2002). Graham et al, (1999) reports that thinning from below and intermediate tree harvest can effectively alter fire behavior by reducing crown bulk density and ladder fuels, but will not reduce crown fire potential unless tree densities are substantially reduced. The same scientific document also states that all intermediate treatments should be accompanied by surface fuel modification, and the most success is achieved when using prescribed fire for such treatments.

There are three types of fuels that affect fire behavior; fine fuels such as grass or forbs, small woody fuels less than three inches in diameter and large woody fuels greater than three inches in diameter. Fine fuels are the major contributors to fire spread, carrying the ignition and flaming front of a fire

(Rothermel 1983). They are especially influential to fire's rate of spread and intensity because they lose their moisture faster, therefore igniting easier and burning more readily (Agee 1993). Without these fine fuels, many fires will not get large, although there are exceptions. However, eliminating fine fuels entirely from the landscape is neither possible nor desirable. Fine fuels are constantly being produced from needlecast or deciduous leaf fall and dying and falling branches. Under a frequent fire regime it will be more possible to maintain fine fuels at lower levels and various patch sizes than under a less frequent fire regime, decreasing fire intensities and decreasing the area's resistance to control.

In order to analyze and compare the effects of alternatives as they relate to fuels management, the fire behavior conditions of flame length and potential fire type will be used. Burn probability will also be analyzed as an indicator of potential fire spread rates, i.e. landscape attributes, like fuel conditions, that contribute to higher spread rates result in a higher burn probability.

In addition to the professional judgment of fuels specialists and the latest scientific data available, state of the art modeling was used to facilitate a more specific comparison of alternatives as the comparison relates to actual acres on the ground. FlamMap, a fire behavior mapping and analysis program that computes fire behavior characteristics (rates of spread, flame length, crown fire potential, burn probability, etc.), was used to determine the existing stand condition's potential fire behavior. Remote sensing satellite imagery from 2004 was analyzed in the computer model under specific fuel moisture conditions. The data inputs necessary for FlamMap include aspect, slope, elevation, fuel model, canopy height, canopy base height, crown bulk density, and crown class. The fuel moisture conditions used were those representing the 97th percentile fuel moistures for summer conditions from the Round Mountain Remote Access Weather Station (RAWS). Round Mountain RAWS is the closest weather station to the EXF planning area and is on the butte just directly south and west of Lookout Mountain. See Appendix D for the 97th percentile fuel moisture conditions and wind conditions used.

General assumptions made in effects analysis

Alternative development and environmental effects are based on the following assumptions:

- Lightning will remain a source of potential ignitions
- An increase in average tree diameter of the stand reduces fire severity. Larger trees have thicker bark and are more resistant to flame scorch from surface fuels. The more acres thinned from below, the greater the average diameter of remaining trees.
- Treatment of natural surface fuels will reduce fire severity.
- Wildland fire will not be eradicated in these ecosystems. A successful strategy will be built upon designing a vegetative environment, including species and structural characteristics that will produce desired, safely manageable fire behavior in the event of an unplanned ignition.
- There are no ecosystems that are completely "fire safe." Certain combinations of ignition, fuel moisture in the live and dead vegetation, wind, and relative humidity can combine under extreme circumstances to threaten any vegetated ecosystem.
- Public and firefighter safety is the top priority in fuels and fire management. Treatments in the forest will focus on creating a safe working environment for fire suppression forces.
- Ground suppression forces can operate safely adjacent to flames that are 4 feet in length and less. Extreme fire behavior, including crown fire, rapid surface spread and long range spotting, create an unsafe environment for the public and firefighters.
- The Experimental Forest is valued for a variety of reasons, including wildlife habitat, unique vegetative communities, visual quality and current and future research, among others. Any management done in the name of hazardous fuels reduction in that zone must also consider the other objectives.

- Weather conditions at the 97th percentile for FlamMap analysis are defined as the combination of temperature, relative humidity, and wind speed on a summer day that is warmer, drier, and windier than 97% of all other recorded summer days. "Fire season" is defined as the 92 day period between July 1st and September 30th, during which most fires and acres burn. Under 97th percentile conditions, there will be about 3 days on average that are hotter, drier, and windier than those 97th percentile conditions.
- For the analysis in this document, the effects of treatments are assumed to cover 100% of the treatment area. There is currently no way to spatially analyze untreated areas within treatment units (e.g. some small existing research plots will not be treated). Leaving certain areas of units untreated would likely reduce the effectiveness of hazard fuel reduction indicated in the analysis, but to what extent is unknown.
- There are 12 plots of ½ acre each that fall within the EXF planning area where fuels will remain untreated following density reduction. For the purpose of analysis, these small plots have been considered as a part of treated acreage. It is assumed that these plots will be surrounded in treated areas that will produce desired, safely manageable fire behavior in the event of an unplanned ignition and allow for protecting the plots from unplanned ignitions occurring outside of the plots. Treatments will not protect from unplanned ignitions occurring inside the plots.

Alternative 1

Direct and Indirect Effects

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability

With no management activities occurring, more acres would transition from low and moderate fire behavior potential towards high and extreme fire behavior potential. Currently an estimated 1,769 acres (50%) exhibiting low flame length potential would naturally transition over the next 20 years, due to tree and shrub growth to either a moderate or high fire behavior category. The remaining 50% of acres within EXF planning area are predicted to exhibit moderate and high flame lengths. Moderate flame lengths (4-8 feet) may make direct attack of a wildfire under the stated conditions possible with a bulldozer, although the damage that bulldozers can make while fighting a fire is particularly critical in a research-rich area, such as the experimental forest. Flame lengths of over 8 feet (high fire behavior) cannot be safely suppressed by direct attack of ground resources. Other forms of suppression, like indirect attack, would have to be considered, and could also increase the amount of damage to the experimental forest. These fuel conditions that would support moderate and high fire behavior would also continue to transition; fuel loadings would further increase and shrub heights would increase. Increased fuel loadings and shrub heights translate to higher burn probabilities. Higher burn probabilities predict larger fires on the landscape over time.

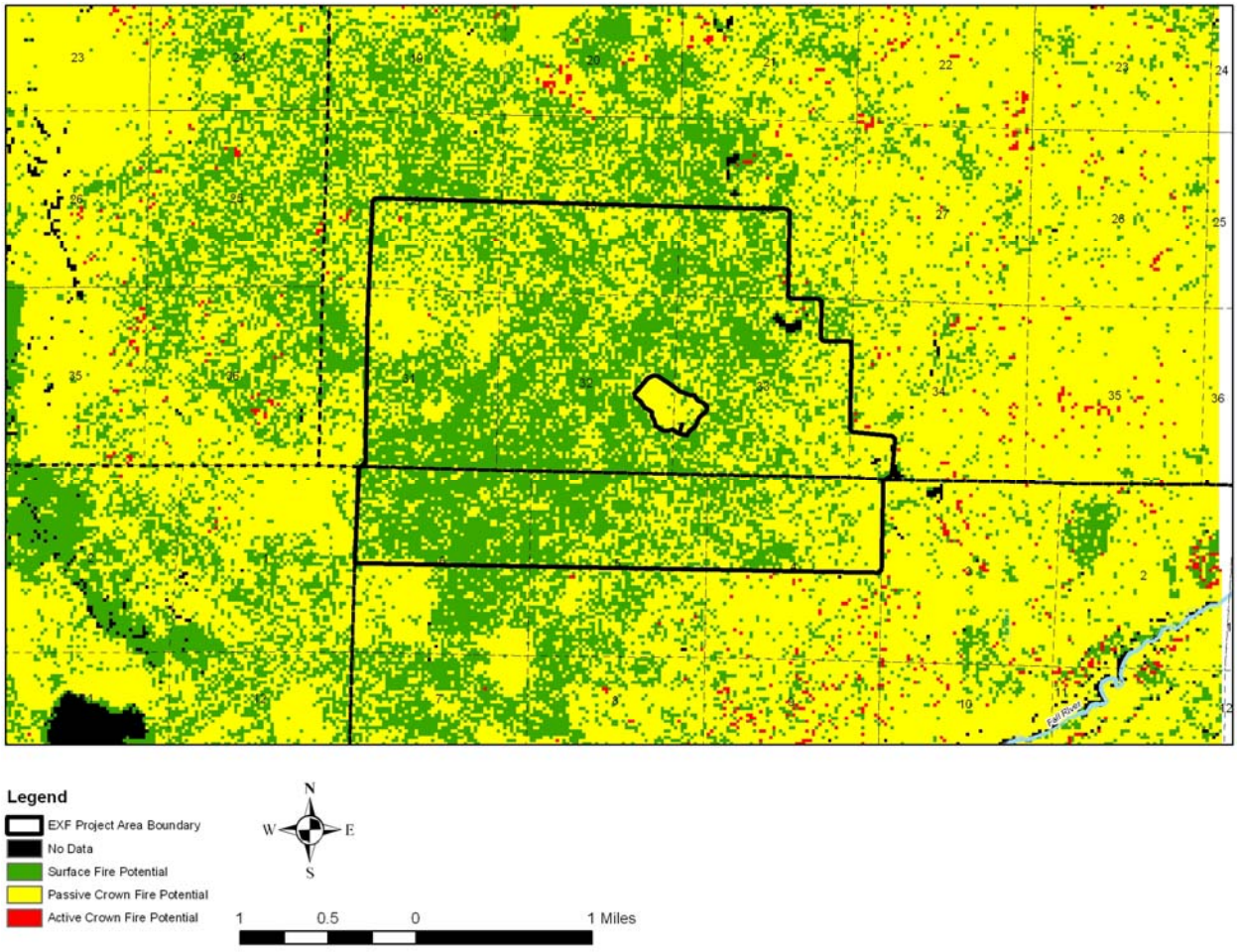
The only way that fuels reduction would occur is with a wildfire that under the no action alternative would be intense with high flame lengths, torching and spotting over at least half the area, making suppression difficult and possibly terminating any of the ongoing research within the area.

Measure 2: Reduction in crown fire potential

Under current conditions, the FlamMap model shows that 47% of the project area would support a passive crown fire. Refer to Figure 13 for the predicted existing crown fire potential across the entire project area. High stand densities would eventually lead to disease and insect infestations (See Forested

Vegetation), which would then lead to red-needled pine, adding to crown fire susceptibility. Incoming reproduction has added to the ladder fuels and would continue to add to the ladder fuels, increasing the potential of initiation of a crown fire. With an increase in ladder fuel development and canopy closure, the 53% of acres currently exhibiting surface fire potential would transition over time to the potential for passive crown fire. In the same vein, the 47% of acres currently exhibiting passive crown fire potential would transition over time to the potential for more active crown fire, due to the same conditions.

Figure 13. Existing Crown Fire Potential in EXF Planning Area



Measure 3: Production of Particulate Matter (PM) 10 and 2.5

The effects on air quality would occur when higher quantities of PM_{10} and $PM_{2.5}$ are released when inevitable wildfire comes through the project area. These quantities of particulate matter are much higher than what would be released under prescribed fire conditions. This can be attributed to the fact that weather conditions are usually, windier, hotter and drier in the summer and in the case of a wildfire a greater amount of surface and canopy fuels are consumed. In order to determine the differences in particulate matter released during wildfire compared to prescribed fire, an analysis was first done in the computer model FOFEM (First Order Fire Effects Model). FOFEM is a computer program that was

developed to meet needs of planners in predicting and planning for fire effects, including smoke impacts. The assumptions made with FOFEM are as follows:

- Prescribed underburning and wildfires occur in Interior Ponderosa Pine (SAF 237) under natural fuel conditions.
- Prescribed underburning is conducted under spring and moderate fuel moisture default conditions; wildfires occur under summer and very dry fuel moisture default conditions with an adjustment of the 10 hour fuels to 4%, and 1000 hour fuels to 9% (97^{th} percentile conditions; see Appendix D).
- Prescribed underburning would be conducted with light 3+ inch diameter fuels and sparse herbaceous, shrub, foliage, and branch conditions; wildfires occur under typical conditions for all fuel types.

During high intensity wildfire, smoke emissions of both PM_{10} and $PM_{2.5}$ is in the range of 624 pounds/acre. As shown in Table 37, this is about one and a half times the result of mowing and prescribed underburning on the same acre. Where down woody fuels have accumulated or stands are particularly dense; particulate matter production of PM_{10} and $PM_{2.5}$ would exceed these estimates.

Table 37. Estimated smoke emissions from a wildfire under extreme conditions compared to prescribed fire conditions.

Fire condition	Pounds PM_{10}/1 Acre Fuel Consumed	Pounds $PM_{2.5}$/1 Acre Fuel Consumed
Wildfire	338	286
Prescribed Fire	223	189

Under wildfire conditions, smoke from within the project area would impact the communities of LaPine, Sunriver and Bend because the smoke would be a result of a wildfire that most likely would not be occurring under conducive smoke dispersion conditions. It is possible that the air quality within the Three Sisters Wilderness, a Class 1 Airshed would be adversely affected. Recreational sites near and around the EXF area, like Fall River, Twin Lakes, Crane Prairie and the Deschutes River could also be adversely impacted by smoke when tourism and recreation are at their highest.

Particulate matter can be hazardous to human health, create poor visibility conditions and, in general, be a nuisance. The health effects to people of smoke can range from irritation of the eyes and respiratory tract to more serious disorders that include asthma, bronchitis, reduced lung function, and premature death. Airborne particles are respiratory irritants, high concentrations can cause persistent cough, phlegm, wheezing, and physical discomfort when breathing. Particulate matter can also alter the body's immune system and affect removal of foreign materials from the lung like pollen and bacteria (NWCG 2001). Haze caused by wildfire can also add to other sources of haze and affect scenic visibility. Nuisance smoke is defined by the US Environmental Protection Agency as the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources (US EPA 1990). Nuisance smoke includes complaints of loss of visibility, odors, collisions on highways due to lack of visibility, and eye and nose irritation. Although the vast majority of prescribed burns occur without negative smoke impact, wildland fire smoke can be a problem anywhere in the country (NWCG 2001).

Cumulative Effects

Since there would be no new proposed activities, there would be no cumulative effects. However, there would be the direct and indirect effects noted above from the continued suppression of fire starts and

ongoing vegetative growth and recreational use, including continuing to place areas outside of EXF at risk from fire.

Alternative 2

Direct and Indirect Effects

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability

The resulting predicted fire behavior for Alternative 2 was analyzed using the same technique as the analysis for the existing condition. The remote sensing satellite imagery data from 2004 was changed to reflect the proposed treatments on the ground, as per the professional judgment of Paul Brna, silviculturist and Deana Wall, fuels specialist. The change in data can be referenced in Appendix Section 5. Once the data was changed using ArcGIS, the data was analyzed in FlamMap under the same 97th percentile extreme summer weather conditions from Round Mountain weather station that were used for the existing condition. The resulting predicted fire behavior is shown in Table 38.

Table 38. Alternative 2 predicted fire behavior.

Fire Behavior	Alternative 2 Condition Acres*					
	Low		Moderate		High	
	Acres	Percent	Acres	Percent	Acres	Percent
Flame Length (ft)	3,037	85	173	5	356	10
Fire Type	2,990	84	577	16	0	0

*The entire EXF project area totals 3615 acres, 47 acres are considered in this analysis as missing values or having not enough data to complete analysis.

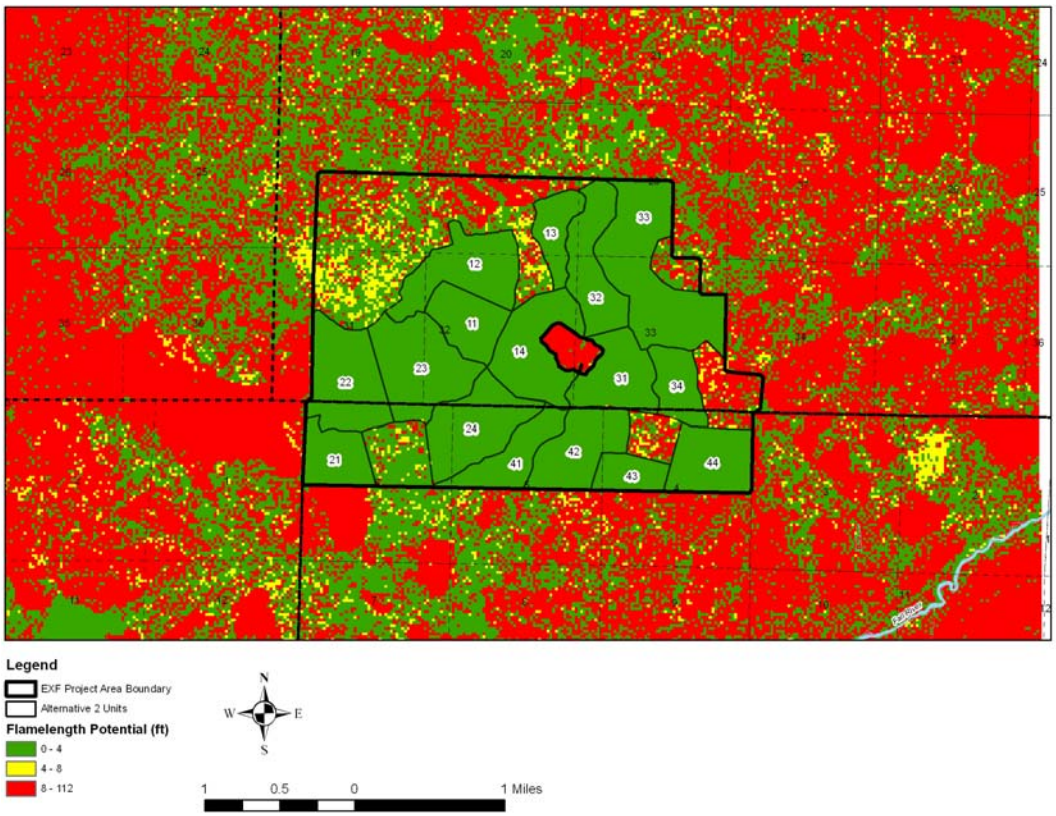


Figure 14. Flame Length Potential following Alternative 2 Treatments.

Treatments proposed in Alternative 2 would result in 1,268 more acres with low flame lengths relative to the existing condition. Seven hundred one acres of predicted high flame lengths within the existing condition would be reduced to low flame lengths with proposed Alternative 2 treatments. This is a substantial change in fire behavior. This change would allow direct attack with hand crews of a wildfire under 97th percentile conditions on 3037 acres of the EXF project area. Direct attack on these low flame length acres allows unwanted fires to be contained at small fire sizes, thereby protecting valuable research on those acres.

Burn probability for Alternative 2 was calculated in the same fashion as the burn probability for the existing condition (No Action Alternative). Table 39 compares the burn probability for Alternative 2 with the burn probability for existing condition. Figure 15 is a map of the burn probability for Alternative 2 spatially across the analysis area.

Because the project employs whole-tree yarding, there will be very little activity slash to clean up. Smaller trees (generally < 7" DBH) will be felled by hand and utilized as market conditions allow. If it cannot be utilized, the lighter concentrations will be lopped and scattered and heavier concentrations grapple piled and burned. There may be a period of time where there may be an elevated level of fine fuels in the short term (typically ranging from 3 to 12 months) between small tree thinning and fuel treatments.

Thinned stands of trees can have a shortened time lag for drying fuels and potential increases in surface winds relative to more closed stands. This effect becomes less of a factor for fire behavior as summertime weather progresses. Although closed stands take longer to reach low fuel moistures than open sites, as less moisture recovery occurs in July, August, and September, fuel moistures in closed stands reach equilibrium with open sites relatively quickly. When this occurs, crown-driven wildfires

are much easier initiated. The closed sites have more available flammable fuel due to higher levels of biomass across the fuels strata and live tree fuel moisture at its lowest level. Where thinning is followed by sufficient treatment of surface fuels, the overall reduction in expected fire behavior and fire severity usually outweigh the changes in fire weather factors such as wind speed and fuel moisture (Weatherspoon 1996).

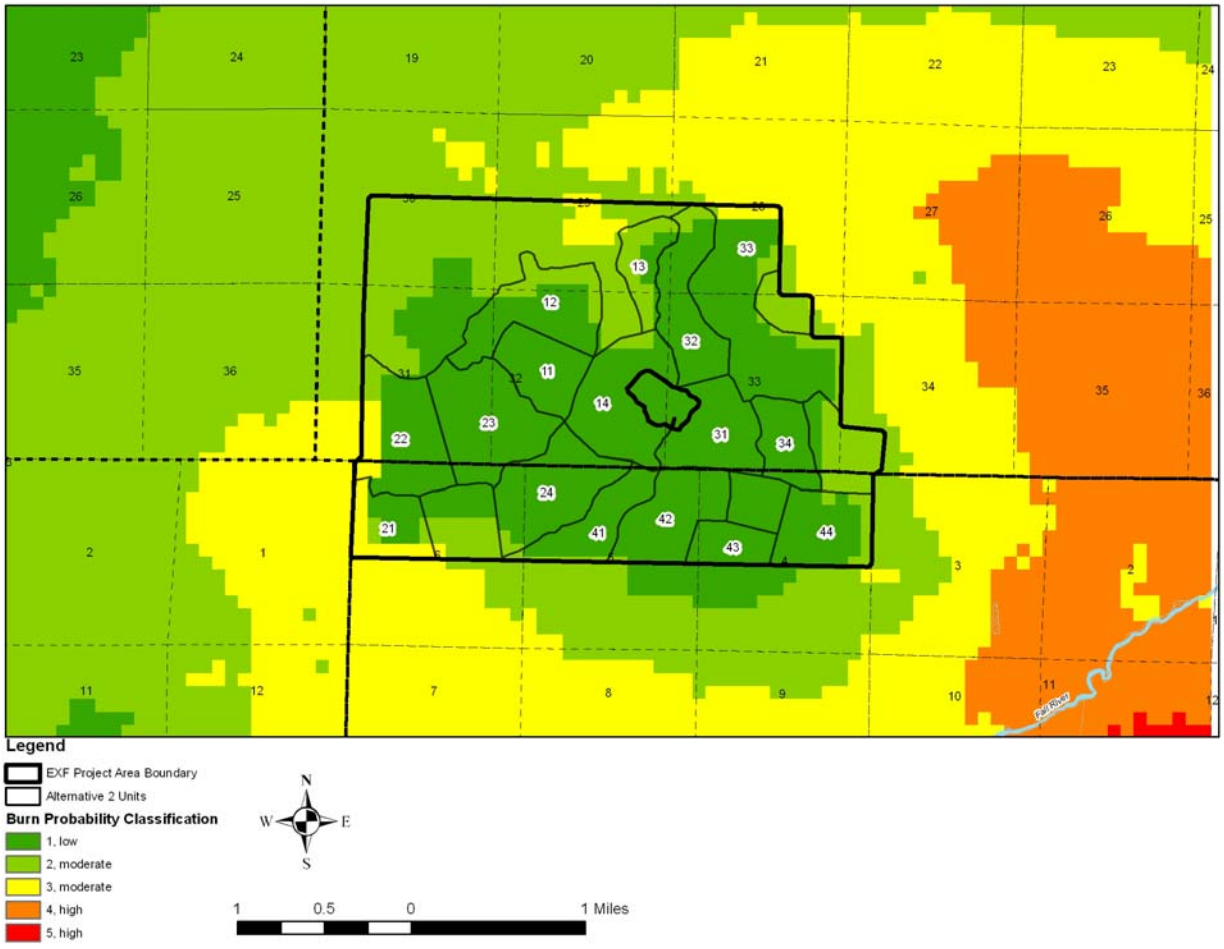
Table 39. Burn probability within Alternative 2 of the EXF project area

Burn probability classification	Alternative 2 Acres*	Existing condition Acres*
1 (low)	2,487	117
2 (moderate)	954	1,359
3 (moderate)	153	2,074
4 (high)	0	43
5 (highest)	0	0

*The entire EXF project area totals 3615 acres, 21 acres are considered in this analysis as missing values or having not enough data to complete analysis.

When comparing burn probability resulting from Alternative 2 with the burn probability for the existing condition, it can be seen that treatments proposed under Alternative 2 would lower the burn probability considerably across the treatment area. All 43 acres of the project area with the highest classification of 4 were reduced to a burn probability classification of 1 after treatment. Nineteen hundred twenty one acres of the area classified as a 3 for burn probability before treatment was reduced to a burn probability of 1 after treatment. An additional 405 acres of burn probability classification 2 were also reduced to a classification of 1 post-treatment (see Figure 15). The result is a reduction in burn probability across the planning area by 2,369 acres. Considering that 117 acres of the project area started out with a classification of 1, and only 2,554 acres were modeled to be treated, a reduction in burn probability from all classifications down to a 1 for 2,369 acres is a substantial reduction.

Figure 15. Spatial representation of Alternative 2 Burn Probability across analysis area



Measure 2: Reduction in crown fire potential

The proposed treatments of Alternative 2 would affect all areas being treated by lowering any potential for a passive or active crown fire to a surface fire (refer to Table 38). This results in 1,103 additional acres to the existing condition burning as a surface fire under 97th percentile conditions, for a total of 2,990 acres of the project area. The 577 remaining acres of passive crown fire potential are areas that would remain untreated under Alternative 2.

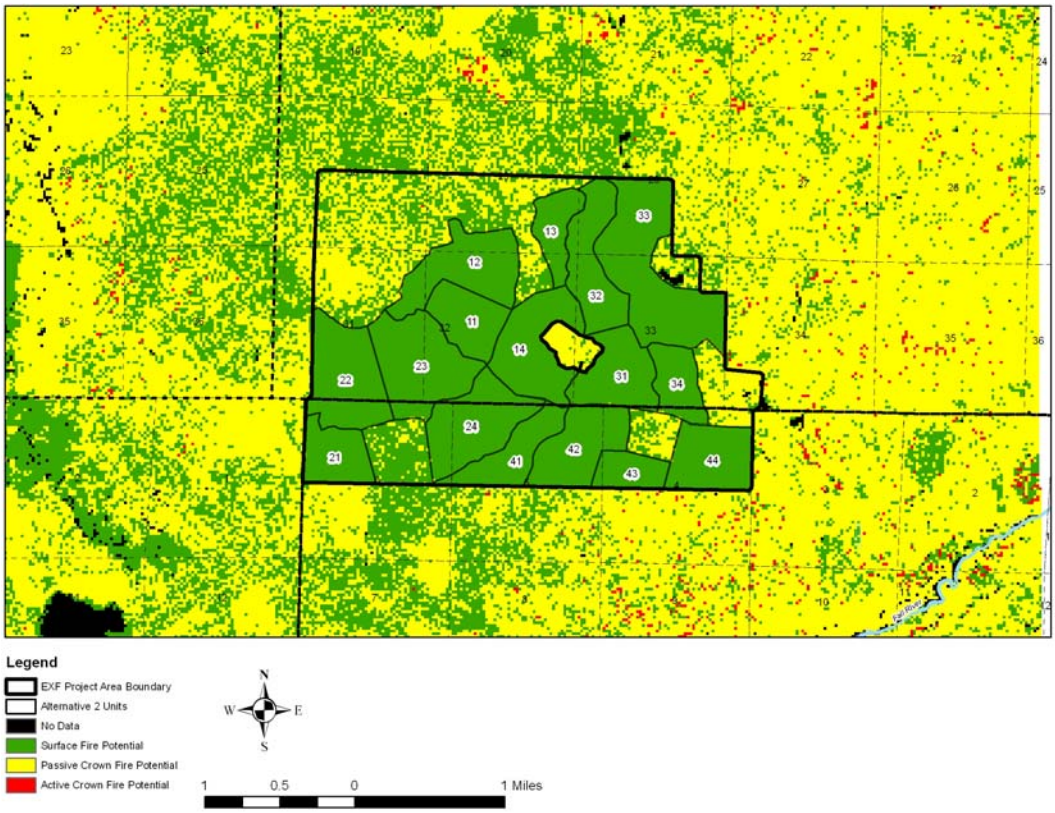


Figure 16. Crown Fire Potential Under Alternative 2.

Measure 3: Production of Particulate Matter (PM) 10 and 2.5

The amount of particulate matter emitted due to underburning and pile burning within Alternative 2 are shown in Table 40. The total tons of particulate matter shown in Table 39 were calculated by multiplying the smoke emissions per acre for a prescribed fire for both PM_{10} and $PM_{2.5}$ (predicted in FOFEM) by the number of net acres that would be prescribed underburned (2,554 acres). For comparison, to calculate the tons of PM_{10} and $PM_{2.5}$ emitted from a wildfire, the smoke emissions per acre for a wildfire (predicted in FOFEM) were multiplied by the largest acreage represented by the action alternatives (2,554 acres). Table 39 shows that an average wildfire would produce one and a half times as much emissions for both PM_{10} and $PM_{2.5}$ as the proposed treatments in Alternative 2. The emissions from Alternative 2 could be less than what is shown here, if any of the material produced during treatment can be utilized for biomass.

Table 40. Estimated smoke emissions from Alternative 2 prescribed fire treatments compared to the same amount of acres consumed under wildfire conditions without treatment.

Fire condition	Tons PM10	Tons PM2.5
Alternative 2- 2554 ac. prescribed underburn	285	241
Wildfire- 2554 total acres	432	365

Burning would be conducted in compliance with National Ambient Air Quality Standards and under the Oregon Smoke Management Plan. Burning would only be conducted when prevailing and predicted wind patterns would result in negligible effects to LaPine, Sunriver, Bend, and the Three Sisters Wilderness Class 1 Airshed. Implementation of the action alternative, based on the measures included to reduce emissions and to disperse smoke during favorable conditions, is expected to protect air quality to adjacent communities while having no visible effects to the Class 1 Airshed (Three Sisters Wilderness). This is because the Three Sisters Wilderness area is higher in elevation and located eight to ten miles west/northwest of the EXF project area. The prevailing wind patterns reflect a northwest to westerly flow and would result in minimal potential for impacts to the airshed.

On burn days, persons responsible for burning operations modify ignitions patterns and mop-up procedures to consider the effects to the Class 1 Airshed and smoke sensitive areas. Monitoring is done by the State Forester to ensure compliance with the smoke management program to determine effectiveness of smoke management procedures. Other monitoring techniques include posting personnel as lookouts (Lava Butte Lookout) on burn days. If a certain threshold is reached where additional particulate release is undesired, firing operations are ceased and immediate mop-up procedures initiated. However, given the location and layout of the project area, some smoke into adjacent communities may be temporarily inevitable, but would not be at a level to cause air quality concerns and would not persist.

In contrast to Alternative 1, fuel treatments under Alternative 2 would reduce potential wildfire size per occurrence and emissions produced in the treated units of the project area. Under extreme fire behavior conditions, the remaining untreated dense stands and areas of excessive fuel loading could burn intensely and produce unwanted amounts of smoke in addition to the predicted amounts of smoke for Alternative 2. There would be some dust created from the proposed mechanical operations under this alternative, mainly from logging operations within project units. The amount of dust actually created would be minimal due to dust abatement which includes watering dirt roads identified for hauling.

Cumulative Effects

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability

There are no known ongoing activities within EXF that impact fuels or fire behavior.

Past activities of the last 15 years, not including ongoing activities of the Snow, Fall, and Charlie Brown EAs, across the 6th field Crane Prairie and Fall River watersheds total 6,631 acres. Ongoing activities include Snow (2,777 acres), Fall (1,926 acres), and Charlie Brown (3,188 acres) EAs. The total amount of treated acres for both 6th field watersheds including proposed treatments under Alternative 2 within EXF would be 17,076 acres. This total includes any area where there may have been pre-commercial thinning, commercial harvest and/or fuels treatment, like mowing or underburning. These past and ongoing treatments in the areas outside EXF may or may not reduce fire behavior to a low rating, but any work that treats/reduces surface fuels will lower the susceptibility across the landscape for uncharacteristic wildfire.

There are no other known reasonably foreseeable actions or projects within or adjacent to the EXF planning area.

Measure 2: Reduction in crown fire potential

There are no known ongoing activities within the EXF project area that affect crown fire potential.

Past activities of the last 15 years, not including ongoing activities of the Snow, Fall, and Charlie Brown EAs, across the 6th field Crane Prairie and Fall River watersheds total 6,631 acres. Ongoing activities include Snow (2,777 acres), Fall (1,926 acres), and Charlie Brown (3,188 acres) EAs. The total amount

of treated acres for both 6th field watersheds including proposed treatments under Alternative 2 within EXF would be 17,076 acres. This total includes any area where there may have been pre-commercial thinning, commercial harvest and/or fuels treatment, like mowing or underburning. These past and ongoing treatments in the areas outside EXF may or may not reduce fire behavior to a low rating, but any work that reduces ladder fuels, reduces crown bulk density/cover, raises canopy base heights and/or treats/reduces surface fuels will lower the potential for crown fire potential and the susceptibility of uncharacteristic wildfire.

There are no other known reasonably foreseeable actions or projects within or adjacent to the EXF planning area.

Measure 3: Production of Particulate Matter (PM) 10 and 2.5

All burning activity would be conducted in compliance with National Ambient Air Quality Standards and Oregon Department of Environmental Quality regulations and restrictions to ensure that there would be no cumulative effects on air quality. Burning activity on Federal lands near, but not within, the EXF project area is also subject to the same restrictions, requirements, and regulations, so would not have any additive effect on air quality within Central Oregon.

Alternative 3

Direct and Indirect Effects

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability

The resulting predicted fire behavior for Alternative 3 was analyzed using the same technique as the analysis for the existing condition (No Action Alternative) and Alternative 2. The remote sensing satellite imagery data from 2004 was changed to reflect the proposed treatments on the ground, as per the professional judgment of Paul Brna, silviculturist and Deana Wall, fuels specialist. The change in data can be referenced in Fuels Report Appendix Section 5. Once the data was changed using ArcGIS, the data was analyzed in FlamMap under the same 97th percentile extreme summer weather conditions from Round Mountain weather station that were used for the existing condition. The resulting predicted fire behavior is shown in Table 41.

Table 41. Alternative 3 predicted fire behavior.

Fire Behavior	Alternative 3 Condition Acres*					
	Low		Moderate		High	
	Acres	Percent	Acres	Percent	Acres	Percent
Flame Length (ft)	2,877	81	214	6	477	13
Fire Type	2,834	79	733	21	0	0

*The entire EXF project area totals 3615 acres, 47 acres are considered in this analysis as missing values or having not enough data to complete analysis.

Treatments proposed in Alternative 3 would result in 1,108 more acres with low flame lengths relative to the existing condition. Five hundred eighty acres of predicted high flame lengths within the existing condition would be reduced to low flame lengths with proposed Alternative 3 treatments. This is a slightly less considerable change in fire behavior than Alternative 2. This difference would mean that direct attack with hand crews of a wildfire under 97th percentile conditions is possible on 2,877 acres of the EXF project area – 160 fewer acres than Alternative 3,037 acres possible under Alternative 2 (see

Figure 17). Direct attack on these acres of low flame length acres would allow unwanted fires to be contained while still small, thereby protecting valuable research on those acres.

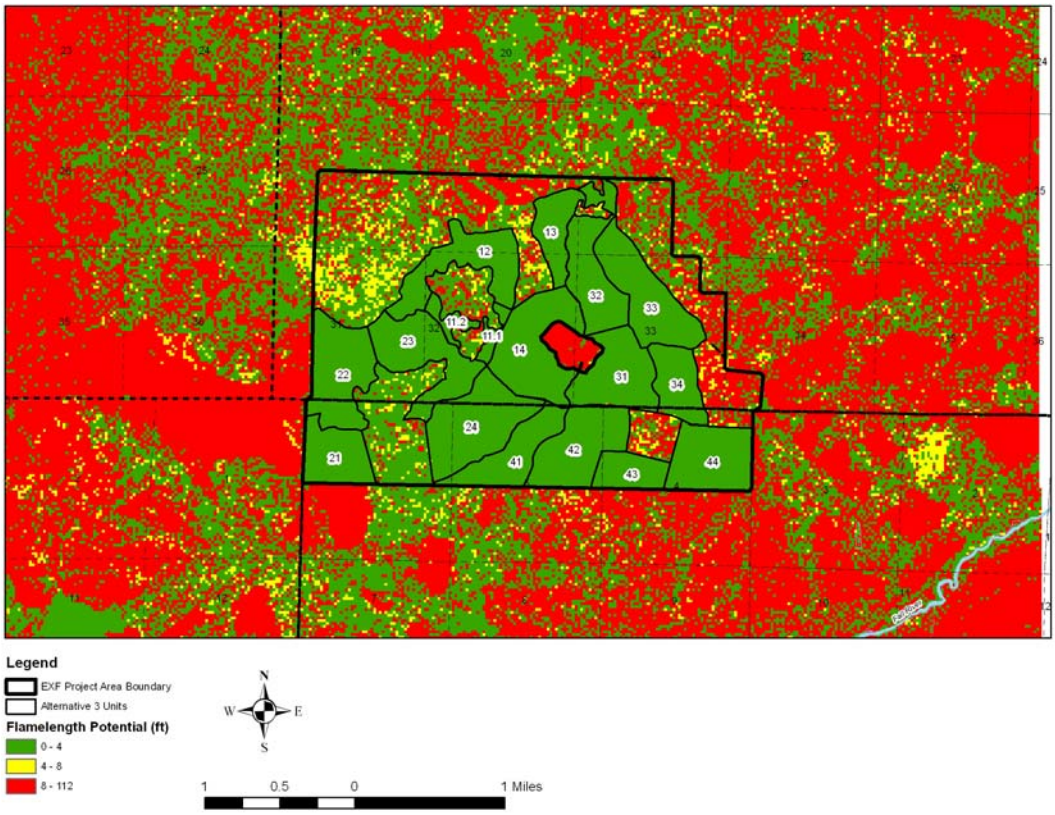


Figure 17. Flame Length Potential Following Alternative 3 Treatments.

Burn probability for Alternative 3 was calculated in the same fashion as the burn probability for the existing condition (No Action Alternative). Table 42 compares the burn probability for Alternative 3 with the burn probability for Existing condition. Figure 18 is a map of the burn probability for Alternative 3 spatially across the existing condition.

Table 42. Burn probability within Alternative 3 of the EXF project area.

Burn probability classification	Alternative 3 Acres*	Existing condition Acres*
1 (low)	2270	117
2 (moderate)	1000	1359
3 (moderate)	324	2074
4 (high)	0	43
5 (highest)	0	0

*The entire EXF project area totals 3615 acres, 21 acres are considered in this analysis as missing values or having not enough data to complete analysis.

When comparing the burn probability of Alternative 3 with the burn probability for the existing condition, it can be seen that treatments proposed under Alternative 3 would lower the burn probability substantially across the treatment area. All 43 acres of the project area with the highest classification of 4 were reduced to a burn probability classification of 1 after treatment. Seventeen hundred fifty acres of the area classified as a 3 for burn probability before treatment was reduced to a burn probability of 1 after treatment. An additional 359 acres of burn probability classification 2 were also reduced to a classification of 1 post-treatment. The result is a reduction in burn probability across the planning area, by 2,152 acres. Considering that 117 acres of the project area started out with a classification of 1, and only 2,178 acres were modeled to be treated, a reduction in burn probability from all classifications down to a 1 for 2,152 acres is a considerable reduction relative to the existing condition. It is a slightly less substantial reduction relative to Alternative 2 when strictly considering acres. However, when considering the effectiveness of acres treated; there is a 99% reduction in burn probability with proposed treatments under Alternative 3, and only a 93% reduction in burn probability with proposed treatments under Alternative 2.

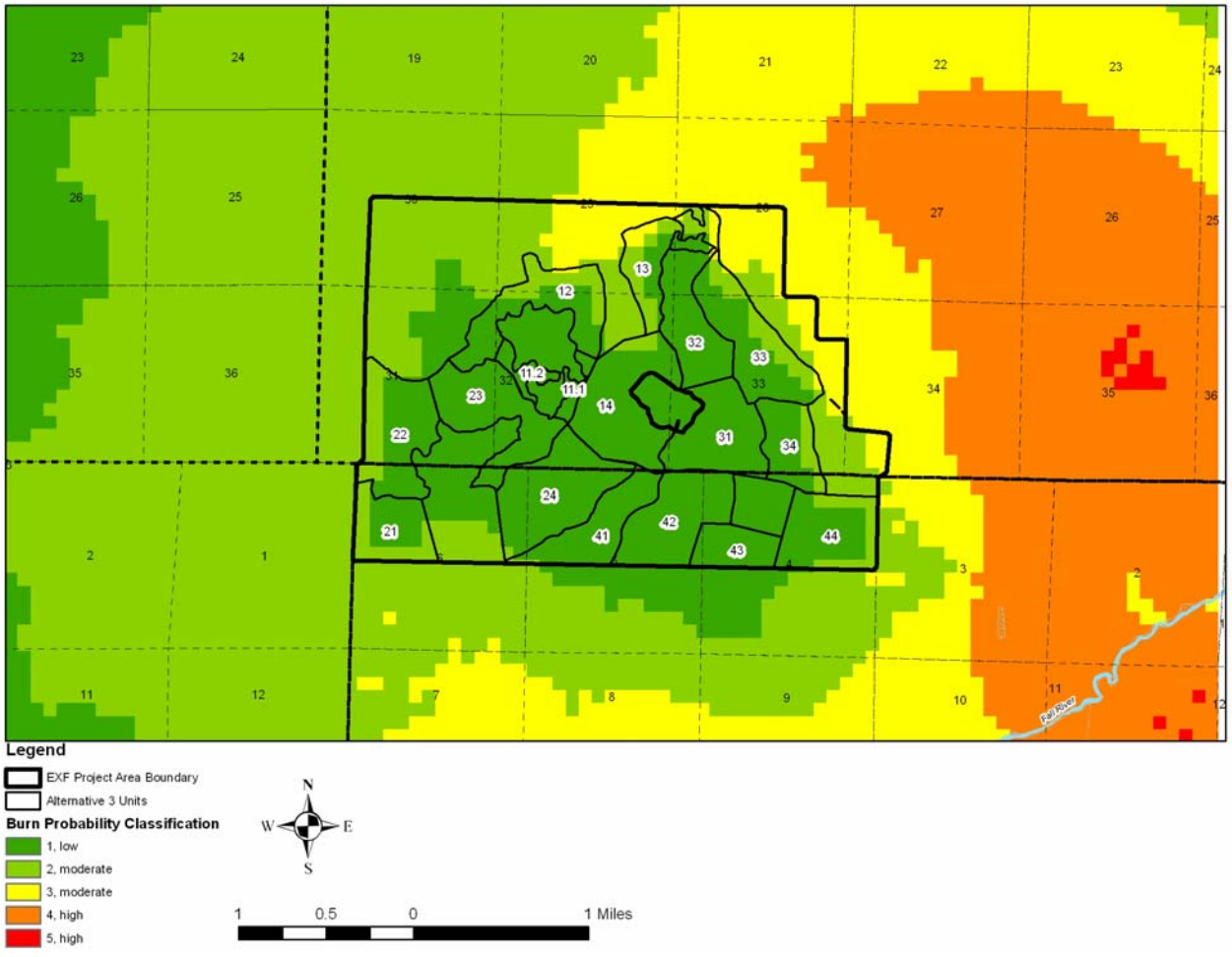


Figure 18. Spatial representation of Alternative 3 Burn Probability across analysis area

Measure 2: Reduction in crown fire potential

The proposed treatments of Alternative 3 would affect all areas being treated by lowering any potential for a passive or active crown fire to a surface fire (refer to Table 41). This results in 947 additional acres to the existing condition burning as a surface fire under 97th percentile conditions, for a total of 2,834 acres of the project area. The 733 remaining acres of passive crown fire potential are areas that would remain untreated under Alternative 3.

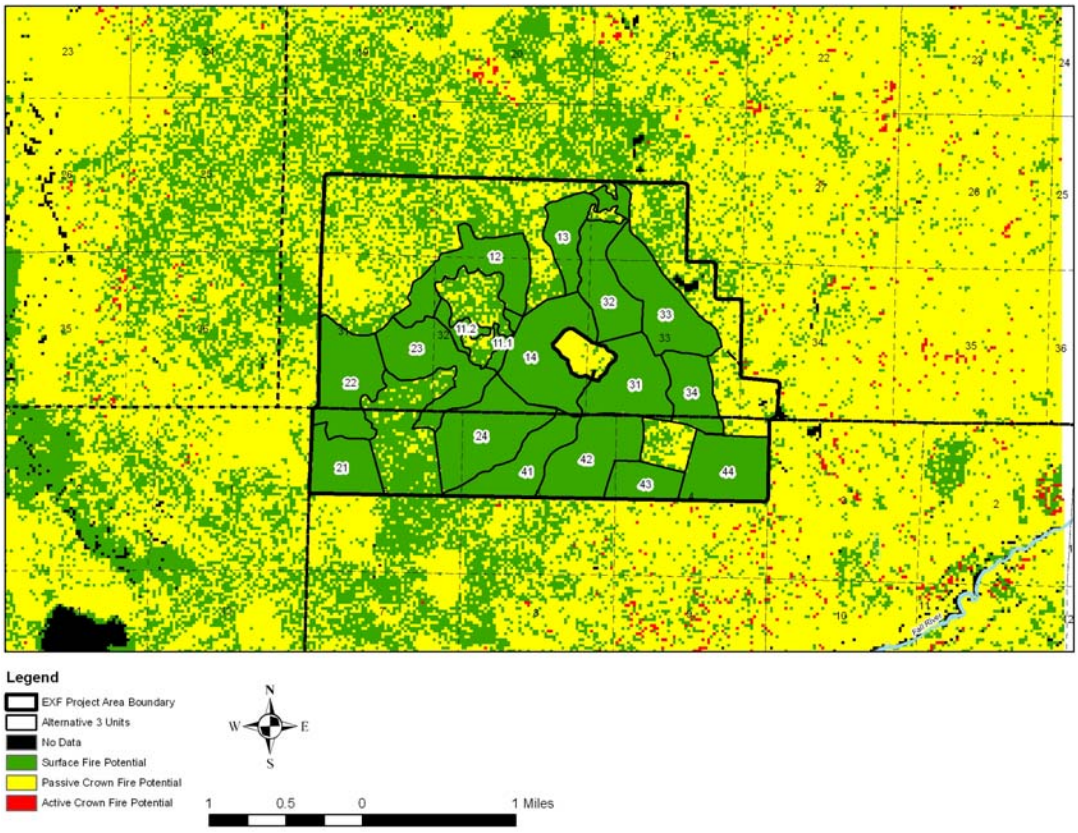


Figure 19. Crown Fire Potential Under Alternative 3.

Measure 3: Production of Particulate Matter (PM) 10 and 2.5

The amount of particulate matter emitted due to underburning and pile burning within Alternative 3 is shown in Table 43. The total tons of particulate matter shown in the table were calculated by multiplying the average smoke emissions per acre for a prescribed fire for both PM_{10} and $PM_{2.5}$ (predicted in FOFEM) by the number of net acres that would be prescribed underburned (2,369 acres). For comparison, to calculate the tons of PM_{10} and $PM_{2.5}$ emitted from a wildfire, the average smoke emissions per acre for a wildfire (predicted in FOFEM) were multiplied by the largest acreage represented by the action alternatives (2,554 acres). Table 43 shows that an average wildfire would produce more than one and a half times as much emissions for both PM_{10} and $PM_{2.5}$ as the proposed treatments in Alternative 3. Due to the 186 fewer acres treated, the amount of emissions predicted to be emitted from Alternative 3 is less than those that would potentially be emitted from Alternative 2. Alternative 3 would emit approximately 21 tons less PM_{10} and 17 tons less $PM_{2.5}$ than Alternative 2. The emissions from Alternative 2 could be less than what is shown here, if any of the material produced during treatment can be utilized for biomass.

Table 43. Estimated smoke emissions from Alternative 3 prescribed fire treatments compared to the same amount of acres consumed under wildfire conditions without treatment.

Fire condition	Tons PM10	Tons PM2.5
Alternative 3- 2369 ac. prescribed underburn	264	224
Wildfire- 2554 total acres	432	365

Burning would be conducted in compliance with National Ambient Air Quality Standards and under the Oregon Smoke Management Plan. Burning would only be conducted when prevailing and predicted wind patterns would result in negligible effects to LaPine, Sunriver, Bend, and the Three Sisters Wilderness Class 1 Airshed. Implementation of the action alternative, based on the measures included to reduce emissions and to disperse smoke during favorable conditions, is expected to protect air quality to adjacent communities while having no visible effects to the Class 1 Airshed (Three Sisters Wilderness). This is because the Three Sisters Wilderness area is higher in elevation and located eight to ten miles west/northwest of the EXF project area. The prevailing wind patterns reflect a northwest to westerly flow and would result in minimal potential for impacts to the airshed.

On burn days, persons responsible for burning operations modify ignitions patterns and mop-up procedures to consider the effects to the Class 1 Airshed and smoke sensitive areas. Monitoring is done by the State Forester to ensure compliance with the smoke management program to determine effectiveness of smoke management procedures. Other monitoring techniques include posting personnel as lookouts (Lava Butte Lookout) on burn days. If a certain threshold is reached where additional particulate release is undesired, firing operations are ceased and immediate mop-up procedures initiated. However, given the location and layout of the project area, some smoke into adjacent communities may be temporarily inevitable, but would not be at a level to cause air quality concerns and would not persist.

In contrast to Alternative 1, fuel treatments under Alternative 3 would reduce potential wildfire size per occurrence and emissions produced in the treated units of the project area. Under extreme fire behavior conditions, the remaining untreated dense stands and areas of excessive fuel loading could burn intensely and produce unwanted amounts of smoke in addition to the predicted amounts of smoke for Alternative 3. There would be some dust created from the proposed mechanical operations under this alternative, mainly from logging operations within project units. The amount of dust actually created would be minimal due to dust abatement which includes watering dirt roads identified for hauling.

Cumulative Effects

Measure 1: Acres of project area rated as low for fire behavior potential; acres of project area rated as low for burn probability.

There are no other ongoing activities within the EXF project area that impact fire behavior potential.

Past activities of the last 15 years, not including ongoing activities of the Snow, Fall, and Charlie Brown EAs, across the 6th field Crane Prairie and Fall River watersheds total 6,631 acres. Ongoing activities within Snow, Fall, and Charlie Brown EAs total 2,777, 1,926 and 3,188 acres respectively. The total amount of treated acres for both 6th field watersheds including proposed treatments under Alternative 3 within EXF would be 16,891 acres. This total includes any area where there may have been pre-commercial thinning, commercial harvest and/or fuels treatment, like mowing or underburning. These past and ongoing treatments in the areas outside EXF may or may not reduce fire behavior to a low rating, but any work that treats/reduces surface fuels will lower the susceptibility across the landscape for uncharacteristic wildfire.

There are no other known reasonably foreseeable actions or projects within or adjacent to the EXF planning area.

Measure 2: Reduction in crown fire potential

There are no known ongoing activities within the EXF project area.

Past activities of the last 15 years, not including ongoing activities of the Snow, Fall, and Charlie Brown EAs, across the 6th field Crane Prairie and Fall River watersheds total 6,631 acres. Ongoing activities within Snow, Fall, and Charlie Brown EAs total 2,777, 1,926 and 3,188 acres respectively. The total amount of treated acres for both 6th field watersheds including proposed treatments under Alternative 2 within EXF would be 16,891 acres. This total includes any area where there may have been pre-commercial thinning, commercial harvest and/or fuels treatment, like mowing or underburning. These past and ongoing treatments in the areas outside EXF may or may not reduce fire behavior to a low rating, but any work that reduces ladder fuels, reduces crown bulk density/cover, raises canopy base heights and/or treats/reduces surface fuels will lower the potential for crown fire potential and the susceptibility of uncharacteristic wildfire.

There are no other known reasonably foreseeable actions or projects within or adjacent to the EXF planning area.

Measure 3: Production of Particulate Matter (PM) 10 and 2.5

All burning activity would be conducted in compliance with National Ambient Air Quality Standards and Oregon Department of Environmental Quality regulations and restrictions to ensure that there would be no cumulative effects on air quality. Burning activity on Federal lands near, but not within, the EXF project area is also subject to the same restrictions, requirements, and regulations, so would not have any additive effect on air quality within Central Oregon.

3.3.3 Wildlife

Introduction

This section of the EIS will address the following:

- Federally Threatened, Endangered, and Candidate Species
- Regional Forester's Sensitive Species
- Management Indicator Species
- Birds of Conservation Concern
- Snags and Coarse Woody Material
- LOS Habitat and Connectivity

Federally Threatened, Endangered, and Candidate Species

A Biological Evaluation has been prepared in compliance with the requirements of Forest Service Manual (FSM) 2630.3, FSM 2670-2671, FSM W.O. Amendments 2600-95-7, and the Endangered Species Act (ESA) of 1973. A Biological Assessment (BA) will be prepared in compliance with the requirements of FSM 2630.3, FSM 2672.4 and the ESA (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 listing (FSM 2670.1)

Those species thought to occur presently or historically on the Deschutes National Forest and analyzed in the Biological Evaluation include the northern spotted owl (*Strix occidentalis*). **Effects to the northern spotted owl are documented in this EIS in Chapter 3.2 Key Issue #1 (page 40).**

Table 44. Threatened and Endangered Species Summary

Species	Status	Habitat	Presence on the Deschutes NF
Northern spotted owl	Federal threatened, MIS	Old Growth Mixed Conifer Forests	Documented

Table 45. Summary of Conclusion of Effects, Threatened, Endangered, Species

Species / Habitat	Alt. 1	Alt. 2	Alt. 3
Northern spotted owl	No Effect	Likely to Adversely Affect	Not Likely to Adversely Affect
Northern spotted owl critical habitat	No Effect	No Effect	No Effect

Regional Forester's Sensitive Species

Species classified as sensitive by the Forest Service are to be considered by conducting biological evaluations (BE) to determine potential effects of all programs and activities on these species (FSM 2670.32). The BE is a documented review of Forest Service activities in sufficient detail to determine how a proposed action may affect sensitive wildlife species, and to comply with the requirements of the Endangered Species Act.

The Forest Service Region 6 Sensitive Animal List (USDA 2008) and the Update to the Regional Forester's Sensitive Species List (USDA 2008) were reviewed for species that may be present on the Deschutes National Forest (Table 46). After a review of records, habitat requirements, and existing habitat components, it was determined that the following sensitive animal species have habitat or are known to occur in the project area and will be included in this analysis:

Pacific Fisher (*Martes pennanti*)
California Wolverine (*Gulo gulo leuteus*)
White-headed Woodpecker (*Picoides albolarvatus*)
Lewis' Woodpecker (*Melanerpes lewis*)
Johnson's Hairstreak (*Callophyrs johnsoni*)

Table 46. Regional Forester's Sensitive animal species that are either known to occur or may potentially occur on the Bend-Ft Rock Ranger District.

SPECIES	FEDERAL and FOREST CLASSIFICATION	HABITAT	NATURESERVE RANKING	PRESENCE IN PROJECT AREA
Birds				
Northern Bald Eagle *(Haliaeetus leucocephalus)*	S, MIS	Lakeside or riverside with large trees	S4B, S4N	No habitat
American Peregrine Falcon *(Falco peregrinus anatum)*	S, MIS∗	Riparian, cliffs	S2B	No habitat
Bufflehead (*Bucephala albeola*)	S	Lakes, snags	S2B, S5N	No habitat
Harlequin Duck (*Histrionocus histrionicus*	S	Rapid streams, large trees	S2B, S3N	No habitat
Greater Sage Grouse *(Centrocercus urophasianus)*	S∗	Sagebrush flats	S3	No habitat
Horned Grebe (*Podiceps auratus)*	S	Lakes, emergent vegetation	S2B, S5N	No habitat
Yellow Rail (*Coturnicops noveboracensis*)	S∗	Marshes	S1B	No habitat
Tricolored Blackbird (*Agelaius tricolor*)	S∗	Lakeside, bullrush	S2B	No habitat
White-headed Woodpecker (*Picoides albolarvatus*)	S*, MIS, Landbird focal species	Mature ponderosa pine forests; weak excavator	S2	Yes, habitat available
Lewis Woodpecker *(Melanerpes lewis)*	S*, MIS, Landbird focal species	Ponderosa pine forests, burned forests	S2	Yes, habitat available
Northern Waterthrush *(Seiurus noveboracensis)*	S	Riparian vegetation	S2	No habitat
Mammals				
Pacific Fisher (*Martes pennanti*)	S	Mixed conifer forest, complex forest structure	S2	Yes, habitat available
California Wolverine (*Gulo gulo luteus*)	S, MIS	Mixed conifer, high elevation	S1	Yes, habitat available
Pygmy Rabbit (*Sylvilagus idahoensis*)	S	Sagebrush flats	S2	No habitat
Townsend's Big-Eared Bat *(Corynorhinus townsendii)*	S, MIS	Caves	S2	No habitat
Amphibian				
Oregon spotted frog	C, S	Stream, Marsh		No Habitat
Invertebrates				
Crater Lake tightcoil *(Pristiloma arcticum crateris)*	S	Riparian and wet areas	S1	No habitat
Silver-bordered fritillary *(Boloria selene)*	S	Open riparian bogs and marshes	S2	No habitat
Johnson's hairstreak (*Callophrys johnsoni*)	S	Conifer (western hemlock, red firs, and gray or digger pines) forests with the mistletoe Arceuthobium	S2	Yes, habitat available

Key to abbreviations: T=Threatened, E=Endangered, P=Proposed for Federal listing, S=USFS Region 6 Sensitive, C=USFWS Candidate species, ∗Birds of Conservation Concern

SPECIES	FEDERAL and FOREST CLASSIFICATION	HABITAT	NATURESERVE RANKING	PRESENCE IN PROJECT AREA
Oregon Sensitive Species determined from the Natureserve database for Oregon: S1, critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, S5 = secure, B = breeding, N = non-breeding				

Summary of Conclusions for Sensitive Species

1. After a review of records, habitat requirements, and existing habitat components, it was determined that the following sensitive species do not occur and have no habitat in the project area and will not be included in any further analysis: Oregon spotted frog, bald eagle, harlequin duck, bufflehead, horned grebe, tri-colored blackbird, yellow rail, greater sage grouse, American peregrine falcon, Townsend's big-eared bat, silver-bordered fritillary, Crater Lake tightcoil, northern waterthrush, and pygmy rabbit. All alternatives analyzed for the EXF project would have **No Impact** to these species.

2. The No Action Alternative is not expected to have any impacts on California wolverine, Pacific fishers, white-headed woodpeckers, Johnson's hairstreak, or Lewis' woodpeckers and their associated habitats.

3. The Action Alternatives "**May Impact Individuals or Habitat**" but will not likely contribute to a trend toward Federal listing for the California wolverine, Pacific fishers, Johnson's hairstreak, white-headed woodpeckers, or Lewis woodpeckers due to the removal of potential nesting habitat (snags),reduction in downed logs and multi-layered stands, and improved health of stands and reduction of mistletoe (for the hairstreak). The action alternatives will have beneficial impacts to Lewis woodpeckers and white-headed woodpeckers in the long-term, through the favoritism and development of large ponderosa pine stands.

Table 47. Summary of Conclusion of Effects, Region 6 Sensitive Species

Species	Alt. 1	Alt. 2	Alt. 3
Northern Bald Eagle	NI	NI	NI
Horned Grebe	NI	NI	NI
Bufflehead	NI	NI	NI
Harlequin Duck	NI	NI	NI
American Peregrine Falcon	NI	NI	NI
Western Sage Grouse	NI	NI	NI
Yellow Rail	NI	NI	NI
Tri-colored Blackbird	NI	NI	NI
White-headed Woodpecker	NI	MIIH/BI	MIIH/BI
Lewis Woodpecker	NI	MIIH/BI	MIIH/BI
Northern Waterthrush	NI	NI	NI
California Wolverine	NI	NI	NI
Pacific Fisher	NI	MIIH	MIIH
Pygmy Rabbit	NI	NI	NI
Oregon Spotted Frog	NI	NI	NI
Crater Lake Tightcoil	NI	NI	NI
Silver-bordered fritillary	NI	NI	NI
Johnson's hairstreak	NI	MIIH	MIIH

NI = No Impact; MIIH = May impact individuals or habitat, but will not likely contribute a trend toward federal listing or loss of viability to the population or species; BI = Beneficial Impact

Analysis by Species

Rationale for Species not Further Analyzed

Essential habitat elements for the continued recovery of the northern bald eagle are nest sites, communal night roosts, foraging areas, and perch sites. On the Deschutes National Forest, ponderosa pine and Douglas-fir trees averaging 32 inch+ DBH 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. Bald eagles are sit-and-wait predators, which predominantly capture prey from perches over water; ideal perches are large trees and snags within 330 ft. (100 m) of water (Anthony et al. 1995). Prey items include fish, waterfowl and other birds, small mammals, and carrion (Stalmaster 1987). There are no territories within the EXF Project area. The project area is not within 1 mile of foraging habitat, therefore there is no bald eagle habitat within the project area. For these reasons, implementation of the No Action or any Action Alternative proposed in the EXF Project area would have **"No Impact"** on the bald eagle or their habitat.`

Harlequin ducks winter in rough coastal waters, especially along rocky shores or reefs; summering non-breeders also occur in this habitat. Harlequins also nest along fast-moving rivers and mountain streams on rocks or banks. (NatureServe 2009). On the Bend-Fort Rock Ranger District, the Deschutes River may provide the best potential suitable breeding habitat. Habitat for the harlequin duck does not occur within the project area. Implementation of any of the alternatives would have **no impact** on harlequin ducks.

Horned grebes utilize marshes, ponds, lakes, and occasionally occur along sluggish streams for breeding. They nest among tall vegetation in shallow water on small and large lakes and ponds (approximately ¼ acre or larger), in calm waters of marshes, along rivers and streams. The highest breeding densities occur in pothole marshes of aspen woodlands. Outside the breeding season, horned grebes are found on bays, estuaries and seacoasts, and in migration commonly in inland freshwater habitats, especially lakes and rivers (NatureServe 2009). Habitat for the harlequin duck does not occur within the project area. Implementation of any of the alternatives would have **no impact** on horned grebes.

Buffleheads utilize lakes, ponds, rivers, and seacoasts. The birds nest in natural cavities or abandoned northern flicker holes in mixed coniferous-deciduous woodlands near lakes and ponds. Females often nest in the same site in successive years (NatureServe 2009). This duck eats both animal and plant material. However, during the breeding season, aquatic insects and larvae are the most important item in their diet. They also eat seeds of pondweeds and bulrushes (Csuti et al. 1997 p. 100). Buffleheads winter on sheltered bays and estuaries as well as freshwater environments (NatureServe 2009). Bufflehead population numbers are generally low in Oregon and a shortage of natural cavities has brought attention to the breeding segment of the population (Csuti et al. 1997 p. 100). Habitat for the harlequin duck does not occur within the project area. Implementation of any of the alternatives would have **no impact** on buffleheads.

Tri-colored blackbird breeding takes place in freshwater marshes of cattails, tules, bulrushes, and sedges. In migration and winter they are found in open cultivated lands and pastures. (NatureServe 2009). Nesting habitat does not occur on the Bend-Fort Rock Ranger District due to the lack of cattails, tules, etc. in large quantities. Implementation of any of the alternatives would have **no impact** on tri-colored blackbirds.

Yellow rail breeding takes place in emergent wetlands, grass or sedge and wet meadows in freshwater situations. From information gathered over the last six years, nesting habitat of the yellow rail in Oregon has been described as marshes or wet meadows which have an abundance of thin-leaved sedges, a layer of senescent (old) vegetation to conceal their nests, and an average water depth of 7 cm (Popper 2001). This specific habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on yellow rails.

Greater sage grouse are found in foothills, plains, and mountain slopes where sagebrush is present and the habitat contains a mixture of sagebrush, meadows, and aspen in close proximity. Winter habitat (palatable sagebrush) is probably the most limited seasonal habitat in some areas (NatureServe 2009). This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on Greater sage grouse.

American peregrine falcons often nest on ledges or holes on the face of rocky cliffs or crags. They are commonly situated on ledges of vertical cliffs, commonly with a sheltering overhang. This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on peregrine falcons.

The northern waterthrush inhabits riparian habitat. As stated in other discussions for riparian species, this specific habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on northern waterthrushes.

Pygmy rabbits typically occur in dense stands of big sagebrush growing in deep loose soils (NatureServe 2009). This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on pygmy rabbits.

Townsend's big-eared bats inhabit caves and occasionally old buildings, and often feed over open areas and water sources. This specific habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on Townsend's big-eared bats.

The Oregon spotted frog (*Rana pretiosa*) is currently listed as a candidate species by USFWS. Spotted frogs have a historic distribution that covers a small part of western North America, from southern British Columbia to northeastern California, and from the west side of the Willamette Valley to the east side of the Oregon Klamath basin. They have been extirpated in much of their range by introduction of the bullfrog (*Rana catesbeiana*), habitat alteration and loss through intensified agriculture, grazing, and urbanization (USGS 2003). Oregon spotted frogs are marsh specialists tied to permanent water in marsh type habitats with abundant floating vegetation and good hiding areas. Egg masses are typically deposited communally, attached to vegetation in shallow water (Hayes et al 1997). Often found in the flooded upland adjacent to permanent water, the diet of spotted frogs consist mainly of insect material including moths, water striders, hoverflies, grasshoppers, spiders, beetles, and caddisflies. There are no direct, indirect, or cumulative effects to Oregon spotted frogs or their habitat. Implementation of any of the alternatives would have No Effect to the Oregon spotted frog.

"The Crater Lake Tightcoil may be found in perennially wet situations in mature conifer forests, among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and riparian areas, generally in areas which remain under snow for long periods during the winter. Riparian habitats in the Eastern Oregon Cascades may be limited to the extent of permanent surface moisture, which is often less than 10 m. from open water" (Duncan et al. 2003). This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on Crater Lake tightcoil.

The silver-bordered fritillary ranges from Central Washington south along the Rocky Mountains to northern New Mexico and east to Illinois, Virginia and Maryland. They inhabit wet meadows, bogs, and marshes as well as forest openings in mountainous areas, and spring-fed meadows in dry prairies (NatureServe 2009). Two primary colonies exist in Oregon: one at Big Summit Prairie on the Ochoco

National Forest and one in the Strawberry Mountains in the Malheur National Forest (Miller and Hammond 2007). Threats to this species include livestock overgrazing, wetland loss, and woody vegetation encroachment of willows and hawthorns from fire suppression (Miller and Hammond 2007). Adults lay eggs singly near host plants of the violet family including *Viola glabella* and *V. nephrophylla*. Caterpillars that develop from the eggs feed on these host plants and overwinter by hibernating, emerging as adults in the spring. Favored nectar sources for adults are composite flowers including goldenrod and black-eyed susans. Adults fly May to July with a second generation flying from August into September. This specific habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on silver-bordered fritillary.

Discussion for Species Further Analyzed

Field Reviews

Field reviews to assess habitat conditions for the species considered have been ongoing since 2007 by a variety of field personnel (e.g. Wildlife Biologists, Biological Technicians, Silviculturists, and Forest Technicians). Habitat information has been gathered formally and informally. Formal habitat information has been gathered using stand exams, systematic plots for dead wood (snags and logs), transects for multi-layered canopy cover, and spotted owl habitat assessment. Also there have been formal surveys for northern spotted owls and goshawks since 2007. Often during these surveys, other species will respond. Any wildlife observations were always noted during any formal effort. Informal habitat assessments have been ongoing during project and alternative development.

Assumptions

In the absence of scientifically rigorous surveys for all species listed within the different tables, a species was presumed present unless proven absent. The assumption is if appropriate habitat components are available, then that species occupies or could occupy the habitat. Analysis focused on the habitat components. Examples of specific habitat components analyzed include: snag/coarse woody material (CWM), green tree replacements (GTRs), late/old structural habitat (LOS). Conclusions as to the whether the proposed actions would or would not cause a trend towards federal listing were determined by assessing how the alternatives impact the structure and function of the vegetation (i.e. habitat components) relative to the current and historic habitat availability in conjunction with state conservation status information and ranking for the species in the Natureserve (2009) database (http://www.natureserve.org/explorer).

In addition to field reconnaissance information, current analysis tools, and best available science, Geographical Information System databases provided additional information.

Some wildlife habitats required a more detailed analysis and discussion. Level of analysis depended on the existing habitat conditions (i.e. limited habitat availability versus widespread habitat availability), the magnitude and intensity of the effects of the proposed actions (i.e. would the proposed actions cause a loss, no change, or increase in habitat), the risk to the resources (sustainability and availability of the habitat), and the issues identified during the formulation of the alternatives (see this project's Environmental Impact Statement). These factors were used to form conclusions as to how the information, in regards to the effects, would be useful and relevant in the process of making an informed decision.

Cumulative Effects Bounding: For a majority of species, potential cumulative effects are bounded by the Crane Prairie and Fall River 6th field watersheds (64,802 acres). The proposed activities would occur on 2,554 acres (Alt. 2) and 2,178 acres (Alt. 3), approximately 4% of the combined 6th field watersheds. This scale sets a logical ecological boundary (subwatershed), while also taking in a larger scale perspective of the habitat and stand types found within the project area. This boundary takes in

multiple territories of a majority of wildlife species and gives a landscape perspective in regards to management and human uses. Cumulative effects are generally considered within 20 years, because it not only can represent multiple generations of a species, but also tree growth can alter the classification of habitat structure within this timeframe. Similarly, new management policies are often in place after 20 years. Table 10 at the beginning of Chapter 3 lists the present and reasonably foreseeable actions that are considered in the cumulative effects analysis. Any effects from past actions are indistinguishable from each other and combined have been considered as part of the existing condition and the suitability or quality of the habitat.

Pacific Fisher, Region 6 Sensitive

Affected Environment

There are no known fishers in the project area. Occupation of the area by fishers is likely low because of limited suitable habitat and the patch size of habitat when compared with this species' territory size.

The Pacific fisher primarily uses mature, closed-canopy coniferous forests with some deciduous component, frequently along riparian corridors (Csuti et al. 2001). In Ruggiero et al. (1994), it is suggested fishers prefer closed-canopy (greater than 60%), late-successional forests with large physical structures (live trees, snags, and logs), especially if associated with riparian areas. A 2004 Species Assessment by the US Fish and Wildlife Service documents key aspects of fisher habitat as those associated with late-successional forests (i.e. high canopy closure, large trees and snags, large logs, hardwoods, and multiple canopy layers). Distribution of fishers is limited by elevation and snow depth (Krohn et al. 1997 *in* US Fish and Wildlife Service Species Assessment). Fishers generally avoid areas of high human disturbance, primarily high road density or recreational developments. Fishers are fairly large, weighing 3 to 13 lbs and 29 to 47 inches long. This may suggest a need of larger log sizes for dens than other animals with similar needs (e.g. marten). Aubry and Raley (2006) found in southwestern Oregon, fishers were found denning and resting at 4,000 feet elevation, more than 80% canopy closure, and more than 16 snags and 67 logs at least 20" DBH per acre; supporting the suggestion that this species utilizes large to very large structure. Denning and resting sites were also observed in large live trees (mostly Douglas-fir) with mistletoe brooms, limb clumping, rodent nests, or some other deformity. They also found fishers were preying upon woodpeckers, jays, grouse, quail, squirrels, hare, porcupine, and skunks. Most of these prey species can be found in the watershed.

Fishers have been historically documented in the Crane Prairie watershed, although always rare, in the Three Sisters area, Mt Bachelor, Elk and Hosmer Lakes, and west of little Cultus Lake (Deibert et al. 1970s). More recently (2005) an unconfirmed sighting of an immature fisher was reported in the Wickiup Reservoir area. Based on habitat descriptions in the literature and using the 2004 Satellite Imagery vegetation data, there is approximately 4,223 acres of quality habitat (greater than 20" average stand DBH; and greater than 55% canopy closure) in the Crane Prairie and Fall River watersheds combined. A total 11,276 acres of potential habitat exists by including multi-storied, high canopy closure (greater than 55%) stands with at least 15" average DBH. Fishers generally have large territories (a minimum of 10 square km or 2,500 acres). Within the project area there are approximately 1,690 acres of potential habitat with 703 acres of this being what may be considered quality habitat.

In regards to other habitat attributes, there is a wide range of log densities present throughout the watershed. Sampling within the project area found a range of 118 lineal feet of logs >16" diameter per acre. Most logs were lodgepole or ponderosa pine generally ranging from 7-29" DBH with 12 in. average diameter, which may be on the smaller end for fisher utilization. There was an average of 8 snags per acre greater than 10" DBH, with an average of approximately one snag larger than 20" DBH per acre. Most snags were ponderosa pine, but there were large fir snags present. Not recorded as part of this sampling effort but noted, was the prevalence of trees larger than 20" DBH that were not dead, but mostly dead or with decay and/or defects. Species such as the fisher, or its prey, could utilize these for habitat. In the DecAID advisor (Mellen et al 2006), information on fisher use of dead wood is

provided in the montane mixed conifer habitat type. In studies cited in this tool, 50% of the areas with a fisher population had 5.6 % downed wood cover and 13 snags per acre larger than 10" DBH. Existing estimates within the EXF project area are <2% downed log cover and an average of 8 snags per acre. This would suggest that fisher habitat within the project area, from the perspective of the snag and log components, is at the lower tolerance level or does not match well with habitat known to have fisher populations according to research.

Over 30% of the entire Crane Prairie watershed and 13% of the entire Fall River watershed are LSR or Old Growth Management Areas (i.e. in allocations with no scheduled timber harvest). These are areas where it may be more prudent to manage for high dead wood levels. Of these areas a majority are within habitat types used by fishers, although it has not been determined how much quality or potential habitat is within each allocation. Approximately, 703 acres in the EXF Project Area (17% of all quality habitat within the 6th field watersheds) meets the definition of quality fisher habitat.

Environmental Consequences

Alternative 1 – No Action

There would be no direct or indirect impacts to fishers or their habitat with the implementation of this alternative. There would be continued risks to the fisher habitat within the project area due to a catastrophic wildfire start within the Lookout Mt. Unit. Other projects within the watersheds, when implemented, will have helped to reduce the risks of fisher habitat to catastrophic fire in the project area if the fire starts outside of the Lookout Mt. Unit. In other words, other projects within the watersheds have been planned to address and reduce wildfire affects outside of the project area.

Because there is no proposed action under this alternative that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

Alternative 2 - Proposed Action

Direct and Indirect Impacts

This alternative proposes varying amounts of thinning within the 1,352 acres of potential fisher habitat found in the project area. Thinning, including thinning from below (thinning of understory and/or small diameter trees), reduces the multi-storied characteristic of a stand and its overall canopy closure. Prescribed burning reduces the density of downed logs, although the potential for destroying large logs is low under this alternative because the proposed mowing of shrubs will reduce fuel amounts and flame intensities. This outcome was observed within the Pringle Falls Unit of the Experimental forest where shrubs were treated and left untreated and then prescribed burned. Although small diameter logs were consumed where shrubs were not treated the larger logs, although charred, still retained a majority of their size and length. Prescribed burning may also reduce snag numbers by burning the base of the snags and causing them to fall. In other project areas and in the Pringle Falls Unit this was observed to happen more frequently with the smaller diameter (<15" DBH) snags, but during the same treatment similar sized snags were created. As demonstrated in the Pringle Falls Unit, the mowing and thinning associated with this alternative would help protect many of the existing snags in the project area.

Heavy thinning and thinning across all age classes (i.e. removing some of the upper canopy trees) in potential fisher habitat would most notably remove habitat components important to fishers. These types of treatments would reduce canopy closure and multi-storied characteristics, in addition to the potential of reducing log densities. This alternative proposes 1,034 acres of these types of treatments, of which approximately 550 acres are potential fisher habitat.

For the areas treated with lighter thinning prescriptions, the reduction of habitat is more temporary, as stands respond to the thinning and fuels reduction, and tree growth increases. However, with an element of maintenance implied with the proposed action, the quality habitat (i.e. higher log densities and multi-storied stands) will not likely return for the long-term. The objective of the experimental

forest is to provide an area for silvicultural research focused on ponderosa pine. This founding objective of the project area is generally not conducive to maintaining fisher habitat. That is to say, the area (i.e. this portion of the experimental forest) would get little use from this species.

Gating the 4245 road will reduce human disturbance impacts that result from vehicular use. The project area does not receive a lot of recreation use, compared to other parts of the watersheds, likely because of the lack of water and developments. The proposed actions may result in increased opportunities for OHV (off-highway vehicles) travel through the area by opening up the stands through thinning and creation of 3-4 ft. wide firelines (which closely resemble the designs for OHV trails).

Cumulative Impacts

The reduction in habitat (short or long-term) described in the above section amounts to approximately 12% of the entire estimated fisher habitat in the Crane Prairie and Fall River watersheds. This project is incremental with the anticipated effects to fisher habitat of the Snow Fuels Reduction project. Other ongoing or foreseeable projects are not expected to add incremental effects to fisher habitat because they are either 1) not within fisher habitat or potential habitat (e.g. developed recreation site maintenance, road way maintenance, SIBUN post/pole sale) or 2) they would affect individual trees but not add up to whole stand effects (e.g. EXF Biomass study removes <30 understory trees of three different species each, negligibly affecting multi-layered canopy, and personal use firewood removal would remove individual snags mostly near roads affecting the future downed wood component). The additive or cumulative effects of degraded or removed habitat with the Snow Fuels Reduction project amounts to approximately 13% (12% from this alternative and 1% from the Snow Fuels Reduction) of the total potential fisher habitat within the watersheds.

Continued reduction of fisher habitat along the easternmost portions of the Crane Prairie watershed would restrict fisher use of the watershed to the west. It is not likely that fishers would disperse further east of the Crane Prairie watershed. Dispersal and movement is more likely in a north/south or westerly direction because that is where there is more contiguous habitat. For these reasons, the cumulative effect of this reduction in habitat by this alternative is likely minimal, with the least amount of reduction overall in comparison to the other alternatives.

Fishers are not known to utilize the area. Based on habitat descriptions within recent literature, there is potential habitat within the project area although much of it is not in contiguous blocks that would best meet fisher's territory size.

Although each of the alternatives has different amounts or risks of habitat reduction, they each reduce some habitat. The amount of habitat reduction ranges from 8-12 % which is approximately 9-13% of the available habitat in the Crane Prairie and Fall River watersheds. This percentage is small, but because there is some habitat reduction selection of any of the alternatives **May Impact Individuals or Habitat, but would not likely Contribute To a Trend Towards Federal Listing**

Alternative 3

Direct and Indirect Impacts

This alternative would have the least amount of habitat reduction and therefore less effects to fishers than Alternative 2 because the areas not entered can also be described as fisher habitat. Stand characteristics that define spotted owl NRF habitat closely match those described for fishers. Fishers can also be described as using late-successional habitat, which is the habitat purpose and goal of LSRs (that is, to provide habitat for species that utilize late-successional and old-growth stands). This alternative does not treat within LSR or spotted owl habitat and thereby retains the most fisher habitat in the project area. However the benefits of retaining these areas are somewhat reduced because in order to not have these areas be part of the prescribed burning aspect, more fireline would have to be built.

The building of fireline would create strips of disturbed habitat around these areas as well as add to the opportunity for OHV travel.

This alternative would still remove approximately 514 acres of habitat in the shorter term (allowing for increased tree growth) and approximately 405 acres in the longer term (the heavier thinned stands). Risks and benefits from mowing and prescribed burning would be similar as those described under Alternative 2.

Cumulative Impacts

The reduction in habitat described in the above section amounts to approximately 8% of the entire estimated fisher habitat in the Crane Prairie and Fall River watersheds. Similar to the discussion under Alternative 2, this project is incremental with the anticipated effects to fisher habitat of the Snow Fuels Reduction project. The additive or cumulative effects of degraded or removed habitat with the Snow Fuels Reduction project amounts to approximately 9% of the total potential fisher habitat within the watersheds.

Continued reduction of fisher habitat along the easternmost portions of the watershed would restrict fisher use of the watershed to the west. It is not likely that fishers would disperse further east of the Crane Prairie watershed. Dispersal and movement is more likely in a north/south or westerly direction because that is where there is more contiguous habitat. For these reasons, the cumulative effect of this reduction in habitat by this alternative is likely minimal, with the least amount of reduction overall in comparison to the other alternatives.

Because of the amount of habitat reduced, this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Determination

Fishers are not known to utilize the area. Based on habitat descriptions within recent literature, there is potential habitat within the project area although much of it is marginal according to the habitat definitions in recent research.

Although each of the alternatives has different amounts or risks of habitat reduction, they each reduce habitat. The amount of habitat reduction ranges from 8-12 % which is approximately 9-13% of the available habitat in the Crane Prairie and Fall River watersheds. This percentage is small, but because there is some habitat reduction selection of either action alternative **May Impact Individuals or Habitat, but would not likely Contribute Towards a Trend for Further Listing**.

California Wolverine, Region 6 Sensitive, MIS

Affected Environment

The wolverine is the largest member of the weasel family (weasels, martens and fishers), and is known to be a solitary and wide-ranging species. Wolverines utilize downed logs and rock crevices or talus for denning. Prey is not a limiting factor for wolverines because they are opportunistic carnivores that also eat a variety of berries and roots (Natureserve 2009). They utilize high elevation (7,000 to 9,000 feet), alpine habitat where snow coverage remains well into the denning season (spring) with only slight variations in habitat use between summer and winter (Copeland et al. 2007; Aubry et al. 2007). They have a large home range, averaging 422 square km (104,000 acres) and, even with the best habitat, are found in low densities. Wolverines tend to avoid areas of high human population or road densities (Krebs et al. 2007). It has been suggested timber harvesting, backcountry skiing, snowmobiling, roads and other forms of human disturbance can have a negative association with wolverine occurrence in research cited by Ruggiero et al. (2007). Hornocker and Hash (1981) concluded that wolverine populations should be treated as regional rather than local. However, Edelman and Copeland (1999)

suggest that wolverine populations move along corridors of mountainous habitats and that features such as the Columbia River Gorge and shrub-steppe habitats serve as barriers to dispersal. They also conclude that sightings occurring across the arid mountains of Central Oregon may suggest a movement corridor from the Cascade Mountains to the Wallowa Mountains.

Diebert et al. (1970s) recorded wolverine observations in the area of Three-Fingered Jack (1965), Broken Top (1969), Many Lakes Basin (1972), and Willamette Pass (1973). More recently, wolverine tracks were found in the Deschutes Bridge area during winter track surveys by the Oregon Dept. Fish and Wildlife (ODFW; Glen Ardt, personal communication, 4/20/2007). Aubry et al. (2007) shows the last verifiable and documented wolverine sighting in Oregon was in 1992. This paper also shows that in breakdowns of decades going back to 1900, there have been 0 to 2 records of sightings per decade for Oregon.

Although there is wolverine habitat within the Crane Prairie watershed, habitat within the project area is of very low potential for denning; even for the portion of the Sheridan Mt LSR in the project area. There are no talus slopes, cirque basins, or large areas without roads within the project area. In fact the project is heavily roaded, although use of the roads is sporadic since the roads do not lead to any developed or dispersed recreation sites, and there is no water (i.e. little to attract most users of the forest).

For this project analysis it was assumed the Montane Mixed Conifer and alpine non-forest types adequately represent potential wolverine habitat (this representation would encompass the cirque basins that are most often described as habitat). There are 438 acres of potential wolverine habitat in the combined watersheds (Crane Prairie and Fall River). A small cluster of these acres are at the top of Lookout Mountain (outside of the treatment areas), while a majority of these acres are more than 6 air miles outside of the experimental forest.

Because the wolverine has an extremely large range, it is reasonable to assume that an individual may travel through the project area as it disperses across the Cascades and Oregon. Effects of the project largely concern this aspect of wolverine use since there is not denning habitat.

Environmental Consequences

All Alternatives

Direct and Indirect Impacts

There would be no direct impact to wolverine or their habitat with the implementation of any alternative. It is estimated that there are only 19 acres of potential wolverine habitat (i.e. Montane Mixed Conifer) within the project area.

Harvest of trees would not alter the use of the area by wolverine. Prey availability would not be reduced by activities nor would they inhibit the wolverine's ability to travel across the landscape. Proposed activities would not take place within or adjacent to potential denning habitat.

Fuel treatments in the action alternatives would reduce down woody material levels allowing for more big game use. Heavy fuel densities have been shown to impede big game travel (Lyon and Jensen 1980). Studies have shown the importance of large mammal carrion to wolverine and the availability of large mammals underlies the distribution, survival, and reproductive success of wolverines (Ruggerio et al. 1994). This may increase potential foraging opportunities for wolverine, especially within snow-free periods.

Major travel routes by humans (roads) will not change. During peak use times, these may function as barriers to dispersal. This effect can be reduced by the placement of a gate, under the action alternatives, at the 4245/4240 junction that would restrict travel on a majority of roads within the project

area. The effect of the increased opportunity for OHV use due to the construction of fireline and opening of the stands on wolverines would be similar for both action alternatives.

Cumulative Impacts

Several recent projects in the Crane Prairie watershed, where there is the greater amount of habitat, have proposed road closures (Charlie Brown: decommission 53.3 miles of road, and Fall: reduce road density by 0.63 mi/sq. mi.). These proposals will aid in reducing overall road densities in the watershed over time.

There will be no additive cumulative impact to wolverine with the implementation of any action alternative. Cumulatively, these alternatives would not likely cause a trend toward Federal listing.

Determination

Wolverines are thought to be infrequent visitors to the project area. Activities proposed in any of the action alternatives would not alter prey availability or use of the area by wolverine. Implementation of any of the alternatives would have **No Impact** the wolverine.

White-headed Woodpecker, Region 6 Sensitive, MIS

Affected Environment

White-headed woodpeckers utilize both live and dead ponderosa pines. They will forage on both live and dead pines often selecting the large diameter pines because they have more seeds and contain more suitable nesting habitat. Having large ponderosa pine does not assure this species' presence. Indications have been made that a well-developed understory of trees and shrubs may encourage mammalian predation on nests (Marshall 1997). White-headed woodpeckers are absent from early seral ponderosa pine stands. These woodpeckers are poor excavators and generally select for a more moderately decayed or softer snag in which to nest (Dixon 1995).

Habitat for white-headed woodpeckers is limited within the Crane Prairie watershed but more common in the Fall River watershed, and more importantly, in the project area. There are stands with large ponderosa pines (live and dead) in the project area, thus potential habitat is present (approximately 804 acres in the project area and 6,087 acres in the watersheds combined). There have been no known observations of white-headed woodpeckers in the project area.

Mellen et al (2009) show that for this species the 30% tolerance level is 0.3 snags >10" DBH per acre and the 50% level is 2 snags >10" DBH per acre and 4 snags >10" DBH per acre at the 80% tolerance level (Figure PPDF_PF.sp20). Using the $1/10^{th}$ acre plot data gathered within the project area in 2008, the current ponderosa pine snag ($\geq$ 10" DBH) density is 4.2/acre. This currently meets the 80% tolerance level. However of these, 0.5 snags/acre are >20"DBH and this currently meets the 30% tolerance level. In summary, the project area has a high likelihood of white-headed woodpeckers utilizing the area based on the overall ponderosa pine snag density, but the likelihood of nesting is less because of the low density of ponderosa pine snags >20" DBH.

According to Altman (2000), this is a focal species of large patches of old ponderosa pine forest with large snags. Conservation issues for this species include: loss of large diameter ponderosa pine trees to logging; lack of recruitment of young ponderosa pine due to fire suppression that has allowed understory encroachment of firs; increased fuel loads that predisposes ponderosa pine stands to stand-replacement fires; loss of snags and downed wood; and fragmented habitat increases energy expenditure and risk of predation to individual woodpeckers.

The project is somewhat unique for the watershed because of its status as an Experimental Forest and past research that favored ponderosa pine. Stands of ponderosa pine >15" DBH are relatively common and almost all of the stands within the experimental forest have some component of large ponderosa pine. Areas where white-headed woodpecker habitat would be limited are those that contain a heavy and tall shrub component. Most of the shrubs found within the experimental forest are ceanothis and chinquapin. This shrub understory contributes to the fuel loadings that are part of the conservation issues for this species.

Conservation strategies relevant to the proposed actions include: inventory to identify stands meeting desired conditions and stands that can be managed to meet desired conditions; conduct thinning, partial cuts, group selection cuts, shelterwood, planting, snag creation, or prescribed burning as appropriate to meet desired conditions but not clear cuts or overstory removal; manage for large diameter trees through wider tree spacing and longer rotation periods; retain all snags and high cut stumps >10" DBH, soft snags, broken-topped snags, leaning logs, high stumps, downed logs, and all ponderosa pine trees >17" DBH.

Environmental Consequences

Alternative 1 – No Action

There would be no direct or indirect impacts to white-headed woodpeckers or their habitat with the implementation of this alternative. The existing habitat within the project area would remain at risk to a catastrophic wildfire, especially if one were to start within the Lookout Mountain unit itself; other projects within the watersheds have been planned to reduce the risks from wildfire starts outside of the project area.

Because there is no proposed action under this alternative that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

Alternative 2 - Proposed Action

Direct and Indirect Impacts

This alternative proposes varying amounts of thinning within 804 acres of potential white-headed woodpecker habitat. The thinning prescriptions are based on the ponderosa pine stand type and thinning densities would favor species such as ponderosa pine and Douglas-fir. Prescribed burning and mowing would reduce the shrub cover that may inhibit white-headed woodpecker use. Prescribed burning poses a risk of consuming snags, however because of the size of snags favored by this species (>15-20" DBH) and with mowing to reduce ground fuel loadings, the risk to large snags is low.

Part of the proposed treatments, however, would include the ability to remove ponderosa pine greater than 21" trees if necessary to achieve the desired basal area. It is estimated that in Units 41 and 43 the density of large ponderosa pine would be reduced from approximately 26 trees per acre >21" DBH to 8-9 trees per acre>21"DBH; in Units 42 and 44 the density would be reduced from 26 trees per acres to 14-20 trees per acre. Similar treatments are in the ponderosa pine dominated units are Units 31 and 34. Because the white-headed woodpecker heavily utilizes large ponderosa pine, the removal of large ponderosa pine would negatively impact this species. Removal of large ponderosa pine would most likely occur in other areas with the heavily thinned units and the units that remove some overstory component. A majority of the thinning proposed within white-headed woodpecker habitat would fall into these proposed levels of thinning (a total 428 acres of the 804 total acres of potential habitat). The removal of these larger pines would be removing immediate food sources, and potential nest snags, assuming the large pine are under stress and would die in the short-term. Foraging habitat does not

appear to be limiting in the watersheds because seed-production is a recurring event in the ponderosa pine. Nesting structure may be more limiting because of this species utilization of large, fairly well-decayed ponderosa pine snags. Existing estimates show a low density of large ponderosa pine snags, but it is likely that with increased stress due to tree density, more ponderosa pine snags would be created. Based on the 1/10th acre plot data, there are more large, live ponderosa pine (up to 28 ponderosa pine ≥20" DBH per acres). The proposed thinning would reduce the amount of new large snags being created by improving the health of the remaining trees. According to the Deschutes Wildlife Tree and Log Implementation Strategy, the density of large diameter ponderosa pine retained under all thinning option would provide enough green tree replacements per acre to provide for the 100% population potential. Although this population potential measure is outdated (Rose et al 2001 and Mellen et al 2009) it is still used a determination of meeting the LRMP.

Over time, habitat will improve as stands respond to the thinning and fuels reduction, and tree growth increases. With an element of maintenance implied with the proposed action, the amount of shrub cover will be reduced and the quality of the habitat will likely increase in the long-term. This improvement in habitat would benefit the species. The proposed actions meet the intent of the conservation strategies to conduct thinning, or prescribed burning as appropriate to meet desired conditions; manage for large diameter trees through wider tree spacing and longer rotation periods. The proposed actions would not meet the strategy to retain all ponderosa pine trees > 17" DBH.

Recent literature has raised concerns over the potential for loss of large ponderosa pine due to prescribed burning (Kolb, et al 2007; Fire Science Brief, 2009; Fontaine, 2005; Tyler, 2006). The different articles, discussions, and research do not agree on one set of mitigations or conditions by which to prevent inadvertent loss of large pine due to prescribed fire. However, there is a concern within this project area that because some of the treatment areas focusing on ponderosa pine development are within the mixed conifer associations and wildfire has not occurred within the project area for decades, that there is potential for high fuel levels at the base of some of the large pines, which could result in tree mortality due to the prescribed fire aspect of the proposed actions. There is no data on the Bend Ft. Rock Ranger District that shows this is actually occurring and prescribed burning within the Pringle Falls portion of the experimental forest had mixed results. Monitoring of fuel levels around the retained large ponderosa pines within the proposed units and mortality (or the lack thereof) will validate the assumption that the proposed burning will not kill any of the retained large ponderosa pine. This monitoring will help reconcile the conflicting recent science regarding prescribed burning and ponderosa pine mortality.

Cumulative Impacts

As a result of this proposed action, 13% of the white-headed woodpecker habitat in the combined watersheds would be treated; this is cumulative to the 3% of habitat treated in the Crane Prairie watershed by the Snow Fuels Reduction Project. Over time, white-headed woodpecker habitat would actually increase within the watersheds because of the emphasis on large ponderosa pine habitat and fuels reduction efforts; especially within this project area. This would be a beneficial cumulative effect. Although the treatments are proposed largely within mixed conifer stands, the actions would favor conditions for late-seral ponderosa pine in the long-term. A monitoring item to determine retention of large ponderosa pine trees and snags post-treatment will aid in validating this assumption of short-term negative effects for long-term positive ones.

Because of the amount of habitat reduced and in the long-term habitat may be improved, this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Alternative 3

Direct and Indirect Impacts

This alternative would treat 146 fewer acres of white-headed woodpecker habitat than Alternative 2; however the treatments in Units 31, 34, 41 and 43 would remain the same (heavy thinning or thinning of overstory included). Effects to white-headed woodpecker habitat would be similar to those described under Alternative 2. The reduced amount of white-headed woodpecker affected would have only minimal reductions in effects.

Cumulative Impacts

The reduction in habitat described in the above section amounts to approximately 11% of the estimated white-headed woodpecker habitat in the combined watersheds.

Because of the amount of habitat reduced and in the long-term habitat may be improved, this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Lewis' Woodpecker, Region 6 Sensitive, MIS

Affected Environment

This species utilizes dead wood (large snags) in open forests (ponderosa pine and in some cases riparian) that may have been logged or burned (Winkler et al. 1995; Natureserve, 2009; Saab et al. 2002). Marshall et al. (2003) reports that this species is associated with open woodland habitat near water. It primarily breeds in Oregon white oak, ponderosa pine, and riparian cottonwood communities. Important components of breeding habitat include an open woodland canopy and large-diameter dead or dying trees. Potential habitat, as described in the literature, is found within the watershed, and may be found within some of the proposed treatment areas. Because of the lack of riparian areas the subwatersheds and especially the project area, analysis will focus on the ponderosa pine habitat.

For this project analysis, the Lewis' woodpecker habitat is the same as the habitat described for the white-headed woodpecker. Lewis' woodpeckers may tolerate more open stand conditions than white-headed woodpeckers. Habitat for white-headed woodpeckers is limited within the Crane Prairie watershed but more common in the Fall River watershed, and more importantly, in the project area. There are stands with large ponderosa pines (live and dead) in the project area, thus potential habitat is present (approximately 804 acres in the project area and 6,087 acres in the watersheds combined). There have been no known observations of Lewis' woodpeckers in the project area. Mellen et al. (2006) show that for this species the 30% tolerance level is 24 snags >10" DBH per acre and the 80% level is 63 snags >10" DBH per acre and 16 snags >20" DBH per acre (Figure PPDF_PF.sp20). Current snag densities estimated within and adjacent to the proposed units does not meet the snag densities at the 30% tolerance level. Because the DecAID densities were taken from research in a post-fire landscape and there has not been a major wildfire within the ponderosa pine habitat in the watershed, habitat is naturally limited in the watershed.

According to Altman (2000), this species is a focal species for patches of burned old ponderosa pine forest, and conservation issues for this species relevant to the proposed actions include: fire suppression; salvage logging of burned ponderosa pine trees; alteration of old ponderosa pine forest to young forest due to logging or fire suppression; increased competition with European starlings for nest sites; and lack of advanced decay snags or ones with cavities already present.

Conservation strategies relevant to the proposed actions include: increase levels of acceptable opportunities to allow wildfires to burn; use prescribed burning and understory thinning to maintain existing old forest ponderosa pine stands and accelerate development of mid-successional stages to old forest; prohibit or limit salvage logging to retain both hard and soft snags in clumps; close roads where

large ponderosa pine snags are present; retain standing dead or diseased trees where they occur; promote a shrubby understory; thin young pines in dense stands ; and retain large living and dead trees.

Environmental Consequences

Alternative 1 – No Action

There would be no direct or indirect impacts to Lewis' woodpecker or their habitat with the implementation of this alternative.

Because there is no proposed action under this alternative that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

Alternative 2 - Proposed Action

Direct and Indirect Impacts

Impacts to Lewis' woodpecker habitat as a result of this alternative would be similar to those described for white-headed woodpeckers because within the project area the two species share the same habitat type. This species may be more impacted by the increased vigor and health of the ponderosa pine as a result of thinning because they utilize well-decayed, large ponderosa for nesting. Because this species utilizes more open ponderosa pine habitat, the risk of losing some large ponderosa pine to prescribed fire may benefit habitat conditions; and negative impacts due to the thinning of some large ponderosa pine may not be as notable as those for white-headed woodpecker. Creation of new, large diameter ponderosa pine in a more open stand will create favorable habitat conditions for this species sooner.

The proposed actions would likely add little to the conservation issues associated with this species. Similarly, many of the conservation strategies for this species are addressed: use of prescribed burning, accelerate development to old forest, and maintain existing old forest ponderosa pine. The latter strategy would occur through the control units and the lighter thinned areas. According to Altman (2000), this species is a focal species for patches of burned old ponderosa pine forest, and conservation issues for this species relevant to the proposed actions include: fire suppression; salvage logging of burned ponderosa pine trees; alteration of old ponderosa pine forest to young forest due to logging or fire suppression; increased competition with European starlings for nest sites; and lack of advanced decay snags or ones with cavities already present.

Conservation strategies relevant to the proposed actions include: increase levels of acceptable opportunities to allow wildfires to burn; use prescribed burning and understory thinning to maintain existing old forest ponderosa pine stands and accelerate development of mid-successional stages to old forest; prohibit or limit salvage logging to retain both hard and soft snags in clumps; close roads where large ponderosa pine snags are present; retain standing dead or diseased trees where they occur; promote a shrubby understory; thin young pines in dense stands ; and retain large living and dead trees.

Cumulative Impacts

Cumulative impacts, as a result of this alternative, would be the same as those described for white-headed woodpeckers.

Because of the amount of habitat reduced, and the potential for some beneficial effects, this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Alternative 3

Direct and Indirect Impacts

This alternative would treat 146 fewer acres of Lewis' woodpecker habitat than Alternative 2. Otherwise, effects to woodpecker habitat would be similar to those described under Alternative 2.

Cumulative Impacts

The reduction in habitat described in the above section amounts to approximately 11% of the estimated woodpecker habitat in the combined watersheds.

Because of the amount of habitat reduced, and the potential for some beneficial effects, this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Johnson's Hairstreak, Region 6 Sensitive

Affected Environment

The Johnson's hairstreak is small, three-quarter inch uncommon butterfly that ranges from southern British Columbia, south through eastern and western Washington, and western Oregon, to central and south California. Isolated populations exist in northeastern Oregon to central Idaho. In Oregon, it has been found sparsely in the Cascades, Coast Range, Siskiyou Mountains, Blue Mountains and Wallowa Mountains (Pyle 2002). Elevations range from sea level to 6,000 feet. Most of the 52 records for Oregon are above 2,000 feet (Hinchliff 1994). This butterfly species depends on coniferous forests that contain dwarf mistletoes (genus *Arceuthobium*) found in western hemlock, red fir, and Jeffrey pine (Natureserve, 2008). Miller and Hammond (2007) reports this species as utilizing moist old-growth stands in the Pacific Northwest on the westslope of the Cascades Mountains. Peak conditions for this butterfly exist in old-growth and late successional second growth forests although younger forests that contain dwarf mistletoe may also support Johnson's hairstreak populations. This species typically spends much of its time in the top of the forest canopy which may contribute to the rarity of sightings (Scott 1986, Pyle 2002). Males typically perch in the tops of mistletoe-infested conifers to await females but have been observed perching on hilltops in California (Scott 1986). The larvae feed on and mimic the aerial shoots of mistletoes, making observation very difficult. Two closely related hairstreaks with overlapping ranges—*C. nelsoni* and *C. spinetorum*—can be confused with *C. johnsoni*.

Red fir has been documented in the upper NW portion of the experimental forest based on the location of the Seidel 1977 study listed in Table 7. It likely also exists as scattered individuals in the higher elevation mixed conifer stands on Lookout Mountain. These are also areas that may contain more of the cool, moist features suggested as habitat by Miller and Hammond (2007). It is assumed that some of the red fir trees could have mistletoe in them, since other mistletoe trees have been documented within the experimental forest.

Environmental consequences

Alternative 1 – No Action

There would be no direct or indirect impacts to Johnson's hairstreaks or their habitat with the implementation of this alternative. Habitat would continue to cycle through the area as trees affected by mistletoe infect trees around it, with the exception that should a catastrophic wildfire occur, these host trees would not survive.

Because there is no proposed action under this alternative that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

Alternatives 2 and 3

Direct and Indirect Impacts

The proposed actions do not directly target trees with mistletoe, let alone red fir or moist mixed conifer with mistletoe, however individuals that provide a host for this species may be removed but is expected to be a fraction of what is currently there. The area where the study was conducted and other parts of the NW corner of the Lookout Mt. Unit are not part of the proposed treatment areas. Therefore, habitat will remain for this species within the area.

Cumulative Effects

This species is more associated with moist, mixed conifer, old-growth habitat. Most of the Lookout Mt. Unit is of the ponderosa pine and dry mixed conifer types, suggesting a general lack of habitat. There is red fir present in scattered individuals in the higher elevation stands of the Lookout Mt. Unit of the experimental forest. Also, these areas and the NW portion of the experimental forest tend to have more moist plant associations. This portion is not part of the proposed actions.

Because of the general lack of habitat and the limited amount of potential habitat that may be treated and removed this alternative may impact individuals or habitat, but would not likely contribute towards a trend for further listing.

Deschutes Forest Plan Management Indicator Species, Landbird Focal Species, and Birds of Conservation Concern

A Wildlife Report has been prepared to address the project's effects upon Management Indicator Species [LRMP, (MIS)], ecological indicators (FSM, species and/or habitats), and Species of Concern [Fish and Wildlife Service designation, (SOC)] and the components of these species' habitats. This report has considered and applied the best science available; including papers, reports, literature reviews, review citations, peer reviews, science consistency reviews, and results of ground-based observations. The best available science was used to determine species or habitat presence and effects. A complete list of the science used can be found within the species discussions and in the Literature Cited section of this document. Generally three documents provide guidance or species lists for consideration in the management of federal lands. Management actions should minimize negative impacts, promote habitat development or provide habitat protection to some degree for those species that occur within the habitats of federally managed land. The three documents and associated species lists include the Deschutes National Forest – Management Indicator Species, the US Fish and Wildlife Service Birds of Conservation Concern, and a Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington. Species listed in these documents overlap with each other as well as the federal threatened, endangered and sensitive species lists.

Neotropical migratory birds have become species of interest recently, due to the downward trend of landbirds in the western United States. The decline of these populations are a result of many complex issues, but factors believed to be responsible include; loss, fragmentation, and alteration of historic vegetation communities. Other probable causes to the decline include predation from feral species, nest parasitism, and use of pesticides associated with agriculture areas. There is currently an Executive Order (13186) that provides for enhanced cooperation between the Forest Service and USFWS in regards to addressing impacts to neotropical migratory birds in conjunction with the Migratory Bird Treaty Act. Specific activities are identified where cooperation between the parties will substantially contribute to conservation and management of migratory birds, their habitat, and associated values, and thereby advances many of the purposes of the Executive Order.

In response to this Executive Order and subsequent compliance with the Migratory Bird Treaty Act, the Deschutes National Forest is currently following guidelines from the "Conservation Strategy for

Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington" (Altman 2000). This conservation strategy addresses key habitat types as well as biological objectives and conservation strategies for these habitat types found in the East Slope of the Cascades, and the focal species that are associated with these habitats. The conservation strategy lists priority habitats: 1) Ponderosa Pine 2) Mixed Conifer (Late Successional) 3) Oak-Pine Woodland 4) Unique Habitats (Lodgepole Pine, White Bark Pine, Meadows, Aspen, and Subalpine Fir). There is no Oak-Pine Woodland, White Bark Pine, Meadows, or Subalpine Fir habitat within the proposed treatment areas.

Another publication became available in 2002 from the U.S. Fish and Wildlife Service entitled "Birds of Conservation Concern 2002" and updated in 2008 (BCC) which identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973. Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame species in Alaska, and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. While all of the bird species included in BCC 2008 are priorities for conservation action, the list makes no finding with regard to whether they warrant consideration for ESA listing. The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservations actions (USFWS 2008).

From this publication, Bird Conservation Regions (BCRs) were developed based on similar geographic parameters. The BCR encompassing the project area is BCR 9, Great Basin. See "Landbird" discussion for a list of the bird species of concern for each area, the preferred habitat for each species, and whether there is potential habitat for each species within the proposed treatment areas. Species on these lists are discussed within this document if they were known to or potentially could occur within the proposed treatment areas.

Table 48 contains the name, status, a brief habitat description, and the presence of habitat relative to this project of each of the wildlife species considered in this document. Following this table is a brief review of the rationale for the "No habitat within or adjacent to proposed treatment areas" conclusion for each of the species for which this was made, and no further analysis is done. Those species with any other conclusion, are further analyzed in this document.

Habitat manipulation affects species differently. An action that may increase habitat for one species may decrease habitat for another species. Federal threatened, endangered, and regionally sensitive species lists are always consulted first (analysis for these species can be found in the project's Biological Assessment and Evaluation). Species that do not appear on these lists but show up as a management indicator species, focal species, or species of concern may have persistence issues at a regional or national level but may not have persistence issues at the state or local level. This list also shows the connection between the species and its different habitat components analyzed, particularly those components seen as being limiting factors for the species. For example, the pygmy nuthatch is not only listed with its status, but is also shown to be associated with ponderosa pine habitat and snags.

Table 48. Wildlife species considered in this document. Those in bold receive further consideration *

Species	Status	Habitat	Presence
Northern goshawk	MIS	Mature and old-growth forests; especially high canopy closure and large trees	Potential habitat in proposed treatment areas
Cooper's hawk	MIS	Similar to goshawk, can also use mature forests with high canopy closure/tree density	Potential habitat in proposed treatment areas
Sharp-shinned hawk	MIS	Similar to goshawk in addition to young, dense, even-aged stands	Potential habitat in proposed treatment areas
Great gray owl	MIS	Mature and old growth forests associated with openings and meadows	Potential habitat in proposed treatment areas

Species	Status	Habitat	Presence
Great blue heron	MIS	Riparian edge habitats including lakes, streams, marshes and estuaries	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Golden eagle	MIS, BCC	Large open areas with cliffs and rock outcrops	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Red-tailed hawk	MIS	Large snags, open country interspersed with forests	Potential habitat in proposed treatment areas
Osprey	MIS	Large snags associated with fish bearing water bodies	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Townsend's big-eared bat	MIS	Caves and old dwellings	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Elk	MIS	Mixed habitats	Habitat in proposed treatment areas
American marten	MIS	Mixed conifer or high elevation late-successional forests with abundant down woody material	Potential Habitat within or adjacent to proposed treatment areas
Mule deer	MIS	Mixed habitats	Habitat in proposed treatment areas
Snags and Downed Wood associated species and habitat	MIS	Snags and down woody material	Habitat in proposed treatment areas
Pygmy nuthatch	Landbird focal species	Mature ponderosa pine forests and snags	Habitat in proposed treatment areas
Chipping sparrow	Landbird focal species	Open understory ponderosa pine forests with regeneration	Habitat in proposed treatment areas
Brown creeper	Landbird focal species	Large trees in mixed conifer forests	Potential habitat within or adjacent to proposed treatment areas
Flammulated owl	Landbird focal species, BCC	Interspersed grassy openings and dense thickets in mixed conifer forests	Potential habitat within or adjacent to proposed treatment areas
Hermit thrush	Landbird focal species	Multi-layered/dense canopy in mixed conifer forests	Potential habitat within or adjacent to proposed treatment areas
Olive-sided flycatcher	Landbird focal species	Edges and openings created by wildfire in mixed conifer forests	Potential habitat within or adjacent to proposed treatment areas
Waterfowl Species:			
Common loon	MIS	Edges of remote freshwater ponds and lakes	No Habitat within or adjacent to proposed treatment areas
Pied-billed grebe	MIS	Edge of open water in freshwater lakes, ponds, sluggish rivers and marshes	No Habitat within or adjacent to proposed treatment areas
Horned grebe	MIS	Open water with emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Red-necked grebe	MIS	Lakes and ponds in forested areas	No Habitat within or adjacent to proposed treatment areas
Eared grebe	MIS	Open water with emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Western grebe	MIS	Marches with open water and lakes and reservoirs with emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Canada goose	MIS	Variety of habitat: shores of lakes, rivers, and reservoirs especially with cattails and bulrushes	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Wood duck	MIS	Cavity nester	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas

Species	Status	Habitat	Presence
Gadwall	MIS	Concealed clumps of grasses in meadows and tall grasslands	No Habitat within or adjacent to proposed treatment areas
American widgeon	MIS	Clumps of grasses in meadows or tall grasslands	No Habitat within or adjacent to proposed treatment areas
Mallard	MIS	Open water with emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Blue-winged teal	MIS	Marshes, lakes, ponds, slow-moving streams	No Habitat within or adjacent to proposed treatment areas
Cinnamon teal	MIS	Cover of vegetation near shoreline	No Habitat within or adjacent to proposed treatment areas
Northern shoveler	MIS	Grassy areas near water	No Habitat within or adjacent to proposed treatment areas
Northern pintail	MIS	Open areas near water	No Habitat within or adjacent to proposed treatment areas
Green-winged teal	MIS	Freshwater marshes with emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Canvasback	MIS	Emergent vegetation	No Habitat within or adjacent to proposed treatment areas
Redhead	MIS	Freshwater marshes and lakes concealed in vegetation	No Habitat within or adjacent to proposed treatment areas
Ring-necked duck	MIS	Thick emergent vegetation on shorelines	No Habitat within or adjacent to proposed treatment areas
Lesser scaup	MIS	Dry grassy areas near lakes at least 10 ft. deep	No Habitat within or adjacent to proposed treatment areas
Common goldeneye	MIS	Cavity nester	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Barrow's goldeneye	MIS	Cavity nester	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Hooded merganser	MIS	Cavity nester	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Common merganser	MIS	Cavity nester	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Ruddy duck	MIS	Freshwater marshes, lakes, ponds in dense vegetation	No Habitat within proposed treatment areas; potential habitat adjacent to proposed treatment areas
Woodpecker Species			
Williamson's sapsucker	MIS, Landbird Focal species, BCC	Mature or old growth conifer forests with open canopy cover; weak excavator	Potential habitat within or adjacent to proposed treatment areas
Red-naped sapsucker	MIS	Riparian hardwood forests	No Habitat within or adjacent to proposed treatment areas
Downy woodpecker	MIS	Riparian hardwood forest	No Habitat within or adjacent to proposed treatment areas
Hairy woodpecker	MIS	Mixed conifer and ponderosa pine forests	Habitat in proposed treatment areas
Three-toed woodpecker	MIS	High elevation and lodgepole pine forests	Potential habitat within or adjacent to proposed treatment areas
Black-backed woodpecker	MIS, Landbird focal species	Lodgepole pine forests, burned forests	Habitat in proposed treatment areas
Northern flicker	MIS	Variety of forest types but more associated with forest edges	Habitat in proposed treatment areas
Pileated woodpecker	MIS	Mature to old-growth mixed conifer forests	Potential habitat within or adjacent to proposed treatment areas

Species	Status	Habitat	Presence
Other Species			
Swainson's hawk	BCC	Open country	No Habitat within or adjacent to proposed treatment areas
Ferruginous hawk	BCC	Open sagebrush flats; open country	No Habitat within or adjacent to proposed treatment areas
Prairie falcon	BCC	Rimrock, cliffs in open country	No Habitat within or adjacent to proposed treatment areas
Greater sage grouse	BCC	Sagebrush flats	No Habitat within or adjacent to proposed treatment areas
American golden plover	BCC, Shorebird	Upland tundra, rare in OR in dry mudflats, fields and pastures	No Habitat within or adjacent to proposed treatment areas
Snowy plover	BCC, Shorebird	Sandy beaches	No Habitat within or adjacent to proposed treatment areas
American avocet	BCC	Shallow water	No Habitat within or adjacent to proposed treatment areas
Solitary sandpiper	BCC, Shorebird	Small, freshwater mudflats	No Habitat within or adjacent to proposed treatment areas
Whimbrel	BCC, Shorebirds	Grassy marshes and tidal flats	No Habitat within or adjacent to proposed treatment areas
Long-billed curlew	BCC, Shorebird	Dry grasslands	No Habitat within or adjacent to proposed treatment areas
Marbled godwit	BCC	Expansive mudflats and sandflats on beaches	No Habitat within or adjacent to proposed treatment areas
Sanderling	BCC, Shorebird	Sandy beaches with wave action	No Habitat within or adjacent to proposed treatment areas
Wilson's phalarope	BCC, Shorebird	Shallow ponds within grassy marshes	No Habitat within or adjacent to proposed treatment areas
Yellow-billed cuckoo	BCC	Riparian hardwoods	No Habitat within or adjacent to proposed treatment areas
Burrowing owl	BCC	Open grassland or agricultural land	No Habitat within or adjacent to proposed treatment areas
Black swift	BCC	Damp coastal cliffs	No Habitat within or adjacent to proposed treatment areas
Loggerhead shrike	BCC	Open habitat with scattered trees and shrubs	No Habitat within or adjacent to proposed treatment areas
Gray vireo	BCC	Rocky, dry hillsides with scattered trees	No Habitat within or adjacent to proposed treatment areas
Virginia's warbler	BCC	Mountain mahoghany	No Habitat within or adjacent to proposed treatment areas
Brewer's sparrow	BCC	Sagebrush habitats	No Habitat within or adjacent to proposed treatment areas
Sage sparrow	BCC	Sagebrush habitats	No Habitat within or adjacent to proposed treatment areas
Piping plover	Shorebird	Rare in OR on sandy beaches	No Habitat within or adjacent to proposed treatment areas
Mountain plover	Shorebird	Shortgrass prairies	No Habitat within or adjacent to proposed treatment areas
Buff-breasted sandpiper	Shorebird	Nests in tundra, forages on shortgrass prairie	No Habitat within or adjacent to proposed treatment areas
Black oystercatcher	Shorebird	Coastal rocks	No Habitat within or adjacent to proposed treatment areas
Upland sandpiper	Shorebird	Grassy fields (4-8" tall) with open patches	No Habitat within or adjacent to proposed treatment areas
Bristle-thighed curlew	Shorebird	Rare in OR in marshes or beaches. Nests in Alaska tundra	No Habitat within or adjacent to proposed treatment areas
Hudsonian godwit	Shorebird	Mudflats and shallow water; nests around spruce woods	No Habitat within or adjacent to proposed treatment areas

Species	Status	Habitat	Presence
Marbled godwit	Shorebird	Prairie ponds, mudflats and sandflats	No Habitat within or adjacent to proposed treatment areas
Black turnstone	Shorebird	Tundra, winters on rocky, coastal shores	No Habitat within or adjacent to proposed treatment areas
Surfbird	Shorebird	Nests on barren gravel hilltops, winters on rocky shorelines	No Habitat within or adjacent to proposed treatment areas
Western sandpiper	Shorebird	Mudflats and sandy beaches	No Habitat within or adjacent to proposed treatment areas
Rock sandpiper	Shorebird	Rocky shorelines	No Habitat within or adjacent to proposed treatment areas
Short-billed dowitcher	Shorebird	Mudflats and shallow muddy ponds along coast	No Habitat within or adjacent to proposed treatment areas
American woodcock	Shorebird	Damp, brushy woods	No Habitat within or adjacent to proposed treatment areas
Wilson's plover	Shorebird	Rare in OR on sandy beaches, sandflats or mudflats away from shoreline	No Habitat within or adjacent to proposed treatment areas
American oystercatcher	Shorebird	Rare in OR on rocky coasts	No Habitat within or adjacent to proposed treatment areas
Bar-tailed godwit	Shorebird	Low tundra in western Alaska	No Habitat within or adjacent to proposed treatment areas
Ruddy turnstone	Shorebird	Rocky and sandy shorelines	No Habitat within or adjacent to proposed treatment areas
Red Knot	Shorebird	Sandy beaches	No Habitat within or adjacent to proposed treatment areas
Dunlin	Shorebird	Sandy beaches and mudflats	No Habitat within or adjacent to proposed treatment areas
Calliope hummingbird	BCC	Open montane forest, mountain meadows, and willow thickets	No Habitat within or adjacent to proposed treatment areas
Sage thrasher	BCC	Juniper, sagebrush shrublands. Mt. mahogany and aspen	No Habitat within or adjacent to proposed treatment areas
Nashville warbler	BCC	Open deciduous and coniferous woodland, forest edge and undergrowth	No Habitat within or adjacent to proposed treatment areas
Black-chinned sparrow	BCC	Desert, shrubland/chapparal	No Habitat within or adjacent to proposed treatment areas
Willow flycatcher	BCC	Brushy areas with willow and riparian shrubs	No Habitat within or adjacent to proposed treatment areas
Pinyon jay	BCC	Pinyon/juniper woodland	No Habitat within or adjacent to proposed treatment areas
Green-tailed towhee	BCC	Sagebrush shrublands	No Habitat within or adjacent to proposed treatment areas
Black rosy-finch	BCC	Alpine rocky, grassy areas	No Habitat within or adjacent to proposed treatment areas

Landbird focal species come from the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000); **Management Indicator Species** come from the Deschutes National Forest Land and Resource Plan (LRMP)[1990]; **Birds of Conservation Concern (BCC)** come from the US Fish and Wildlife Service Birds of Conservation Concern – BCR 9 (Great Basin) [2008]; and **Shorebirds** come from the 2004 US Fish and Wildlife Service U. S. Shorebird Conservation Plan.

Rationale for Species not considered in detail

The Wildlife Report provides more specific rationale and clarification to the previous table for species that are not considered in detail, including conclusions about the presence or absence of the species based on habitat availability and suitability. Those species that have suitable habitat within or in the vicinity of the proposed treatment areas will be further analyzed/discussed (those in bold in Table 48) in the following sections.

Analysis Methodology (for those species receiving further consideration)

Species populations and distributions were not discussed in depth. Rather, effects on habitats and habitat components were discussed with the assumption that if appropriate habitat is available for a species, then that species occupies or could occupy the habitat. Examples of specific habitat components analyzed include: snag/coarse woody material (CWM), habitat/green tree replacements (GTRs), and late/old structural habitat (LOS). Population trends were determined by assessing how the alternatives impact the structure and function of the vegetation (i.e. habitat) relative to the current and historic habitat availability in conjunction with state conservation status information for the species in the Natureserve (2009) an online encyclopedia of life, available at http://www.natureserve.org/explorer. Rankings are given for global, national, and state levels. Only the state rankings will be used in this analysis.

Inferences regarding species diversity and relative population levels were made based upon habitat quality, condition, and quantity. Where needed and applicable, professional judgment, supported by the available information and field visits, were used to assess habitat conditions and quality. The project's Silvicultural Report (2009 Paul Brna, Silviculturist) details the historical patterns and structure within the planning area. Field reconnaissance information, current analysis tools, recent literature, and Geographical Information System databases provided additional information.

Some wildlife habitats required a more detailed analysis and discussion. Level of analysis depended on the existing habitat conditions (i.e. limited habitat availability versus widespread habitat availability), the magnitude and intensity of the effects of the proposed actions (i.e. would the proposed actions cause a loss, no change, or increase in habitat), the risk to the resources (sustainability and availability of the habitat), and the significant issues identified. These factors were used to form conclusions as to how the information in regards to the effects would be useful and relevant in the process of making an informed decision.

Tables 9 and 10 (Chapter 3.1.2) list the past, present, and reasonably foreseeable actions that were used for the analysis of cumulative effects. The effects of past projects prior to those listed have been included in the existing condition discussion under each subject heading and do not appear as separate projects. These past actions are either no longer having effects that would overlap the effects of the proposed action in time and space, or if their effects are ongoing, these effects have been incorporated into the existing habitat conditions and it is not useful nor relevant to the decision making process to analyze them separately. Any other past projects that overlap in time and space with the proposed actions do contribute effects that are additive to the proposed actions and may be useful and relevant to the decision-making process are listed.

Because the effects deal with forest development which inherently involve multiple decades, short-term impacts are addressed over a 20-30 year time span while long-term impacts are addressed for over a time span > 30 years. Similarly, the timeframes used to address cumulative effects may vary by species but will generally include a time span of 20 years, which would roughly equate to more than one generation of the species. Spatially, cumulative effects will generally start at the proposed treatment area level (approximately 2,000 acres) and then, dependent upon potential impacts, may include adjacent and nearby planning areas. The spatial boundary for cumulative effects is dependent on the species or wildlife habitat discussion and potential additive effects with the proposed action(s). These cumulative effects boundaries will provide for a range of habitat conditions that occur on the landscape that generally encompass at least a few home ranges of a species.

Effects on wildlife will be evaluated in terms of both amount and quality of habitat and of animal population trends (36 CFR 219.19 9(a)(2)). The following evaluation criteria have been developed in order to measure and compare effects as a result of the no action and the action alternative.

Goshawk: *Deschutes Management Indicator Species, S3 Vulnerable*

In Oregon, **goshawks** tend to select mature or old-growth stands of conifers for nesting, typically those having a multi-layered canopy with vegetation extending from a few meters above ground to more than 40 meters high. Generally nesting sites are chosen that are near a water source and are on moderate slopes, usually having northerly aspects. This habitat type is quite similar to that used by the Cooper's hawk, but the trees tend to be older and taller and have a better-developed understory of coniferous vegetation (Reynolds, Meslow, and Wight, 1982 in Csuti et al. 2001). Foraging generally occurs within these mature stands where small openings occur. These birds generally forage on passerines (e.g. songbirds), but often utilize small mammals such as rodents as well as the occasional snowshoe hare. Some gallinaceous bird species are also preyed upon such as blue and ruffed grouse. Species and abundance of gallinaceous prey varies in the range of the goshawk depending on elevation and latitude.

Within "Scenario A of the Eastside Screens Standard and Guides" as it amends the Deschutes LRMP, the direction for management is as follows:

Protect every known active and historically used goshawk nest-site from disturbance. "Historically" refers to known nesting activity occurring at the site in the last 5 years. Seasonal disturbance restrictions may be implemented at sites.

30 acres of the most suitable nesting habitat surrounding all active and historical nest tree(s) will be deferred from harvest.

A 400 acre "Post Fledging Area" (PFA) will be established around every known active nest site. While harvest activities can occur within this area, retain the LOS stands and enhance younger stands toward LOS condition, as possible.

Surveys have been conducted within the proposed treatment areas in 2007 and 2008, using the method outlined in Woodbridge and Hargis (2005). A goshawk nest was found in 2008 within a proposed control unit. This nest was found active again in 2009. The location of the nest is within land managed under the Northwest Forest Plan (i.e. west of the spotted owl range line). The Northwest Forest Plan does not contain specific standard and guidelines for goshawks, instead relying on standards and guidelines for late-seral species and habitat. The Eastside Screens amended Forest Plans (LRMPs) that were east of the owl line. This project area is unique in that both amendments apply in different portions of the project area.

The proposed treatment areas overlap approximately 2,118 acres of potential habitat, defined as stands with a mean canopy cover of 40% or greater, and stands with an average tree diameter of more than 15" DBH. This amounts to approximately 41% of potential habitat in the watershed (a total of 5,183 acres meeting this definition within the two 6th field watersheds).

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 – No Action

This alternative is not likely to have any direct, indirect, or cumulative impacts to goshawks. Stands currently providing habitat would continue to do so until the event of a stand replacing wildfire, whereby there would not be habitat.

Alternative 2 – Proposed Action

The Lookout Mt. Unit of the Pringle Falls Experimental Forest represents a large portion of the available goshawk habitat in the watersheds. This is likely due to the following: 1) many of the stands within this Experimental Unit have not been included in past scheduled harvest activities; 2) past research has focused on smaller areas; 3) the average stand diameter in the area is higher than many of the other stands outside of the experimental forest and; 4) a wildfire has not burned through the area for decades.

Generally, the minimal canopy closure stand to meet goshawk habitat matches that for spotted owl dispersal habitat (i.e. 40%). In fact, many of the characteristics of spotted owl nesting habitat would also meet goshawk habitat. Ironically, goshawks will prey upon spotted owls and to manage habitat levels for both species within the same area would seem counterproductive.

Although the existing nest is within one of the control units and will not be treated, approximately 381 acres of potential nesting, fledging and foraging habitat would be removed. These acres are within mixed confer vegetation types, meet the characteristics for potential habitat, and would receive the heavy thin prescriptions (thin to 50% UMZ or Thin to 75% UMZ and create small openings). Of the different habitat uses, goshawks are most tolerant of a variety of foraging conditions but will first utilize stands that are similar to their nest stand. Approximately 275 acres of goshawk habitat proposed to be removed are adjacent to the nest stand. The nest stand itself is approximately 64 acres. The removal of 275 acres of habitat adjacent to the current nest stand may result in the goshawks abandoning this nest site after treatment.

The underburning and mowing portions of the proposed actions are not expected to have impacts to potential goshawk nesting habitat. As the remaining trees in the lighter thinned units respond to thinning with diameter growth, more suitable nesting habitat than presently available is expected to develop; especially within the moist mixed conifer associations. Goshawks are not typically associated with late-seral ponderosa pine, therefore development and maintenance of less dense, single story and late-seral ponderosa pine stands are not expected to provide goshawk nesting habitat, but may provide foraging and fledging habitat. In the future, goshawks may utilize the control units as nest stands and the remaining areas utilized as fledging and foraging habitat.

The 381 acres of habitat removed represents 18% of the available habitat within the Lookout Mt. Unit of the Experimental Forest and 7% of the available habitat within the two 6th field watersheds. The loss of 275 acres in proximity to a known nest could ultimately result in abandonment of this territory post-treatment despite a mitigation measure to reduce disturbance during the nesting season.

Alternative 3

This alternative would have similar effects to goshawks as Alternative 2. The treatments proposed under Alternative 3 are the same as the proposed action but with fewer acres. The acres dropped from treatment under this alternative include 39 acres of goshawk habitat in proximity to the current nest stand. The cumulative difference of 39 acres of habitat is minor: 16% habitat reduction within the project area due to the proposed treatments and a 6.6% reduction of habitat over the two 6th field watersheds.

Consistency with LRMP standards and guidelines:

As mentioned earlier, the Screens that amended the Deschutes LRMP with specific guidelines for goshawks do not apply to the current nest because it is west of the spotted owl range line and falls under the Northwest Forest Plan. Therefore, no new PFAs or 30-acre nest cores need to be established. Alternative 3 best meets the intent of this guideline by limiting the amount of harvest closest to the nest stand.

In accordance with the LRMP, a goshawk nest site is to be protected from disturbance. The LRMP outlines a disturbance distance of ¼ mile for non-blasting activities. Mitigation measures address this circumstance.

WL-6: "nesting habitat for at least 40 goshawk pairs will be provided in mixed conifer, mountain hemlock, and ponderosa pine forests…Habitat for an additional 30 pairs in lodgepole pine forest…" The proposed treatments impact one nest stand. Nesting habitat may develop, in the long-term, within the proposed units especially within the wet mixed conifer associations (those with a heavier fir component). Mitigation measures will ensure that any nests discovered receive protection.

WL-7: "Nesting habitat is available in …old growth (MA15)…" there are no MA15 areas within or adjacent to the treatment units. The proposed actions will likely create late seral habitat in the future, but with the emphasis on late-seral ponderosa pine. This creation may have limited use by goshawks because they tend to utilize more dense multi-storied stands.

WL-9: "Nest sites will be selected on the basis of present or past use whenever possible…" The proposed treatment areas and an adjacent larger area have been surveyed.

Cooper's Hawk *Deschutes Management Indicator Species, S4 Apparently Secure*

The **Cooper's hawk** prefers coniferous, mixed and deciduous forests, as well as riparian, juniper, and oak woodlands. Vegetative profile around nests are trees 30-60 and 50-70 years old in northwest and eastern Oregon, respectively with tree density of 265/ac. and 469/ac. Coopers hawks commonly nest in deformed trees infected with mistletoe. (Marshall et al. 2003). There are no known Cooper's hawks nests within or adjacent to the proposed treatment areas. Surveys for goshawks, often can disclose Cooper's hawk territories. , and any Cooper's hawk responses were noted during goshawk surveys. No Cooper's hawks were observed and no evidence of Cooper's hawk nesting was found.

In considering the vegetative conditions within proposed units, potential habitat for this species is similar as the goshawk. Within the larger 46,000 acre area, however, there is approximately 3144 acres of potential Cooper's hawk habitat (102 acres of this within proposed units) when using the LRMP definition of a stand has a "mean canopy cover of 60% or greater, tree density of at least 365 trees per acre, stand age of 50-80 years (LRMP WL-17). A Cooper's hawk territory can be 200-1700 ac in size; with ranking in Oregon being "apparently secure" (Natureserve, 2009). This information would suggest that the larger area may have up to 2 pairs of Cooper's hawks when using the larger territory size.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 – No Action

This alternative is not likely to have any direct, indirect, or cumulative impacts to goshawks. Stands currently providing habitat would continue to do so until the event of a stand replacing wildfire.

Alternative 2 – Proposed Action

Similar to the effects to goshawks, heavier commercial thinning (thin to 50% UMZ or Thin to 75% UMZ and create small openings) would remove nesting habitat, in the short-term. Where treatment units overlap potential Cooper's hawk habitat, 937 acres would be thinned/degraded (37% of the habitat within the project area and 13% of the potential habitat in the watersheds). Underburning or mowing, is not expected to have impacts to potential nesting habitat because the goal of the mowing and underburning is to retain the trees remaining after thinning. As the remaining trees respond with diameter growth, more suitable nesting habitat than presently available is expected.

The proposed actions are not expected to impact Cooper's hawk foraging. Juxtaposition of non-treatment areas both within the units and adjacent to the units would provide for a diversity of prey. This juxtaposition would also minimize any impacts to any fledged Cooper's hawks from the larger area.

The incremental effect that the proposed treatments have on potential Cooper's hawk nesting habitat in conjunction with other present or reasonably foreseeable projects is small. The clump sizes of the habitat being impacted by the proposed actions are not large enough to constitute an entire nest core.

Alternative 3

This alternative would have similar effects to Cooper's hawks as Alternative 2. The treatments proposed under Alternative 3 are the same as the proposed action but with fewer acres. The acres dropped from treatment under this alternative include 428 acres of Cooper's hawk habitat. The cumulative difference of these 428 acres of habitat is minor: 17% habitat reduction within the project area due to the proposed treatments and a 6% reduction of habitat over the two 6th field watersheds.

Consistency with LRMP standards and guidelines:

WL-13: "Nesting habitat for at least 60 pairs of Cooper's hawk will be provided in mixed conifer and ponderosa pine forests outside of wilderness and the Oregon Cascades Recreation Area." The will remove 509-937 acres of potential Cooper's hawk nesting habitat. This acreage is scattered into various sized parcels from 3-30 acres. Because these affected acres are scattered, the cumulative effect is diluted and not concentrated on one territory. Overall nesting habitat is still being provided.

Pairs of Cooper's hawks in eastern Oregon have been found at a density of one for every 4,589 acres (Henny, 2003), for sharp-shinned hawks, there was one nest for every 6,793 acres in southern Oregon (White Scheuering and McAtee, 2003). Considering the potential habitat present within the proposed treatment areas with the larger area (6th field watersheds), there could be upwards of 2 pairs of Cooper's hawks based on the territory size reported by Henny (2003) and White Scheuering and McAtee (2003). Currently there are no known Cooper's hawk nests within this larger area.

WL-16: "Prospective sites with appropriate vegetative structure…will be identified before they have been precommercially or commercially thinned…" Potential habitat was identified and it has been acknowledged that commercial thinning would affect habitat. Mitigation measures will ensure that any nests discovered receive protection.

Sharp-Shinned Hawk: *Deschutes Management Indicator Species, S4 Apparently Secure*

Sharp-shinned hawks, in Oregon, breed in a variety of forest types that have a wide range of tree species, though most are dominated by conifers. Nests have been located at elevations that range from roughly 300 to 6000 feet. Vegetative characteristics found at nest sites, include high tree density and high canopy cover, which produce cool, shady conditions. Nest stands preferred by sharp-shinned hawks are younger than those preferred by Coopers' and goshawk, usually 25-50 yr old, even-aged stands. In eastern Oregon all nest sites found by Reynolds et al. (1982) were in even-aged stand of white fir, Douglas-fir, ponderosa pine, or aspen, with ground vegetation limited to grasses and creeping barberry (Marshall et al. 2003). Natureserve reports that the sharp-shinned hawk has a ranking of "apparently secure" in Oregon. The Deschutes LRMP defines sharp-shinned hawk habitat as stands with a mean canopy cover of 65% or greater, tree density of at least 475 trees per acre, stand age 40-60 years (LRMP WL-25). Using the 2004 satellite data for the EXF project area and subwatersheds, sharp-shinned nesting habitat was defined as areas with >55%, and an average tree diameter of >5". Sharp-shinned hawks have similar home range sizes to Cooper's hawks (i.e. 1700 acres; Natureserve 2009).

There are approximately 525 acres of potential habitat within the project area and a total of 1,756 acres of sharp-shinned habitat within the watersheds. The high canopy closure appears to be the limiting factor for sharp-shinned hawk habitat in the watersheds. The largest blocks of habitat in proximity to the project area are on the northwest flank of Lookout Mountain. Within the project area itself, habitat exists in small patches with the larger parcels being in Units 21, 22, 15 (A No Treat unit), 13, and 32.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 – No Action

This alternative is not likely to have any direct, indirect, or cumulative impacts to sharp-shinned hawks. Stands currently providing habitat would continue to do so until the event of a stand replacing wildfire.

Alternative 2 – Proposed Action

Because of this species utilization of stands with high canopy closure, any of the thinning proposed under this alternative would likely remove habitat. Where treatment units overlap potential sharp-shinned hawk habitat, 461 acres would be thinned/degraded (88% of the habitat within the project area and 26% of the potential habitat in the watersheds). Underburning or mowing, is not expected to have impacts to potential nesting habitat because the goal of the mowing and underburning is to retain the trees remaining after thinning. As the remaining trees respond with diameter growth, more suitable nesting habitat than presently available is expected.

The proposed actions are not expected to impact sharp-shinned hawk foraging. Juxtaposition of non-treatment areas both within the units and adjacent to the units would provide for a diversity of prey. This juxtaposition would also minimize any impacts to any fledged sharp-shinned hawks from the larger area.

The incremental effect that the proposed treatments have on potential sharp-shinned hawk nesting habitat in conjunction with other present or reasonably foreseeable projects is small. The largest patches of habitat are found outside of the project area but not within and ongoing or reasonably foreseeable projects. The study design would not support the creation of new habitat for this species. The study design focuses on creation of ponderosa pine dominated stands that generally do not develop the high canopy closure characteristics used by this species. No sharp-shinned hawks were observed during any other raptor surveys, and it is unlikely that and new territories would be established after project implementation.

Alternative 3

This alternative would have similar effects to sharp-shinned hawks as Alternative 2. The treatments proposed under Alternative 3 are the same as the proposed action but with fewer acres. The acres dropped from treatment under this alternative include 51 acres of habitat. The cumulative difference of these acres of habitat is minor: 78% habitat reduction within the project area due to the proposed treatments and a 23% reduction of habitat over the two 6th field watersheds.

Consistency with LRMP standards and guidelines:

WL-21-25: "Nesting habitat for at least 60 pairs of sharp-shinned hawk will be provided in mixed conifer and ponderosa pine forests outside of wilderness and the Oregon Cascades Recreation Area." The will remove 410-461 acres of potential sharp-shinned hawk nesting habitat. There are no known sharp-shinned hawks in the project area. Based on habitat requirements, the project area would not likely support a pair of sharp-shinned hawk post treatment.

WL-26-28: "Prospective sites with appropriate vegetative structure…will be identified before they have been precommercially or commercially thinned…" Potential habitat was identified and it has been acknowledged that thinning would affect habitat. Mitigation measures will ensure that any nests discovered receive protection.

Red-tailed Hawk: *Deschutes Management Indicator Species, S5 Secure*

Red-tailed hawks have an extremely wide tolerance for habitat variation. Red-tails are largely perch hunters. Red-tailed hawks typically utilize habitat types that provide suitable perches (trees, utility poles, outcrops, etc.) and are open enough to permit the detection of ground-dwelling prey. Red-tails

frequent woodland, agricultural land, clearcuts, grasslands, sagebrush plains, alpine environments, and urban areas. They construct nests in a variety of situations including tree, utility poles cliffs, and place there nests higher than other broad-winged hawks (Marshal et al. 2003). The planning area provides nesting and foraging habitat, although there are no known nest sites. Natureserve (2009) ranks this species as "secure" in most of continental United States, including Oregon.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 – No Action

No action would have no direct or indirect effect to this species. Because of this species generalist nature, it is expected that habitat will be stable in the long-term.

Alternative 2 – Proposed Action & Alternative 3

Because of the red-tailed hawk's tolerance for a wide variety of habitats, the fact that there are tens of thousands of acres of potential habitat within the watershed, and the proposed actions under each alternative are similar in the change in habitat that would result, these alternatives are analyzed together.

Removal of commercial sized trees (those trees that contribute to the upper canopy), and especially trees >21" DBH, removes potential nest habitat for red-tailed hawks. Red-tailed hawks, however, can use a variety of habitats and often hunt over more open areas. This habitat would still be available in the watershed. It is unlikely that the proposed actions under either alternative would have tangible effects to red-tail hawk populations within the watershed.

Prey habitat will improve under the action alternative. The thinning treatments, in conjunction with the mowing and burning, would create more open stand conditions, allowing greater maneuverability and greater visibility and access to prey. The mechanical shrub treatment and prescribed underburning, specifically, would promote greater plant diversity, providing habitat for a wide variety of small mammals, the primary prey of the red-tailed hawk.

It is unlikely that the proposed actions would have additive effects to the ongoing and reasonably foreseeable actions because of the limited direct and indirect effects to red-tailed hawks.

Consistency with LRMP standards and guidelines:

WL-2 "Active nest sites will be protected by maintaining the forest character of an area at least 300 feet in radius around the nest…."

WL-3 "Active nest sites should be protected from disturbing activities within ¼ mile …March 1 – August 31…"

The action alternatives comply with current direction for this species. Potential habitat was analyzed for effects, and mitigation measures are proposed to protect any active nests from disturbance.

American Marten: *Deschutes Management Indicator Species, S3 Vulnerable*

There are no known sightings of **marten** within the project area. American martens occupy a narrow range of habitat types, living in or near coniferous forest (Allen 1987). More specifically, they associate closely with late-successional stands of mesic (moist or wet) conifers, especially those with complex physical structure near the ground (Buskirk and Powell 1994). The information synopsis in Natureserve

(2006) states that fallen logs and debris are special habitat features, and that an average territory size is approximately 10 sq. km (4 sq. mi or 2,560 acres) with densities as high as 1-2 per sq. kilometer (approx. 250-500ac) in the fall. Complex physical structure addresses important life needs. It provides protection from predators, access to the subnivean (below snow) space where most prey are captured in winter, and provides protective thermal microenvironments (Buskirk and Powell 1994). In the western U.S. in winter, most prey is captured beneath the snow surface. In these areas, structure near the ground is important in providing access to subnivean spaces (Corn and Raphael 1992 in Ruggiero et al. 1994). Desirable forest types of the marten are large, somewhat dense, stands of lodgepole pine, mixed conifer, and mountain hemlock. Abundant coarse woody material in these stands is important to support a rodent prey base (LRMP WL-61). Natureserve (2009) ranks this species as being "vulnerable" in Oregon.

Based on the types of habitats used by marten described in the literature and the LRMP, there is approximately 824 acres of habitat in the project area and 6,663 acres of habitat in the watersheds (average stand tree diameter > 9" with > 55% canopy closure; or > 20" average tree diameter and > 40% canopy closure). Potential habitat is well-distributed throughout the project area except for the extreme SE portion which is heavier to the dry ponderosa pine habitat types.

Direct, Indirect, Cumulative Effects Discussion

Alternative 1 – No Action

Because there are no proposed actions with this alternative, there would no change from the existing condition and therefore no effects resulting from this alternative. However, a wildfire through the area would have the potential to have serious effects to marten habitat.

Alternative 2 – Proposed Action

The proposed actions will treat marten habitat. Units with proposed thinning and containing patches of the best marten habitat (larger [>15"] average stand diameters and >40% canopy closure) are 11, 12, 13, 21, 22, 23, and 32. Each of the proposed thinning methods would simply the existing stand structure (i.e. fewer canopy layers, and reduced canopy closure) and thereby negatively impact marten habitat. In addition, mowing and prescribed burning may reduce downed log numbers. Marten will use a variety of log sizes for foraging and larger logs and snags for denning. Although the loss of large logs will likely be low, it is reasonable to assume that some smaller logs will be consumed by the prescribed burning because the purpose is to reduce fuel loadings.

Because of the proposed emphasis on ponderosa pine management levels and the combined effects of thinning and prescribed burning, potential marten habitat would likely remain only in the control or 'No Treat" units (342 acres); a net reduction of approximately 482 acres of marten habitat. Maintenance of this ponderosa pine dominated habitat would likely limit marten presence and use in this unit of the Experimental Forest.

This reduction of 482 acres of marten habitat represents approximately 7% of the habitat available in the two 6th field watersheds. A majority of the marten habitat is within the Crane Prairie 6th field watershed and LSRs. Approximately half of the 1,068 acres of marten habitat degraded or removed under the Snow Fuels Reduction Project lies within the Crane Prairie 6th field watershed. Prescribed burning planned in the Fall River watershed would further reduce downed log densities. This additive reduction of 482 more acres would further limit the best marten habitat to the wet mixed conifer and montane mixed conifer stands that are more prevalent in the western most portion and the upper elevations of the Crane Prairie watershed. There would be an overall cumulative reduction of 15% of the habitat in the watersheds (7% from EXF and 8% from Snow).

The marten is a management indicator species under the LRMP for dense lodgepole, mixed conifer, and mountain hemlock habitat, especially these types with abundant downed woody debris. The LRMP did not assume that habitat for this species would be managed within Experimental Forests, and the NWFP does not make any specific standard and guidelines for martens (their habitat features tend to fall under coarse woody debris, LSR, and old-growth fragments). Although vulnerable in Oregon, the marten is considered secure across its range (Natureserve, 2009). Some habitat would remain within the project area (no treat units) and within the larger (5th field) watersheds.

Consistency with LRMP standards and guidelines:

WL-61 "Pine marten prefer extensive stands of relatively dense lodgepole pine, mixed conifer, or mountain hemlock forest containing abundant dead woody material as habitat for rodent prey"

These habitat types were analyzed as potential marten habitat and the effects disclosed.

WL-63 "In preferred forest types, concentrations of down woody material (logging slash, cull logs, fallen trees, etc.) will be left at an average rate of approximately one per acre after any timber harvest. Concentrations incorporating high tree stumps, logs, or snags are especially desirable. This structure will simulate naturally-occurring leaning trees, large fallen logs, ad other debris protruding above winter snow in an uncut forest…"

Compliance with downed wood standards and guidelines can be found in the Dead Wood section of this report.

Elk: *Deschutes Management Indicator Species, National Status –Secure*

Mule Deer: *Deschutes Management Indicator Species, S5 Secure*

Elk do use the proposed treatment areas for hiding cover and foraging largely in the summer and fall months.

Mule deer are known to use the proposed treatment areas for hiding cover, and foraging. The proposed treatment areas are within summer range.

For the purposes of this analysis, effects to these species will be addressed concurrently and focused on habitat uses (i.e. hiding cover, foraging habitat) since many similarities in habitat requirements exist. Because the LRMP more directly addresses elk and deer habitat under a variety of topics, the format for addressing effects is different than that used for other species.

Hiding Cover

Hiding cover is defined as vegetation capable of hiding 90 percent of a standing adult deer or elk from view of a human at a distance equal to or less than 200 feet (Thomas, 1979, LRMP WL-54). Hiding cover provides security to big game and protection from predators. Hiding cover is especially important for reducing vulnerability to hunting and poaching pressure by providing concealment in areas that have high open road densities and easy access by hunters (e.g., the proposed treatment areas). Hiding cover is evaluated in deer summer range (the entire Forest outside the Deer Habitat management allocation) on an Implementation Unit basis, per LRMP direction. The NWFP does not speak directly to the management of big game habitat but does give direction that any underlying LRMP standard and guidelines that are more restrictive than the ones in the NWFP then the LRMP shall prevail. This is the case with deer and elk hiding cover.

Although hiding cover is best judged in the field, it was not time and cost efficient to visit every stand within the implementation unit to determine if it met hiding cover. Instead, estimates of the amount of hiding cover within the proposed action areas and the watershed were derived from satellite imagery data and then a sampling was field verified or modified. For the purposes of querying the vegetation

data, hiding cover was defined as stands with trees DBH of 7 inches. Based on the field verification, younger lodgepole pine stands and the shrub stands also serve as hiding cover. It is estimated that 69% of the total 6th field watersheds, and 44% of the Implementation Unit is hiding cover or has hiding cover value.

The EXF project area itself has 639 acres of hiding cover, based on the previous definitions. Field observations would suggest a higher level of hiding cover due to the existing shrub layer in many stands. Many of the current stands, however, are even-aged and the satellite data would not necessarily pick out the shrub layer.

Because of its slope and lack of water, deer and elk use of the area is probably minimal when compared to other areas within the watersheds and Implementation Unit. In general, big game are likely to be found bedding, calving, and/or fawning in relatively flat areas closer to water. The project area received greatest use as foraging areas as big game travel to and from wintering and summering areas.

Road Density

Current LRMP standards and guidelines call for a further evaluation of road density/management in order to make a final judgment in compliance with the LRMP. Currently the LRMP WL-53 states that "Target open road densities are 2.5 miles per square mile to achieve deer summer range habitat effectiveness targets unless impacts on deer can be avoided or the proposed project would result in a net benefit to deer habitat. The density will be applied as an average for an implementation unit and will be used as a threshold requiring further evaluation". The current road density in the EXF project area is 2.72 miles per sq. mile. The current open densities for the Implementation Unit and the larger watersheds average 4-5 miles per sq. mile.

An additional total of 1 mile (in 0.2 mile segments) of temporary road will be built in order to access Units 11, 12, 14, and 21.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative would not remove hiding cover, not build any temporary roads, and would have no fireline construction.

The catastrophic fire risk would remain, especially the risk posed by the high shrub densities throughout the project area.

Because there is no proposed action under this alternative, there would be no additive effects of this alternative with other ongoing and reasonably foreseeable project in the watersheds.

Alternative 2 - Proposed Action

The proposed thinning, mowing, and prescribed burning would effectively remove the hiding cover currently found within the units. The synergistic effect of all three of these treatments means that despite the varying levels of thinning, the added mowing and burning would remove the hiding cover. Cover would remain in the No Treat control units and in the portions of the Experimental Forest now part of this project. Construction of 12 miles of 3-4 ft wide fireline could compromise any remaining hiding cover by attracting OHV use.

Conversely, a synergistic benefit of the proposed treatments to big game would be the potential increase in grasses and forbs that would offer a variety of forage within the area. Elk are more likely to forage on grasses and forbs, thus this may a more likely benefit to their foraging.

Although no roads would be closed as a result of this alternative (except the temporary roads), a gate restricting use to administrative purposes would reduce the use on a majority of the roads within the project area. This effect is tempered by the possibility of the firelines attracting OHV use in the area. Human disturbance of the area as a result of vehicles would continue. The gate, however, would have a net benefit of at least reducing some vehicular use in the area.

This alternative would cumulatively add a reduction of at least 639 acres of hiding cover across the watersheds and the Implementation Units. Overall hiding cover density would be reduced by an added 1% over the two 6th field watersheds and an added 3% reduction over the Implementation Unit.

Alternative 3 -

The effects from this alternative are similar to those discussed for Alternative 2. Under this alternative, however, there would be approximately 15 miles of fireline built in order to protect the spotted owl habitat and LSR from prescribed burning. On the other hand, this alternative would have more untreated areas throughout the project area that would further create areas of cover and forage diversity.

The 3 mile difference in fireline construction is not expected to have a noticeable increase in the additive or cumulative effects discussed under Alternative 2. These effects would be nearly the same.

Consistency with LRMP standards and guidelines

Hiding Cover

WL-54 "Hiding areas must be present over at least 30% of National Forest land in each implementation unit. Generally, this will result in 70% of each implementation unit existing either as a hiding area or within 600 ft. of a hiding area…"

It is projected that hiding cover would occur on over 40% of the implementation unit post-treatment.

WL-55 "Hiding areas will be dispersed throughout the implementation unit…"

The project area itself contains the No Treat or control units that would provide hiding cover as well as other part s of the Experimental Forest that are not part of the proposed project area. Within the implementation unit there are hiding cover patches scattered throughout.

WL-56 "Travel corridors will be provided where needed by linking stands of hiding cover"

This standard and guideline is addressed under the "corridors" in this report.

WL-58 "If possible, a narrow strip of trees should be left along roads to reduce view distances."

This standard and guideline would not be possible due to proposed study design and the connected action to improve haul routes and remove danger trees.

Road densities would be above the desired density as suggested within the LRMP. The Deschutes LRMP contains direction that specifies when this situation occurs that the project biologist is to perform a further evaluation (standard and guidelines: TS-13 and 14, WL-53). This section of the analysis serves as the further evaluation of road densities. To summarize, seasonal and permanent road closures combine to help achieve the standard and guidelines and improve the existing condition. However, disturbance and harassment to wildlife as a function of the open road densities throughout the Implementation Unit continue to contribute to a cumulative negative effect on big game because the road densities remain at the higher end or exceed these thresholds. These road densities in conjunction with other effects contribute to declining habitat and a decline in big game numbers.

The project proposes to help alleviate the high road densities by gating the 4245/4240 junction. This will effectively reduce the travel on upwards of 15 miles of road within the project area. OHV travel is not calculated into the open road density but the effects can be similar. However, it is difficult to say if, when, and how much OHV travel may occur on these firelines. This situation will be monitored after project implementation, and if necessary, the firelines will be disguised to prevent use.

Neotropical Migratory Birds

The Deschutes NF is currently following guidelines from the "Conservation Strategy For Landbirds Of the East-Slope Of The Cascade Mountains In Oregon And Washington" (Altman 2000). This conservation strategy addresses key habitat types as well as biological objectives and conservation strategies for these habitat types found in the east-slope of the Cascade Mountains, and the focal species that are associated with these habitats. The conservation strategy lists priority habitats: 1. Ponderosa Pine, 2. Mixed Conifer (Late Successional), 3. Oak-Pine Woodland, and 4. Unique Habitats. There is no Oak-Pine Woodland habitat within the proposed actions areas. Unique habitats listed in the Conservation Strategy include lodgepole pine, whitebark pine, meadows, aspen, and subalpine fir. Only lodgepole pine occurs in the proposed actions areas.

Table 49. Priority habitat features and associated focal species for conservation in selected habitats in the East-Slope Cascades Landbird Conservation Planning Region and found within the proposed action areas.

Habitat	Habitat Feature/ Conservation Focus	Focal Species by Subprovince Central Oregon/Klamath Basin
Ponderosa Pine	large patches of old forest with large snags	white-headed woodpecker
	large trees	pygmy nuthatch
	open understory with regeneration pines	chipping sparrow
Mixed Conifer	large trees	brown creeper
	large snags	William's sapsucker
	interspersion grassy openings and dense thickets	flammulated owl
	multi-layered/dense canopy	hermit thrush
	edges and openings created by wildfire	olive-sided flycatcher
Lodgepole Pine	old growth	black-backed woodpecker

Effects to habitat for the white-headed woodpecker have been discussed earlier under Sensitive species.

Pygmy Nuthatch: *Landbird Focal Species, S4 Apparently Secure*

Chipping Sparrow: *Landbird Focal Species, S4 Apparently Secure*

Pygmy nuthatches are a focal species for large trees in the ponderosa pine stand types. It is likely that they can be found in the proposed treatments. Most of the units are of the ponderosa pine plant associations and pygmy nuthatches have been observed in similar habitats.

Chipping sparrows are a focal species of more open ponderosa pine stands with active regeneration. They are a species that will nest relatively close to the ground in young pine trees (e.g. 4-8 ft. tall). This kind of habitat can be found in small pockets within the Experimental Forest. Their habitat is limited by the more even-aged, tall, and high density of the proposed treatment units.

According to the Conservation Strategy, the desired condition in ponderosa pine forest is a large tree, single layered canopy with an open, park-like understory dominated by herbaceous cover with scattered shrub cover and pine regeneration. Ponderosa pine forest within the East-Slope Cascades Landbird Conservation planning unit occurs extensively at low elevations in all the subprovinces except Columbia Foothills where it is a minor component. The proposed units fall into the range of this strategy.

There is an estimated 28,449 acres of habitat for pygmy nuthatch in the 6th field watersheds; 2,666 acres of habitat within the project area. Habitat definitions used were ponderosa pine habitat types with average stand diameters >9 inches. Amount of habitat for shipping sparrows was more difficult to assess with the 2004 satellite data because this species utilizes more of a n understory component that does not show up well with the data. Trying to query the data gives results ranging from 92-3,018 acres of habitat. This is not helpful. Chipping sparrows are apparently secure within Oregon, and effects to habitat will be made more on a qualitative rather than quantitative basis.

Landbird conservation in ponderosa pine forest emphasizes maintaining healthy ecosystems through representative focal species for three habitat conditions mentioned above (i.e. large trees, large snags, and open understory). The lower slopes of Lookout Mt are characterized by stands of relatively large ponderosa pine (>12" DBH), large ponderosa pine snags are present, but canopy densities are such that ponderosa pine has little representation in the understory; currently more shade tolerant shrubs and trees dominate.

Conservation strategies for management of this habitat include: use of prescribed burning and/or thinning when and where appropriate to reduce fuel loads and accelerate development of late-seral conditions; retain all large trees, especially ponderosa pine >20" DBH; initiate snag creation and recruitment where necessary; retain all existing snags and broken-topped trees in units; implement road closures (obliteration); and minimize invasion of exotic and noxious weeds and soil erosion.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does not address the conservation strategies recommended by Altman, (2000). There is the potential effect of further loss of these habitats by retaining the existing condition. In the event of a catastrophic wildfire, it would take decades for late seral habitat to develop. The current 160 yr old stands are a result of such a stand-replacing fire

Currently the existing condition provides habitat for the focal species (pygmy nuthatch and chipping sparrow). However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands would contribute to an overall reduction of habitat for these focal species (pygmy nuthatch and chipping sparrow).

Alternative 2 - Proposed Action

Both action alternatives address the management strategies for these habitat types (e.g. prescribed burning and thinning). No snags are proposed for harvest, although some trees over 21" DBH will be harvested. The construction of 12 miles of fireline will need to be monitored to prevent invasive weed introduction as an unintended side effect of possible OHV use on the lines.

The design of the study plan will favor habitat conditions for pygmy nuthatches rather than chipping sparrows. Mowing and burning after thinning will reduce the amount of understory and tree regeneration in the short-term (<20 yrs). The proposed treatments will encourage the diameter growth of the remaining ponderosa pines. Prescribed burning may result in the loss of some ponderosa pine snags, but it may also create some. It is difficult to predict the extent of this effect because of the variables in weather the day of the burning, and the varying duff layer amount around the large trees and snags. The latter is a proposed monitoring item with this project to determine the potential loss or gain of ponderosa pine snags.

The thinning and burning will open the stands and increase the trees' resiliency to insect and disease. This may result in a short or small scale gap in snag creation by these agents. New snags would develop in the control/no treat units and areas outside of the project. Other than the potential for the prescribed burning to create snags within the thinning units, snags would not develop in these areas for many years. This may result in small reductions in local pygmy nuthatch populations.

Habitat for the chipping sparrow is most likely to occur in the stands thinned across all age groups which will create open pockets for ponderosa pines to naturally regenerate. This would likely occur after all mowing and burning is accomplished and results are monitored.

The effects of this alternative would be additive to other effects on chipping sparrow and pygmy nuthatch habitat from ongoing and foreseeable actions throughout the watersheds. The projects listed in Tables 2a and 2b are generally small scale and have effects that would favor the health and resistance of ponderosa pine. This may limit the recruitment of new habitat (specifically snags and open regeneration stands), but because both these species are considered apparently secure in Oregon, this additive effect is not likely to have lasting effects to the population.

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, there would be more opportunity for understory development that favors the chipping sparrow. As insects continue to infest and kill the trees (including ponderosa pine), snag habitat for pygmy nuthatches would exist.

As stated in the analysis for Alternative 2, thinning in the other areas would provide larger snags into the future, but it would take many years since the thinning would actually improve the trees' resiliency to insect and disease. This effect is over a smaller area, under this alternative because of the fewer acres thinned.

This alternative would require an additional 3 miles of fireline to be built (a total of 15 miles); thus extending the effects mentioned within Alternative 2.

This alternative has the same benefits to pygmy nuthatch habitat and limits the negative impacts to chipping sparrows while also meeting the conservation strategies.

Cumulative effects of this alternative would be the same as those described for Alternative 2 because the difference between the two alternatives in amount of habitat treated and the effects are small scale on the watershed level.

Consistency with LRMP standards and guidelines:

Although pygmy nuthatches and chipping sparrows are not Management Indicator Species under the LRMP, they are considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Brown Creeper: *Landbird Focal Species, S4 Apparently Secure*

Brown creepers are a focal species for large trees within mixed conifer (i.e. white or Douglas-fir) plant association. Brown creepers have been observed an adjacent watershed with similar habitat diversity. Marshall et al. (2003) cites literature that suggests creeper numbers are reduced by clear cutting and thinning, but will utilize closed canopied stands. To determine potential habitat, white or Douglas-fir associations with some larger trees (greater than 15" DBH) and at least 40% canopy closure were considered. Information in Mellen-McLean et al. (2009) suggests that brown creepers will utilize snags 9 to 20" DBH (Figure EMC_L.sp17), but there was no information in regards to densities. There is an estimated 2,091 acres of habitat found within the project area, and 4,962 acres of habitat within the 6th field watersheds. The project area contains the largest block of habitat within the Fall River 6th field watershed. This is not unexpected considering this watershed is lower elevation and more eastern with a heavy preponderance of ponderosa pine dominated habitat types. According to snag survey data in the project area, there are at least 8 snags/acre greater than 10" DBH with at least one per acre being greater than 20" DBH. This would fit habitat descriptions for brown creepers.

According to Altman (2000), conservation issues for this species include: loss of large diameter trees (especially Douglas-fir) to logging; and indications that it may be a forest interior species (i.e. avoids edges to openings).

Conservation strategies discussed in Altman (2000) include: maintaining stands in largest tracts possible to reduce the amount of edge and fragmentation; designate areas of unmanaged late-successional forest likely to provide the most suitable nesting habitat; managing for large diameter trees through longer rotation periods; and in harvest units retained trees should be clumped rather than dispersed and should be primarily Douglas-fir.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does not address the conservation strategies recommended by Altman, (2000), except from the standpoint that the large trees present would remain through longer rotation since the Experimental Forest is not part of a regulated harvest allocation. There is the potential effect of further loss of these habitats by retaining the existing condition. In the event of a catastrophic wildfire, it would take decades for large tree habitat to develop. The current 160 yr old stands are a result of such a stand-replacing fire

Currently the existing condition provides habitat for brown creepers. However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands may contribute to an overall reduction of habitat for this species.

Alternative 2 - Proposed Action

Thinning will remove trees potentially used by brown creepers. This species tends to utilize larger trees (especially firs), and Douglas-fir is the last choice of tree to be cut (ponderosa pine is the favored tree to leave). Heavier thinning and thinning across all diameters are more likely to have negative impacts and alter creeper habitat than the light to moderate thinning. This species nests with the crevices and sloughing bark of trees, and only the older and larger trees have these characteristics. Although there will be habitat remaining within the project area it will be altered and different after the thinning with a reduction in nest tree densities and perhaps foraging; especially with the reduction of true firs since ponderosa pine is favored.

Mowing and burning is expected to have little effect to brown creeper habitat. This species is not associated with the understory and shrub cover that these actions will affect. However, with the building of temporary roads and fireline, there is the indirect effect of creating edge effects. This species is suspected to avoid openings and edges; and it is uncertain if the width of a temporary road or 3-4 ft wide fireline would constitute enough edge to discourage creeper use of the stand. This may add to further degradation of the habitat in the project area.

Removal of danger trees along the haul routes for this project could also remove potential nesting and foraging trees for this species. The use of these trees may limited though, based on the earlier discussion about brown creeper's avoidance of edges.

This alternative does not address many of the conservation strategies for this focal species. Proposed actions including the LSR portion of the project area; does not meet the strategy to designate areas of unmanaged late-successional forest likely to provide the most suitable nesting habitat; managing for large diameter trees through longer rotation periods. Ponderosa pine is being favored over Douglas-fir does not meet the strategy that retained trees should be clumped rather than dispersed and should be primarily Douglas-fir. Although the thinning across all age cohorts would result in a more clumped appearance, ponderosa pine would still be favored. The connected actions to maintain the roads, remove hazard trees, and building fireline will not necessarily meet the strategy to maintain stands in largest tracts possible to reduce the amount of edge and fragmentation.

Cumulatively, this project would remove or degrade an additional 1,076 acres of brown creeper habitat in the watershed. This is additive to the 4 acres removed by the Snow Fuels Reduction project. The 1,076 acres is limited to the Experimental Forest, but also represents a large portion within the watersheds (22%); especially the Fall River 6th field watershed. This species is "apparently secure" in the state of Oregon, although localized population effects would occur.

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, there would be more habitat patches retained within the project area and the watersheds for brown creepers. This alternative would affect 128 fewer acres than Alternative 2 (i.e. a total of 948 acres)

This alternative would require an additional 3 miles of fireline to be built (a total of 15 miles); thus extending the effects mentioned within Alternative 2.

This alternative better meets the conservation strategies, specifically by not treating the LSR which meets the strategies: 1) to maintain stands in largest tracts possible to reduce the amount of edge and fragmentation; 2) to designate areas of unmanaged late-successional forest likely to provide the most suitable nesting habitat; and 3) to manage for large diameter trees through longer rotation periods

Consistency with LRMP standards and guidelines:

Although brown creepers are not Management Indicator Species under the LRMP, they are considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and

Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Flammulated Owl: *Landbird Focal Species, S4 Apparently Secure*

Flammulated owls are a focal species of grassy openings and dense thickets within late-successional mixed conifer plant associations. Flammulated owls were heard in the project area and within the watersheds during surveys for other owl species. There was no confirmed nesting, although it is suspected because observations were made during the breeding season and consistent from particular area(s).

There is an estimated 28,600 acres of potential habitat (as defined as ponderosa pine component, large to medium sized trees, and at least 10% canopy closure to represent openings) within the 6th field watersheds and 2,732 acres of habitat in the project area. Snag densities within this habitat type are the same as those detailed under the Brown Creeper.

According to Altman (2000), conservation issues for this species include: loss of mature and old-growth trees and snags for nest and roost sites; loss of open understory because of invasion of exotics and fire intolerant species; requires small patches of dense thickets for roosting; creation of large areas of even-aged stands is detrimental; fuelwood collection reduces the densities of snags.

Some of the conservation strategies relevant to the proposed actions include: target conservation efforts near grassland or dry meadow openings; leave patches of dense sapling thickets to function as roost sites; retain large snags (greater than 12 " DBH); create snags or use nest boxes as a short-term supplement; and maintain grassy openings.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does not address the conservation strategies recommended by Altman, (2000). There is the potential effect of further loss of these habitats by retaining the existing condition. In the event of a catastrophic wildfire, it would take decades for late seral habitat to develop; although such a fire may also create the mosaic of openings and thickets that this species appear to utilize.

Currently the existing condition provides habitat for the flammulated owl. However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands may contribute to an overall conversion of habitat from a majority of large but less of a mosaic pattern, to more of a mosaic but with fewer large trees.

Alternative 2 - Proposed Action

The proposed project does not directly address the conservation strategies for this species. There are currently no grassy openings or dry meadow openings within the experimental forest, although the heavy thinning, mowing, and burning may create some of this habitat. Sapling thickets would be discouraged, at least for the short-term (0-20 yrs), because of the fuels treatments proposed. Attempts will be made to retain large snags (see monitoring section of EIS); however recruitment of new large ponderosa pine snags may slow due to the reduced competition and increased health of the trees in the stand from the thinning.

The proposed actions would address the conservation issues (i.e. loss of open understory because of invasion of exotics and fire intolerant species; and creation of large areas of even-aged stands is detrimental). The proposed actions will create open understories, at least for the short-term, over the entire project area. The invasion of exotics may still be a risk from the creation of temp roads and fireline that result in soil disturbance that facilitate the invasion. The proposed action to thin to 75% UMZ and create openings, effectively would create a multi-aged stand whereas now most of the stands are of a single age cohort.

The timing of these actions may have the greatest impact to this species. Proposed actions would occur during the nesting season. Although nesting by flammulated owls has not been confirmed; the consistency of responses over the years of survey in the same general area would suggest that there may be some nesting activity. A majority of the responses have come from the north/northeast portions of the experimental forest. Units 33, 11, and 12 have also contained responses. Actions during the breeding season have the potential to disrupt feeding or incubating activities exposing the nest or young to predators.

Flammulated owls are expected to continue to use the area after all proposed actions are completed. The actions alter the habitat some for the better and some for the worse. Because the actions focus on ponderosa pine habitat and its resiliency it is expected overall habitat conditions would improve for this species.

Because the project area as a whole is habitat for the flammulated, and the actions will both negatively and positively affect habitat; cumulative impacts of the proposed actions are likely neutral. This species is considered "apparently secure" in the state of Oregon and this project is unlikely to change that standing.

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, there would be more current habitat maintained. Given the evidence that flammulated owls are already using the area, this alternative would likely have less intense effects than the proposed action. This alternative would have fewer disturbance issues because of the fewer acres treated.

This alternative would require an additional 3 miles of fireline to be built (a total of 15 miles); thus extending the effects and potential for invasive species mentioned within Alternative 2.

This alternative has the same cumulative effects as Alternative 2.

Consistency with LRMP standards and guidelines:

Although flammulated owls are not a Management Indicator Species under the LRMP, they are considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Hermit Thrush: *Landbird Focal Species, S4 Apparently Secure*

Hermit thrushes are a focal species of multi-layered, dense mixed conifer stands. Hermit thrushes have been observed within the watershed and within the project area. No nesting was confirmed but it is

assumed because of the presence of suitable habitat and the observations of adults in suitable habitat during the breeding season.

Potential habitat for this species was defined as multi-layered habitat in montane, eastside, and ponderosa pine/Douglas-fir mixed conifer stands. Only areas in these associations with greater than 40% canopy closure and medium to large sized trees were considered in order to fully account for a multi-layered stand. Using this definition, there are 8,421 acres of potential habitat in the watershed and 2,690 acres within the project area.

Conservation issues associated with this species include the loss or alteration of habitats (loss of understory and structural complexity) from fire, grazing, and winter recreational activities.

The conservation strategy listed to address the issues for this species is to retain tracts of forest as unmanaged or lightly managed to ensure structural diversity.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does address the conservation strategies recommended by Altman, (2000). However, the conservation issues are not addressed because there is the potential effect of further loss of habitat by retaining the existing condition. In the event of a catastrophic wildfire, it would take decades for late seral habitat to develop. The current 160 yr old stands are a result of such a stand-replacing fire

Currently the existing condition provides habitat for the hermit thrush. However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands would contribute to an overall reduction of habitat.

Alternative 2 - Proposed Action

The proposed action will not address the conservation strategy for this focal species, and would likely contribute to the conservation issues. Thinning, burning, and mowing would synergistically reduce the multi-storied stands within the project area. The No Treat or control units would continue to provide habitat. Units that receive a light thin (thin to UMZ) may retain some characteristics of a multi-storied stand; but the other treatment levels would reduce canopy cover and the multi-storied feature of the stands. Although over time the shrub layer would grow back and provide for some vertical structure, hermit thrushes are not shrub nesting birds and this would be of little benefit. The connected actions of fireline building, temp road building, hazard tree reduction, etc. would not have additive impacts to the thinning, burning and mowing on hermit thrush habitat.

Based on the 2004 satellite data, the best habitat (large trees, multi-story, and high canopy closure) exists within Units 11-14, 21-24, 32, 33, and 44. The following table summarizes the effects of the proposed actions on the habitat in these units.

Table 50. Summary of Effects to Hermit Thrush Habitat

Treatment Type	Units	Acres Degraded	Acres Eliminated
Thin to UMZ	24, 14, 32	554	
Thin to 75% UMZ	22, 44, 11, 33		806
Thin to 50%	23, 12		417

UMZ			
Thin to 75% UMZ w/ openings	21, 13		189
TOTAL		**554**	**1412**

This alternative would cumulatively degrade or reduce hermit thrush habitat by 23% over the 6th field watersheds. Approximately 73% of the habitat within the project area would be impacted. Although this species is apparently secure in Oregon, and there is little threat to species over the watersheds, the proposed actions would likely restrict hermit thrush use of the Experimental Forest noticeably.

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, the conservation issues and strategy are better addressed. More habitat is retained under this alternative (a difference of 376 acres).

Table 51. Summary of Effects to Hermit Thrush Habitat

Treatment Type	Units	Acres Degraded	Acres Eliminated
Thin to UMZ	24, 14, 32	541	
Thin to 75% UMZ	22, 44, 11.1 &11.2, 33		540
Thin to 50% UMZ	23, 12		322
Thin to 75% UMZ w/ openings	21, 13		187
TOTAL		541	1049

This alternative would cumulatively degrade or reduce hermit thrush habitat by 19% over the 6th field watersheds. Approximately 59% of the habitat within the project area would be impacted. Although this species is apparently secure in Oregon, and there is little threat to species over the watersheds, the proposed actions would likely restrict hermit thrush use of the Experimental Forest noticeably.

Consistency with LRMP standards and guidelines:

Although hermit thrushes are not a Management Indicator Species under the LRMP, they are considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Olive-sided Flycatcher: *Landbird Focal Species, S4 Apparently Secure*

This species will perch and hunt from dead trees within an open area and usually nest within the forest surrounding the opening (Natureserve, 2007). There are no areas within the watersheds that have been burned recently outside of prescribed burns for other projects. These prescribed burns do not necessarily create the opened, burned conditions this species utilizes. Olive-sided flycatchers have been observed within the watershed and within some of the proposed treatment areas.

Olive-sided flycatchers are a focal species of edges and openings created by wildfires (Altman, 2000). Conservation issues associated with this species include: changes in fire regimes that have resulted in

fewer but larger fires that reduce amount of edge between early and late seral forest; and brush control limits understory growth that provides insect productivity.

Some of the Conservation Strategies in Altman (2000) for this focal species and relevant to the proposed actions include: 1) using prescribed fire with manual understory clearing where appropriate to create a patchy mosaic of burned forest; 2) increase the level of acceptable opportunities to allow wildfires to burn or ignite fires when conditions and opportunities exist; 3) where possible, prohibit salvage logging to occur in post-fire habitat; 4) for protection of snags, close roads or restrict fuelwood permits in areas where large snags are present; 5) retain standing dead or diseased trees where they occur; 6) If snags are limiting, create suitable snags through girdling, topping, etc.;7) minimize brush control; 8) selective logging can be used to increase suitability of habitat as long as sufficient large living and dead trees are retained; and 9) eliminate or minimize pesticide spraying near nesting pairs which may reduce insect prey base.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does not address the conservation strategies recommended by Altman, (2000). There is the potential effect to create habitat for this species by retaining the existing condition. In the event of a catastrophic wildfire; the current 160 yr old stands are a result of such a stand-replacing fire

Currently the existing condition provides limited habitat for this focal species. However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands would contribute to an overall increase in habitat for this focal species.

Alternative 2 - Proposed Action

The proposed actions may create more edge. The varying levels of thinning and associated prescribed burning will open the stands to create conditions favored by olive-sided flycatchers. The area would not be open to woodcutting and there are no proposals to remove any snags unless posing a safety hazard along the roads.

This alternative addresses most of the conservation strategies for this species (e.g., using prescribed fire with manual understory clearing where appropriate to create a patchy mosaic of burned forest; increase the level of acceptable opportunities to allow wildfires to burn or ignite fires when conditions and opportunities exist; where possible, prohibit salvage logging to occur in post-fire habitat; for protection of snags, close roads or restrict fuelwood permits in areas where large snags are present; and retain standing dead or diseased trees where they occur; and dead trees are retained). This alternative would not meet the strategy to limit brush control, for this is a connected action with the prescribed burning. The construction of 12 miles of fireline will need to be monitored to prevent invasive weed introduction as an unintended side effect of possible OHV use on the lines.

The design of the study plan will favor habitat conditions for olive-sided flycatchers by creating a more open stand. However, mowing and burning after thinning will reduce the amount of shrub growth in the short-term (<20 yrs), which may reduce prey habitat for this species.

There may be additive benefits to this species throughout the watersheds, as more edge will likely be created through the implementation of more prescribed burning (Fall) and this project in completed

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, there would be more opportunity for understory that favors prey species; and more edge created by firelines built around the no treatments stands and to protect the LSR and NRF habitat.

This alternative would require an additional 3 miles of fireline to be built (a total of 15 miles); thus extending the effects mentioned within Alternative 2.

This alternative has very similar benefits (direct, indirect, and cumulative) to olive-sided flycatchers as Alternative 2 while also meeting many of the conservation strategies.

Consistency with LRMP standards and guidelines:

Although olive-sided flycatchers are not a Management Indicator Species under the LRMP, they are considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Williamson's Sapsucker: *Deschutes Management Indicator Species, Landbird Focal Species, S4 Apparently Secure*

Williamson's sapsuckers are a focal species for large snags in mixed conifer habitat. They will often utilize ponderosa pine habitat, specifically dead and live trees for foraging and select for large (greater than 20" DBH) snags for nesting (Bull et al. 1986). Williamson's sapsuckers have been observed within the watershed and in proximity to the project area.

To determine potential habitat, the 2004 satellite Imagery data was queried for areas with some ponderosa pine and large tree components and greater than 40% canopy closure. There are 4,962 acres of potential habitat for Williamson's sapsuckers within the watersheds and 1,845 acres within the project area. Similar to the discussion for brown creepers, there are at least 8-10 snags/acre greater than 10" DBH with at least one of these being greater than 20" DBH. Mellen-McLean et al. (2006) show this species utilizes large diameter snags at high densities (nesting in snags 20 to 34" DBH). The 30% tolerance level for this species is 14 snags 10" DBH per acre and 3 snags greater than 20" per acre; and at the 80% tolerance level 50 snags greater than 10" DBH per acre and 17 snags greater than 20" DBH per acre (PPDF_S/L.sp17). Although there is snag habitat at the 80% level within the watershed; The project area does not meet the 30% tolerance level.

According to Altman (2000), conservation issues for this species relevant to the proposed actions include: loss of large diameter snags to logging; snag management policies on managed lands are often deficient in large snags required by this species unless recruitment snags are maintained through the rotation; and fire suppression has resulted in closed understories which inhibit growth of large trees.

Conservation strategies include: extend rotation ages to retain snags; retain largest live trees, particularly dying or defective trees in harvest units retain known or suitable nesting and roosting snags and restrict access from fuelwood cutters.

Direct, Indirect, and Cumulative Effects Discussion

Alternative 1 - No Action

This alternative does not address the conservation strategies recommended by Altman, (2000). There is the potential effect of further loss of these habitats by retaining the existing condition. In the event of a

catastrophic wildfire, it would take decades for late seral habitat to develop. The current 160 yr old stands are a result of such a stand-replacing fire

Currently the existing condition provides habitat for the focal species. However, maintaining the current level of risk to beetle-induced mortality and/or wildfire in these stands would contribute to an overall reduction of habitat for the focal species.

Alternative 2 - Proposed Action

Thinning will alter habitat for this species in the project area by reducing the canopy closure of the stands, removing some large trees, and improving the health of the stands that will decrease snag recruitment in the short-term (provided no large tree are killed during the prescribed burn portion of the treatment). Williamson's sapsuckers have been seen and heard in the watersheds in more dense stands with large trees.

No snags are proposed for harvest, although some trees over 21" DBH will be harvested. The construction of 12 miles of fireline will need to be monitored to prevent invasive weed introduction as an unintended side effect of possible OHV use on the lines.

The proposed treatments will encourage the diameter growth of the remaining ponderosa pines. Prescribed burning may result in the loss of some ponderosa pine snags, but it may also create some. It is difficult to predict the extent of this effect because of the variables in weather the day of the burning, and the varying duff layer amount around the large trees and snags. The latter is a proposed monitoring item with this project to determine the potential loss or gain of ponderosa pine snags.

The thinning and burning will open the stands and increase the trees' resiliency to insect and disease. This may result in a short or small scale gap in snag creation by these agents. New snags would develop in the control/no treat units and areas outside of the project. Other than the potential for the prescribed burning to create snags within the thinning units, snags would not develop in these areas for many years. This may result in small reductions in local pygmy nuthatch populations.

The proposed actions would reduce the current available habitat in the 6th field watersheds by approximately 37%. The proposed actions, in absence of snags created by prescribed burning, would also contribute to a snag recruitment gap in the short –term, although new ones created would be larger than if they were recruited immediately. By impacting the habitat that is currently available within the project area, the proposed actions may limit future Williamson sapsucker use of the project area. Although this will have local impacts to the species, it is "apparently secure" in the state of Oregon.

Being within an experimental forest, the stands are placed on a longer rotation and firewood cutting is not allowed. These are the conservation strategies that are addressed by the proposed project.

Alternative 3

This alternative would have similar effects to those described for Alternative 2, except for the fact that by not treating the LSR and spotted owl NRF habitat, there would be more habitat retained (approximately 307 acres). As insects continue to infest and kill the trees (including ponderosa pine), snag habitat would be recruited. Approximately 34% of the currently available habitat in the watersheds would be impacted by the proposed actions in this alternative.

As stated in the analysis for Alternative 2, thinning would provide larger snags into the future, but it would take many years since the thinning would actually improve the trees' resiliency to insect and disease. This effect is over a smaller area, under this alternative because of the fewer acres thinned.

This alternative would require an additional 3 miles of fireline to be built (a total of 15 miles); thus extending the effects mentioned within Alternative 2.

This alternative has the same impacts to the conservation strategies as Alternative 2.

Consistency with LRMP standards and guidelines:

Williamson's sapsuckers are a Management Indicator Species under the LRMP (cavity nesters), as well as considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Williamson sapsuckers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of this report.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided. Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard as been addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…" See Dead Wood section for complete discussion.

Black-backed Woodpecker: *Deschutes Management Indicator Species, Landbird Focal Species, S3 Vulnerable*

According to Goggans (1988) and Bull et al. (1986), the black-backed woodpecker uses mature ponderosa pine and lodgepole pine habitat types at relatively low elevations (less than 4,500 feet), but can be found at higher elevations. Altman (2000) designates black-backed woodpeckers as a focal species for old-growth lodgepole pine. The black-backed woodpecker will use smaller snags for nesting as well as foraging. Bull et al. (1986) suggested the use of smaller diameter snags for nesting is a way of competing with other woodpecker species in the same habitat (e.g. white-headed woodpecker, northern flickers, etc.). The planning area and adjacent areas have snags of this size class that can serve as potential habitat. Saab and Dudley (1998) found black-backed woodpeckers selecting for clumps of snags and unlogged control plots in their study on fire and salvage logging. As mentioned under the discussion for three-toed woodpeckers, Goggans et al. 1988 study was conducted on the Bend/Ft. Rock RD with one of the study areas for black-backed woodpeckers being within the Crane Prairie Watershed. Black-backed woodpeckers have continued to be observed within the watershed since this 1988 study. Similar to the three-toed woodpecker, the black-backed woodpecker "key in" on stands currently undergoing mountain pine beetle infestations, and will either nest in these areas or in areas adjacent to where the infestation has already moved through but snags exist. The black-backed woodpecker co-exists with the three-toed woodpecker by being able to utilize habitats at lower elevations.

Habitat for black-backed woodpeckers is more extensive in the watershed than habitat for three-toed woodpeckers because they can use a wider range of habitat types and elevations. There are approximately 88,801 acres of potential black-backed woodpecker habitat within the watershed. Similar to the three-toed woodpecker, this species may only be limited by the number of standing snags, although this species has been observed utilizing other species of snags than just lodgepole pine.

Mellen-McLean et al. (2009) reports that snag densities for species range from 2.5 to 29 snags greater than 10" DBH per acre for the 30 to 80 tolerance levels, and 0 to 6 snags greater than 20" DBH per acre for the 30 to 80% tolerance level. Current snags levels within the proposed action areas appear to meeting the 30 to 50% tolerance level for this species (7 snags greater than 10" DBH per acre and 1 snag greater than 20" DBH per acre). Downed log densities were <2% cover of logs greater than 5" diameter at the large end. Current direction provides log densities at less than the 30% tolerance level as does estimates of current log densities averaged over the project area. Similarly, based on these figures and using the inventory data for unharvested plots (Mellen-McLean et al. 2009), most of the project area could provide habitat at the 30-50% tolerance level for snags, while log densities are at less than the 30% tolerance level. Goggans et al. (1988) reported the percent cover of downed logs at black-backed and three-toed woodpecker nest sites solely as a site characteristic. Therefore, the downed log density may not be a critical component of black-backed woodpeckers.

According to Altman (2000), conservation issues for this species include: reduction in mature and old-growth lodgepole pine trees due to logging, insect outbreaks, fire suppression, overstocked stands; and salvage logging.

Conservation strategies detailed in Altman (2000) include: in burns and bug-killed forest, leave unsalvaged or if salvaging, maintain greater than 40% as unsalvaged; exempt areas from commercial or salvage timber management, and manage these areas to retain late-successional characteristics as long as possible. These conservation strategies mirror the recommendations set forth in Goggans et al. (1988) to exempt areas (956 acres in size) from salvage and commercial logging

Using the recommended exempt acreage size to reflect one pair of black-backed woodpeckers, there is habitat available for an estimated 28 pairs of woodpeckers within the watershed, and 1-2 pairs within the project area.

Direct, Indirect, and Cumulative Effects Discussion

No Action

This alternative would retain the lodgepole stands and the other stand in their current condition. The lodgepole pine habitats within the project area are relatively small. Black-backed woodpecker, can also be found in mixed conifer habitat. The maintenance of high risk of losing these stands in the event of a beetle-outbreak or wildfire would initially increase habitat (especially foraging) as a result of disturbance in these stands, however, in the long-term it may take more than 40 years for new habitat to develop within the project area.

Alternative 2 - Proposed Action

The proposed actions would result in the stands becoming healthier and more resilient, as well as favoring ponderosa pine dominance. This would not create new black-backed habitat nor sustain the current levels of habitat. The thinning, mowing, and burning proposed would degrade the habitat currently available. Thinning would reduce the density of the trees and target the removal of lodgepole pine. Mowing and burning could influence the current snag and log densities, as well as increase the resiliency of the remaining stands to wildfire. This species utilizes stands that are currently stressed or recently burned. This alternative proposes to prevent this in the project area.

Cumulatively, this alternative would degrade 7% of the black-backed woodpecker habitat in the watersheds. This is additive to the 4% of the habitat affected by the Snow Fuels Reduction project. It was estimated that there was habitat for 28 pairs of woodpeckers (one pair for each territory) in the 6th field watersheds. Using this rationale, this alternative, as a worse case scenario, may reduce that to 26

pairs. However, the proposed project uses a variety of thinning densities interspersed with control units. This may still provide some habitat opportunity for this species. Although there would be very localized effects to the black-backed woodpecker populations, there may not be noticeable effects to populations from the proposed actions on the 5th field watershed or larger scales.

The proposed actions do not address, nor do they add to, the conservation issues and strategies discussed in the Landbird Strategy (Altman, 2000). The strategies and issues focus on salvage and lodgepole pine habitat. As stated, there are very few stands dominated by lodgepole pine in the project area. Late-successional characteristics are being managed for under this alternative, however it is for ponderosa pine old growth and clack-backed woodpeckers are not a focal species for this type of old-growth.

Alternative 3

This alternative has similar effects as those discussed under Alternative 2, but the effects would be less intense because fewer acres are treated. Alternative 3 treats 376 fewer acres, notably the LSR and the NRF. Both of these areas currently provide some black-backed woodpecker habitat.

Cumulatively, this reduces the amount of habitat impacted in the watersheds by 1% (7% in Alternative 2 and 6% in this alternative). This is not much different than Alternative 2, although the location of the acres retained may help maintain a territory or reduce the effect on local populations.

Consistency with LRMP standards and guidelines

Black-backed woodpeckers are a Management Indicator Species under the LRMP (cavity nesters), as well as considered under the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mts. in Oregon and Washington. This Conservation Strategy is used to address the requirements to assess the impacts to neotropical migratory birds under Executive Order 131186. The Conservation strategies have been addressed under the proposed actions. Habitat provisions for many of the MIS species also provides habitat for various landbirds and meets the intent of the Conservation Strategy.

Black-backed woodpeckers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of this report.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided.. Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard as been addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…" See Dead Wood section for complete discussion.

Hairy Woodpeckers: *Deschutes Management Indicator Species, S4 Apparently Secure*

Bull et al (1986) reported hairy woodpeckers using both lodgepole and ponderosa pine habitats and a variety of snags sizes. This species would be in mature stands and utilize (i.e. nest and forage) snags greater than 10 inches in diameter. There is habitat for this species within the project area. Hairy woodpeckers have been observed within the watershed and in the project area. Because of its wide use of plant associations, in general, habitat is not limited for this species within the watershed (42,838 acres

which is more than half of the entire 6th field watershed areas). There are at least 8 to 10 snags per acre within the project area; based on dead wood surveys in 2007. This supports the assumption that hairy woodpecker habitat is not limiting in the watershed.

Direct, Indirect, and Cumulative Effects Discussion

No Action

The No Action alternative will not likely have any direct or short-term indirect effects to hairy woodpeckers. Development of larger snags for nesting may be delayed as a result of stagnating, dense stands; although recruitment of new, smaller snags (<20" DBH) would continue..

Alternative 2 - Proposed Action

The proposed actions will not have any direct effects to hairy woodpecker habitat because no snags are proposed for harvest. Short-term indirect effects to hairy woodpecker habitat would include removal of potential nest trees (i.e. trees greater than 16"DBH) through thinning. In the long-term, better habitat may develop more quickly as retention trees respond to the thinning, individuals die, and more large snags are created; although this would not occur without a gap in snag recruitment due to the increased health of the trees. Snags would still develop but not at the rate at which they would under the No Action alternative.

New snags may develop during the prescribed burning phase of the project. It is difficult to determine how this may impact hairy woodpeckers and their habitat, because the intention is not to kill any trees with the burning.

Hairy woodpecker habitat would remain on the landscape. Populations of hairy woodpeckers will likely remain stable.

Alternative 3

Effects to hairy woodpeckers as a result of actions proposed under this alternative would be the similar to those described under Alternative 2. The exception is that this alternative treats fewer acres, therefore the rate of snag recruitment may not be noticeably changed.

Consistency with LRMP standards and guidelines

Hairy woodpeckers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of this report.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided… Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard is addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…"

Three-toed Woodpecker: *Deschutes Management Indicator Species, Landbird Focal Species, S3 Vulnerable*

Three-toed woodpeckers use higher elevation (greater than 4500 feet) habitats of mature lodgepole pine stands or stands with a lodgepole component (Goggans et al, 1988; Bull et al 1986). Habitat for this species (19 acres) is found within one of the proposed treatment areas. The three-toed woodpecker is often associated with the black-backed woodpecker. Both species utilize smaller diameter snags for foraging and nesting. One way this woodpecker competes with other woodpecker species, specifically the black-backed woodpecker, is by utilizing higher elevation habitat (Bull et al 1986). When using Goggans et al (1988) to compare this species habitat with the black-backed woodpecker, it appears that the three-toed woodpecker does not generally occupy a wide range of habitat conditions. Therefore, areas considered as marginal black-backed woodpecker habitat, would not likely be three-toed woodpecker habitat. There is approximately 14,238 acres of habitat within the watersheds. However, almost half of this may actually be unsuitable because it is not above 4500 feet in elevation.

Direct, Indirect, and Cumulative Effects Discussion

No Action

The No Action alternative will not likely have any direct or short-term indirect effects to three-toed woodpeckers. The amount of habitat within the project area is of such a small amount and an isolated patch that it is probably little used by this species. Similar to the black-backed woodpecker, this species can capitalize on insect outbreaks, no action may provide a foraging patch for this species as it disperses through the watersheds.

Alternative 2 - Proposed Action

Suitable habitat (i.e. lodgepole pine dominated stands) is found in Unit 12 of the proposed project area. Unit 12 is 192 acres, but only 19 acres is estimated to be suitable habitat. Unit 12 is proposed for heavy thinning (50% of UMZ), and lodgepole is one of the first trees targeted to be cut. Lodgepole also does not survive prescribed burning very well. It is likely that this unit will not provide habitat for this species post-project.

The result of this project, in conjunction with other project in the watersheds, would likely limit this species to the upper elevations west of the Experimental Forest. Similar to the black-backed woodpecker, this species can capitalize on insect outbreaks. The proposed project will remove this small patch of potential foraging habitat.

Alternative 3

Effects to three-toed woodpeckers as a result of actions proposed under this alternative would be the similar to those described under Alternative 2. Although Unit 12 under this alternative is smaller than Alternative 2, the same patch of habitat is being treated

Consistency with LRMP standards and guidelines

Three-toed woodpeckers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of this report.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided… Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard is addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…"

Northern Flicker: *Deschutes Management Indicator Species, S5 Secure*

Northern flickers are perhaps the most common woodpecker resident in Oregon. They can be found in a range of terrestrial habitat but are generally abundant in open forests and forest edges adjacent to open country (Marshall et al. 2003). Being a large cavity nester (12.5" long according to Sibley, 2005); they require large snags or large trees with decay in order to build their nests.

Northern flickers have been observed within the watershed and within proximity to proposed treatment areas. Potential habitat for this species is considered any plant association with large trees (average >20"DBH). Using this as a definition for habitat, there are approximately 6,225 acres of habitat in the 6th field watersheds and 904 acres within the project area.

The northern flicker is a relatively common species that can utilize a variety of habitat types from wilderness to back yards. Marshall et al. (2003) report that flickers require open space. It is a relatively large bird, thereby requiring large snags in which to nest. The requirement of large snags may limit flicker populations. Mellen-McLean et al. (2009) recorded data for this species in the mixed conifer types utilizing snags from 17-29" DBH. There are approximately 2 snags >17" per acre within the project area.

Discussion of Direct, Indirect, and Cumulative Effects:

Alternative 1 No Action

The No Action alternative will not likely have any direct or short-term indirect effects to flickers. This species can occupy a wide habitat range, and may only be limited by the availability of larger snags. This alternative would encourage the creation of larger snags in a relatively small area by retention of the current densities that increase the risk of wildfire and maintain the active insect activity.

Effects Common to Alternative 2 (Proposed Action) and Alternative 3

The alternatives (2 and 3) will impact 189 and 187 acres, respectively, of the best potential flicker habitat. These acres reflect the units with large trees and the proposal to thin across all diameters (i.e. some large trees will be removed). Under both alternatives, the more open habitat that flickers utilize will be created and there would still be large snags available in the control units and untreated portions of the Experimental Forest. Alternative 3 would retain more areas by not treating the spotted owl habitat or the LSR. Hazard tree removal as a part of other projects within the watershed would act additively with the proposed alternatives in the removal of snags for foraging. These additive effects resulting from the proposed actions would be minimal because of the small amount of effects (3% of the habitat in the watersheds) the actions would have, and the ability of this species to use a variety of habitats.

Consistency with LRMP standards and guidelines

Northern flickers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of this EIS.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided… Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard is addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…"

Pileated Woodpecker: *Deschutes Management Indicator Species, S4 Apparently Secure*

The pileated woodpecker is associated with forest habitats that have large trees, especially snags, for nesting and foraging. It is most common in old-growth ponderosa pine/mixed conifer forests in eastern Oregon (Csuti et al. 2001). Although there is a lack of observations of the actual bird, there are observations of pileated foraging on some of the white fir and Douglas-fir within proposed units and in adjacent no treatment areas revealing their presence within the watershed.

Using habitat information in Bull and Holthausen (1993) and the 2004 satellite imagery data, there are approximately 4,718 acres of potential habitat in the watershed and 1,600 acres of habitat in the project area. Mellen-McLean et al. (2009) report that for this species, that snags densities for the 30 to 80% tolerance level would be 15 to 49 snags greater than 10" DBH per acre and 3.5 to 18 snags greater than 20" DBH per acre; pileated woodpeckers nest in trees 26 to 37" DBH. Current snags estimates in proximity to the proposed action acres suggest that current dead wood levels are less than the 30% tolerance level for this species.

Direct, Indirect, and Cumulative Effects:

Alternative 1 - No Action

A high severity wildfire burning through the area would reduce the canopy closure, simplify the stand structure, and remove large dead and decaying trees from the watershed. This would remove pileated woodpecker habitat.

Alternative 2 – Proposed Action

These proposed actions will degrade the habitat by reducing canopy closure below the levels described by Bull and Holthausen (1993) as being used by pileated woodpeckers. Because the actions are in mixed conifer stands and the tree species favored to be retained (often Douglas-fir and ponderosa pine) are known nest tree species of pileated woodpeckers, the effect to pileated woodpecker populations will be reduced. The heaviest thinning (thinning to 50% of UMZ) and thinning across all sizes, would remove pileated habitat through the loss of large trees, and the opening of the canopy. The lighter thinning proposals (to UMZ or to 75% of UMZ) would degrade habitat because the trees utilized by pileateds for nesting would be retained, although the species often used for foraging (white fir) will be targeted. The thinning, mowing, and prescribed burning may also create a delay in the recruitment of large snags by improving the resiliency of the stands. This effect is off-set by the habitat remaining in the control units and possible creation of snags through burning.

Table 52. Summary of Effects to Pileated Woodpecker Habitat

Treatment Type	Units	Acres Degraded	Acres Eliminated
Thin to UMZ or 75% of UMZ	24, 14, 32, 11, 33, 22	1165	
Thin to 50% UMZ or Thin to 75% UMZ w/ openings	23, 12 21, 13		430
TOTAL		**1165**	**430**

The proposed thinning would be additive to the hazard tree removal; which may remove trees that could be used by pileateds for foraging and, rarely, nesting.

Many of the ongoing and reasonably foreseeable projects are not treating pileated woodpecker habitat. The proposed actions under this Alternative would contribute to the alteration of 34% of the current available habitat in the 6th field watersheds. This would have impacts to local populations of pileated woodpeckers but would likely have limited impact populations on a larger scale because it is considered "apparently secure" in Oregon.

Alternative 3

The direct and indirect effects of the proposed actions under this alternative are similar to those under the discussion for Alternative 2, with the difference being the amount of habitat affected (see Tables 52 and 53).

Table 53. Summary of Effects to Pileated Woodpecker Habitat

Treatment Type	Units	Acres Degraded	Acres Eliminated
Thin to UMZ or 75% of UMZ	24, 14, 32, 11, 33, 22	886	
Thin to 50% UMZ or Thin to 75% UMZ w/ openings	23, 12 21, 13		333
TOTAL		886	333

Many of the ongoing and reasonably foreseeable projects are not treating pileated woodpecker habitat. The proposed actions under this Alternative would contribute to the alteration of 26% of the current available habitat in the 6th field watersheds. This would have impacts to local populations of pileated woodpeckers but would likely have limited impact populations on a larger scale because it is considered "apparently secure" in Oregon.

Consistency with LRMP standards and guidelines

Pileated woodpeckers are a management indicator of snag habitat. In the LRMP, compliance with WL-37 that addresses woodpeckers relies on discussions and guidance provided by the Deschutes National Forest Wildlife Tree Implementation Plan. This is analyzed in the Dead Wood section of the EIS.

WL-37 "…In all other management areas, at least 60% of cavity nesting species potential population needs will be provided… Compliance will be based on the harvest unit area…"

The Eastside Screens revised this standard and guideline to reflect the 100% potential population level. This standard is addressed under the Snag discussion.

WL-38 "Specific guidance will be provided by the Deschutes National Forest Wildlife Tree Implementation Plan."

NWFP S&Gs page C-42: " As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40% of potential population levels…"

Snags/Coarse Woody material and Green Tree Replacement

Snags

Numerous species of animals use snags and coarse woody material (CWM) for foraging, nesting, denning, roosting and resting. A snag is defined as a dead tree that is over 10 inches DBH and taller than 10 feet. Coarse woody material is considered to be dead and down material that is greater than 5 inches in diameter (Ohmann and Waddell 2002; Mellen-McLean et al. 2009). The most notable species using snags and CWM are the primary cavity nesters (e.g. woodpeckers and nuthatches) that excavate nest cavities in decayed wood in standing trees. Vacated cavities are subsequently used by many other birds and small mammals (i.e. secondary cavity users such as marten, bats, and owls). Selected wildlife species known or suspected to occur in the proposed action areas that utilize these habitats are listed in the various tables and can be found in the earlier discussions under each species (e.g. hairy woodpecker, three-toed woodpecker, flammulated owl, etc.).

Snag and CWM habitat conditions were analyzed and compared using current direction and newer research, including the DecAID Advisory tool (Mellen-McLean, et al 2009). The DecAID Advisor is a planning tool intended to help specialists manage snag and log levels best suited for their management area's habitat types and associated wildlife species. This tool uses the best available science and most recent research for species dependent on snags and coarse woody material. Densities are given in the form of wildlife species tolerance levels at the 30%, 50%, and 80% levels. For example, assuming normally distributed data, if 20% of a species' nests were in areas with greater than 18 snags per acre, then 80% of the nests were found in areas with 0 to 18 snags per acre, and 18 snags per acre is the 80% tolerance level. Information in regards to existing snag and log densities and sizes were gathered through field sampling and aerial insect and disease maps.

Table 54 details the proportions of the different plant association groups and structural stages within the watershed (the scale appropriate for DecAID comparisons and the collective-proposed project areas:

Table 54. Acres of Wildlife Habitat and Structural Types in the Crane Prairie and Fall River 6th field Watersheds. Figures in Parentheses Show the Percentage within a Proposed Unit and the Relative Potential for Dead Wood Influenced by Fire Regime and Topographic Position

Habitat Type	Potential Dead Wood Levels	Structural Type		
		Large	Small/Medium	Open

Lodgepole (LP)	High	N/A	13, 804 (1%)	6,891 (0.03%)
Ponderosa Pine/Douglas-fir (PPDF)	Low-High	6,076 (14%)	23,373 (9%)	5, 728 (10%)
Eastside Mixed Conifer – East Cascades Blue Mts (EMC_EB)	Low-Moderate	63 (0.3%)	88 (3%)	6 (0%)
Montane Mixed Conifer (MMC)	High	67 (<1%)	368 (3%)	4 (0%)

*Types are those categories used in the DecAid Advisor; acres come from 2004 Satellite Imagery data; Potential Dead Levels come from the DecAID Implementation Guide, with the exception of the LP type which is an assumption

The wildlife and inventory data within the specific habitat types displayed in DecAID were used to analyze the current condition within the planning area in its relation to providing habitat for the various species. In characterizing the landscape, several links within the DecAID advisor were used including "Relative potential for dead wood within wildlife habitat types as influenced by fire regime, sub-series, and topographic position" found in the DecAID Implementation Guide.

The habitat types found within the proposed action areas and adjacent planning areas are within a moderate to high frequency fire regime. Topography is generally moderate slopes, and north and east aspects. This suggests that the relative potential levels of dead wood would be low to high. The higher potential levels would be in the more mesic or moist habitat types, higher elevation types, and the north and east aspects. It also suggests that the project area would have variable densities of downed wood; some areas meeting the lower 30% tolerance level for wildlife and other areas capable of meeting the higher 80% tolerance level.

Results of the snag survey, in comparison with the wildlife data in DecAID, show that in the EXF Project Area current snag densities (an average of 7.3 snags per acre 10-19.9" DBH and 0.6 snags per acre ≥20"DBH) are providing snags for white-headed woodpeckers at the 80% tolerance level; at the 50-80% level for pygmy nuthatches and general cavity nesters; at the 30% tolerance level for black-backed woodpeckers; and at less than the 30% tolerance level for the marten, fishers, pileated woodpecker, and Williamson's sapsucker. The current level of snags is meeting the LRMP and NWFP direction.

Table 55. Snag densities for wildlife species at 30, 50, 80 percent tolerance level for snags > 10"DBH based on wildlife data in DecAID (Table references included).

	30% Tolerance level (#snags/acre)	**50% Tolerance level (#snags/acre)**	**80% Tolerance level (#snags/acre)**
	>10"DBH	**>10"DBH**	**>10"DBH**
LP_S/L (reference Table LP_S/L.sp-22)			
AMMA	12	13	14
Current Direction for LP	1.9-2.4 N/A		
PPDF_S/L (reference Table PPDF_S/L.sp-22)			
Black-backed woodpecker (BBWO)	2.5	14	29
Cavity-Nesting Birds (CNB)	1	5	10
Pileated Woodpecker (PIWO)	15	30	49
Pygmy Nuthatch (PYNU)	1	6	12
White-headed woodpecker (WHWO)	0.3	2	4
Williamson's Sapsucker (WISA)	14	28	50
Current Direction for the Ponderosa Pine1	3.4-4.2		

EMC_ECB_S/L (reference Table EMC_ECB_S/L.sp.22)			
Black-backed woodpecker (BBWO)	2.5	14	29
Pileated Woodpecker (PIWO)	15	30	49
Pygmy Nuthatch (PYNU)	1	6	12
White-headed woodpecker (WHWO)	0.3	2	4
Williamson's Sapsucker (WISA)	14	28	50
American Marten (AMMA)	12	13	14
Current Direction for Mixed Conifer	3.5-4.3		
MMC_S/L (reference Table MMC_S/L.sp-22)			
American Marten (AMMA)	12	13	14
Pacific Fisher (FISH)	?	13	?
Current Direction for Mixed Conifer	3.5-4.3		

1 Current Direction (LRMP & NWFP) is provided by habitat type and densities >10". It is not broken down into tolerance levels but rather represents a biological potential which has been determined to be a flawed technique (Rose et al. 2001 in Johnson and O' Neil 2001)

The existing low density of snags coupled with the importance of large diameter snags to many of the MIS species, emphasizes the need to retain all existing snags as possible in the planning area, as well as creating conditions that will favor the recruitment of large snags.

The EXF project area is fairly unique in the watershed because it contains higher snags densities and larger snags than other areas of the watersheds. Using the studies and information within DecAID, it is entirely expected and realized within this analysis area that distribution of snags will be clumpy (i.e. some areas have no snags while others have many snags). Since most of the planning area falls within the small/medium tree types, the clumps of snags would be expected to be small (2-5/acre) with the majority of these snags being less than 20" DBH. The 2008 Insect and Disease maps show outbreaks of mountain pine beetle in ponderosa and lodgepole pines occurring within some of the proposed units. These areas may provide the higher density clump of snags utilized by some species (e.g. BBWO), and immediate recruitment of larger snags.

In considering the distribution of snags for those habitat types within proposed treatment areas, the DecAID data show that for the PPDF small/medium habitat type 54 % of the area had no snags (PPDF_S.inv-14, 15). Over 80% of area had less than 4 snags/acre greater than 10" DBH and less than 2 snags per acre >20" DBH. When looking at the inventory data for the PPDF large tree habitat; there are similar results: only about 8% of all of the plots had more snags >10" DBH per acre than the current estimates in the project area (7.9 snags >10" DBH, PPDF_L.inv-18) and 12% had more snags >20" DBH per acre (0.6 >20" DBH, PPDF_L.inv-19). This reflects the relative uniqueness of the area to provide large diameter snags and snags at higher densities; thus providing a patch of higher quality habitat for some species in the watershed.

In summary, there is snag habitat being provided albeit at lower levels than may be optimal for many MIS species. The planning area may be capable of providing more habitat than is currently present but with current land allocation as a silvicultural research forest and the current study plan, is not likely to sustain habitat at more than the 50% tolerance level. Populations may remain limited due to the current availability of habitat. As past management within the watersheds trends towards the historic range of variability and an increase in large ponderosa pine habitat more of this type of habitat may develop without relying on the present condition of an experimental forest.

Coarse Woody Materials (CWM)

In order to analyze downed log habitat (CWM), two sources were used. DecAID was used to compare the distribution of CWM material over an area. Screens direction specifies pieces per acre of certain sizes to be retained according to habitat type. The NWFP directs a certain lineal feet of downed wood

be retained. The following tables compare the existing levels with these two measurements. Table 56 displays the comparison of current LRMP and NWFP direction (with a reconciling of terms) and the existing levels with the best science available in the DecAID advisor.

Table 56. Comparison of Existing CWM and Directed Levels. Estimates of Percent Cover are Given in Order to Compare with Information in DecAID Advisor

		Lineal Feet/ac	**Pieces/ac**	**% Cover/ac**
Current Direction	LRMP/Eastside Screens	PP:20-40 ft Mix Con: 100-140 ft. LP: 120-160 ft	PP: 3-6 Mix Con.: 15-20 LP: 15-20	
	NWFP	120	Approx. 7-8	LP = 0.8-0.9% PPDF, EMC_EB, MMC=0.5%
DecAID	Wildlife Level*			4.2-32% : black-backed & three-toed woodpeckers 0.8-5%: golden-mantled ground squirrel
	Inventory Level (PPDF as the dominant type in EXF)			0-2% cover on 87-91% of area >2% cover on 9-13% of area
Existing		118	11	0.4-0.9

*The information for % cover levels from DecAID was taken from the wildlife and inventory data. The wildlife data source either had limited sources (PPDF – one species); or source was from within a active beetle outbreak (LP). The ranges given reflect the 30-80% tolerance levels for all the structural stages.

Based on the above table, the project area is currently meeting CWM guidelines or close to it. However, in considering the DecAID information, for many wildlife species this density of downed wood is not meeting the 30% tolerance level; the exception if the golden-mantled ground squirrel at the 30% tolerance level.

Research by Brown et al. (2003) suggests that the optimum quantity of coarse woody debris for fuel loading and wildlife habitat needs is 5 to 10 tons per acre for warm, dry ponderosa pine and Douglas-fir types (PPDF); 10 to 20 tons per acre for cool Douglas-fir types (EMC_EB); and 8-24 tons/ac for cool lodgepole pine and lower subalpine fir types (LP and MMC). Using the plot data and bole weight conversion table (Table 2 in Brown et al 2003), it is estimated the EXF Project Area has 5 tons per acre averaged over all of its habitat types. These are estimates because the conversion of differing units of measure can limit the precision. This does suggest that currently fuel loadings, as averaged over the project area and using the driest habitat type, is at the optimum quantity.

Direct, Indirect, and Cumulative Effects:

Alternative 1 - No Action

Because there are no proposed actions associated with this alternative there would be no change from the existing conditions, and therefore no direct, indirect or cumulative effects.

Insect mortality would continue to occur, ensuring steady recruitment of new snags and logs. A wildfire that will eventually burn through the area would create more dead wood as well as consume the existing dead wood. More large snags would likely be available as the large green trees are killed by a fire throughout the watershed.

Alternative 2 - Proposed Action

It is not the intention of any of the proposed actions to remove snags or downed logs. The exception is the connected action: hazard tree removal, which will likely result in some snags next to roads being removed.

Removal of dead wood (i.e. snags and logs) would occur as an indirect effect of sorts resulting from prescribed burning, falling of trees posing a safety risk to workers, and the break up of logs as firelines are built and harvested trees removed. Although the project area is currently meeting directed levels, and there may be indirect effects that put dead wood levels below directed levels and further below the lowest displayed tolerance level in DecAID. This conclusion is more speculative because prescribed burning can consume as well as create dead wood, and log break up and falling of snags for safety reasons can be avoided through careful project layout and equipment use.

Past anecdotal evidence from prescribed burns in the Pringle Falls unit has shown that with the thinning and mowing prescribed, the burning does not consume the large large logs and snags.

Using the plots established to gather existing information, monitoring after the different project phases (thinning, mowing, and burning) can provide data as to whether or not dead wood is being retained as directed.

Cumulatively, this alternative's potential effects are additive to other ongoing, and reasonably foreseeable projects. The Snow Fuels Reduction Project plans to remove downed logs and snags in lodgepole pine habitat, there is continued prescribed burning being implemented in the Fall and Charlie Brown project areas. The additive effect is the continued reliance on land allocations outside of regulated timber harvest, and may be in this case outside of silvicultural research, to provide the highest dead wood levels for myriad wildlife species.

Alternative 3

In one aspect, this alternative has a greater risk of removing more dead wood because of the need to build more line. However, it also treats fewer acres with prescribed burning and thinning that would reduce the exposure of workers to hazard trees, reduce the risk equipment (mowers or harvesters) from breaking up logs, and reduce the risk of a prescribed fire from consuming any dead wood.

Cumulative effects would be similar to those described under Alternative 2.

Green Tree Replacements (GTRs)

Green tree replacements are trees retained, or managed through time, to provide snag or CWM habitat at some point in the future. The treatment unit is the area of accountability for meeting GTR objectives (Deschutes National Forest Wildlife Tree and Log Implementation Strategy [WLTL], 1994). The objective for treatment units is to provide patches of habitat, or GTRs in a distribution pattern suitable for home range needs of primary cavity excavators (WLTL 1994). According to the WLTL, green tree replacements do not need to be provided on every acre in the forested ecosystem. A mosaic distribution across the landscape maintaining viable populations and ecological functions is the desired condition. The desired condition is based on the assumptions that: 1) deficits or surpluses, whether natural or related to past management activities, will continue to be part of the landscape; 2) treatment units will

be designed to meet WLTL objectives each entry or treatment; and 3) that some treatment units will not provide WLTLs due to preference given to other resource issues. In the NWFP, green-tree and snag retention in the Matrix allocation emphasizes retention in a mosaic of clumps and well-distributed individuals. Specific standard and guidelines for green tree and snag retention are to retain at least 15% of each unit indefinitely.

The Eastside Screens direction requires all sale activities (including intermediate in both even-age and uneven-age systems) to maintain GTRs of >21 inches DBH, or the representative DBH of the overstory layer if less than 21 inches, at 100 percent maximum potential population levels (MPP) of primary cavity excavators. As shown in Table 57, this 100% MPP is estimated to be 4 snags/acre for ponderosa pine and mixed conifer habitat types and 6 snags/acre for lodgepole pine habitat types. Table 57 illustrates the number of GTRs per acre that would be needed to meet current direction assuming the average diameter of the stands after is at least 13 inches.

Table 57. Estimated GTRs (trees per acre or "tpa") required to meet current direction

	Habitat Type		
	Ponderosa Pine	**Mixed Conifer**	**Lodgepole Pine**
Current Direction (100% MPP based on more recent research)	4 snags/acre	4 snags/acre	6 snags/acre
GTRs @ 13-19" residual stand	5 tpa	5 tpa	1 tpa

Direct, Indirect, and Cumulative Effects Discussion

No Action

The No Action alternative would maintain green tree replacements in the current condition during the short-term (<20 years). However, natural disturbances such wildfire, wind events, insect and disease pathogens, and lightning would recruit snag and CWM habitat through time in the project area. High tree density in some of the ponderosa pine stands would not only retard the development of large diameter (>21") ponderosa pine trees and future snags but also may hasten the development of smaller diameter snags and CWM as a result of mortality from bark beetles or fire.

Because there are no additive effects as a result of this alternative, there are no cumulative effects anticipated to dead wood habitat.

Alternative 2 - Proposed Action

In the short-term, thinning would directly affect green tree replacements (GTR) by reducing the number of trees in treatment units. However the units would retain enough GTRs to exceed currently directed levels (Table 57).

Indirect effects of the proposed actions include prolonging the recruitment of snags and CWM by removing trees, thereby reducing the risk of wildfire and increasing the resiliency of the remaining green trees to bark beetles. Although the recruitment of dead wood habitats would slow, thinning would

provide beneficial long-term, indirect effects by promoting faster growth of GTRs, ultimately providing larger diameter snags and CWM. There would still be some recruitment of snags as a result of beetle activity in the control units.

The cumulative effects of the proposed, current, past, and foreseeable actions, would be a reduction in the amount and recruitment of snags and CWM over the landscape due to harvest prescriptions that would improve the health of the stands and make them less susceptible to beetle-induced and/or wildfire mortality. One benefit over the watersheds is that in the long-term (>30 years), reduced tree competition would allow for accelerated tree growth resulting in snags and CWM, as trees grow, die, and fall, that would be of the larger diameters (20" or more), thereby substantially improving the density of large snags and log available over the larger 6th field watershed areas. It is this large size structure that is currently the most lacking.

Consistency with LRMP standards and guidelines

Snags

Eastside Screens, 6. Interim Wildlife Standard, d. Scenario A, 4) a) Snags, Green Tree Replacements and Downed Logs: (1) "All sale activities…will maintain snags and green tree replacement trees of ≥ 21" DBH, (or whatever is the representative DBH of the overstory layer if it is less than 21 inches), at 100% potential population levels of primary cavity excavators. This should be determined using the best available science on species requirements as applied through current snag models or other documented procedures. NOTE: for Scenario A, the live remnant trees (≥ 21" DBH) left can be considered for part of the green replacement tree requirement."

CWM

WL-72 "…An average of at least 3 cull logs-per-acre, plus 3 additional logs-per-acre…will be retained after timber management activities. Minimum qualifying sizes are 10 inches in diameter at the small end and 15 feet long…"

WL-73 "Where logs…are not available, and average of 1 slash pile…or concentration…per acre will be retained to supplement qualifying logs."

The Screens (6. Interim wildlife standard; d. Scenario A, 4) Snags, Green Tree Replacements and Down Logs; [2]) revised these standards to read: " Pre-activity (currently existing) downed logs may be removed only when they exceed the quantities listed below…It is not the intention of this direction to leave standing trees for future logs in addition to the required snag numbers…"

Quantities of logs: 3-6 pieces greater than 6 ft long and 12" in diameter or greater be maintained in ponderosa pine types (15-20 in mixed conifer), and 15-20 pieces greater than 8 feet long and 8" in diameter be maintained in lodgepole pine types.

GTRs

Eastside Screens, 6. Interim Wildlife Standard, d. Scenario A, 4) a) Snags, Green Tree Replacements and Downed Logs: (1) "All sale activities…will maintain snags and green tree replacement trees of ≥ 21" DBH, (or whatever is the representative DBH of the overstory layer if it is less than 21 inches), at 100% potential population levels of primary cavity excavators. This should be determined using the best available science on species requirements as applied through current snag models or other documented procedures. NOTE: for Scenario A, the live remnant trees (≥ 21" DBH) left can be considered for part of the green replacement tree requirement."

LRMP direction refers to Deschutes DWTL for GTR numbers. This document gives figures based on Thomas 1979. In Bull et al (1997) it is suggested that Thomas figures were not high enough to cover all

habitat needs. Using Screens direction to use most recent research, the GTR figures given in the DWTL were recalculated to reflect the updated 100% potential population levels based on newer research.[3]

Rose et al (2001) and Mellen-McLean et al (2009) determined that the "potential population level" is a flawed technique. Mellen-McLean et al (2009) uses statistical "tolerance levels" in the DecAID tool. DecAID is not part of the Screens direction, therefore its use was for comparison purposes.

As illustrated in Table 57 GTR levels after project implementation are expected to be met. Proposed treatments are expected to retain at least 30-90 trees per acre, and will meet the directed levels for the habitat types. These levels exceed the baseline GTR levels given in the Screens direction and WLTL that were based on Thomas (1979).

No snags or logs are planned to be removed under any alternative, and the remaining stands would retain GTRs at the directed densities. Monitoring will be required to accurately determine the effects of the proposed actions on the possible, unintended removal, or even creation of snags and logs.

LOS Habitat/Connectivity

Late and Old Structure Forest Habitat (LOS)

Late and old structure forest habitat is defined by the Eastside Screens as multi-strata stands with large trees and single strata stands with large trees. A large tree is defined as being greater than or equal to 21 inches in DBH. Multi-stratum stands are comprised of two or more tree canopy layers and two or more size cohorts of trees. Medium and large sized trees dominate the overstory but trees of all size classes may be present. Stand structure and tree sizes are diverse. Single stratum LOS stands are comprised of a single dominant canopy stratum consisting of medium or large sized trees. Large trees are common. Young trees are absent or few in the understory. The stand may appear "park-like."

There are no Old-Growth Management Areas (OGMAs) within or proximate (within 5000 acres) of the project area. There are 369 acres of classified LOS within the project area; and 7,075 acres in the Fall River watershed. Multi-storied LOS habitat is below the Historical Range of Variability (HRV) in the watershed; single-storied LOS habitat is below the HRV in the dry ponderosa pine plant association group. Low amounts of this habitat limit the abundance of LOS-associated wildlife species in the area, such as the northern goshawk, flammulated owl, white-headed woodpecker, pygmy nuthatch, white-breasted nuthatch, and brown creeper. Table 58 displays the amount of LOS habitat around the project area. For further discussion of the HRV refer to the project silviculturist's report (Paul Brna, Bend-Ft. Rock Ranger District Silviculturist. July 2009).

[3] During public scoping, the Rose et al, (2001) was mentioned. This literature refers the "current" controversy of using the concept of a "biological potential" level for maintaining dead wood habitat for species that utilize such habitat. This literature has been incorporated into the analysis for dead wood as well as the various species discussions. In fact, the analysis uses the most recent version of the DecAID tool (Mellen-McLean et al, 2009), and represents the best available science for dead wood habitat. The governing land management documents (e.g. LRMP and NWFP) however, have not been updated to address this controversy, thus in order to determine compliance with these documents analysis on the biological potential is included.

Table 58. Acres of LOS Habitat in the Watershed Area by Structural Stage, Plant Association Group, and LOS Associated Wildlife Species.

Structural Stage (Eastside Screens)	Plant Association Group (PAG)	Acres	HRV	Selected LOS Associated Wildlife Species
Medium & Large , 21"+ DBH (Late, multi-storied)	Lodgepole Pine	434	Below	Northern Goshawk, Northern Pygmy Owl, Black-backed Woodpecker, American Marten
	Ponderosa Pine Dry	644	Below	Cooper's Hawk, Northern Goshawk, Sharp-shinned Hawk, Flammulated Owl, Williamson's Sapsucker, Pygmy Nuthatch, Brown Creeper, White-breasted Nuthatch, Hermit Thrush, Golden-crowned Kinglet
	Mixed Conifer Wet	285	Below	
Medium & Large , 21"+ DBH (Late, single-storied)	Lodgepole	4,732	Above	Northern Goshawk, Northern Pygmy Owl, Black-backed Woodpecker, American Marten
	Ponderosa Pine Dry	205	Below	Flammulated Owl, Lewis's Woodpecker, White-headed Woodpecker, Pygmy Nuthatch, White-breasted Nuthatch
	Mixed Conifer Wet	775	Within	
Total		7,075		

Direct, Indirect, and Cumulative Effects Discussion

No Action -

Late and old structure (LOS) forest habitats would continue to age and mature, developing LOS characteristics (large diameter trees, large lateral limbs, snags, CWM). Earlier structural stage stands (structural stages 1 through 5) would also mature, moving these stands towards LOS habitat. High tree densities in many of the ponderosa pine stands would retard tree growth, increasing the amount of time to attain large diameter trees, and also place these stands at risk to insects, disease, and wildfire and may result in loss of LOS habitats.

In the long-term (40 years for lodgepole and 70-90 years for ponderosa pine), assuming there are no large-scale disturbances (e.g. fires or beetle outbreaks), a growth rate of 1 inch DBH per decade and that there are a number of large trees existing within the stands, LOS may develop from existing Understory Reinitiation and Multi-story without Large Trees stands. As stated earlier this would take many decades, which would also be many generations of LOS species. Current LOS may remain LOS in the long-term.

Alternative 2 - Proposed Action

This alternative proposes thinning, mowing, and burning within 18 acres of multi-storied LOS and 4 acres within single-storied LOS. These acres are scattered over 4 units (Units 34, 42, 43, and 44) and the largest LOS patch size is approximately 9 acres (in Unit 44; patch size range 0.15 ac - 9.26 ac). The proposed thinning in each of the units covers the variety of thinning density (i.e. thin to UMZ to thin to 50% of UMZ, and thin across all age cohorts). Any of the thinning prescriptions would result in the stand no longer meeting the definition of LOS (see Silvicultural Report).

Thinning within LOS further reduces the levels in the watershed below HRV. This further reduces the habitat for the species listed in Table 58. Specific effects to these species have been discussed earlier. Further reduction in LOS habitat within the watershed limits these species', although to a small degree because of the small patch sizes, the dispersal and ability to create new territories.

There are no other ongoing or reasonable foreseeable projects within the watershed that propose to remove LOS habitat. Therefore, there are no cumulative effects of this action.

Alternative 3

Because this alternative proposes the same treatments within the same LOS habitat as Alternative 2, the effects are the same as those described.

Consistency with LRMP standards and guidelines

Eastside Screens, 6. Interim wildlife standard, d. Scenario A "DO NOT allow timber sale harvest activities to occur within LOS stages that are BELOW HRV." 2) (a) "maintain all…live trees ≥21" DBH that currently exist. b) manipulate vegetative structure that does not meet late and old structural conditions…in a manner that moves it towards these conditions as appropriate to meet HRV."

The proposed alternatives are not consistent with this standard. The proposed actions would harvest timber in LOS where the LOS levels are below HRV, and some trees >21" DBH would be removed. A Forest Plan Amendment has been developed for this scenario (see page 18).

Connectivity

Maintaining connectivity between habitats, particularly late and old structured habitat, is believed to be important for numerous wildlife species. Connectivity of habitats is believed to allow free movement, interaction of adults, and dispersal of young. Although there is current controversy regarding the value of corridors (Weldon 2006), management direction pertaining to maintaining connectivity between late and old structured stands, in addition to designated old growth management areas, is provided by the Eastside Screens. The Browns/Wickiup Watershed Analysis and Browns/Round Mountain Late-Successional Reserve Assessment (1997) also addressed connectivity within NWFP lands in the project by designating corridors. The effects to these corridors have been analyzed within the Biological Assessment for this project. The following analysis specifically refers to connectivity as it relates to the Eastside Screens portion of the project area.

Eastside Screen direction is to maintain or enhance the current level of connectivity between LOS stands and between all LRMP designated old growth (OGMA) habitats by maintaining stands between them. LOS stands and old growth (OGMA) habitats need to be connected to each other inside the project area, as well as, to adjacent project areas, by at least two directions. Connectivity corridor stands should be those in which medium diameter or larger trees are common, and canopy closures are

within the top one-third of site potential. Stand widths should be at least 400 feet wide at their narrowest point. If stands meeting this description are not available then the next best stands should be used for connections. The length of corridors between LOS stands and old growth management areas should be as short as possible.

Connectivity corridors, meeting Eastside Screens direction, were identified within the overall project area through previous planning efforts (Charlie Brown and Fall). The corridors connect all Forest Plan Old Growth management areas to stands classified as LOS, and to old growth management areas and LOS stands in adjacent project areas.

Direct, Indirect, and Cumulative Effects Discussion

No Action -

Similar to the discussion for LOS and old growth habitat, connections to these stands would also be at risk to wildfires and beetle infestation. However, these linkages may provide for dispersal and movement until the surrounding treated areas develop LOS characteristics (taking many decades). The current levels of connectivity in the project area would be maintained given no major disturbance events occur. Some of the acres within LOS corridors are at high risk of beetle-caused mortality. These acres are dispersed over a number of linkages. If beetle-caused mortality were to occur, connectivity could then be disrupted across the landscape.

Alternative 2 - Proposed Action

Currently mapped corridors overlap six proposed units (four with proposed thinning, mowing, and burning; two control units). Using the same dispersal definitions and analysis used for the Biological Assessment (for consistency within the project area and because similar species would use both corridors), one proposed unit that overlaps a current connectivity corridor would not meet definitions after treatment (Unit 44). The mapped corridor does not entirely overlap this 147 ac unit; but mainly falls within Unit 35, a control unit. Because it is only a small piece that overlaps this unit, the corridor will likely still function. The corridor that wildlife will actually use will probably involve more of the control unit, and the look less linear on a map.

Some current roads do cut across the corridors; and it is likely that some of the firelines will be built through the corridors. Ideally, a corridor would not have roads or a 3-4 ft wide fireline so as to eliminate any barrier to movement. Roads going through corridors, although narrow, may limit movement of small, ground-dwelling species. Forest roads that cross corridors are not expected to have measurable impacts to birds (e.g. forest hawks) or large mammals (e.g. wolverine).

The proposed actions under this alternative are additive to other actions in the watershed that impact these corridors. The Charlie Brown and Fall projects have continuing fuels treatments (prescribed burning) planned; some within the corridors. The result of these actions, combined with this project's actions, would be the shifting of the actual corridor to the most suitable habitat adjacent to it. It is unlikely that wildlife move in such a smooth linear fashion, but more likely use a "stepping stone" approach, moving from suitable patch to suitable patch. The proposed actions contribute to a narrowing of the corridors to the minimal standard and guideline levels.

Consistency with LRMP standards and guidelines

Eastside Screens, #6 Interim wildlife standard, d. Scenario A, 3) "Maintain connectivity and reduce fragmentation of LOS stands by adhering to the following standards…(1) …a contiguous network pattern by at least 2 different directions…(2) canopy closures are within the top one-third of site potential. Stand widths should be at least 400 ft. wide…(4) Harvesting within connectivity corridors is permitted if all the criteria in (2) above can be met, and if some of understory…is left in patches or scattered to assist in supporting stand density and cover. Some understory removal, stocking control, or salvage may be possible activities, depending on the site."

The proposed actions would maintain the minimal levels outlined in these standard and guidelines.

3.3.4 Soil Quality

Introduction

The long-term sustainability of forest ecosystems depends on the productivity and hydrologic functioning of soils. Ground-disturbing management activities directly affect soil properties, which may adversely change the natural capability of soils and their potential responses to use and management. A detrimental soil condition often occurs where heavy equipment or logs displace surface organic layers or reduce soil porosity through compaction. Detrimental disturbances reduce the soils ability to supply nutrients, moisture, and air that support soil microorganisms and the growth of vegetation. The biological productivity of soils relates to the amount of surface organic matter and coarse woody debris retained or removed from affected sites. Maintenance or enhancement of soil productivity is an integral part of National Forest management. Therefore, an evaluation of the potential effects on soil productivity is essential for integrated management of forest resources.

Soil productivity was not identified as a key issue and it was not used to formulate any of the alternatives for this project. However, plans for projects must include provisions for mitigation of ground disturbances where activities are expected to cause resource damage that exceeds Regional and LRMP standards and guidelines. The proposed use of ground-based equipment can potentially increase the amount and distribution of detrimental soil conditions within the individual activity areas proposed for mechanical treatments. The removal of trees from activity areas can potentially cause adverse changes in organic matter levels.

Soil productivity measures that track how each of the alternatives address these management concerns are provided below:

- Change in extent of detrimental soil conditions following proposed harvest and mitigation treatments within the individual activity areas proposed for mechanical treatments. Predicted amounts of soil impacts are analyzed quantitatively in both acres and percentages within each activity area (EIS Unit).
- Amount of coarse woody debris (CWD) and surface organic matter that would likely be retained to protect mineral soil from erosion and provide both short and long-term nutrient supplies for maintaining soil productivity on treated sites. Professional judgment is used to evaluate the probable success of implementing recommended guidelines for meeting soil productivity and wildlife habitat objectives.

Scope of the Analysis

The soil resource may be directly, indirectly, and cumulatively affected within each of the activity areas proposed within the project area. An activity area is defined as "the total area of ground impacted activity, and is a feasible unit for sampling and evaluating" (FSM 2520 and Forest Plan, page 4-71). For this project proposal, activity area boundaries are considered to be the smallest identified area where the

potential effects of different management practices would occur. Thus, the discussion of soil effects and soil quality standards will be focused on the EIS units (activity areas) proposed for silvicultural and fuel reduction treatments. These activity areas range in size from approximately 22 acres to 335 acres.

Quantitative analyses and professional judgment were used to evaluate the issue measures by comparing existing conditions to the anticipated conditions which would result from implementing the proposed management activities. The Geographic Information System (GIS) was used to assess disturbed areas associated with the transportation system and logging facilities.

The temporal scope of the analysis is defined as short-term effects being changes to soil properties that would generally revert to pre-existing conditions within 5 years or less, and long-term effects as those that would substantially remain for 5 years or longer. This analysis also considered the effectiveness and probable success in project design and implementation of the management requirements, mitigation measures, and Best Management Practices (BMPs) which are designed to avoid, minimize or reduce potentially adverse impacts to soil productivity.

Affected Environment

Landscape Characteristics

The EXF planning area covers approximately 3,535 acres within the Bachelor Butte-Lookout Mountain physiographic area, where essentially all landforms, rocks, and soil are products of volcanic events. Approximately 84 percent of the planning area is characterized by gently sloping plains, uneven lava flows, toe-slopes and benches which lie below and surround cinder cones, buttes and a shield volcano that account for the remaining 16 percent of the total acreage. Dominant landforms have slope gradients that range from 0 to 30 percent. Steeper slopes (25 to 80 percent) are associated with smooth-to-moderately dissected side slopes of Lookout Mountain, escarpments of buttes and ridges, and a few scattered cinder cones. Except for localized areas of broken lava flows, the majority of the planning area (over 95 percent) has been covered by a moderately thick layer of volcanic ash and pumice deposits that consist mainly of non-cohesive (loose), sand-sized soil particles with little or no structural development. Elevation ranges from approximately 4,380 feet in the southeastern corner of the planning area to 6,215 feet on the summit of Lookout Mountain. Mean annual precipitation generally ranges from about 18 to 25 inches.

Most of the water yielded from these lands is delivered to streams as deep see page and subsurface flows at lower elevations. The sandy textures of the ash-influenced soils have high infiltration and percolation rates that readily drain excess moisture and account for low amounts of overland flow. There are no perennial or intermittent stream channels, wetlands, riparian areas, Riparian Reserves, or Riparian Habitat Conservation Areas within the planning area (Walker, 2008). Any channeled surface flows within ephemeral channels are discontinuous and of short duration. Consequently, there would be no effects to any Oregon Department of Environmental Quality 303(d) listed water bodies or essential fish habitat

The project area contains eight landtype units based on similarities in landforms, geology, and climatic conditions that influence defined patterns of soil and vegetation (Soil Resource Inventory, Larsen, 1976). The biophysical characteristics of these landtype units can be interpreted to identify hazards, suitabilities, and productivity potentials for natural resource planning and management.

Two dominant landtype units, Soil Resource Inventory (SRI) mapping units 65 and 67, comprise approximately 80 percent of the planning area. These lands consist of gently-sloping lava plains, toe-slopes, and benches of buttes with slopes that range from 0 to 30 percent. Dominant soils are moderately deep (20 to 40 inches) to deep (greater than 40 inches) with loamy-sand textures and moderate productivity potential for the growth of vegetation. The more productive soils are commonly found on north and east slope aspects and on concave slope positions such as toe slopes, swales and

depressions. Less than one percent of the planning area is comprised of landtypes that contain localized, low-productivity sites on rocky lava flows with shallow soils (less than 20 inches).

Soils derived from volcanic ash and pumice deposits tend to be non-cohesive (loose) and they have very little structural development due to the young geologic age of the volcanic parent materials. These ash-influenced soils have naturally low bulk densities and low compaction potential. Mechanical disturbances can still reduce soil porosity to levels that limit vegetative growth, especially where there is a lack of woody debris and surface organic matter to help cushion the weight distribution of ground-based equipment. Due to the absence of rock fragments on the surface and within soil profiles, these ash-influenced soils are well suited for soil restoration treatments (subsoiling) that loosen compacted soil layers and improve the soils ability to supply nutrients, moisture, and air that support vegetative growth and biotic habitat for soil organisms. The dominant sandy-textured soils within the planning area are not susceptible to soil puddling damage due to their lack of plasticity and cohesion.

The sandy-textured surface layers are also easily displaced by equipment operations, especially during dry moisture conditions. The maneuvering of equipment is most likely to cause soil displacement damage on steep landforms. Approximately 126 acres (3.6 percent) of the planning area contains steep slopes (greater than 30 percent) associated with smooth-to-moderately dissected side slopes of Lookout Mountain, escarpments of buttes and ridges, and a few scattered cinder cones.

Surface erosion on undisturbed sites with gentle slopes occurs at naturally low rates because soils are protected by vegetation and organic litter layers. Currently, soils in the planning area are adequately protected to maintain erosion rates within acceptable limits. Surface erosion by water is generally not a concern due to gentle slopes and the low-to-moderate erosion hazard ratings of the dominant landtypes. Accelerated rates of surface erosion are usually associated with disturbances or events that reduce vegetative cover, displace organic surface layers, or reduce soil porosity through compaction. Due to the lack of structural development, soils derived from volcanic ash are easily eroded where water becomes channeled on disturbed sites such as road surfaces, recreation trails, and logging facilities.

Land Suitability and Inherent Soil Productivity

The suitable lands database for the Deschutes National Forest LRMP identifies areas of land which are considered to be suitable for timber production using criteria affecting reforestation potential (FSH 2409.13). Lands that do not meet these criteria are considered unsuitable or partially suitable for timber harvest due to regeneration difficulties or the potential for irreversible damage to resource values from management activities.

Dominant landtypes within the EXF planning area generally have moderate productivity ratings. Less than 1 percent of the planning area is comprised of landtypes that contain localized areas of rocky lava flows with little or no natural soil. These sparsely vegetated sites have low productivity and typically support only scattered non-commercial trees. The locations of the proposed activity areas exclude areas which are considered to be unsuitable for timber production. All activity areas proposed for commercial timber harvest and/or non-commercial thinning treatments meet the criteria for land suitability that would allow them to be regenerated or resist irreversible resource damage.

Sensitive Soil Types

Based on criteria for identifying sensitive soils to management (Deschutes LRMP (Appendix 14, Objective 5), sensitive soils within the EXF planning area include:

1) soils on slopes greater than 30 percent (slopes range from 25 to 80 percent (see Figure 18)

* Cinder Cones – Forested: Map Units 80 and 81 (42 acres on south aspects)
* Escarpments/Side Slopes – Forested: Map Units 68, 69, and HM (81 acres on lava domes, ridges, and side slopes of shield volcano)

2) soils that occur in localized areas on rocky lava flows with variable soil depths

* Map Unit 76 (29 acres of ponderosa pine, site index 50 to 80) (only occurs in Control Unit 35)

There are no potentially wet soils with seasonally high water tables or sensitive soils with high or severe ratings for surface erosion.

Approximately 152 acres (4 percent) of the planning area contains landtypes with localized areas of sensitive soils (Figure 20). It should be emphasized that only portions of these total landtype acres actually contain sensitive soils. Areas with sensitive soils are typically confined to specific segments of the dominant landform and they are generally too small to delineate on maps.

Sensitive soil areas that occur within activity areas are discussed under the direct and indirect effects of implementing the management activities proposed under Alternative 2, page 182.

Existing Condition of the Soil Resource

Detrimental Soil Disturbance

Natural Events

There is currently no evidence of detrimental soil conditions associated with past wildfires, mass movements (landslides) or other natural disturbance events within the EXF planning area. Fire history data indicates that the Lookout Mountain Eastside Fire (1914) burned vegetation and natural fuels within portions of five proposed activity areas. There is no evidence of severely burned soil. Enough time has passed that the recovery of native vegetation and forest litter are providing adequate ground cover protection and surface erosion rates have returned to natural levels.

There are no natural or management-related landslides known to exist within the planning area. Dominant landforms do not meet criteria for landslide prone terrain and the high permeability of ash-influenced soil materials generally precludes the buildup of hydraulic pressures that could trigger landslides.

Therefore, natural disturbances are not included as existing sources of detrimental soil conditions within any of the activity areas proposed for this project.

Management-Related Disturbances

The existing condition of the soil resource has mainly been influenced by the transportation system and ground-based logging facilities which were used for timber harvest and yarding activities between 1973 and 1988. The EXF planning area was not affected by intensive railroad logging during the early 1900s. The Geographic Information System (GIS) was used to assess disturbed areas associated with existing roads and past harvest areas within each of the activity areas proposed for this project. There are no developed recreation sites, livestock water developments, special use facilities, or other land uses that have committed the soil resource to a non-productive condition.

Based on harvest history and field observations, timber management activities have not been intensive within the activity areas proposed for this project. Stand entries that overlap with activity areas proposed under Alternative 2 include approximately 1,576 acres of commercial thinning, 292 acres of intermediate (partial removal), and 16 acres of regeneration harvest. Past harvest areas that overlap with activity areas proposed under Alternative 3 include approximately 1,503 acres of commercial thinning, 215 acres of intermediate (partial removal), and 16 acres of regeneration harvest. Ground-based logging equipment disturbed soils on portions of 15 EIS units proposed for mechanical harvest under Alternative 2 and Alternative 3. There was no overlap of past harvest within EIS units 11, 11.1, and 11.2. Temporary roads, log landings, and primary skid trails were constructed and used to access individual treatment units. Most project-related impacts to soils occurred on and adjacent to these heavy-use areas

where mechanical disturbances removed vegetative cover, displaced organic surface layers, or compacted soil surface layers. Research studies and local soil monitoring have shown that soil compaction and soil displacement account for the majority of detrimental soil conditions resulting from ground-based logging operations (Page-Dumroese, 1993; Geist, 1989; Powers, 1999; Deschutes Soil Monitoring Reports). Much of the random disturbance between main skid trails and away from landings has decreased naturally over time. Visual evidence of old logging facilities is difficult to observe due to the abundance of ground cover vegetation and forest litter. Current levels of soil impacts would remain unchanged within the four control units (EIS units 15, 25, 35, and 45).

The extent of detrimentally disturbed soil is dependent on a number of variables including the types of silvicultural prescriptions, the intensity of equipment use with each entry, and the spacing distances between main skid trails. Local knowledge and experience with past and current harvest practices, research references, field investigations, and local monitoring reports were used to make conservative estimates of existing soil conditions within each of the activity areas planned for this project. Soil monitoring results on local landtypes and similar soils have shown that 15 to 30 percent of the unit area can be detrimentally disturbed by ground-based harvest systems depending on harvest prescriptions and soil conditions at the time of harvest (Deschutes Soil Monitoring Reports, 1995, 1996, 1997, and 1999).

Conservative estimates were used to predict how much surface area is currently impacted by existing roads, main skid trail systems, and log landings. The spacing distances between main skid trails generally average between 75 and 100 feet (approximately 11 to 14 percent of the unit area). Local soil monitoring has shown that the use of ground-based equipment for commercial thinning treatments generally causes about 3 to 5 percent more soil impacts than disturbed area estimates based solely on skid trail spacing distances and the average size of log landings. Seventeen percent (17%) was used to calculate existing amounts of detrimental soil conditions in areas where past thinning treatments overlap with portions of EA units proposed for mechanical harvest. Activity areas which were previously managed with intermediate harvest prescriptions generally have about 23% detrimental soil conditions associated with existing skid trails and log landings. Past regeneration treatments (e.g., clear cuts, shelterwood, final removal, etc.) generally cause about 6 % more detrimental soil conditions (29 percent) than thinning and intermediate prescriptions because equipment use is more intensive throughout activity areas. Based on the proportionate extent of overlap with the proposed activity areas, these percentages were used to calculate existing amounts of detrimental soil conditions. The existing amount of detrimentally disturbed soil associated with past logging facilities is included in the estimated percentages displayed in Table 59 (Alternative 2) and Table 60 (Alternative 3) of the Environmental Consequences section.

Much of the random disturbance between main skid trails and away from landings has decreased naturally over time. Research has shown that the detrimental effects of soil compaction generally require more than 3 to 5 equipment passes over the same piece of ground (McNabb, Froehlich, 1983). Where logs were skidded with only 1 or 2 equipment passes, soil compaction was shallow (2 to 4 inches) and the bulk density increases did not qualify as a detrimental soil condition. Frost heaving and freeze-thaw cycles have gradually restored soil porosity in areas with slight to moderately compacted layers near the ground surface. Other factors that have helped the recovery process include root penetration, rodent activity, wetting and drying cycles, and surface organic matter. The establishment of vegetative ground cover and the accumulation of litter and organic matter has also been improving areas of past soil displacement.

There is no evidence that post-harvest broadcast burn treatments caused any severely burned soil in random locations off designated logging facilities in previously managed areas.

There have been no restoration treatments, such as subsoiling, which have rehabilitated compacted soil on existing skid trails and log landings in any of the activity areas proposed for mechanical harvest. The long-term effects of deep compaction still persist where multiple equipment passes were made in

previously harvested areas. Impacted soils will remain in a detrimental condition until such time that reclamation treatments are implemented to improve the hydrologic function and productivity on disturbed sites.

Roads detrimentally disturb soil properties and convert the soil resource to a non-productive condition. Most of the precipitation that falls on compacted road surfaces is transmitted as surface runoff, and roads are primary sources of accelerated surface erosion. The planning area contains approximately 32 miles of classified system roads. This equates to approximately 50 acres or 1.4 percent of the planning area. Segments of these existing roads, ranging from 0.1 to 2.9 miles (0.2 to 4.4 acres), cross through portions of all 16 EA units proposed for mechanical treatments under both action alternatives. Some local system roads are currently closed to public use, but segments of these roads may be re-opened to provide necessary access. Road surveys will be conducted to identify where maintenance may be necessary to correct drainage problems on existing system roads that would be used as haul routes for this project. The estimated amount of detrimentally disturbed soil committed to existing system roads is included in acres and percentages in Tables 48 and 49.

The planning area contains a cinder borrow pit and surrounding steep slopes that are excluded from mechanical vegetation treatments within EIS Unit 33. The activity area boundaries have been adjusted and approximately 49 acres have been removed from the proposed treatment area.

Soil impacts from dispersed recreation activities are usually found along existing roads, trails and other management facilities where vegetation has been cleared and soils have been previously disturbed by other land use activities. Many of these disturbances often occur on or adjacent to existing roads and old skid trail networks of past harvest areas. Conservative estimates were used to account for soil disturbances from existing roads and logging facilities. Due to the size of the EIS units, the minor extent of soil disturbances from dispersed camping and other incidental recreation uses would not be expected to have a measurable effect on site productivity. Therefore, soil disturbances from dispersed recreation activities were not included as existing sources of detrimental soil conditions within any of the individual activity areas proposed for this project.

Summary of Existing Detrimental Soil Disturbances:

The primary sources of detrimental soil conditions are associated with the transportation system and existing logging facilities which were used for past timber harvest activities. The extent of detrimentally disturbed soil associated with dispersed recreation use is relatively minor in comparison. For activity areas that have already been impacted by previous management, project plans need to include options for avoiding, reducing, and mitigating cumulative levels of existing and predicted amounts of new soil disturbance from project activities.

Previous harvest entries consisted of commercial thinning treatments, intermediate (partial removal), and regeneration harvest using ground based equipment. Segments of existing roads, ranging from 0.1 to 2.9 miles (0.2 to 4.4 acres), cross through portions of all activity areas proposed under each of the action alternatives. Most project-related impacts to soils occurred on and adjacent to heavy-use areas such as skid trail systems, log landings and roads that were used for access in past timber sale units. Based on the extent of overlap with past harvest areas, it was concluded that one activity area (EIS Unit 21) proposed under both action alternatives currently has detrimental soil conditions that exceed 20 percent of the unit area. The remaining EA units (15 units in Alternative 2 and 16 units in Alternative 3) have existing detrimental soil conditions that range from less than one to 20 percent and average 14 percent.

Table 59 and Table 60 display quantitative, unit-specific information that shows the predicted amounts of detrimental soil conditions before and after implementation of project activities. The extent of soil

impacts associated with existing roads and logging facilities is included in the estimated acres and percentages shown in Column 3 of these tables.

Coarse Woody Debris (CWD) and Surface Organic Matter

The effects of management activities on soil productivity also depend on the amount of coarse woody debris and surface organic matter retained or removed on affected sites. Decaying wood on the forest floor is critical for maintaining the soils ability to retain moisture and provide both short and long-term nutrient supplies and biotic habitat for microorganism populations. Mycorrhizal fungi and other soil organisms depend upon the continuing input of woody debris and fine organic matter. A balance between fuel management objectives and ensuring adequate amounts of CWD is an important goal for maintaining long-term soil productivity. Using mycorrhizal fungi as a bio-indicator of productive forest soils, research studies were used to develop conservative recommendations for leaving sufficient CWD following management activities (Graham et al. 1994, Brown et al. 2003). A minimum of 5 to 10 tons per acre of coarse woody debris (greater than 3 inches in diameter) should be retained on dry, ponderosa pine sites and 10 to 15 tons of CWD per acre on mixed conifer and lodgepole pine sites to maintain soil productivity. A sufficient number of standing dead snags and/or live trees should also be retained for future recruitment of organic matter.

Conserving surface litter (i.e., organic materials such as leaves, twigs and branches less than 3 inches in diameter) is also important for protecting mineral soil from erosion, buffering the effects of soil compaction, and supplying nutrients that support the growth of vegetation and native populations of soil organisms. Surface litter also provides on-site moisture retention.

Current levels of coarse woody debris and surface litter are not known for site-specific locations throughout the planning area. However, it is expected that adequate amounts of each currently exist to protect mineral soil from erosion and provide nutrients for maintaining soil productivity within the majority of previously managed areas. Since past vegetation management activities were implemented 20 to 35 years ago, levels of CWD and surface litter have been improving towards optimum conditions. Coarse woody materials have accumulated through natural mortality, windfall, and recruitment of fallen snags over time. Annual leaf/needle fall, small diameter branches, twigs and other forest litter have increased organic matter levels for short-term nutrient cycling and humus development in the mineral soil. In some portions of the planning area, fire exclusion has resulted in vegetation conditions that have fuel loadings in excess of historic pre-settlement conditions.

Management Direction

The Pacific Northwest Region developed soil quality standards and guidelines that limit detrimental soil disturbances associated with management activities (FSM 2520, R-6 Supplement No. 2500-98-1). This Regional guidance supplements the Deschutes Land and Resource Management Plan (LRMP) standards and guidelines and provides policy for planning and implementing management practices which maintain or improve soil quality. It is consistent with LRMP interpretations for standards and guidelines SL-3 and SL-4 that limit the extent of detrimental soil conditions within activity areas. Standard and Guideline (SL-4) directs the use of rehabilitation measures when the cumulative impacts of management activities are expected to cause damage exceeding soil quality standards and guidelines on more than 20 percent of an activity area. Standard and Guideline (SL-5) limits the use of mechanical equipment in sensitive soil areas.

Management direction requires that when initiating new activities;

1. Design new activities that do not exceed detrimental soil conditions on more than 20 percent of an activity area, including the permanent transportation system;

2. In activity areas where less than 20 percent detrimental soil impacts exist from prior activities, the cumulative amount of detrimentally disturbed soil must not exceed the 20 percent limit following project implementation and restoration; and
3. In activity areas where more than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration must, at a minimum, not exceed the conditions prior to the planned activity and should move conditions toward a net improvement in soil quality.

Detrimental soil conditions are those that meet the following criteria:

- ***Detrimental Compaction*** in volcanic ash/pumice soils is an increase in soil bulk density of 20 percent, or more, over the undisturbed level.
- ***Detrimental Puddling*** occurs when the depth of ruts or imprints is six inches or more.
- ***Detrimental Displacement*** is the removal of more than 50 percent of the A horizon from an area greater than 100 square feet, which is at least 5 feet in width.
- ***Severely Burned*** soils are considered to be detrimentally disturbed when the mineral soil surface has been significantly changed in color, oxidized to a reddish color, and the next one-half inch blackened from organic matter charring by heat conducted through the top layer on an area 100 square feet or greater with a width of at least five feet.

Environmental Consequences

The magnitude and duration of potential effects, both physical and biological changes in soil productivity, depend on the intensity of site disturbance, the timing and location of activities, and the inherent properties of the volcanic ash-influenced soils within affected activity areas. Direct effects occur at essentially the same time and place as the actions that cause soil disturbance, such as soil displacement and compaction from equipment operations. Indirect effects occur sometime after or some distance away from the initial disturbance, such as increased runoff and surface erosion from previously compacted areas. Cumulative effects include all past, present, and reasonably foreseeable actions that cause soil disturbance within the same activity areas proposed with this project.

The potential for detrimental changes to soil physical properties was quantitatively analyzed by the extent (surface area) of temporary roads, log landings, and designated skid-trail systems that would likely be used to facilitate yarding activities within each of the proposed activity areas. Professional judgment was used to evaluate changes in the amount and composition of coarse woody debris and surface organic matter. This analysis also considered the effectiveness and probable success of implementing the soil mitigation and resource protection measures which are designed to avoid, minimize or reduce potentially adverse impacts to soil productivity.

Alternative 1

Direct and Indirect Effects

Detrimental Soil Disturbance

Under Alternative 1 (No Action), the management activities proposed in this document would not take place. The extent of detrimental soil conditions would not increase above existing levels because no additional land would be removed from production to build temporary roads and logging facilities. Implementation of project design criteria and mitigation measures would not be necessary. The existing amount of detrimentally disturbed soil associated with system roads and existing logging facilities is included in the unit-specific information displayed in Table 59 and Table 60 and the summarized information in Table 61.

Although disturbed soils would continue to recover naturally from the effects of past management, the current percentages of detrimental soil conditions would likely remain unchanged for an extended period of time. This alternative would defer opportunities for soil restoration treatments that reduce existing impacts and help move conditions toward a net improvement in soil quality.

Soil productivity would not change appreciably unless future stand-replacing wildfires create intense ground-level heating that results in severely burned soils. Detrimental changes to soil properties typically result from extreme surface temperatures of long duration, such as the consumption of large diameter logs on the forest floor. Although hazardous fuels have been reduced in some previously managed areas, fire exclusion has resulted in undesirable vegetation conditions and excessive fuel loadings in other portions of the planning area (see Fire/Fuels Section). Alternative 1 would defer fuel reduction opportunities at this time.

If a large amount of fuel is present in timber stands, soil temperatures during an intense ground-level fire can remain high for an extended period of time and excessive soil heating would be expected to produce detrimental changes in soil chemical, physical, and biological properties. Severely burned soil would mainly be confined to localized microsites beneath downed logs, stumps, or around the root crowns of individual trees. Severe burning may cause soils to repel water, thereby increasing surface runoff and subsequent erosion. The loss of protective ground cover would also increase the risk for accelerated wind erosion on the loose, sandy textured soils which are widespread throughout the planning area. The loss of soil nutrients from fire volatilization would likely have the greatest impact on soil productivity during the fire recovery period. Recent research studies within experimental plots burned by the 2002 Biscuit Fire showed that losses of carbon and nitrogen from intense soil heating were much higher than most previous estimates (Bormann et al. 2008).

Coarse Woody Debris (CWD) and Surface Organic Matter

In the short term, the amount of coarse woody debris and surface litter would continue to be maintained or gradually increase if they are not consumed by fire. In forested areas, coarse woody materials will accumulate through natural mortality, windfall, and recruitment of fallen trees and snags over time. Short-term nutrient sources will also increase through the accumulation of small woody material from shrub and tree branches, annual leaf and needle fall, and decomposition of grass and forb plant materials.

In the long term, fuel loadings will continue to increase thereby increasing the potential for an uncharacteristic, high intensity wildfire. Existing and projected high fuel loadings would be expected to support a future wildfire that is capable of killing and/or consuming large areas of vegetation, coarse woody material, and surface organic matter. Potential productivity reductions would be greatest in areas where CWD and surface litter are completely consumed by fire. Intense ground-level fire would likely create areas of severely burned soil and increase the potential for accelerated wind and water erosion. The loss of surface organic matter would adversely affect ground cover conditions, the nutrient supply and water storage capability on affected sites. Over time, at least some of the CWD losses in timber stands would be replaced as fire killed trees are recruited to the forest floor.

Effects Common to Alternatives 2 and 3

Important Interactions

The proposed management activities include mechanical harvest of commercial size trees, non-commercial thinning and a combination of various fuel reduction treatments to reduce stand densities, lower the susceptibility to insect infestations, and reduce the risk for stand replacement wildfires. The same types of treatment would be used for each action alternative (EIS, Alternative Descriptions), but the overall extent and locations of some activity areas would be somewhat different. The action alternatives are similar because the same types and locations of soil disturbance would occur on the

same landtypes and existing soil conditions. There is little difference between Alternatives 2 and 3 in terms of the number of activity areas and treatment acres proposed for mechanical harvest (Alternative 2: 16 activity areas in four treatment blocks totaling 2,554 acres and Alternative 3: 17 activity areas in four treatment blocks totaling 2,178 acres). Four untreated control units would retain current structure without any manipulation for each action alternative. The primary difference is Alternative 3 would exclude portions of seven activity areas (approximately 425 acres) where wildlife concerns (NRF) and/or Late Successional Reserve (LSR) plant communities overlap with the EIS Units. The nature of the effects to the soil resource is similar for project activities that use mechanical harvest equipment to accomplish management objectives.

The development and use of temporary roads, log landings, and skid trail systems are the primary sources of physical disturbance that would result in adverse changes to soil productivity. Soil condition assessments for similar soils and the same types of ground-based harvest systems, research references, local monitoring reports (including the effectiveness of subsoiling treatments), EXF field investigations, and personal communications with local, sale administration and soil scientist personnel were used to predict the potential extent of detrimental soil disturbance within proposed activity areas. Research studies and local soil monitoring have shown that soil compaction and soil displacement account for the majority of detrimental soil conditions resulting from ground-based logging operations (Page-Dumroese, 1993; Geist, 1989; Powers, 1999; Deschutes N.F., Soil Monitoring Reports). For the commercial harvest prescriptions proposed with Alternatives 2 and 3, conservative estimates were used to predict how much surface area would likely be impacted by logging facilities that would be needed to accommodate the harvest and yarding activities.

No new roads would be constructed and retained as part of the transportation system. Some currently closed roads may be opened to provide necessary access, but these roads would be re-closed following harvest activities. No additional road closures or road decommissioning treatments are proposed under either action alternative.

Under Alternative 2, approximately 1.0 mile (total) of temporary road segments would be established to allow access to four activity areas proposed for commercial harvest. Under Alternative 3, about 0.5 miles of temporary road would be required to allow access to four activity areas. Temporary roads are built to low specification with the amount of surface area limited to the minimum necessary to get equipment into log landing areas. The magnitude of soil disturbance associated with temporary roads for this project would be essentially the same as the disturbed widths of primary skid trails. None of the temporary road locations would require excavation of cut-and-fill slopes because they are located on nearly level to gentle slopes. All temporary road segments would be subsoiled (obliterated) following their use, so disturbed area estimates are balanced by restoration treatments which are designed to improve soil quality by reclaiming and stabilizing compacted road surfaces.

Mechanical harvest would likely be accomplished using a track-mounted machine equipped with a felling head (harvester shear). Commercial material would be whole-tree yarded to main skid trail networks and rubber-tired grapple machines would then transport the bunched trees to landings for processing and loading. The grapple skidding equipment would be restricted to designated skid trails at all times. It is estimated that skid trails would have an average disturbed width of 12 feet and the average spacing distance between main trails would be approximately 100 feet. On moderately flat ground with small timber, research found that skid trail spacing of 100 feet would account for approximately 11 percent of the unit area (Froehlich, 1981, Garland, 1983). There would be no new development of skid trail systems on the steeper portions of the proposed activity areas. Primary skid trails are not constructed trails on gentle to moderately sloping terrain. Therefore, surface organic layers are not scraped away by equipment blades or removed off site. These organic materials are either retained near the top of the skid trail, or through operations fluffed to the edges of the trail. It is not mixed deeper into the soil profile, and these organic materials are easily redistributed onto the skid trails during rehabilitation treatments.

Based on personal communications with timber sale administrators, the Forest average for log landings is one landing (100 feet by 100 feet) for 10 acres of harvest (approximately 2 percent of the unit area). Disturbed area calculations for log landings are added to the acreage estimates for main skid trails to determine the overall soil disturbance from logging facilities.

The majority of soil impacts would consist of soil compaction on heavy use areas (i.e., roads, log landings, and main skid trails) in known locations that can be reclaimed when these facilities are no longer needed for future management. In unmanaged portions of the proposed activity areas, the development and use of new logging facilities would result in approximately 13 percent of the activity area (11 percent in skid trails plus 2 percent in log landings). This amount was used to analyze the extent of detrimental soil conditions which are expected to occur in undisturbed portions of activity areas proposed for mechanical harvest treatments.

Past monitoring information was used to predict the extent of new soil disturbance in activity areas that overlap with previously managed areas. The estimates of detrimental soil conditions account for the expected amount of volume removal, the type of logging equipment, the spacing of skid trails, the number of log landings that would be needed to deck accumulated materials, and the fact that not all existing logging facilities can be reutilized due to their orientation within units. Although existing skid trail networks and log landings would be used wherever possible, soil condition assessments have shown that the extent of detrimental soil conditions can be expected to increase by 5 to 10 percent with each successive entry into a stand (Craigg 2000). An average increase of 7 percent detrimental soil conditions associated with additional logging facilities was used to analyze the proportionate extent of overlap for previously managed areas that occur within activity areas proposed for commercial thinning. Tables 59 and 60 display acres and percentages of detrimental soil conditions for existing conditions and the predicted effects from project implementation, including soil restoration treatments, for each of the activity areas proposed for commercial harvest. These estimates assume that mechanical harvest operations would occur under dry conditions during the summer/fall operating season. If mechanical thinning is implemented during favorable winter logging conditions, the direct and indirect effects to soils is greatly reduced or eliminated.

Machine traffic off designated logging facilities would be limited in extent. Mechanical harvesters would only be allowed to make no more than two equipment passes on any site-specific area between main skid trails or away from log landings. Physical impacts to the soil resource incurred by off-trail machine traffic are generally considered to be detrimental where multiple passes are made by heavy equipment. Research has shown that the detrimental effects of soil compaction generally require more than 3 to 5 equipment passes over the same piece of ground (McNabb and Froehlich 1983). The direct effects of only two equipment passes do not inhibit the growth of vegetative ground cover and natural processes (i.e., frost heaving, freeze-thaw and wet-dry cycles) generally offset slight-to-moderately compacted soil layers near the ground surface in the short-term. The maneuvering of equipment on gentle to moderately sloping terrain generally does not remove soil surface layers in areas that are at least 5 feet in width to qualify as detrimental soil displacement (FSM 2520, R-6 Supplement).

Under both action alternatives, pre-commercial thinning on all acres proposed for commercial harvest would be accomplished by hand felling small-diameter trees with chainsaws. These manual thinning treatments would not cause cumulative increases in detrimental soil conditions because machinery would not be used for yarding activities. Resource protection measures and site-specific mitigation would not be necessary for these non-mechanical treatments. Some of these trees would remain on the ground to provide surface cover and a source of nutrients as these organic materials gradually decompose. This would have beneficial effects to site productivity by improving the soils ability to resist surface erosion and providing fine organic matter for humus development in mineral soil.

Fuel Reduction Activities

Recent research findings suggest that forest managers should carefully consider the effects of wildfire on soils when planning to reduce and/or change the distribution of fuels across the landscape (Bormann et al. 2008). Under both action alternatives, a combination of various fuel reduction treatments would be implemented to reduce hazardous fuels and the potential for stand replacement wildfires. Fuel treatments include thinning trees, machine piling and burning slash materials, mechanical shrub/slash treatments (mowing), and the use of prescribed fire.

Most of the slash generated from commercial harvest would be machine piled and burned on log landings. Burning large concentrations of machine-piled logging slash would cause severely burned soil because heat is concentrated in a localized area. However, this slash disposal method would not result in a net increase in detrimental soil conditions because burning would occur on previously disturbed sites. Therefore, there would be no cumulative increase from the predicted amount of detrimentally disturbed soil associated with the mechanical harvest and yarding activities.

Machine piling from designated logging facilities would also be accomplished within portions of all EIS Units proposed for commercial harvest under Alternatives 2 and 3. Machine piling on main skid trails would have no effect on the extent of detrimentally disturbed soil because equipment would operate on the same logging facilities used during yarding operations. The same designated skid trail systems would be used as primary travel routes. The use of specialized equipment such as tracked excavators and small backhoes with grapple arms are capable of accumulating woody materials without moving appreciable amounts of topsoil into slash piles. This fuel reduction method would not cause additional soil impacts because the piling and burning would occur on previously disturbed sites that already have detrimental soil conditions.

It is expected that the hand pile-and-burn method may also be used to burn small concentrations of slash materials in localized areas of treatment units that may not meet fuel management objectives. Hand piles would be well-distributed within activity areas and this non-mechanical fuels treatment does not cause soil displacement or compaction damage. Due to the relatively small-size of hand piles, ground-level heating is usually not elevated long enough to detrimentally alter soil properties that affect long-term site productivity. These activities are conducted at times and under conditions that reduce the risk of resource damage, including impacts to soils and understory vegetation. Soil heating is reduced when the soil surface layer is moist, so piles are typically burned following periods of precipitation. Nutrient releases may actually benefit site productivity in small localized areas. Conservative estimates were used to account for the cumulative amount of surface area that could be potentially impacted from harvest and yarding activities. The cumulative effects to soils from this post-harvest treatment would be minor in comparison. Therefore, the overall extent of detrimental soil conditions is not expected to increase above the predicted levels in any of the proposed activity areas.

Specialized machinery with attachments for mowing would be used in portions of all EIS Units proposed for commercial harvest under Alternatives 2 and 3. It is expected that brush mowing activities may occur on as much as 70% to 80% of an activity area. Only brush and light fuels will be mowed to reduce the height of tall shrubs and small trees to within six to eight inches of the ground. Any large-diameter downed logs would be retained on-site and protected from disturbance to the extent possible. Brush mowing does not cause detrimental soil displacement and increases in soil bulk density are inconsequential. The primary factors that limit soil compaction are the low ground pressure of the tractor and mowing heads, the limited amount of traffic (one equipment pass), and the cushioning effect of surface organic matter. These activities have been monitored in the past, and results show that increases in soil displacement and compaction do not meet the criteria for detrimental soil conditions (Deschutes N.F., Soil Monitoring Reports, 1995 and 1997).

Prescribed fire would be used to reduce ground fuels in portions of all EIS Units following commercial harvest, pre-commercial thinning and mowing treatments. Prescribed burning activities are conducted at times and under conditions that maximize benefits while reducing the risk of resource damage.

Prescribed underburns in timber stands would be accomplished under carefully controlled conditions to minimize damage to standing trees and remove only a portion of the surface organic matter. Natural fuel accumulations consist mainly of fine fuels (i.e., decadent brush, tree branches, and needle cast litter) that typically do not burn for long duration and cause excessive soil heating. Ponderosa pine logs and existing snags will be retained to meet coarse woody debris requirements for wildlife habitat and soil productivity. It is expected that adequate retention of coarse woody debris and fine organic matter (duff layer) would still exist for protecting mineral soil from erosion and supplying nutrients that support the growth of vegetation and populations of soil organisms.

Prescribed burn plans would comply with all applicable LRMP standards and guidelines and Best Management Practices (BMPs) prior to initiation of burn treatments. Soil moisture guidelines would be included in burn plans to minimize the risk for intense ground-level heating. Duff moisture levels of approximately 50 percent are typical during light intensity underburns (USDA forest Service, RMRS-GTR42-Volume 4). Soil heating during spring burns would be negligible because higher moisture levels at this time of year generally result in cooler burns with lower potential for causing severely burned soil. Ground cover vegetation is expected to recover rapidly, and it is not anticipated that these burn treatments would accelerate surface erosion above tolerable limits. Fall burning would be conducted following brief periods of precipitation. Fuel reductions achieved through planned ignitions usually burn with low-to-moderate intensities that do not result in detrimental changes to soil properties. The successful implementation of prescribed underburning would likely result in beneficial effects by reducing fuel loadings and wildfire potential as well as increasing nutrient availability in burned areas.

Mechanical and hand lines would be used in conjunction with existing roads to effectively control the spread of fire. Fire lines would be needed to keep fire out of the control units, the tree plantation, and wildlife sensitive areas (NRF). The extent of disturbed soil would be limited to the minimum necessary to achieve fuel management objectives. In locations where mechanical fuel breaks are necessary, a low-ground pressure machine would pull a small plow to expose mineral soil in areas approximately 2.5 feet to 3 feet wide. Soil compaction is not a concern because this activity would be accomplished with a single equipment pass. No mechanical fire line would be constructed on sensitive soils or steep slopes over 30 percent. Hand lines would likely be less than 18 to 24 inches in width. Neither method would result in the removal of surface organic layers in large enough areas, at least 5 feet in width as defined in FSM 2520, to qualify as detrimental soil displacement. Displaced topsoil and unburned woody debris would be redistributed over mechanical fire line following prescribed burning activities. Litter from adjacent trees, coupled with the establishment of herbaceous grasses, forbs, shrubs, and tree seedlings will provide new sources of fine organic matter for humus development in the mineral soil.

Soil Restoration Treatments on Temporary Roads and Logging Facilities

Subsoiling treatments are designed to promote maintenance or enhancement of soil quality. Subsoiling improves the hydrologic function and productivity on disturbed sites by fracturing compacted soil layers, thereby reducing soil strength and increasing macro pore space with soil profiles. Subsequently, this contributes to increased water infiltration, enhanced vegetative root development, and improves the soils ability to supply nutrients, moisture, and air that support vegetative growth and biotic habitat for soil organisms. Additional treatment options for improving soil quality on disturbed sites include redistributing topsoil in areas of exposed mineral soil and pulling available logging slash and woody materials over the treated surface. These conservation practices comply with Regional policy and LRMP interpretations for Forest-wide standards and guidelines SL-3 and SL-4 that limit the extent of detrimental soil conditions.

Soil restoration treatments would be applied with a self-drafting winged subsoiler to reduce the cumulative amount of detrimentally compacted soil within 14 activity areas proposed under Alternative 2 and 14 activity areas proposed under Alternative 3 to comply with management direction. This would include subsoiling all temporary roads and some of the primary skid trails and log landings following

post-harvest activities. The majority of existing and new soil impacts would be confined to known locations in heavy use areas which facilitates where subsoiling treatments would need to be implemented on compacted sites. Table 48 and Table 49 (Column 5) display the number of acres within each EIS Unit that would be subsoiled and the percentage of detrimental soil conditions that would remain upon completion of the subsoiling treatment. These comply with Regional policy (FSM 2520, R-6 Supplement No. 2500-98-1) by reducing the cumulative levels of detrimental soil conditions anticipated from this project proposal.

As previously described under Affected Environment, extensive areas of the planning area have been covered by loose, non-cohesive ash and pumice deposits that consist mostly of sand-sized soil particles. These coarse-textured soils have little or no structural development within the principal root development zone (4 to 12 inches in depth) where changes in soil compaction (bulk density) are assessed according to Regional direction (FSM 2521.03). Dominant soils are well suited for tillage treatments due to their naturally low bulk densities, low compaction potential, and absence of rock fragments on the surface and within soil profiles. These are the soil properties which are typically affected by mechanical forces that either reduce or improve soil porosity in the compaction zone. Although equipment traffic during harvest operations can decrease soil porosity on these soil materials, compacted sites can be mitigated physically by tillage with a winged subsoiler (Powers, 1999).

Monitoring of past subsoiling activities on the Deschutes National Forest has shown that these treatments are highly effective in restoring detrimentally compacted soils. The winged subsoiling equipment used locally has been shown to lift and shatter compacted soil layers in greater than 90 percent of the compacted zone with one equipment pass (Craigg, 2000). Field observations have shown that bulk densities return to natural levels after a year or two of physical settling and moisture percolation through the soil profile (Deschutes Soil Monitoring, 1995). Most of the surface organic matter remains in place because the equipment is designed to allow adequate clearance between the tool bar and the surface of the ground for allowing smaller logging slash to pass through without building up. Any mixing of soil and organic matter does not cause detrimental soil displacement because these materials are not removed off site. Since the winged subsoiler produces nearly complete loosening of compacted soil layers without causing substantial displacement, subsoiled areas on this forest are expected to reach full recovery within the short-term (less than 5 years) through natural recovery processes.

Although the biological significance of subsoiling is less certain, these restoration treatments likely improve subsurface habitat by restoring the soils ability to supply nutrients, moisture, and air that support soil microorganisms. Research studies on the Deschutes National Forest have shown that the composition and distributions of soil biota populations rebound back toward pre-impact conditions following subsoiling treatments on compacted skid trails and log landings (Moldenke et al., 2000).

The subsoiling specialist and trained crew members work with the equipment operator to identify locations of detrimentally compacted soil. Implementation and effectiveness monitoring is then conducted on treatment areas to assure that soil restoration objectives have been met.

Effects of Implementing Sale Area Improvement Activities

Sale area improvement opportunities include road closures, boundary signing, weed monitoring, stocking surveys, flagging removal, non-commercial thinning and prescribed burning. Road closures that use signs or barriers do not reduce the number of acres of detrimentally disturbed soil because the road prism remains in place. Manual thinning and prescribed underburn treatments would likely result in beneficial effects by reducing fuel loadings and wildfire potential as well as increasing nutrient availability in burned areas. None of the remaining activities would increase the extent of detrimental soil conditions within any of the proposed activity areas. There would be no cumulative increase in the estimated percentages of detrimental soil conditions disclosed in Table 59 and Table 60.

Project Design / Mitigation

Under both action alternatives, project implementation includes the application of management requirements, project design elements, and mitigation measures to avoid, minimize, or rectify potentially adverse impacts to the soil resource (EIS, Chapter 2). Various references and Forest Service Manual direction were used as guidance to determine project design and mitigation needs for the EXF Thinning, Fuels, and Research project. These information sources are based on the best available technical data, past monitoring of similar activities on representative soils, Forest Plan direction, and nationally and regionally approved soil quality standards and guidelines.

Operational guidelines for equipment use are included in project design elements to provide options for limiting the amount of surface area covered by logging facilities and controlling equipment operations to minimize the potential for soil impacts in random locations of activity areas. Existing logging facilities would be reutilized to the extent possible. Grapple skidders would only be allowed to operate on designated skid trails spaced on average of 100 feet apart (11 percent of the unit area). Machine traffic off designated logging facilities would be limited in extent. The short-term effects of only two passes by mechanical harvesters and other specialized machinery off designated logging facilities are not expected to qualify as a detrimental soil condition. Natural processes, such as frost heaving and freeze-taw cycles, can generally offset soil compaction near the soil surface. Conventional ground-based logging operations would be avoided in random locations of activity areas that contain sensitive soils on steep slopes over 30 percent. Other requirements include avoiding equipment operations during periods of high soil moisture and operating equipment over frozen ground or a sufficient amount of compacted snow. The successful application of these management practices would help lower the estimated percentages of detrimental soil conditions displayed in Table 59 and Table 60 and the summarized information in Table 61.

The project area is located on the eastern flanks of the Cascade Mountain Range where ample snowfall accumulations typically provide favorable winter logging conditions. The direct and indirect effects to soils is greatly reduced or eliminated by skidding over frozen ground or compacted snow. Best results are achieved by skidding over frozen ground (at least 6 inches in depth) or on a compacted snow base (at least 12 inches in depth) if the soil is not frozen. Skidding over shallower snow packs should only be considered during snow accumulation periods and not during melt periods. If the compacted snow base begins to melt due to warmer temperatures or rain-on-snow events, skidding operations would be discontinued until freezing temperatures and/or additional snowfall allows operations to continue. There is no potential for soil puddling damage because the dominant coarse-textured soils lack plasticity and cohesion. If project implementation includes the use of winter logging operations, it is anticipated that there would be very little or no visual evidence of soil compaction, rutting, displacement, or loss of protective plant and litter cover.

All reasonable Best Management Practices (BMPs) would be applied to minimize the effects of road systems and timber management activities on the soil resource. A variety of BMPs are available to control erosion on roads and logging facilities. The BMPs are tiered to the Soil and Water Conservation Practices Handbook (FSH 2509.22), which contains conservation practices that have proven effective in protecting and maintaining soil and water resource values. The Oregon Department of Forestry evaluated more than 3,000 individual practices and determined a 98 percent compliance rate for BMP implementation, with 5 percent of these practices exceeding forest practice rules (National Council for Air and Stream Improvement, 1999).

Soil restoration treatments (subsoiling) would be applied with a self-drafting winged subsoiler to rectify impacts by reclaiming and stabilizing detrimentally disturbed soils committed to roads, log landings, and main skid trails. The majority of existing and new soil impacts would be confined to known locations in these heavy use areas which facilitates where soil restoration treatments need to be implemented on compacted sites. The predicted amount of detrimental soil conditions was evaluated

for each activity area proposed for commercial harvest. Individual activity areas that would receive subsoiling treatments are identified by unit number in a site-specific mitigation measure (EIS, Chapter 2). The predicted amount of subsoiled acres within specific activity areas were used for deductions in the estimated percentages of detrimental soil conditions in Table 59 and Table 60.

Monitoring of past subsoiling activities on the Deschutes National Forest has shown that these treatments are highly effective in restoring detrimentally compacted soils. Restoration treatments, such as subsoiling, are designed to promote maintenance or enhancement of soil quality, and they are consistent with Regional policy (FSM 2520, R-6 Supplement) and LRMP interpretations of standards and guidelines SL-3 and SL-4.

Soil moisture guidelines would be included in prescribed burn plans to minimize the potential for intense ground-level heating and adverse effects to soil properties. Under both action alternatives, guidelines for adequate retention of coarse woody debris and fine organic matter are included as management requirements to assure both short-term and long-term nutrient cycling on treated sites.

If the Responsible Official selects an action alternative, the management requirements, project design elements and mitigation measures are to be implemented during and following project activities to meet the stated objectives for protecting and maintaining soil productivity.

Direct and Indirect Effects of Alternatives 2 and 3

Detrimental Soil Disturbance

The use of ground-based equipment for commercial harvest activities would increase the amount and distribution of soil impacts within each of the proposed activity areas. The development and use of temporary roads, log landings, and skid trail systems are the primary sources of new soil disturbance that would result in adverse changes to soil productivity. Most soil impacts would occur on and adjacent to these heavy-use areas where multiple equipment passes typically cause detrimental soil compaction. Mitigation and resource protection measures would be applied to avoid or minimize the extent of soil disturbance in random locations between main skid trails and away from log landings. Non-commercial thinning by hand felling small-diameter trees with chainsaws would not cause additional soil impacts because machinery would not be used for yarding activities. Under all action alternatives, the overall extent of detrimental soils conditions from fuel reduction activities is not expected to increase above the predicted levels within any of the proposed activity areas.

The amount of surface area committed to new logging facilities would be limited to the minimum necessary to achieve management objectives. Although existing facilities would be used to the extent possible, some additional skid trails and log landings will be needed to accommodate harvest and yarding activities in all activity areas proposed for commercial harvest. A total of approximately 1.0 mile (total) of temporary road segments would be established to allow access in EIS Units 11, 11.1, 11.2, 12, 14, and 21. The re-use of existing road prisms would not cause additional soil impacts because machinery access would occur on previously disturbed sites. The magnitude of soil disturbance associated with new temporary roads would be essentially the same as the disturbed widths of primary skid trails. None of the temporary road locations would require excavation of cut-and-fill slopes because they are located on nearly level to gentle slopes. All temporary road segments would be subsoiled (obliterated) following their use, so the disturbed area estimates are balanced by restoration treatments which are designed to improve soil quality by reclaiming and stabilizing compacted road surfaces.

Conservative estimates indicate that a total of approximately 217 acres of soil would be removed from production to establish designated skid trail systems and log landings within portions of the 16 activity areas proposed for commercial harvest under Alternative 2. Approximately 178 acres in 17 activity areas would be detrimentally disturbed by logging facilities under Alternative 3.

Under both action alternatives, soil restoration treatments would be applied with a self-drafting winged subsoiler to reduce the cumulative amount of detrimentally compacted soil within proposed activity areas which are expected to exceed the Regional guidance provided in FSM 2520, R-6 Supplement No. 2500-98-1. Surface area calculations (acres) of designated areas such as roads, main skid trails, and log landings determine how much area needs to be reclaimed within individual activity areas of known size.

Under Alternative 2, portions of 14 activity areas would receive subsoiling treatments to rehabilitate approximately 98 acres of compacted soil on all temporary roads and some of the primary skid trails and log landings. Under Alternative 3, it is predicted that approximately 94 acres of compacted soil would be subsoiled within portions of 14 activity areas to comply with management direction. Since commercial thinning is proposed under both action alternatives, the transportation system (including main skid trails and log landings) is typically left in place so these facilities can be reused for future entries. Activity areas that would receive soil restoration treatments are identified by unit number in a site-specific mitigation measure (Chapter 2.2.4).

Following soil restoration treatments (subsoiling), the analysis indicates that the extent of detrimental soil conditions relative to existing conditions would either: 1) remain the same, 2) increase, but remain within the LRMP standard of 20 percent, or 3) decrease levels below existing conditions.

Table 59 (Alternative 2) and Table 60 (Alternative 3) display quantitative, unit-specific information that shows the predicted amounts of detrimental soil conditions before and after implementation of the mechanical harvest and subsoiling mitigation treatments. It does not include any detrimental soil disturbances associated with fuel reduction activities. The column for existing detrimental soil conditions includes existing roads and past logging facilities if those disturbed sites are located within the proposed activity area boundaries.

Table 59. Alternative 2: Estimates of Detrimental Soil Conditions following Mechanical Harvest and Soil Restoration Treatments by Activity Areas.

EIS Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Conditions After Harvest		Estimated Detrimental Soil Conditions After Restoration	
		Acres Unit	Percent of	Acres Unit	Percent of	Subsoil Acres Unit	Percent of
11	118	0.5	< 1 %	15.3	13 %	0.0	13 %
12	192	8.9	5 %	32.6	17 %	0.0	17 %
13	83	12.7	15 %	19.8	24 %	3.2	20 %
14	194	30.0	16 %	45.7	24 %	6.9	20 %
21	106	23.7	22 %	30.9	29 %	9.7	20 %
22	206	39.1	19 %	55.6	27 %	14.4	20 %
23	225	41.0	18 %	58.5	26 %	13.5	20 %
24	196	29.0	15 %	45.2	23 %	6.0	20 %
31	148	26.2	18 %	37.0	25 %	7.4	20 %
32	164	24.5	15 %	37.7	23 %	4.9	20 %
33	335	48.3	14 %	77.4	23 %	10.4	20 %
34	94	18.2	19 %	24.8	26 %	6.0	20 %
41	116	17.0	15 %	26.7	23 %	3.5	20 %
42	160	19.9	12 %	33.6	21 %	1.6	20 %
43	70	12.8	18 %	17.5	25 %	3.5	20 %
44	147	25.8	18 %	36.8	25 %	7.4	20 %

Table 60. Alternative 3: Estimates of Detrimental Soil Conditions following Mechanical Harvest and Soil Restoration Treatments by Activity Areas.

EIS Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Conditions After Harvest		Estimated Detrimental Soil Conditions After Restoration	
		Acres	Percent of Unit	Acres	Percent of Unit	Subsoil Acres	Percent of Unit
11.1	22	0.5	2 %	3.3	15 %	0.0	15 %
11.2	27	0.2	1 %	3.8	14 %	0.0	14 %
12	155	8.6	6 %	26.4	17 %	0.0	17 %
13	81	12.7	16 %	19.6	24 %	3.4	20 %
14	194	30.0	16 %	45.7	24 %	6.9	20 %
21	106	23.7	22 %	30.9	29 %	9.7	20 %
22	170	32.4	19 %	45.8	27 %	11.8	20 %
23	167	28.4	17 %	41.9	25 %	8.5	20 %
24	196	29.0	15 %	45.2	23 %	6.0	20 %
31	148	26.2	18 %	37.0	25 %	7.4	20 %
32	151	24.4	16 %	36.3	24 %	6.1	20 %
33	174	35.1	20 %	47.3	27 %	12.5	20 %
34	94	18.2	19 %	24.8	26 %	6.0	20 %
41	116	17.0	15 %	26.7	23 %	3.5	20 %
42	160	19.9	12 %	33.6	21 %	1.6	20 %
43	70	12.8	18 %	17.5	25 %	3.5	20 %
44	147	25.8	18 %	36.8	25 %	7.4	20 %

Table 61 summarizes current, post-harvest, and post-rehabilitation soil conditions within the proposed vegetation treatment units under both Alternatives 2 and 3. This summarized information from Tables 59 and 60 reflects the net change in detrimental soil conditions for the total area of soil impacts for the combined number of activity areas (EIS units) proposed with the action alternatives.

Table 61. Summary[1] of Net Change in Detrimental Soil Conditions following Mechanical harvest and Soil Restoration (Subsoiling) Treatments proposed under Alternatives 2 and 3.

Net Change in Detrimental Soil Conditions from Existing Condition	Alternative 2			Alternative 3		
	Detrimental Soil Conditions			Detrimental Soil Conditions		
	<=20%	>20%	Total	<=20%	>20%	Total
Existing Condition	15 units 354 acres	1 unit 24 acres	16 units 378 acres	16 units 321 acres	1 unit 24 acres	17 units 345 acres
Following Harvest	2 units 48 acres	14 units 547 acres	16 units 595 acres	3 units 34 acres	14 units 489 acres	17 units 523 acres
Post-Project Condition Following Subsoiling Mitigation	16 units 497 acres	0 units 0 acres	16 units 497 acres	17 units 428 acres	0 units 0 acres	17 units 429 acres

[1] Summarizes unit specific information found in Table 3-1 and Table 3-2 of the Soil Specialist Report.

The following conclusions summarize the potential increases in detrimental soil conditions associated with additional logging facilities that would be needed to facilitate mechanical thinning and yarding operations.

Under **Alternative 2**, it is anticipated that ground-based equipment would be used in portions of 16 activity areas that total approximately 2,603 acres. An estimated total of approximately 378 acres of soil is currently impacted by existing roads, skid trails, and log landings. One of the proposed activity areas (EIS Unit 21) has pre-harvest detrimental soil conditions that exceed 20 percent of the unit area. It is predicted that the direct effects of the proposed harvest and yarding activities would result in a total increase of approximately 217 acres of additional soil impacts associated with skid trail systems and log landings. Soil compaction would account for the majority of these impacts and the total amount of detrimental soil conditions would be approximately 595 acres prior to soil restoration activities. In order to comply with management direction, portions of 14 activity areas would receive subsoiling treatments to rehabilitate approximately 98 acres of detrimentally compacted soil on all temporary roads and some of the primary logging facilities. Following subsoiling mitigation, the total amount of detrimentally disturbed soil associated with management facilities is predicted to be approximately 497 acres.

The analysis concludes that after project implementation, including subsoiling mitigation, all 16 of the proposed activity areas will have percentages of detrimental soil conditions that are less than or equal to 20 percent of the unit area. Commercial harvest activities would increase levels of detrimental soil conditions above existing conditions by approximately 1 to 13 percent within all of the proposed activity areas. One activity area (EIS Unit 21) would result in a 2 percent net improvement in soil quality (less than existing conditions) following subsoiling mitigation. The net change in detrimental soil conditions is associated with additional logging facilities that would be retained following post-harvest soil restoration treatments.

Under **Alternative 3**, it is anticipated that ground-based equipment would be used in portions of 17 activity areas that total approximately 2,178 acres. An estimated total of approximately 345 acres of soil is currently impacted by existing roads, skid trails, and log landings. One of the proposed activity areas (EIS Unit 21) has pre-harvest detrimental soil conditions that exceed 20 percent of the unit area. It is predicted that the direct effects of the proposed harvest and yarding activities would result in a total increase of approximately 178 acres of additional soil impacts associated with skid trail systems and log landings. Soil compaction would account for the majority of these impacts and the total amount of detrimental soil conditions would be approximately 523 acres prior to soil restoration activities. In order to comply with management direction, portions of 14 activity areas would receive subsoiling treatments to rehabilitate approximately 94 acres of detrimentally compacted soil on all temporary roads and some of the primary logging facilities. Following subsoiling mitigation, the total amount of detrimentally disturbed soil associated with management facilities is predicted to be approximately 429 acres.

The analysis concludes that after project implementation, including subsoiling mitigation, all 17 of the proposed activity areas will have percentages of detrimental soil conditions that are less than or equal to 20 percent of the unit area. Commercial harvest activities would increase levels of detrimental soil conditions above existing conditions by approximately 1 to 13 percent within all of the proposed activity areas. One activity area (EIS Unit 21) would result in a 2 percent net improvement in soil quality (less than existing conditions) following subsoiling mitigation. The net change in detrimental soil conditions is associated with additional logging facilities that would be retained following post-harvest soil restoration treatments.

There is little difference between Alternatives 2 and 3 in terms of the percentage of harvested acres with detrimental soil impacts following mechanized harvest and soil rehabilitation activities. Implementation of Alternative 2 would result in a greater extent of detrimental soil conditions than Alternative 3 following harvest activities due to more treatment acres (approximately 425 acres). Following subsoiling mitigation, the total number of acres with detrimental soil conditions is predicted to be approximately 497 acres under Alternative 2 and 429 acres under Alternative 3 or a difference of 68

acres. Compacted soils on main skid trails and log landings would be reclaimed back to a productive status because subsoiled areas are expected to reach full recovery within the short-term.

The harvest and restoration treatments (subsoiling) proposed in both action alternatives are consistent with Regional policy (FSM 2520, R-6 Supplement) and LRMP interpretations for Forest-wide standards and guidelines SL-3 and SL-4 that limit the extent of detrimental soil conditions (Final Interpretations, Document 96-01, Soil Productivity, 1996). In harvest units where less than 20 percent detrimental impacts currently exist from prior activities, the cumulative amount detrimentally disturbed soil would not exceed the 20 percent limit following project implementation and restoration activities. In EIS Unit 21 where pre-harvest detrimental soil conditions currently exceed the 20 percent standard, subsoiling mitigation would result in a 2 percent net improvement to meet the standard and comply with management direction. Both action alternatives balance the goal of maintaining and/or improving soil quality following project implementation and soil restoration activities.

Sensitive Soils

Both Alternatives 2 and 3 propose mechanical harvest treatments on landtypes that contain sensitive soils in localized areas. Figure 18 shows locations where portions of proposed EIS Units overlap with slopes greater than 30 percent or localized areas with rocky lava flows (SRI Soil Code 76) that limit regeneration potential.

Under both action alternatives, compliance with LRMP standard and guideline SL-5 is addressed by avoiding and/or minimizing the potential for adverse effects in activity areas that contain sensitive soils on steep slopes over 30 percent. The planning area contains a cinder borrow pit and surrounding steep slopes (approximately 49 acres) that have been removed from the proposed treatment area within EIS Unit 33. There are seven additional activity areas that contain localized areas with steep slopes (greater than 30 percent) which are generally too small to delineate on maps and the total area makes up less than 10 percent of the EIS Unit (see Figure 18 next page)). These activity areas are identified by unit number in a site-specific mitigation measure (EIS Chapter 2). In order to avoid soil displacement damage, limitations for equipment use would be enforced to prohibit mechanical disturbances where sustained slopes are steeper than 30 percent and longer than 150 feet. There would be no new development of temporary roads, designated skid trails, or log landings in portions of activity areas that contain slopes steeper than 30 percent. Ground-based equipment would be restricted to existing roads and designated skid trails at all times and operators would be required to winch logs to skidders. It is expected that many of the steeper portions of harvest units will be included as untreated patches to meet wildlife objectives.

None of the proposed EIS Units overlap landtypes that contain sensitive soils with a high hazard for surface erosion or potentially wet soils with high water tables that would require special mitigation.

Under both action alternatives, all EIS Units proposed for mechanical harvest exclude areas of barren lava and rocky lava flows where the potential for successful regeneration is limited by properties such as soil depth and low fertility. Dominant soils have moderate productivity ratings and all proposed treatment units meet criteria for land suitability that would allow them to be regenerated or resist irreversible resource damage. Therefore, there are no reforestation concerns associated with variable soil depths on rocky lava flows.

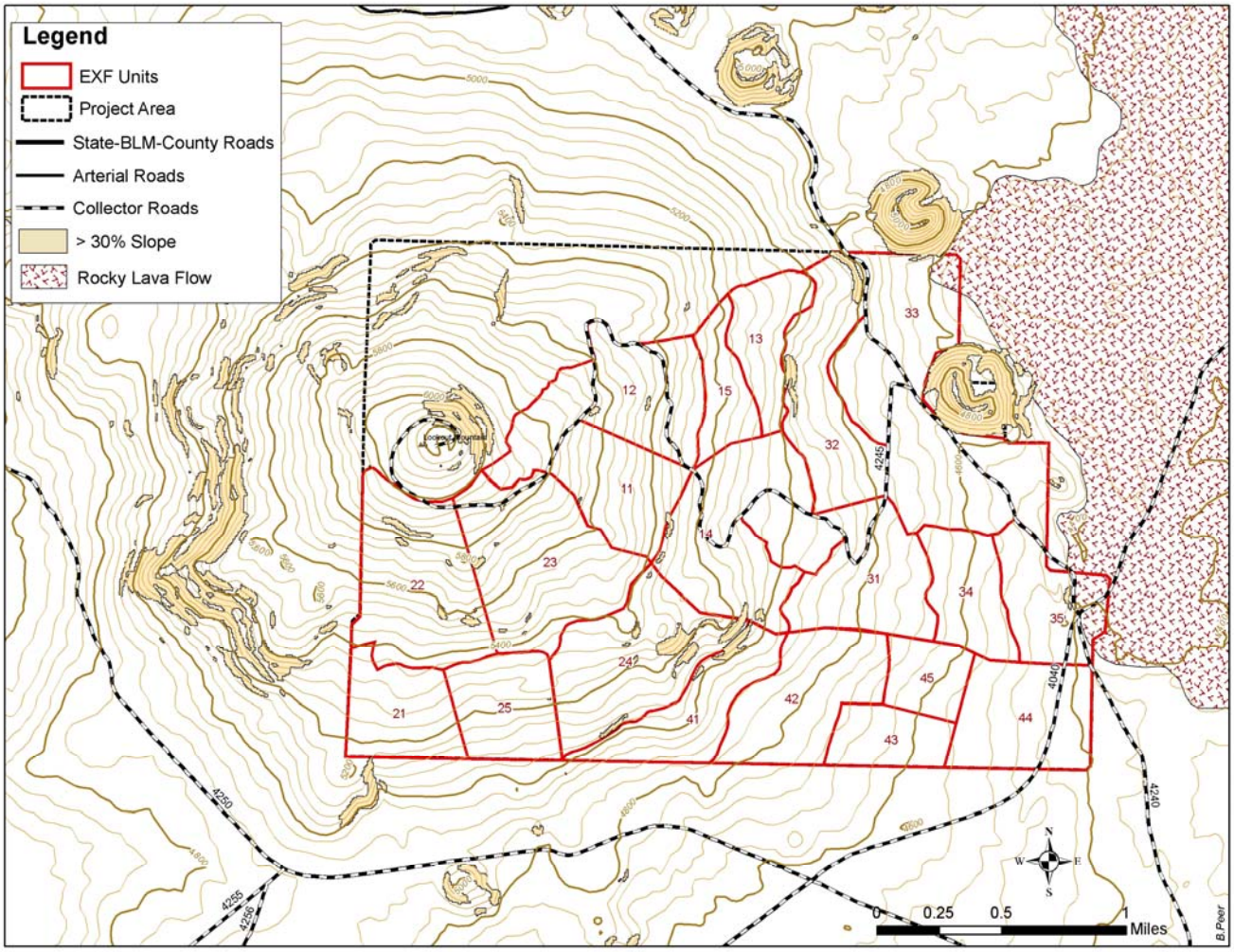


Figure 20. Areas where sensitive soils can occur overlain with project units.

Coarse Woody Debris (CWD) and Surface Organic Matter

CWD and surface organic matter were evaluated qualitatively based on the probable success of implementing appropriate Best Management Practices and recommended guidelines that address adequate retention of these important landscape components to meet soil productivity and wildlife habitat objectives (see Wildlife Section and Chapter 2 Mitigation). A minimum amount of 5 to 10 tons per acre of CWD on ponderosa pine sites and 10 to 15 tons per acre on mixed conifer or lodgepole pine sites is recommended to ensure desirable biological benefits for maintaining soil productivity without creating an unacceptable fire hazard (Brown et al., 2003, Graham et al. 1994). Based on guidelines for estimating tons per acre of CWD (Brown, 1974 and Maxwell, Ward, 1980), the levels of CWD retention to meet wildlife habitat objectives would also meet these soil resource objectives.

The proposed harvest activities would reduce potential sources of future CWD, especially where mechanized whole-tree yarding is used in activity areas. Harvest activities recruit CWD to the forest floor through breakage of limbs and tops during felling and skidding operations. Existing down woody debris would be protected from disturbance and retained on site to the extent possible. Understory trees, damaged during harvest operations, would also contribute woody materials that provide ground cover

protection and a source of nutrients on treated sites. It is expected that enough broken branches, unusable small-diameter trees, and other woody materials would likely be available after mechanical thinning activities to meet recommended guidelines for CWD retention.

Fuel reduction treatments would also reduce CWD by burning logging slash at the log landings. Some of the logging slash generated from commercial harvest may also be machine piled and burned on temporary roads, main skid trails or other previously disturbed sites. Burning small concentrations of logging slash by the hand-pile-and-burn method would have only a minor effect on the overall amount of CWD and surface organic matter within the proposed activity areas.

Post-harvest review by fuel specialists would determine the need for prescribed underburn treatments, especially where fine fuel accumulations increase the risk of wildfire to unacceptable levels. If prescribed fire is recommended, burning would occur during moist conditions to help ensure adequate retention of CWD and surface organic matter following treatment. Fuel reductions achieved through planned ignitions usually burn with low-to-moderate intensities that increase nutrient availability in burned areas. Low intensity fire does not easily consume material much larger than 3 inches in diameter, and charring does not substantially interfere with the decomposition or function of coarse woody debris (Graham et al., 1994). Although prescribed burn treatments are not intended to kill residual trees, tree mortality in varying amounts will likely occur during project implementation. Any dead trees killed from prescribed burn treatments will eventually fall to the ground and become additional sources of CWD. Depending on the rate of decay and local wind conditions, many of the small-diameter trees (less than 10 inches) would be expected to fall within the short-term (less than 5 years). Alternative 2 proposes the use of underburn treatments on more acres than Alternative 3. Assuming the same or similar burning prescriptions and conditions, the beneficial effects in short-term nutrient availability would be somewhat greater under Alternative 2 than Alternative 3. In the long term, there is likely to be no measurable difference in the quantity or distribution of CWD associated with fuel treatments under either action alternative.

A cool-temperature prescribed burn would remove some of the surface litter and duff materials without exposing extensive areas of bare mineral soil. Some of the direct and indirect beneficial effects to the soil resource include: 1) a reduction of fuel loadings and wildfire potential, 2) increased nutrient availability in localized areas, and 3) maintenance of organic matter that supports biotic habitat for mycorrhizal fungi and microorganism populations.

Cumulative Effects

Detrimental Soil Disturbance

Cumulative effects on the soil resource include all past, present, and reasonably foreseeable actions that cause soil disturbance within the same activity areas analyzed under the direct and indirect effects of implementing the proposed actions. The combined effects of past and current disturbances and those anticipated from implementing the proposed actions were previously addressed under existing conditions and the discussion of direct and indirect effects. The effects of future management activities are addressed in a following subsection entitled Foreseeable Actions Common to All Alternatives.

Under Alternative 1 (No Action), the extent of detrimental soil conditions would not increase above existing levels because no additional land would be removed from production to build temporary roads and logging facilities. The unit-specific information in Table 59 and Table 60 displays existing percentages of detrimental soil conditions for each of the activity areas.

Alternatives 2 and 3 would both cause some new soil disturbances where ground-based equipment is used for mechanical harvest and yarding activities. The primary sources of detrimental soil conditions from past management are associated with existing roads and ground-based logging facilities which were used for harvest activities between 1973 and 1988. Likewise, the majority of project-related soil impacts from this entry would also be confined to known locations in heavy use areas (such as roads,

log landings, and main skid trails) that can be reclaimed through subsoiling treatments. Table 59 and Table 60 display acres and percentages of detrimental soil conditions for existing conditions and the predicted effects from project implementation, including soil restoration treatments, for each of the activity areas proposed for commercial harvest under the action alternatives. The net change in detrimental soil conditions is associated with additional logging facilities that would be retained following post-harvest soil restoration treatments.

As previously described for direct and indirect effects, the combined effects of slash disposal and other fuel reduction treatments are not expected to cause cumulative increases in detrimental soil conditions beyond the predicted levels displayed for each of the proposed activity areas in Tables 59 and 60.

Under Alternatives 2 and 3, the cumulative effects from the proposed actions combined with all past and current management activities would be within allowable limits set by Regional direction and LRMP standards and guidelines for protecting and maintaining soil productivity within each of the proposed activity areas.

Coarse Woody Debris (CWD) and Surface Organic Matter

Under Alternative 1, the amount of coarse woody debris and surface organic matter will gradually increase over time. In the long term, the accumulation of CWD and forest litter would increase the risk for wild land fires.

As previously described for the direct and indirect effects, it is expected that Alternatives 2 and 3 would both comply with the recommended management guidelines that ensure adequate retention of snags, coarse woody debris, and fine organic matter for surface cover, biological activity, and nutrient supplies for maintaining soil productivity on treated sites.

Reasonably Foreseeable Actions – No planned timber sales or fuel reduction projects, including timber sales associated with the Snow and Fall EAs are scheduled in areas that would overlap with any of the activity areas of EXF project.

The Invasive Plant Treatment EIS will likely implement various treatments to control invasive plants in site-specific areas, but there are currently no invasive plant sites inventoried in the EXF planning area. The Invasive Plant EIS will allow for treatment of invasive plants under an Early Detection / Rapid Response protocol, but even if future sites are treated in the area, it is unlikely that herbicide treatments would cause any adverse effects or indirect effects to soil properties.

The Forest Access Management Plan will address travel management issues across the Forest. The new direction will eliminate cross-country motorized travel except on designated routes. Implementing this new direction will help to prevent cumulative increases in the extent of detrimental soil conditions in random locations off authorized roads and trails.

Other foreseeable future activities include recreation use and standard road maintenance. Effects from recreational use would be similar to those described under the Affected Environment. Future soil disturbances would be confined mainly to small concentration areas that would have a relatively minor effect on overall site productivity. There are no major soil-related concerns associated with the combined effects of these future activities.

Road maintenance would reduce accelerated erosion rates where improvements are necessary to correct drainage problems on specific segments of existing road. Surface erosion can usually be controlled by implementing appropriate Best Management Practices (BMPs) that reduce the potential for indirect effects to soils in areas adjacent to roadways. There are no major soil-related concerns associated with this activity.

Forest Plan Consistency

LRMP Management Area MA-16 (Experimental Forest) does not contain specific standards and guidelines for the soil resource. The Forest-wide standards and guidelines apply to this management area when they do not conflict with research objectives.

Under the action alternatives, equipment operations would cause some new soil disturbances in portions of previously managed areas where ground-based logging is proposed for this entry. As previously discussed under direct and indirect effects, the project design elements, management requirements, and Best Management Practices (BMPs) built into the action alternatives are all designed to avoid or minimize potentially adverse impacts to the soil resource. The amount of disturbed soil associated with temporary roads and logging facilities would be limited to the minimum necessary to achieve management objectives. Compliance with LRMP standard and guideline SL-5 is addressed by avoiding or controlling the use of mechanized equipment in activity areas with sensitive soils. Limitations for equipment use would be enforced to prohibit mechanical disturbances where sustained slopes are steeper than 30 percent and longer than 150 feet. There would be no new development of temporary roads, designated skid trails, or log landings in portions of activity areas that contain slopes steeper than 30 percent. Ground-based equipment would be restricted to existing roads and skid trails at all times and operators would be required to winch logs to skidders. None of the proposed activity areas (EIS Units) overlap landtypes that contain soils with high erosion hazards or potentially wet soils with seasonally high water tables that would require special mitigation.

All reasonable Best Management Practices for Timber Management and Road Systems would be applied to protect the soil surface and control erosion on and adjacent to roads and logging facilities that would be used during project implementation. These conservation practices are to be implemented during and following project activities to meet the stated objectives for protecting and maintaining soil productivity.

Soil restoration treatments would be applied to rectify impacts by reducing the amount of detrimentally compacted soil dedicated to existing roads, all temporary roads, and some of the primary logging facilities within specific activity areas. Restoration treatments, such as subsoiling, are designed to promote maintenance or enhancement of soil quality. These conservation practices comply with LRMP interpretations of Forest-wide standards and guidelines SL-3 and SL-4. Subsoiling mitigation is also supported by the Forest Service Manual and Regional direction for planning and implementing management activities (FSM 2520, R-6 Supplement No. 2500-98-1).

Both action alternatives balance the goal of maintaining and/or improving soil quality following project implementation and soil restoration activities. There are no violations of Regional policy (FSM 2520, R-6 Supplement) or LRMP Standards and Guidelines SL-3 and SL-4 because the project will not cause an activity area to move from a detrimental soil condition less than 20 percent to one that is greater than 20 percent; nor will the project increase detrimental soil conditions in one activity area (EIS Unit 21) that currently exceeds 20 percent of the unit area.

The proposed actions are also expected to comply with the recommended management guidelines that ensure adequate retention of snags, coarse woody debris, and fine organic matter for surface cover, biological activity, and nutrient supplies for maintaining soil productivity on treated sites.

3.3.5 Water and Fisheries

Affected Environment

Figure 9, page 39, displays the position of the EXF project within the watersheds. Two fifth field watersheds (Crane Prairie and Fall River) are involved.

Nearly all of the project area is within the 116,477 acre Fall River watershed, with a minor portion within the 164,901 acre Crane Prairie watershed. Most of the project area is within lands managed under the 1994 Northwest Forest Plan (NWFP) which amended the 1990 Deschutes National Forest Land and Resource Management Plan (LRMP). The southeast corner of the project area is east of the NWFP boundary and falls within management direction of the1995 Inland Native Fish Strategy (INFISH), which amended the LRMP.

There are no perennial or intermittent streams, wetlands, riparian areas, Riparian Reserves, or Riparian Habitat Conservation Areas within the project area. There are no 303(d) listed streams in or near the project area. The nearest water resource or riparian area is over 1 mile away.

Through the biological evaluation process (FSM 2672.4), actions and programs authorized, funded, or carried out by the Forest Service are to be reviewed to determine their potential for effects on threatened and endangered species and species proposed for listing (FSM 2670.31). Species classified as sensitive by the Forest Service are to be considered in the National Environmental Policy Act process by conducting biological evaluations to determine their potential effect of all programs and activities on these species (FSM 2670.32). Management direction regarding sensitive species is that actions would benefit, have no impact, or minimize impacts so that there is no loss of population viability or creation of a significant trend toward federal listing.

Environmental Consequences (Common to all Alternatives)

Summary of Findings for Proposed, Threatened, Endangered, and Sensitive Species:
Redband trout (Sensitive)
Alternative 1 – NI – No Impact
Alternative 2 – NI – No Impact
Alternative 3 – NI – No Impact

The following table displays the species considered in the analysis of the EXF Project. **There are no threatened or endangered aquatic species or habitat present within the project area**. The Columbia Basin redband trout is a Forest Service Sensitive species.

Table 62. Sensitive species considered in the biological evaluation

Species	Scientific Name	Status	Occur-rence	Effects Determination
Columbia Basin Redband Trout	*Oncorhynchus mykiss gairdneri*	S	None	Alt. 1 – NI Alt. 2 – NI Alt. 3 - NI

There would be no direct, indirect, or cumulative effects to water resources, fisheries, or riparian areas from any of the three alternatives. There will be no effect to Essential Fish Habitat, and no effect to redband trout or any threatened, endangered, proposed, or candidate fish species. There would be no effects to any Oregon Department of Environmental Quality 303(d) listed water body. There would be no effect on the INFISH Riparian Management Objectives, which for a forested system are pool frequency, water temperature, large woody debris, and stream width/depth ratio. All alternatives meet INFISH standards and guidelines.

The Aquatic Conservation Strategy objectives of the NWFP would be maintained by this project. Following is an assessment of the objectives.

Aquatic Conservation Strategy Objectives

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. (USDA, Forest Service, Northwest Forest Plan, 1994)*

The action alternatives do not retard the attainment of this objective at the local or watershed scale. There are no aquatic systems within the project area but they are found over 1 mile to the southeast (Fall River). The project would restore a portion of the landscape to one more fire-resilient within the existing diversity.

ACS Objective 2: *Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include flood plains, wetlands, upsweep 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.*

The project would not affect floodplains, wetlands, upsweep areas, headwater tributaries, and riparian or aquatic refugia. Network connections critical to aquatic and riparian-dependent species are not affected. The project maintains this objective at the local and watershed scale.

ACS Objective 3: *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

The project has no affect on shorelines, banks, and bottom configurations as there are no riparian areas or streams. This objective is maintained at the local and watershed scale.

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.*

The project has no effects on water quality as the nearest stream is more than 1 mile from the project area. This objective is maintained at the local and watershed scale.

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.*

The project would have no effects on sediment regimes as there are no aquatic systems in the project area. This objective is maintained at the local and watershed scale.

ACS Objective 6: *Maintain and restore in-stream flows sufficient to create and restore 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.*

The project would decrease evapo-transpiration rates by reducing vegetation. The nearest aquatic system is Fall River. No measurable changes in the flow regime are anticipated in Fall River, which is a spring-fed, groundwater system. The project would maintain this objective at the local and watershed scale.

ACS Objective 7: *Maintain and restore timing, variability, and duration of flood plain inundation and water table elevation in meadows and wetlands.*

The project would have no effects to floodplain inundation and water table elevations as there are no aquatic systems in the project area, or in Fall River and associated wetlands. The project would maintain this objective at the local and watershed scale.

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 distribution of coarse woody debris sufficient to sustain physical complexity and stability.*

The project would have no effects on riparian plant communities as none exist within or near the project area, therefore this objective would be maintained at the local and watershed scale.

ACS Objective 9: *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

The project includes a diversity of vegetation management activities that supports habitat across the landscape for native plants, invertebrates, and riparian-dependent species. There are no riparian habitats within the project area. The project maintains this objective at the local and watershed scale.

Wetlands and Floodplains

The EXF project does not propose to occupy or modify any floodplains. Therefore, the thinning, mowing, and underburning proposed is consistent with Executive Order 11988. The EXF project does not propose to destroy or modify any wetlands. Therefore, the project is consistent with Executive Order 11990. There are no municipal watersheds within the project area.

3.3.6 Air Quality

Affected Environment and Environmental Consequences

Smoke produced from wildland or prescribed fires can have significant effects on a large urban landscape. Over 80,000 people live in the surrounding communities. Many of the residents in the area live in the larger cities of Bend and Redmond, or small towns such as Sunriver, La Pine, Crescent, and Gilchrist; however, a significant percentage of the populations live in the wildland/urban interface surrounding these cities and towns.

The Clean Air Act prescribes air quality to be regulated by each individual state. The Forest Service is required by law to follow the directions of the State Forester in conducting prescribed burning in order to achieve strict compliance with all aspects of the CAA by working in conjunction with the Oregon Department of Forestry (ODF) to adhere to the Oregon Smoke Management Plan.

Areas affected are called "attainment areas." The EXF analysis area is considered to be in attainment of the National Ambient Air Quality Standards (NAAQS) for Class II airsheds. Class 2 areas are attainment areas that are neither industrialized nor meet the specific requirements for classification as Class I areas. They are protected by the PSD program. The EXF analysis area is a Class 2 area.

The Oregon Smoke Management Plan (OAR 629-043-0043) considers Three Sisters Wilderness as a Class 1 airshed. Class 1 areas are protected by the PSD (Prevention of Significant Deterioration) program and include national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic values. These are considered "smoke sensitive" and require restrictions on prescribed burning accordingly during the Visibility Protection Period July 1 to September 15.

Designated areas are those areas identified as principal population centers or other areas of requiring protection under state or Federal air quality laws or regulations. The EXF analysis area is located approximately 30 miles southwest of Bend, Oregon. Bend is classified as a "Designated Area" by the Oregon Smoke Management Report. The analysis area is considered to be in attainment of the National Ambient Air Quality Standards (NAAQS) for Class II airsheds.

Production of particulate matter is discussed for each alternative in Chapter 3.3.2 Fuels and Fire Hazard, and is summarized here. The First Order Fire Effects Model (FOFEM) is a computer program developed to predict and plan for fire effects. Development of FOFEM involved a search of the fire effects literature for predictive algorithms. These algorithms were screened to evaluate their predictions over a range of conditions. Thus, a major internal component of FOFEM is a decision key that selects the best available algorithm for the conditions specified by a user. Analysis of the EXF alternatives used FOFEM to generate Tables 40 and 43 to summarize fuel consumption and smoke emission information. Alternative 1 was modeled under wildfire conditions (see Chapter 3.3.2, page 85, for description of model). Alternatives 2 and 3 include emissions from planned prescribed underburning.

Although Alternative 1 would not have any activity-generated smoke emission, it carries the highest likelihood for a wildfire with a "Problem Fire" scenario. Table 26 illustrates that emissions and subsequent effect to air quality from a wildfire are far greater than through management actions prescribed in Alternatives 2 and 3.

Prescribed burning operations associated with both action alternatives would be conducted in compliance with National Ambient Air Quality Standards and under the Oregon Smoke Management Plan. Burning would only be conducted when prevailing and predicted wind patterns would result in negligible effects to LaPine Sunriver, Bend, and the Three Sisters Wilderness Class 1 airshed. Implementation of the action alternatives, based on the measures included to reduce emissions and to disperse smoke during favorable conditions, is expected to protect air quality to adjacent communities while having no visible effects to the Class 1 Airshed. This is because the Three Sisters Wilderness is higher in elevation and located about eight to ten miles west / northwest of the EXF project area. Potential effects to human health are displayed in the section titled "Public Health and Safety" in Chapter 3.

3.3.7 Botanical Resources

Introduction

Direction to conserve plant species on Deschutes National Forest is found in several sources. Direction for the conservation of Threatened, Endangered and Sensitive (TES) plant species is found in the Forest Service Manual (FSM Sections 2670.5 and 2672.4), the Endangered Species Act of 1973 Subpart B; 402.12, Section 7, Consultation), and the Deschutes National Forest Land and Resource Management Plan (4-60 and 4-61). The FSM states that habitats for all existing native and desired non-native plants, fish and wildlife should be managed, at minimum, to maintain viable populations for each species. The FSM and the LRMP each direct that habitat for sensitive plant and animal species be managed to ensure that these species not trend toward being listed as federal Endangered and Threatened species.

Affected Environment

Elevations within the approximately 3600 acre project area range from about 4400 feet along its eastern edge to 6200 feet at the summit of Lookout Mountain at the area's western edge. Eastern aspects prevail in the eastern 3/4s of the project area with northern and southern aspects being most common in the area's western 1/4, corresponding to the northern and southern flanks of Lookout Mountain. The project area is essentially fully forested. About 10 acres (0.3%) of the project area is non-forested cinders. Mixed conifers (with a prevalence of white fir) with an understory of snowbrush and/or manzanita, dominate the western 80% of the area. The eastern edge of the project area features a mix of ponderosa pine with snowbrush and bitterbrush. Special habitats associated with water sources and catchments (moist and wet meadows, pond or lake edges, fens, seeps, springs, intermittent and perennial streams) are lacking within the project area.

Prefield Review

Threatened, Endangered or Sensitive (TES) Plants. Most of the rare plants warranting consideration in this project are included in Regional Forester's Special Status Species List of January 31, 2008. There are no federally listed Threatened or Endangered plant species known to exist on Deschutes National Forest. A Deschutes National Forest Sensitive Plant List has been derived from the Regional Forester's List. This List includes 58 taxa, either known (26) or suspected (32) to occur on the Forest. Relevant information concerning Deschutes National Forest Sensitive Plant Species, and an assessment of the probabilities of their occurrence within the EXF Project area, is presented in Table 63.

There are no Threatened or Endangered plants in or near the project area.

Table 63. Relevant information concerning Sensitive Plant Species documented or suspected to occur on Deschutes National Forest. Codes: "VP = vascular plant; "B" = bryophyte; "L" = lichen; "F" = fungus. The five in bold are assessed for effects because of potential habitat within the project area.

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Agoseris elata (VP)	Washington, Oregon, California; Western and Eastern Cascades in Oregon.	Somewhat diverse; typically lower elevation forest openings and alluvial terraces.	No/Yes	Low; potential habitat lacking; not known on DES NF south of the Metolius Basin.
***Alpova alexsmithii* (F)**	**Washington, Oregon; Western Cascades in Oregon.**	**Coniferous forest, particularly including Pacific silver fir, lodgepole pine, Engelmann spruce and mountain hemlock. This is a mycorrhizal species.**	**No/Yes**	**Moderate; specific habitat preferences not well defined.**
Arabis suffrutescens var. horizontalis (VP)	Oregon, California; Western Cascades in Oregon.	Alpine to subalpine meadows, woods; summits, ridges; steep exposed rock outcrops.	No/No	Low; generally at higher and moister sites than present in project area; project may be north of the OR Cascades distribution of this taxon.
Arnica viscosa (VP)	Oregon, California; Western Cascades in Oregon.	Subalpine or higher scree, talus gullies and slopes w/ seasonal water runoff; lava flows; may be in moraine lake basins or crater lake basins.	No/Yes	Low; generally at higher and moister sites than present in project area.

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Astragalus peckii (VP)	Southern to central Oregon; Eastern and Western Cascades.	Basins, benches, gentle slopes, pumice flats; generally non-forest but known from five sites in lodgepole pine openings.	No/Yes	Low; tiny portion (2.8 acres) of potential habitat (CLS2-11) in extreme SE corner of project area.
Barbilophozia lycopodioides (B)	Oregon and Washington; Blue Mountains and Western Cascades in Oregon	On peaty soil on damp ledges of rock outcrops and cliffs at elevations of 3400-7500 feet.	No/No	Low; suitable habitat lacking within project area
Brachydontium olympicum (B)	Oregon and Washington; Western Cascades in Oregon	On subalpine or higher rock or soil in boulder fields, moraines, cliff ledges, often in areas of late snowmelt.	No/No	Low; suitable habitat lacking within project area
Botrychium pumicola (VP)	Central Oregon	Alpine-subalpine ridges, slopes and meadows. Montane forest openings, open forest in basins with frost pockets, pumice flats.	No/Yes	Low; suitable habitat lacking within project area
Calamagrostis breweri (VP)	Oregon, California; Western Cascades in Oregon.	Subalpine to alpine meadows, open slopes, stream banks, lake margins.	No/No	Low; suitable habitat lacking within project area
Carex abrupta (VP)	Oregon and California; Blue Mountains, Western Basin and Range and Western Cascades in Oregon	Subalpine and higher; moist meadow, lake shore, dry grassy hillside and bare roadside.	No/No	Low; suitable habitat lacking within project area
Carex capitata (VP)	Washington, Oregon, California	Montane to alpine fens/bogs, wet meadows	No/Yes	Low; suitable habitat lacking within project area
Carex diandra (VP)	Washington, Oregon, California; Eastern Cascades and Western Cascades in Oregon.	Floating sphagnum bogs	No/No	Low; suitable habitat lacking within project area
Carex lasiocarpa var. Americana (VP)	Washington, Oregon, California; Blue Mountains, Eastern and Western Cascades in Oregon.	Fens/bogs	No/Yes	Low; suitable habitat lacking within project area
Carex livida (VP)	Oregon, Washington, California; Klamath Mountains, Western Cascades and Coast Range in Oregon.	All forest types; peatlands, wet meadows with still or channeled water.	No/No	Low; suitable habitat lacking within project area
Carex retrorsa (VP)	Washington, Oregon; Blue Mountains, Columbia Basin, Willamette Valley in Oregon	Wet, swampy, frequently inundated areas.	No/No	Low; suitable habitat lacking within project area
Carex vernacula (VP)	Washington, Oregon, California; Blue Mountains, Northern Basin and Range, Eastern Cascades and Western Cascades in Oregon.	Subalpine and higher wet/moist meadow complexes, springs, terraces, benches, moist/dry slopes on rocky, gravelly soils.	No/No	Low; suitable habitat lacking within project area

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Castilleja chlorotica (VP)	Central Oregon	Ponderosa pine, lodgepole pine and mixed conifer forest openings; PP at lower, LP at middle to upper, mixed conifer at highest elevations.	No/Yes	Low; plant associations where this species known to occur not present within project area.
Cheilanthes feei (VP)	Washington, Oregon, California; Blue Mountains in Oregon.	Seasonally moist crevices on cliffs of limestone or basalt with limey deposits.	No/No	Low; suitable habitat lacking within project area
Chiloscphus gemmiparus	Oregon	On rocks, often is splash zones of cold, montane streams.	No/No	Low; suitable habitat lacking within project area
Cicuta bulbifera (VP)	Eastern Cascades of Oregon and Washington; California	Shoreline marshes.	No/No	Low; suitable habitat lacking within project area.
Collomia mazama (VP)	Southern to central Cascades, Oregon	Mid- to high elevations,; meadows, stream banks and bars, lakeshores and vernal pool margins, forest edges and openings.	No/No	Low; suitable habitat lacking within project area.
Conostomum tetragonum (B)	Washington, Oregon, California	Likely above timberline on soil in rock crevices in boulder fields, moraines, and ledges of cliffs.	No/No	Low; suitable habitat lacking within project area
Cyperus acuminatus (VP)	Washington, Oregon, California	Low gradient edges of lakes and perennial/seasonal pools with fluctuating water levels.	No/No	Low; suitable habitat lacking within project area
Cyperus lupulinus ssp. lupulinus (VP)	Washingston, Oregon	Rocky lower slopes and terraces along low elevation (= or < 1200 ft.) streams in eastern Oregon.	No/No	Low; suitable habitat lacking within project area
Dermatocarpon meiophyllizum (L)	Washington, Oregon	On rocks in perennial or nearly perennial streams.	No/Yes	Low; suitable habitat lacking within project area
Elatine brachysperma (VP)	Washington, Oregon, California; Blue Mountains and Northern Basin and Range in Oregon.	Muddy shores, shallow pools	No/No	Low; suitable habitat lacking within project area.
Eucephalus gormanii (VP)	Oregon; Western Cascades	Rocky ridges, outcrops, or rocky slopes in alpine or subalpine mixed conifer forest.	No/No	Low; suitable habitat lacking within project area.
***Gastroboletus vividus* (F)**	**Oregon, California; Western Cascades and Klamath Mountains in Oregon.**	**Higher elevation coniferous forest with subalpine fir, Shasta red fir and mountain hemlock. This is a mycorrhizal species.**	**No/No**	**Moderate; potential host (Shasta red fir) present on upper slopes Lookout Mountain.**
Gentiana newberryi (VP)	Oregon and California; Eastern and Western Cascades of Oregon	Alpine to subalpine mixed conifer openings, wet to dry montane meadows, sometimes adjacent to springs, streams, or lakes.	No/Yes	Low; suitable habitat lacking within project area.

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Heliotropium curassavicum (VP)	Washington, Oregon, California; Blue Mountains, Northern Basin and Range, Columbia Basin, Eastern Cascades, Willamette Valley in Oregon	Alkaline, saline playas, receding ponds and clay soils.	No/No	Low; suitable habitat lacking within project area.
Helodium blandowii (B)	Washington, Oregon, California; Blue Mountains, Eastern and Western Cascades in Oregon	Montane fens	No/Yes	Low; suitable habitat lacking within project area.
***Helvella* crassitunicata (F)**	**Washington, Oregon; Western Cascades in Oregon**	**Montane habitats**	**No/Yes**	**Moderate; specific habitat preferences not well defined.**
***Hygrophorus caeruleus* (F)**	**Eastern and Western Cascades in Oregon**	**Coniferous forests near melting snowbanks. This is a mycorrhizal species.**	**No/Yes**	**Moderate; specific habitat preferences not well defined.**
Leptogium cyanescens (L)	Washington, Oregon, California; Coast Range in Oregon	Generally riparian, but recently documented on vine maple, bigleaf maple and Oregon white oak	No/No	Low; suitable habitat lacking within project area.
Lipocarpha aristula (VP)	Washington, Oregon, California; Blue Mountains, Columbia Basin, Eastern Cascades, Snake River Plains in Oregon	Low elevation (< 2500 feet) streamsides and gravel bars	No/No	Low; suitable habitat lacking within project area.
Lobelia dortmanna (VP)	Washington and Oregon; Eastern Cascades of Oregon	In water of lake, pond, slow river or stream, or wet meadow.	No/Yes	Low; suitable habitat lacking within project area.
Lycopodiella inundata (VP)	Washington, Oregon, California; Coast Range, Eastern and Western Cascades	Deflation areas in coastal back-dunes; montane bogs, less often, wet meadows.	No/Yes	Low; suitable habitat lacking within project area.
Lycopodium complanatum (VP)	Washington, Oregon; Blue Mountains, Western Cascades in Oregon	Middle elevations; edge of wet meadow; dry, forested midslope.	No/No	Low; suitable habitat lacking within project area.
Mulenbergia minutissima (VP)	Washington, Oregon; Northern Basin and Range in Oregon	Thin lava soils; associated with cattails, sedges.	No/No	Low; suitable habitat lacking within project area.
Ophioglossum pusillum (VP)	Washington, Oregon, California; Coast Range and Western Cascades in Oregon	Low to mid-elevations in dune deflation planes, marsh edges, vernal ponds and stream terraces in moist meadows.	No/No	Low; suitable habitat lacking within project area.
Penstemon peckii (VP)	Central Oregon	Ponderosa pine or mixed conifer with ponderosa pine, in openings or in relatively open stands; on recovering fluvial terraces and shallow intermittent drainages.	No/Yes	Low; suitable habitat lacking within project area; project area well south of known range of this endemic species.

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Pilularia americana (VP)	Oregon, California; Blue Mountains, Northern Basin and Range, Eastern Cascades and Klamath Mountains in Oregon	Alkali and other shallow vernal pools; not recently used stock ponds; reservoir shores.	No/No	Low; suitable habitat lacking within project area.
Polytrichum sphaerothecium (B)	Washington, Oregon, California; Western Cascades in Oregon	On igneous rocks in subalpine parkland to alpine krummholz.	No/No	Low; suitable habitat lacking within project area.
Potamogeton diversifolius (VP)	Washington, Oregon, California; Northern Basin and Range in Oregon	Ponds, lakes, streams, rivers.	No/No	Low; suitable habitat lacking within project area.
Pseudocalliergon trifarium (B)	Eastern and Western Cascades in Oregon	Montane fens.	No/No	Low; suitable habitat lacking within project area.
Ramaria amyloidea (F)	**Washington, Oregon, California; Western Cascades in Oregon**	**Montane coniferous forests with documented elevations of 1800-5600 feet; associated species include white fir, Shasta red fir, lodgepole pine and western white pine. This is a mycorrhizal species.**	**No/Yes**	**Moderate; specific habitat preferences not well defined.**
Rhizomnium nudum (B)	Washington, Oregon; Western and Eastern Cascades in Oregon	Coniferous forests on moist soil in seepages, vernally wet depressions or intermittently wet, low-gradient channels.	No/Yes	Low; suitable habitat lacking within project area.
Rorippa columbiae (VP)	Oregon, Washington, California; Blue Mountains, Northern Basin and Range, Eastern and Western Cascades and Willamette Valley in Oregon	Low to mid-elevations; wet to vernally moist sites; meadows, fields, playas, lakeshores, intermittent stream beds, banks of perennial streams, along irrigation ditches, river bars and deltas.	No/No	Low; suitable habitat lacking within project area.
Rotala ramosior (VP)	Washington, Oregon, California; Northern Basin and Range, Western Cascades and Willamette Valley in Oregon	Low elevation, low gradient shores, pond edges, river bars.	No/No	Low; suitable habitat lacking within project area.
Scheuchzeria palustris ssp. americana (VP)	Washington, Oregon, California; Eastern and Western Cascades in Oregon	Mid-elevations; open-canopied bogs, fens, and other wetlands where often in shallow water.	No/Yes	Low; suitable habitat lacking within project area.
Schistostega pennata (B)	Washington, Oregon; Coast Range, Western Cascades in Oregon	Usually on mineral soil in crevices on lower and more sheltered parts of root wads of fallen trees. Often near streams or other wet areas. High local humidity essential.	No/Yes	Low; suitable habitat lacking within project area.
Schoenoplectus subterminalis (VP)	Washington, Oregon, California; Coast Range, Klamath Mountains, Western Cascades in Oregon	Generally submerged to emergent in quiet water 2-8 decimeters deep, in peatlands, sedge fens, creeks, ditches, ponds and lakes.	No/Yes	Low; suitable habitat lacking within project area.
Splachnum ampullaceum (B)	Washington, Oregon; Eastern Cascades in Oregon	Peatlands and other wetlands.	No/No	Low; suitable habitat lacking within project area.

R6 Sensitive Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Texosporium santi-jacobi (L)	Washington, Oregon, California; Blue Mountains and Columbia Basin in Oregon	Late seral, dry shrub/grassland.	No/No	Low; suitable habitat lacking within project area.
Tomentypnum nitens (B)	Washington, Oregon; Eastern and Western Cascades, Blue Mountains in Oregon	Montane fens.	No/Yes	Low; suitable habitat lacking within project area.
Trematodon boasii (B)	Western Cascades in Oregon	Bare soil along subalpine streams, trail and pond edges.	No/No	Low; suitable habitat lacking within project area.
Tritomaria exsectiformis (B)	Washington, Oregon; Western and Eastern Cascades in Oregon	In coniferous forest along low-volume, low-gradient perennial springs and seeps.	No/Yes	Low; suitable habitat lacking within project area.
Utricularia minor (VP)	Washington, Oregon, California; Coast Range, Western and Eastern Cascades, Klamath Mountains, Blue Mountains in Oregon	Lowland and montane fens, sedge meadows, low-nutrient lakes and peatbog pools.	No/Yes	Low; suitable habitat lacking within project area.

Prefield review has indicated that no sensitive plant species are documented to occur in or closely adjacent to the project area. Five fungal species are regarded as having a moderate likelihood of occurrence within the project area while, for all other taxa, this likelihood is considered to be low. The absence of perennially or seasonally available surface water or groundwater is the principal factor thought to limit the probability of presence of sensitive plants and sensitive plant habitat within the project area.

Other Rare or Uncommon Plants. Currently there is one uncommon plant species whose probability of occurrence within the project area requires assessment. Information concerning this species is presented in Table 64. One uncommon plant species is known on the Forest, but considered unlikely to occur within the project area. There are no known sites of uncommon plant species that require only site protection within the project area.

Table 64. Relevant information concerning rare or uncommon plant species on Deschutes National Forest. "VP" = vascular plant.

R6 Uncommon Plant Species Documented or Suspected on Deschutes National Forest	Range within western PNW; Physiographic Province in Oregon	Habitat	Known to Occur in Project Area?/ On Forest?	Probability of Occurrence in Project Area
Cypripedium montanum (VP)	Washington, Oregon, California; Western and Eastern Cascades, Blue Mountains, Klamath Mountains and Willamette Valley in Oregon.	Wet mixed conifer forests with canopy closures of 60-80%. Often in stands dominated by ponderosa pine, lodgepole pine or Douglas fir.	No/Yes	Low; potential habitat apparently present, but species not known on DES NF south of the Metolius River watershed.

Surveys

Surveys by Deschutes National Forest botanists have been conducted within the EXF project area in 2004, 2007 and 2008. These botanists reported no detections of sensitive species and an absence of promising habitat for documented or suspected non-fungal Deschutes National Forest sensitive species. Pre-disturbance surveys for the several fungal species identified to have suitable habitat within the project area were not attempted because these are generally neither practical nor especially reliable.

Environmental Consequences

There is a moderate potential for several Sensitive fungal species to be present within the project area because there is potential habitat, based on what is known about their habitat (Table 30). Current research indicates that fungal biomass and diversity is directly correlated with canopy cover and volume of coarse woody debris. The scope of potential effects described below is limited geographically to the extent of the project area, and temporally to the next 0-20 years.

Alternative 1 - The No Action Alternative

The No Action will result in no direct, indirect, or cumulative effects to this potential fungal habitat.

Alternatives 2 & 3

Direct and Indirect Effects

There will be No Impact to all non-fungal Sensitive species and the rare and uncommon specie. For the five fungal Sensitive species, the action alternative May Impact Individuals and Habitat, but will not likely contribute to a trend towards federal listing or loss of viability to the population or species.

As indicated in Table 30, four of the five sensitive fungi determined to have a moderate probability of occurrence within the project area are mycorrhizal. Likely host tree species differ among these four fungal species, but collectively, one or more likely host tree species occurs within each of the activity units proposed under the Action Alternatives. As noted in Table 1, host conifers for these mycorrhizal species are said (Castellano et al., 1999) to include, but not necessarily be limited to, lodgepole pine, white fir, mountain hemlock, western white pine, Shasta red fir, Pacific silver fir and subalpine fir. Castellano (1999) provides no specific host information for *Hygrophorus caeruleus*, but the three documented sites on the Deschutes National Forest each occur in stands with abundant Douglas fir and ponderosa pine. The thinning activity associated with the two Action Alternatives is therefore likely to remove some potential host tree species in each activity unit and, in turn, to some non-quantifiable degree, reduce potential habitat quality for these fungi. As about 370 fewer acres are proposed for thinning under Alternative 3, this alternative is anticipated to result in a somewhat smaller negative effect on potential habitat for the four mycorrhizal fungi. The nutritional requirements of the fifth sensitive fungal species, determined to have a moderate probability of presence within the project area, appears to be poorly documented. It is reasonable to anticipate that substantial loss of canopy cover (through thinning, mowing and burning) and a likely consequent reduction in moisture levels in duff and surface soil layers will be to some extent unfavorable for the production of this species' epigeous (growing aboveground) sporocarps. Current research suggests that efforts to retain forested patches and associated coarse woody debris will help reduce the impact of the Action Alternatives on the quality of potential habitat for the five sensitive fungi listed in Table 63 (Cline et al., 2005; Harvey et al., 1981; Kranabetter and Kroeger, 2001; Luoma and Eberhart, 2005; Walters et al, 1994).

Cumulative Effects

No further projects are currently planned within the EXF project area. Accordingly, within the boundary of the Forest and for the reasonably foreseeable future (0-5 years), no cumulative effects relating to the EXF project are anticipated

3.3.8 Invasive Plants / Noxious Weeds

Introduction

Invasive plants are undesirable in forest ecosystems because they tend to displace native plants, including, potentially, rare and protected species, degrade habitat for animal species, promote soil erosion, and lessen the value of recreational experiences. As continually disturbed, often open areas, roadsides are highly suitable habitats for many invasive plants. Many of the weed sites within the analysis area are located along roadsides. Relating to this, motorized vehicles are most likely the major vector for the introduction and/or spread of invasive plants within the analysis area. Vehicles may include those associated with public recreational use or harvesting of special forest products (e.g., firewood, mushrooms), or general forest management operations including commercial harvest, inventory, monitoring, road maintenance and fire suppression. Vehicles have the potential to transport weed seeds included in soil and muck stuck in tire treads or on undercarriages. Also, portions of whole, seed-bearing invasive plant species can become wedged in bumpers and within undercarriages when vehicles drive through patches of weeds. By these means, weed seeds can be imported or moved about within the analysis area.

Forest Service Manual direction requires that Noxious Weed Risk Assessments be prepared for all projects involving ground-disturbing activities. For projects that have a moderate to high risk of introducing or spreading noxious weeds, Forest Service policy requires that decision documents must identify noxious weed control measure that will be undertaken during project implementation (FSM 2081.03.29; November 1995).

Executive Order 13112 implemented on February 3, 1999 requires Federal agencies to use relevant

programs and authorities to prevent the introduction of invasive species and not authorize or carry out actions that are likely to cause the introduction or spread of invasive species unless the agency has determined, and made public, documentation that shows that the benefits of such actions clearly outweigh the potential harm, and all feasible and prudent measures to minimize risk of harm will need to be taken in conjunction with the actions. The USDA Forest Service *Guide to Noxious Weed Prevention Practices* (July, 2001) supports implementation of Executive Order 13112 on Invasive Species.

Region 6 of the Forest Service has prepared an Invasive Plant Environmental Impact Statement (hereinafter called R6 IP FEIS). The Final EIS was released in June 2005 and the Record of Decision (ROD) was signed in October 2005 (USDA Forest Service R6, 2005); implementation began March 1, 2006. The R6 FEIS applies to non-native invasive plant species, but not to native competing and unwanted vegetation. Standards and Guidelines in the R6 FEIS are incorporated into Forest Plans in the region.

Existing Condition

No invasive plant species are documented to occur within or immediately adjacent to the project area. No detections of noxious weed species were noted by Deschutes National Forest botanists during surveys within the project area in 2005, 2007 and 2008.

Environmental Consequences

The Deschutes National Forest has developed a standardized noxious weed risk assessment process to be conducted as a part of the project planning process. Risk rankings are based on the following sets of criteria.

High Risk results if each of the following applies:

1. Known weeds in or adjacent to project area.

2. Any of vector #s 1-8 in project area.
3. Project operations in or adjacent to weed sites.

Moderate Risk results if:

1. Any of vector #s 1-5 are present in project area.

Low Risk results if:

1. Any of vector #s 6-8 present in project area,
   OR
2. Known weeds present in or adjacent to project area, even if vectors lacking.

Vectors ranked in order of weed introduction/spread risk:

1. Heavy equipment (implied ground disturbance).
2. Importing soil/cinders/gravel.
3. Use by OHVs.
4. Grazing (long-term disturbance).
5. Pack animals (short-term disturbance)
6. Plant restoration.
7. Use by recreationists.
8. Presence of USFS project vehicles.

Both alternatives have been given a MODERATE risk ranking for the introduction and spread of noxious weeds because project activities will require the use of heavy equipment. The risk is proportional to the area of ground disturbance and miles of roads used in each action alternative; therefore, Alternative 2 poses a slightly higher risk than Alternative 3 based on the greater number of acres of ground disturbance.

Chapter 2.2.4 specifies the prevention standards and practices that are incorporated into the project design to reduce the risk of introducing invasive plants. Both action alternatives will require the use of clean-equipment clauses, weed-free fill material, and the minimization of soil disturbance. These prevention techniques will minimize the risk of invasive plants becoming established within the project area where there currently are none.

There are no known projects that are ongoing or reasonably foreseeable that would overlap the project area; therefore, there is no potential for cumulative effects from other federal actions. There is low OHV use in the area which could pose a source of weed introduction. However, the implementation of the Travel Management Rule expected in 2009 would further reduce this risk by limiting motor vehicles to designated routes with no off-trail travel.

3.3.9 Economic Analysis

Introduction

Forest Service Handbooks 1909.17 and 2409.18 direct the evaluation of Economic Efficiency for proposed projects. To assess economic efficiency of Alternatives 2 and 3, the anticipated timber volumes and costs were entered into TEA.ECON, a spreadsheet developed by the Forest Service to assess economic efficiency. The analysis can be used to compare alternatives, not to give an absolute number for the outputs. Numbers useful for comparing alternatives include a benefit/cost ratio, discounted benefits, discounted costs, and present net value. Effects on the local economy include estimated number of jobs created or maintained.

This analysis does not place a value on indirect benefits which may occur (such as reduced risk of stand-replacing wildfire). Other amenity values, such as dispersed recreation or wildlife habitat were included in the discussion but actual values were not developed. Table 54 summarizes this analysis.

Affected Environment

The EXF project is located in Deschutes County. The Deschutes LRMP (1990) identified agriculture, wood products manufacturing, and recreation and tourism as the three most important basic industries in the local area.

The downturn in the primary lumber industry, driven by a lack of consistent forest supplies, automation, and a changing global economy, has affected local forest workers, whose incomes have declined because of steep competition for fewer job opportunities. This is especially true in Central Oregon where in Deschutes County 84% of the land base is dominated by BLM and Forest Service managed lands.

Although the decade from 1990 to 2000 saw a 10% decrease in total forest sector employment in Oregon (with a loss of approximately 9,600 jobs statewide), the industry is still an important contributor to the local economies of Central Oregon. Also, as jobs in the primary and secondary forest product sectors have declined, there has been a reported employment growth in firefighting, ecological restoration and other contract services that fall within the forestry services sector.

Forest sector employment has far more impact in Central Oregon than for the State of Oregon as a whole. Wood products manufacturing is still the single largest industrial employer in Jefferson County and the second largest industry in Crook County. In Deschutes County, according to 2005 Oregon Employment Department, 1,798 people were employed in wood products manufacturing. This places it a distant third behind tourism (7,772 jobs) and Health and Social Assistance (6,062 jobs), but these jobs do represent the seventh highest average paying jobs in the county and 9 per cent of primary industrial jobs, a far higher average than for Oregon as a whole.

The primary effect on local communities would be in terms of employment provided by preparation, implementation and administration of thinning and fuels reduction activities. The alternatives provide a variety of activities that would require widely varying equipment and skills. The level of benefit to local communities would depend on the capacity of existing contractors residing in the area in terms of skills and equipment, the labor force available to these contractors, the amount of existing work they have under contract, their desire to acquire larger contracts, new contractors seeking opportunities, and other contracting requirements such as programs for small businesses. The level would also depend on the amount of funding received for activities over the next 5+ years.

Another economic benefit from thinning activities in the EXF Project area is a supply of wood products to mills in Eastern and Central Oregon and the Willamette Valley. Secondary benefits to employment in the wood products industry could result when this project is implemented.

Environmental Consequences

Assumptions regarding values of possible wood products were based on estimated market value in the 3rd quarter of 2008 for various sizes for ponderosa pine, the primary species to be removed. If the market improves the values would increase, and conversely, if the markets go down, the values would be less. Another assumption was that the wood products would be hauled to Gilchrist, Oregon.

Alternative 1 – No Action

Direct, Indirect, and Cumulative Effects

No commercial forest products would be provided to the economy. There would be no net sale value, and no additional jobs would be created or maintained. There would be no benefit to the local economy. Although Alternative 1 would generate no current revenues to returns, there is a cost resulting from the expenditure of planning funds.

Effects Common to Alternatives 2 and 3

Direct, Indirect, and Cumulative Effects

Included in the analysis is an estimate of the value of the logs. The current estimated value of the timber is 499,790. This value is affected by the logging cost and hauling costs. For example, if fuel prices rise, the price paid for timber would likely decrease. The value of timber is constantly changing dependent on local, regional, and international supplies and demands.

Alternative 3 provides fewer timber products to the economy than Alternative 2, but Alternative 1 would provide no timber products. Harvesting and manufacturing wood products could create 268 jobs under Alternative 2 and 230 jobs under Alternative 3 (15% and 12% respectively of the number of people in Deschutes County employed in the wood products industry). The timber work and jobs created translate into income as shown in Table 65. Roadwork and fuels treatments with both action alternatives would create jobs in addition to the timber jobs.

Table 65. Summary of the EXF Project Outputs

Output	Alternative 1	Alternative 2	Alternative 3
Timber Volume	0	28 mmbf	24 mmbf
Jobs Maintained or Created[1]	0	268	230
Estimated Employee Income[2]	0	$9,145,768	$7,848,980

[1] Calculated using figures for the Deschutes National Forest from Appendix B-5 of the FY 1997 Timber Sale Program Annual Report; estimated 9.6 jobs per million board feet maintained or created.
[2] Derived by multiplying the number of jobs maintained or created by $34,126 the average 2008 salary in Central Oregon for lumber and wood products jobs. Source of salary information: Oregon Covered Employment and Payrolls by County and Industry, Oregon Employment Dept., and US Bureau of Labor Statistics.

3.3.10 Cultural Resources

Introduction

Management direction for cultural resources is found in the Deschutes National Forest LRMP, in the Forest Service Manual section 2360, in Federal Regulations 36 CFR 64 and 36 CFR 800 (amended May 1999), and in various federal laws including the National Historic Preservation Act (NHPA) of 1966 (as amended), the National Environmental Policy Act, and the National Forest Management Act.

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 (National Register), and protect or mitigate effects to resources that are eligible or unevaluated. Specific Standards and Guides that are relevant for this project can be found in Chapter 1, Management Direction.

Affected Environment and Environmental Consequences

The following were reviewed prior to field investigation: previous survey maps, historic inventory maps, Cultural Resource Overview, Township and Range files, Master Title Plats, cadastral survey notes, and the District geology and soil inventory maps. The most recent cultural resource inventory surveys were conducted in the project area in 2006. One new cultural resource site was identified. Project activities will avoid this site, and there will therefore be no direct, indirect, or cumulative effect to cultural resources under either action alternative.

In accordance with stipulations in the 2003 Regional Programmatic Agreement among USDA-Forest Service, the Advisory Council on Historic Preservation, and the Oregon State Historic Preservation Office, a finding of **Historic Properties Avoided** has been determined for this project.

This finding is based on the knowledge that avoidance is the desired option. The protection of eligible or potentially eligible sites from project effects leads to this finding as described in 36CFR800.16(i) (Federal Register Vol. 65, No. 239; Tuesday, December 12, 2000; page 77738).

Project design feature #29 requires that if previously unknown sites or artifacts are found during project implementation, they will be flagged and operations in the area avoided until an archaeologist is consulted. This assures protection by avoidance through all phases of project implementation and subsequent management activities.

3.3.11 Long-term Climate change

Although El Nino/Southern Oscillation and the Pacific Decadal Oscillation comprise the primary factors for climate variability in the Pacific Northwest (Climate Impacts Group[4]), the influence from global climate change is a growing concern. According to the Climate Impacts Group, based out of the University of Washington, climate modeling for the Pacific Northwest predicts a future rate of warming of approximately of approximately 0.5 degrees Fahrenheit per decade for the Pacific Northwest through at least 2050, relative to the 1970-1999 average temperature. Temperatures are projected to increase across all seasons, although most models project the largest temperature increases in summer (June-August), and the average temperatures could increase beyond the year-to-year variability observed in the Pacific Northwest during the 20th century as early as the 2020s.

The proposed and approved research addresses climate change as a research question: What is the long-term influence of climate change interacting with a set of fuel reduction treatments on vegetation dynamics and forest structure? Climate change is a form of disturbance that has not been adequately addressed in thinning and fuel reduction research. This portion of central Oregon has gone through at least five distinct periods of warming climate over the past 110 years (NASA Global Climate Change Website http://climate.jpl.nasa.gov). In the Western United States and at the continental scale (1 km), long-term satellite data show consistently earlier onsets of spring greening and corresponding increases in length of growing season associated with projected climate change (Forest Service Climate Change Resource Center: http://www.fs.fed.us/ccrc). Our ability to downscale current large scale projections to specific project-scale sites remains limited, we are forced to operate with relative little confidence in most projections. Small changes in growing season duration may result in expansion of species that have relatively narrow habitat requirements.

Lookout Mountain provides a unique opportunity to explore vegetation dynamics under a changing climate regime because it is topographically simplistic and contains essentially uniform or homogenous soils (deep pumice derived from the explosion of Mt. Mazama). It also contains several relatively clear and distinct ecotones (boundaries between easily recognized plant associations). Treatment blocks differentiate two elevation zones (above 4,200 feet (1280 m) or below) and two aspect zones (southeast and south). The working hypothesis under the stated research question is that initial or early indications of vegetation dynamics are most likely to become apparent in the shrub and herbaceous strata, and these dynamics will be manifest as expansion of species from drier sites to those that are currently more moist

[4] Intergovernmental Panel on Climate Change (IPCC). Their reports (2007) provide the authoritative scientific basis for subsequent Forest Service analysis of the phenomenon. Information specific to the Forest Service can be found in the latest Synthesis and Assessment Product 4.4.24.

as conditions become increasingly stressed. This means that shrubs and herbaceous species that dominate in plant associations on flat topography outside the treatment area or only on the edges of Block 4, such as antelope bitterbrush (Purshia tridentata), will expand upward in elevation. Under this hypothesis, the niche space of individual species and entire assemblages of species will shift from Block 4 and Block 2 to Block 1 and eventually to Block 3. Within each block, shifts can be expected where disturbance provides access and growing space, and will most likely be manifest under Treatment 2 and 3 and perhaps 4. This work will provide a validity assessment for current efforts to downscale vegetation dynamic projections to 80 m resolution. This will provide insights into the effects of climate change at the community scale, and provide managers much needed information on the restructuring of plant composition as a result of regional climate interacting with legacies of past management. These insights will inform management options to better incorporate these changes.

3.3.12 Human Health & Safety

Under each action alternative, danger trees would be removed from along all haul routes. The signing of project activity areas in addition to notification of additional project-related traffic would promote a safe environment for forest visitors during project implementation. Implementation of action alternatives would increase the potential for encounters on roadways between forest visitors and equipment associated with harvest. This elevated level of risk would be present for the short-term (approximately 5 years). Safety measures such as informational signing, flaggers, and road maintenance activities, such as brushing roads for increased visibility, would be enforced in the timber sale contract.

The work environment during all phases of logging operations would be physically demanding and potentially hazardous; effects to worker health and safety would be possible. Activities with the highest potential for serious injury would include tree felling and helicopter operations (helicopter may be used for prescribed fire ignition). All project activities carried out by Forest Service and Forest Service contract employees would comply with State and Federal Occupational Safety and Health Administration (OSHA) standards. All Forest Service project operations would be consistent with Forest Service Handbook 6709.11 (Health and Safety Code)

The Clean Air Act lists 189 hazardous air pollutants to be regulated. Some components of smoke, such as polycyclic aromic hydrocarbons (PAH) are known to be carcinogenic. Probably the most carcinogenic component is benzo-a-pyrene (BaP). Other components, such as aldehydes, are acute irritants. In 1994 and 1997[5], air toxins were assessed relative to the exposure of humans to smoke from prescribed and wildfires. The five toxins most commonly found in prescribed fire smoke were:

Particulate matter - Particulates are the most prevalent air pollutant from fires, and are of the most concern to regulators. Research indicates a correlation between hospitalizations for respiratory problems and high concentrations of fine particulates (PM2.5, fine particles that are 2.5 microns in diameter or less). Particulates can carry carcinogens and other toxic compounds. Overexposure to particulates can cause irritation of mucous membranes, decreased lung capacity, and impaired lung function. Particulate matter is analyzed for each alternative in Chapter 3.3.2.

Acrolein - An aldehyde with a piercing, choking odor. Exposure severely irritates the eyes and upper respiratory tract.

Formaldehyde - Low-level exposure can cause irritation of the eyes, nose and throat. Long-term exposure is associated with nasal cancer.

Carbon Monoxide - CO reduces the oxygen carrying capacity of the blood, a reversible effect. Low exposures can cause loss of time awareness, motor skills, and mental acuity. Also, exposure can lead to

[5] Results of an April 1997 conference to review the results of health studies and develop a risk management plan for the protection of fire crews were published by Missoula Technology Development Center in Health Hazards of Smoke, Technical Report 9751-2836-MTDC.

heart attack, especially for persons with heart disease. High exposures can lead to death due to lack of oxygen.

Benzene - Benzene causes headache, dizziness, nausea and breathing difficulties, as well as being a potent carcinogen. Long-term exposure can cause anemia, liver and kidney damage, and cancer. The closest Designated Area to the analysis area is the city of Bend, Oregon; the communities of Crescent, Sunriver, and La Pine are closer to the analysis area but are not as highly populated.

The greatest risk of exposure to airborne toxins from prescribed fires or wildfires would be to firefighters and forest workers implementing the prescribed burning. It is unlikely the general public would be exposed to toxin levels adverse to human health during implementation of prescribed burning operations in the EXF analysis area because of the distance from populated areas and the application of prescriptions designed to lessen the release of particulate matter. People who suffer from breathing ailments may experience some difficulty during periods of prescribed burning, especially during atmospheric conditions that do not favor dispersion of smoke. The Forest Service voluntarily follows the guidelines assigned by Oregon Smoke Management to limit state-wide exposure on a cumulative basis, in compliance with the Clean Air Act.

Forest workers and firefighters can face unhealthy levels of smoke when patrolling or holding fire lines on the downward edge of a wildfire or prescribed fire, or while mopping intense hot spots. In most cases, measures such as education on the effects of short and long term exposure, rotation out of the smoke, and the use of respirators can reduce exposure levels. OSHA regulates exposure to hazardous materials in the workplace. All project activities carried out by Forest Service and Forest Service contract employees would comply with State and Federal OSHA standards.

3.3.13 Forest Plan Amendments

Two Forest Plan amendments are required to implement either action alternative. The amendments, shown on page 18, are specific to Eastside Screens Interim Wildlife Standards that prohibit harvesting trees > 21" DBH or harvesting within LOS types that fall below HRV.

Of the 264 acres east of the owl line that are proposed for treatment, approximately 21 acres are classified as LOS (2004 satellite data). Table 66 shows how many acres are involved with the first amendment and what the resulting structure is expected to be.

Table 66. How the Existing LOS is Affected by Thinning.

PAG	LOS Type	Acres Affected in EXF*	% of LOS Type in the Watershed	Resulting Structure
Ponderosa Pine Dry	Late multi-strata w/ large trees (currently below HRV)	11	1%	All but one acre of the ponderosa pine late multi-strata will continue to have enough large trees per acre to meet the single strata LOS criteria.
Mixed Conifer Wet	Late single-strata w/ large trees (currently within HRV)	7	2%	Five acres will no longer meet the criteria for single-strata LOS.

Ponderosa Pine Dry	Late single-strata w/ large trees	3	1%	These 3 acres will remain single-strata with large trees following density reduction.

Stand exam information was gathered within the project area itself. That data shows that even more of the stands may meet the LOS classification. However, for the purposes of the HRV analysis, the satellite data was the best data available for the entire watershed, which is the scale at which HRV is assessed.

The EXF project is designed to implement the Pacific Northwest Research Station's study plan "Forest Dynamics after Thinning and Fuels Reduction in Dry Forests." The research is based on the project area being divided into four blocks of relatively equal aspect and elevation. The treatment types were then randomly assigned to units within each block. The units, or portions of units, east of the owl line fall within treatment blocks 3 and 4 where the all treatment types are planned. Avoidance of patches of the stands that contain sufficient numbers of large trees to quality as LOS would significantly interfere with the ability to answer the research questions posed in the study plan. The control unit will provide an area where any existing LOS is retained; the other treated areas will be put on a trajectory towards resiliency.

The target residual stand density for this area is between 53 square feet of basal area. Region 6 certified cruisers installed forty-two fixed 1/10 acre plots on 217 acres east of the NSO line in units 43 and 44. This was done in order to determine if a site-specific amendment to the Eastside Screens would be needed to remove trees larger than or equal to 21" DBH to meet the target basal area. The 217 acres is approximately 80% of the area east of the owl line.

Analysis of the plot data shows that the area has an existing basal area of 154 square feet per acre. If all trees 21" DBH and greater are retained in accordance with the Screens, residual basal areas would exceed the target of 53 square feet per acre on 31 of the 42 (73.8%) plots and the overall average residual basal area would be approximately 91 square feet per acre in this portion of the Experimental Forest. This level is 20 square feet above the recommended UMZ of 70 for this ponderosa pine plant association. It is also 38 square feet per acre above the study plan's target residual basal area.

To meet the desired residual stand basal area of 53 (plus or minus 5) would require amending the 21 inch maximum diameter Eastside Screen direction for this project so that larger trees could be cut and removed in the timber sale. The largest trees on site will still be retained to provide the desired residual basal area.

Table 67. Proposed Thinning in Units East of the Owl Line.

Unit	Acres Affected	Current Basal Area	Treatment Type	Target Basal Area
31	3	184	thin to 50% UMZ	70
34	17	184	thin to 75% UMZ	105
42	29	154	thin to UMZ	70
43	70	151	thin to 75% UMZ	53
44	147	151	thin to 75% UMZ	53
total	266			

FSM 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 goal for the Experimental Forest management area is to provide an area where field research activities are conducted while considering other resource values; the objective of the Experimental Forest is to serve as a field laboratory for research. Experiments are conducted to evaluate the effects of silvicultural practices on growth and yield of ponderosa and lodgepole pine. The amendment will allow implementation of a study plan (peer reviewed and approved by the PNW Station Director) that meets the goals and objectives of the Pacific Northwest Research Station and specifically the Pringle Falls Experimental Forest, which was established in 1939 for silviculture, forest management and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range. It also provides for activities that will contribute to the achievement of the management prescriptions for the area.

The first amendment would allow the study plan to be implemented as designed on approximately 21 acres of what is considered to be LOS forest that falls below HRV in the watershed. As Table 67 shows, this is a small fraction of the existing LOS in the watershed for these two PAGs. The resulting structure would remove enough large trees that the stands may no longer meet the definition of LOS, but the thinning also follows direction in Interim Wildlife Standard (6. d. 2. c.) to encourage the development and maintenance of large diameter, open canopy structure. The thinning will also follow direction to "manipulate vegetative structure that does not meet LOS conditions in a matter that moves it towards these conditions because thinning in the mid-seral structural stages (that are above HRV for both of the PAGs) will move the stands towards LOS."

The second amendment would allow thinning of trees over 21" DBH on 266 acres (about 0.6% of the Fall 6th field subwatershed). This is a minor change in one interim standard that would not alter the multiple-use goals and objectives for long-term land and resource management. The Eastside Screens were intended to avoid management activities in the interim that would move conditions away from the HRV. The proposed thinning, including removing trees >21" DBH, will leave the largest trees in any given portion of the stands to meet the target basal area. The resulting structure will move the LOS ponderosa pine in the Lookout Mountain Unit closer to pre-Euro-American conditions that could develop old-growth structural characteristics with trees able to survive for centuries.

3.3.14 Other Disclosures

Incomplete and Unavailable Information

Predictions of effects were made with the most current information available. The EXF IDT did not identify any types of incomplete or unavailable information that meet the criteria described in the CEQ Guidelines (Sec. 1502.22 Incomplete or unavailable information).

Relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity

NEPA requires consideration of the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill

the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The Multiple Use – Sustained Yield Act of 1960 requires the Forest Service to manage National Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations. Thinning activities that provide a commercial product, or use of standing timber, can be considered a short term use of a renewable resource. As a renewable resource, trees can be re-established and grown in again if the productivity of the land is not impaired. Maintaining the productivity of the land is a complex, long-term objective. All alternatives protect the long-term objective of the project area through the use of specific Forest plan Standards and Guidelines, mitigation measures, and BMPs. Long-term productivity could change as a result of the various management activities proposed in the alternatives. Timber management activities would have a direct, indirect, and cumulative effect on the economic, social, and biological environment. Those effects are disclosed in Chapter 3 of this analysis.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all alternatives. Sustained yield of timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the analysis area may fluctuate as a result of short-term uses, but no long-term effects to water resources are expected to occur as a result of timber management activities. All alternatives would provide the fish and wildlife habitat necessary to contribute to the maintenance of viable, well distributed populations of existing native and non-native vertebrate species. The abundance and diversity of wildlife species depends on the quality, quantity, and distribution of habitat, whether for breeding, feeding, or resting. Management Indicator Species are used to represent the habitat requirements of all wildlife species found within the project area. By managing habitat of indicator species, the other species associated with the same habitat would also benefit. The alternatives vary in risk presented in wildlife habitat capability.

None of the alternatives would have an effect on the long-term productivity of timber resources.

Unavoidable Adverse Effects

Several unavoidable adverse effects, including some that are minimal and/or short term, were identified during the analysis. Adverse effects are associated with all alternatives, including the No Action and the Action alternatives. Resource protection measures or mitigations were identified for each adverse effect associated with an Action alternative as a means to lessen or eliminate such effects on specific resources.

See the section titled “Resource Protection Measures” in Chapter 2.2.4 of this EIS. Resource areas determined to have potential adverse effects (resulting from any of the alternatives – including No Action and the Action Alternatives) are documented within the appropriate Environmental Consequences sections of each resource in Chapter 3.

Soils

Reference the section titled “Soil Quality” in Chapter 3.3.4 of this EIS. Soil restoration by subsoiling is proposed in all areas that would exceed 20% detrimental soil conditions.

- Alternative 2 would increase the amount of detrimental soil condition in the project area to 497 total acres.
- Alternative 3 would increase the amount of detrimental soil condition in the project area to 429 total acres.

Wildlife

Northern Spotted Owl

Reference the northern spotted owl discussion in the section titled "Threatened and Endangered Species" in Chapter 3.2 of this EIS.

- Alternative 2 would directly reduce or degrade approximately 211 acres of spotted owl nesting, roosting, and foraging habitat and remove 341 acres of dispersal habitat.
- Alternative 3 would remove 283 acres of dispersal habitat.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a 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 power line right-of-way or road.

The action alternatives are not expected to create any impacts that would cause irreversible damage to soil productivity. The development and use of temporary roads and logging facilities is considered an irretrievable loss of soil productivity until their functions have been served and disturbed sites are returned back to a productive capacity. Both action alternatives include soil restoration activities that would improve the hydrologic function and productivity on detrimentally disturbed soils. There would be no irretrievable losses of soil productivity associated with these reclamation treatments.

Prime Farmland, Rangeland, and Forestland

All Alternatives were consistent with the Secretary of Agriculture Memorandum 1827 for the management of prime farmland. The EXF Project area does not contain any prime farm land or rangelands. Prime Forest Land, as defined in the memorandum, is not applicable to lands within the National Forest System.

Energy Requirements of the Alternatives

Under the action Alternatives, additional consumption of fossil fuels and human labor would be expended for the use of vehicles transporting Forest workers, chainsaws, heavy equipment and trucks. Fossil fuel would not be a retrievable resource. There are no irregular energy requirements involved in implementing any of the action alternatives.

Civil Rights and Environmental Justice

Civil Rights legislation and Executive Order 12898 (Environmental Justice) direct an analysis of the proposed alternatives as they relate to specific subsets of the American population. The subsets of the general population include ethnic minorities, people with disabilities, the elderly, and low-income groups. Environmental Justice is defined as the pursuit of equal justice and protection under the law for all environmental statutes and regulations, without discrimination based on race, ethnicity, or socioeconomic status. The minority and low income populations groups living in counties surrounding the project area work in diverse occupations. Some minorities, low income residents, and Native Americans may rely on forest products or related forest activities for their livelihood. This is especially true for those individuals that most likely reside in the rural communities adjacent to National Forest Lands, such as La Pine, Crescent, and Gilchrist, Oregon.

The no action alternative would continue the local economic situation as described in the section titled Economics. Opportunities for employment of minority and low income workers may arise through contract activities for various forest work, such as thinning, hand piling, and various small business contracts related to work outside the project area, but there are no known disproportionately high effects to any ethnic minorities, people with disabilities, and low-income groups.

Under both action alternatives there would be no known adverse effects that would be disproportionately high to any ethnic minorities, people with disabilities, and low-income groups as a result of implementation of either action alternative in the EXF project. Within the social context

presented, the action alternatives developed for this project have the potential to bring in workers from the outside to perform logging and post harvest activities such as small tree thinning and hand piling. While the outside workforce is more likely to be racially diverse than the local resident population, the residents have worked effectively with and supported anticipated fluctuations in the workforce expected with the implementation of an action-based alternative. The primary services needed by the workers would be food and shelter. Local businesses that can supply food (grocery stores and restaurants) and other services would capture most of the money being spent by the workers in the area. Since these businesses have supported similar workforces in the past, capitol expansion would probably not be required.

Chapter 4

Consultation and Coordination

Consultation and Coordination

4.1 Public Notification & Participation

Public Participation

During the initial scoping (see Chapter 1.5), a number of comments and questions were received. Responses varied from those who wanted more clarification to specific suggestions for project implementation. Comments were used to help develop the planning issues and alternatives (see Chapter 1.6 and 1.7). Additional public involvement took place as described in Chapter 1.5. All comments and correspondence are part of the Project Record, located at the Bend/Ft. Rock Ranger District office.

Public Comment Period

A public comment period is offered on this DEIS per NEPA regulations (40 CFR 1503; 1506.10).

The following individuals, agencies, and organizations were either notified of the availability of the Draft EIS, or sent a copy of the document:

National Marine Fisheries Service, Habitat Conservationists Division
Northwest Region
U.S. Army Engr. Northwestern Division
Northwest Power Planning Council
Advisory Council on Historic Preservation
USDA APHIS PPD/EAD
Natural Resources Conservation Service
National Environmental Coordinator, U.S. Department of Agriculture
Susan Jane Brown
Glenn Burleigh
Fred Tanis
Larry McGlocklin
Kate Ramsayer, The Bulletin
Josh Laughlin, Cascadia Wildlands Project
Mr. & Mrs. John Pindar
Kathryn J. Nachand
Franklin Engel
Leonard Houston
Arlie Holm
Scott Odgers
Mr. & Mrs. David Scharfenberg
Ken Wienke, Boise Cascade
Paul Hammerquist
Jon Cain
Larry Ulrich
Ed Duffy
President, Deschutes County 4-Wheelers
Billy Toman
Stan Summers
Rick Bozarth
Bozarth's Offroad Service Specialties
Joani Dufourd, RecConnect LLC
Randy J. Zustiak
Gordon Baker
Robert Mullong
Cynthia West, Assistant Station Director
Stuart Otto, Stewardship Forester, Oregon Dept. of Forestry
Bergen Bull
Mr. Scott Turo, Off Reservation Habitat Biologist, Confederated Tribes of the Warm Springs
Dean Adams, Tribal Chairman, Burns Paiute Tribe
Susan Skakel, Deschutes National Forest
Sally Bird, Manager, Cultural Resources, Confederated Tribes of the Warm Springs
Ron Suppah, Tribal Chairman, Confederated Tribes of the Warm Springs
Mr. Robert Brunoe, General Manager, Natural Resources, Confederated Tribes of the Warm Springs
Amos Firstraised, Burns Paiute Tribe, Natural Resources
Wanda Johnson, Chairperson, Tribal Council, Burns Paiute Tribe
Will Hatcher, Acting Director, Natural Resources Dept., The Klamath Tribes
Clay Penhollow, Dept. of Natural Resources, Confederated Tribes of the Warm Springs
Lonny Macy, Natural Resources Policy Planner, Confederated Tribes of the Warm Springs
Dyarle Sharkey

Patti Gentiluomo
Wade N. Foss
Bruce Cunningham, Moon Country Snowmobilers
Lynne Breese, Eastern Oregon Forest Protection Association
Mr. & Mrs. Scott O'Neill
June Ramey
Mr. & Mrs. Jon Pyland
Mark Davis
Brigette M. Whipple, Confederated Tribes of the Warm Springs
Steve Fitzgerald, Oregon State Universtity Extension Service
Scott McCaulou, Deschutes River Conservancy
Ryan Houston, Upper Deschutes Watershed Council
Vic Russell
Mr. and Mrs. Kenneth Holmes
Northwest Mountain Region, Regional Administrator, Federal Aviation Administration
L. Ulven
Katie Lighthall, Project Wildfire
Jim Gustafson, La Pine Rural Fire Protection District
Rod Boozell
Roger Prowell, City of Bend
Charla Q. Ranch
Mr. and Mrs. Ronald Hart
SROA, Public Affairs Committee Chair
Northwest Environmental Defense Center
Ken Copeland
Unit Forester, Oregon Department of Forestry
Patricia Moore
Mr. and Mrs. John Emerson
Mr. & Mrs. David Jones, East Lake Resort
Joseph Kirk, Chairman, Tribal Council, The Klamath Tribes
Wes Pyne
D. Roberson
Jim Wilson, JTS Animal Bedding
Flip Houston, Scott Logging Inc.
Jim Anderson
Ms. Diane Teeman, Staff Specialist, Cultural Resources, Burns Paiute Tribe
Edward Kerber
Loren Smith
George Worthner
Rick Brown, Defenders of Wildlife
Ginny Murtaugh
Mr. and Mrs. Stan Martineau, Deschutes River Woods Homeowners
Sandra Swanlund
Rod Bjorvik
Chris Kerber
Kenton Dick, Cultural Programs Specialist, Burns Paiute Tribe
Ed Graham
Wildfire
John Zachem
Keith Cloudas
U.S. Department of Energy, Dir. Office of NEPA Policy and Compliance
Lydia Garvey
Mr. Perry Chocktoot, Director, Cultural and Heritage Department, The Klamath Tribes
Larry Langston, Fire Marshall, City of Bend
Sandra Swanlund
Mr. and Mrs. Frank Pennock
Mr. Scott Walley
Chuck Burley, American Forest Resource Council
Robert Speik
Edward J. DePuit, Pacific Northwest Research Station, Wenatchee Forestry Sciences Laboratory
Dave Perry
Jim Barrett
Andy Youngblood, Research Forester, LaGrande Forestry Science Laboratory
Lisa Clark, Fire Mitigation Specialist, Central Oregon Fire Management Service
Asante Riverwind, Eastern Oregon Forest Organizer, Oregon Chapter Sierra Club
Shawn Carroll
Alexander Sahonchik, BS F.
Karen Coulter, Blue Mountains Biodiversity Project
Tim Lillebo, Oregon Wild
Marilyn Miller, Sierra Club - Juniper Group
Nancy Gilbert, USDI Fish & Wildlife Service
John Morgan, Ochoco Lumber
Glen Ardt, Habitat Biologist, Oregon Department of Fish and Wildlife
Jim Larsen, Upper Deschutes River Coalition
Mr. & Mrs. Pat Schatz, Crane Prairie Resort
Joe Stutler, County Forester, Deschutes County
Chandra LaGue, Oregon Wild
Dan Kruse, Cascadia Wildlands Project
David Pitts
Doug Heiken, Oregon Wild
Mr. and Mrs. Donald Kerr
USDA, National Agricultural Library
Environmental Protection Agency, Region 10, EIS Review Coordinator
1200 Sixth Avenue
Patrick Griffiths

4.2 Consultation with other Agencies

An initial consultation meeting with the U.S. Fish and Wildlife Service took place April 29, 2008 at the Bend Fort Rock Ranger District office. The purpose of the meeting was to introduce the purpose and need for the project and the preliminary impacts it may have on spotted owls. It was at this meeting that this project was determined to potentially have adverse effects to spotted owls.

In June 2008 and on October 2, 2008 meetings in the field were held with the same representative of the USFWS to introduce the existing condition of the spotted owl habitat, receive advice/feedback on the field verification of the mapped NRF, and discuss the anticipated effects of the proposed treatments within spotted owl habitat. It was confirmed that ground-truthing and elimination of stands previously mapped as habitat to non-NRF habitat was warranted, and the proposed levels of thinning would affect the stands' abilities to function as NRF habitat. An additional field visit occurred on July 16, 2009 and an office meeting with the researcher occurred on July 31, 2009. A Biological Assessment will be submitted to the USFWS with a request for formal consultation under the Endangered Species Act.

Initial response from the Environmental Protection Agency (EPA) during the scoping phase included a list of analysis to include and factors to consider in the EIS. Per Forest Service regulations, this DEIS is filed with the EPA's Office of Federal Activities in Washington, DC. The EPA will publish a notice of availability in the *Federal Register*.

4.3 Preparers / Interdisciplinary Team

Paul Brna – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Certified Silviculturist

Contribution: Forested Vegetation Analysis

Education / Experience: BS Forest Science, Pennsylvania State University; BS Wood Technology, Pennsylvania State University; 1 ½ years Forestry Tech for BLMN; 14 years as Forester for Bureau of Indian Affairs; 17 years Forester for Forest Service on two National Forests.

Rod Jorgensen – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Soils Scientist

Contribution: Soil Resource Analysis

Education / Experience: BS Soil Science, California State Polytechnic University, Pomona (1977)

31 years professional experience

Janine McFarland – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Archaeologist

Contribution: Heritage Resources

Education / Experience: MA from Oregon State University, 24 years of FS experience on four National Forests; BLM and National Park Service.

Beth Peer, USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Environmental Coordinator

Contribution: Interdisciplinary Team Leader, Writer/Editor.

Education / Experience: Bachelor of Science University of Oregon, 1990. Forest Service 18 years including positions in Heritage Resources, GIS, and Planning.

Charmane Powers – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Botanist

Contribution: Threatened, Endangered, and Sensitive Plants analysis; Invasive Plants analysis.
Education / Experience: Bachelor of Science from The Evergreen State College, 1984. 19 years in the field of botany, 5 years in the field of wildlife (birds).

Jim Schlaich, USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Forester

Contribution: Interdisciplinary Team Leader until December 2008.
Education / Experience: BS Forest Management, Utah State University-1977, 32 years experience

Deana Wall – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Fuels Specialist

Contribution: Fire & Fuels Effects Analysis

Education / Experience: B.A. Biology, minor Chemistry, Lewis and Clark College; 12 years with USFS (Umpqua, Mt. Baker-Snoqualmie, Deschutes NFs), 10 years in Fire and Fuels, 2 years as a Fuels Specialist.

Barbara Webb – USDA Forest Service, Deschutes National Forest, Bend/Ft. Rock Ranger District, Wildlife Biologist

Contribution: Wildlife Effects Analysis; Biological Assessment
Education / Experience: B. S. Environmental & Forest Biology (Wildlife Emphasis) SUNY College Env. Sci. & Forestry magna cum laude; 12 years as a USFS Wildlife Biologist (Wallowa-Whitman, Mt Hood, and Deschutes NFs)

Andy Youngblood, USDA Forest Service, Pacific Northwest Research Station, LaGrande Forestry Science Laboratory, Research Forester/Silviculturist

Contribution: Author of study plan; input on project design and assessment of alternatives against implementation of study plan.

Education / Experience: Ph.D., University of Alaska Fairbanks, Forest Ecology; M.S. and B.S., Utah State University, Forest Ecology. Over 30 years Forest Service research experience in ecosystem and plant community classification; silviculture practices for regeneration and culture of boreal and Pacific Northwest conifers and hardwoods; fire ecology and fire effects; dendrochronology; forest stand structure and dynamics; plant competition and competition effects on tree growth; disturbance ecology and the role of natural and human-caused disturbances. Previous locations include Bend, OR, Fairbanks, AK, and Logan, UT.

INDEX

Glossary

A

Advanced Regeneration - Small trees, usually less than 1 inch in diameter, which are growing under mature trees prior to planned harvest activities.

C

Canopy - The uppermost spreading branchy layer of a forest.

Canopy Base Height – The height above the ground of the first canopy layer where the density of the crown mass within the layer is great enough to support vertical movement of a fire. Low canopy base heights have been shown to initiate crown fire behavior.

Canopy Bulk Density - Canopy bulk density (CBD) describes the density of available canopy fuel in a stand. It is defined as the mass of available canopy fuel per canopy volume unit.

Chain – A standard measurement equal to 66 feet for the rate of spread of fire.

Cohort – A group of trees developing after a single disturbance, commonly consisting of trees of similar age, although it can include a considerable range of tree ages of seedling or sprout origin and trees that predate the disturbance.

Condition Classes - A function of the degree of departure from historical fire regimes. Condition class 1 is within or near historical conditions; class 3 is significantly altered from historical regimes.

Crop Trees -Trees which are considered suitable to meet long term management objectives for an analysis area. These may also be referred to as healthy or manageable trees. This may include both the physical make-up of the tree as well as the species.

Cryic - Soils in this temperature regime have a mean annual temperature higher than 0°C but lower than 8°C.

Cycle - As applied to uneven-aged management, it is the time interval between harvest entries. It should be noted that harvest entries in uneven-aged management are to leave residual levels of growing stock which should not need treatment for at least one cycle length.

D

Desirable Species - Any species of plant or animal which is considered to be compatible with meeting management goals and objectives.

Disturbance - Events that disrupt the stand structure and/or change resource availability or the physical environment (Oliver, 1996).

Diurnal - Active during the daytime, resting during the night.

E

Early Seral - Plants which inhabit a disturbed site within the first few years subsequent to the disturbance.

Excess Trees - Trees which are considered not needed in the stand in order to meet management objectives.

Extended Attack - When a fire has not been contained by the initial attack resources dispatched to the fire, will not have been contained within the management objectives that are established for that zone

or area, and has not been contained within the first operational period.

Extirpated - Local extinction.

F

Fire Regime - A function of the historical frequency of fire and the degree of severity of those fires.

Fuels - Vegetative matter, dead or alive, that burns in a fire. It is broadly characterized by the following categories:

- Surface or ground fuels are within a foot or so of the ground surface.
- Ladder fuels exist when you have a continuous vertical arrangement of fuel that allows fire to easily go from ground level into the tree canopy.
- Crown fuels are the tree limbs and leave that can burn with enough heat and/or wind.
- Live fuels are the green (live) herbs and shrubs.

Fuel Models - Fuel models are a tool used to standardize discussion of fuel conditions on a landscape.

G

Group Selection - A stand management method in which silviculturists identify groups of trees which need to be removed from a stand of trees in order to meet management objectives.

I

Individual Tree Selection - A stand management method in which silviculturists identify individual trees that need to be removed from a stand of trees. In this method, specific types, sizes, or qualities of trees are identified for either removing from the stand or remaining in the stand.

Initial Attack – The fire suppression effort that takes place as soon as possible following a wildland fire report.

L

Ladder Fuels – Fuels that provide vertical continuity between the ground and tree crowns, thus creating a pathway for a surface fire to move into the overstory tree crowns.

M

Mechanical Thinning - Reducing the number of trees in a stand using a factor which is independent of tree quality. The use of spacing for thinning is one type of mechanical treatment. For example, the closest tree to the points of a 15' by 15' grid would be left, regardless of tree quality.

Multi-Cohort – a stand with two or more age classes or cohorts.

N

Noxious Weeds (Invasive species) - Non-native plants listed by the State that generally have either economic or ecosystem impacts, or are poisonous to wildlife and/or livestock. They aggressively invade disturbed areas such as fires, road sides, and construction areas.

P

Prescribed Fire - Fire which is planned and used as a tool to meet specific management objectives.

Percentile Weather - The weather conditions that can be expected of X% of the days during a fire season. The standard percents are Low (0%-15%), Moderate (16%-89%), High (90%-96%) and Extreme (97%+). So low percentile weather is the average suite of weather conditions that would occur less than 15% of the time.

Problem Fire **-** Problem fires are wildfires that, because of extreme fire behavior, present a high risk to human safety and loss of forest resources.

R

Rotation - A pre-determined time frame in which an even-aged forest stand will reach maturity and be harvested.

S

Salvage - Activity, usually removal or chipping, of material killed by a disturbance event such as insects, fire, wind, etc. Where possible, this material is used as some form of forest product of commercial value, such as firewood, pulp, and/or chips.

Seral Stages - Seral stage describes the phase of development of a plant community. Early seral species are those species you would expect to find on a site soon after a major disturbance, like fire. These are species such as pines, Douglas-fir, snowbrush, fireweed, etc. They are generally shade intolerant species. Late seral are the species that can come in under a fully developed vegetative canopy, such as true firs, prince's pine, lichens, etc.

Silviculture -The theory and practice of directing forest establishment, composition, and growth for the production of forest resources to meet specific management objectives. The word is derived from the Latin word silva, which means "forest" and from cultura, which means "to develop and care for." So, it is the development and caring for the forest.

Silviculturist - One who plans, assists in and supervises the implementation of silviculture projects. The silviculturist determines (prescribes) the vegetative treatments necessary to meet the objectives for vegetation on a given site.

Site - A specific location where management activity is considered, planned, or operating.

Site Potential - The specific ability of a site to grow vegetation. It includes the soil, topographic, and climatic conditions that determine the resources available for growing vegetation.

Site Preparation - The removing or rearranging of vegetation or woody debris to meet specific management objectives. Most often it is used to describe the process(es) used to expose mineral soil areas suitable for planting or seeding desirable species of plants.

Stand - A group of trees of similar canopy structure, species composition, and/or size growing on a continuous area . A stand is distinct from neighboring stands in either structure, growing conditions, or management objectives.

Stand Density Index – SDI – A relative density measure based on the relationship between mean tree size and number of trees per unit area in a stand (Reineke 1933).

Stand Dynamics - The changes in forest stand structure with time, including stand behavior during and after disturbances (Oliver, 1996).

Stand Structure - The physical and temporal distribution of trees and other plants in a stand (Oliver, 1996).

Stratum – A distinct layer of vegetation within a forest community; canopy layer.

Subnivean - Living underneath snow.

T

Trees per Acre - The amount of trees of a specific diameter on an acre of land.

Thinning - Any cutting or removal of vegetation (trees, brush, etc.) resulting in a reduction of competition for water, light, and/or nutrients between individual plants. Thinning is commonly referred to as commercial thinning and small tree thinning.

- **Commercial thinning** refers to removing material that has an established dollar value on the open market and can be sold with at least a minimal net value sufficient to pay for the thinning activity.
- **Small tree thinning/Ladder fuel reduction** may or may not have a dollar value and usually includes the need to pay someone to accomplish the work. This is sometimes called small-tree thinning because the trees are smaller than the sizes that have a commercial value.

Thrifty trees - Trees which have at least a 40% live crown ratio and with little or no evidence of disease or insects are called thrifty. They should also show evidence of good growth with long leaders and a good color, usually dark green.

Treatment - A term used to broadly refer to the vegetative changes made to meet management objectives. It may include thinning, cutting of undesirable trees, prescribed fire, salvage, or any manipulation of the vegetative conditions.

Trees per Acre – The number of trees of a specific diameter on an acre of land.

U

Upper Management Zone – UMZ –The level of stocking or relative density beyond which there is imminent risk of catastrophic loss of overstory trees to bark beetles.

Underburn - Using prescribed fire under the canopy of an existing stand of trees.

Undesirable Species - Any species of plant or animal which is NOT considered to be compatible with meeting management goals and objectives.

Ustic - A soil moisture regime in which moisture is limited but is present at a time when conditions are suitable for plant growth.

W

Woody Debris - Dead pieces of woody vegetation such as stems, limbs, or leaves which are on a site.

X

Xeric - A soil moisture regime in which soil is dry for 45 or more consecutive days in the 4 months following the summer solstice, and moist for 45 or more consecutive days in the 4 months following the winter solstice.

References

Agee, J.K. 1993. Fire Ecology of Pacific Northwest Forest. Island Press, Covelo, CA.

Agee, J. K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. USDA Forest Service General Technical Report PNW-GTR-320. Arabas, K. B., K. S. Hadley, and E. R. Larson. 2006. Fire history of a naturally fragmented landscape in central Oregon. Canadian Journal of Forest Research 36:1108-1120.

Agee, J.K. 1996. The influence of forest structure on fire behavior. Presented at the 17th Annual Forest Vegetation Management Conference, Redding CA. January 16-18, 1996.

Aldrich, J. W. 1963. Geographic orientation of American Tetraonidae. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Allen, A. W. 1987. The relationship between habitat and furbearers. In: Novak, M.; Baker, J.A.; Obbard, M.E. comps. eds. Wild furbearer management and conservation in North America. North Bay, Ontario: Ontario Trappers Association: 164-179.

Altman, B. June 2000. Conservation Strategy For Landbirds Of The East-Slope Of The Cascade Mountains In Oregon And Washington. Oregon-Washington Partners In Flight.

Anthony, R.G., R.J. Steidl, and K. McGarigal. 1995. Recreation and bald eagles in the Pacific Northwest. IN: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Island Press, Washington D.C. 372 pp.

Arabas, K.B., K.S. Hadley, and E.R. Larson. 2006. Fire History of a Naturally Fragmented Landscape in Central Oregon. Canadian Journal of Forest Research. 36: 1108-1120.

Arno, S. F., H. Y. Smith, and K. A. Krebs. 1997. Old growth ponderosa pine and western larch stand structures: influences of pre-1900 fires and fire exclusion. USDA Forest Service Research Paper INTRP-495.

Aubry, K. and C. Raley. 2006. Update to the study Ecological Characteristics of Fishers (*Martes pennanti*) in the Southern Oregon Cascade Range. USDA Forest Service, Pacific Northwest Res. Sta. Olympia , WA. 30 pages.

Aubry, K. B., K. S. McKelvey, and J. P. Copeland. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. J. Wildl. Manage. 71(7): 2147-2158.

Barbour, R. W. and W. H. Davis. 1969. Bats of America. University of Kentucky Press. Lexington, KY. 286 pp.

Bate, L.J. 1995. Monitoring woodpecker abundance and habitat in the Central Oregon Cascades. Masters Thesis. Univ. of Idaho, Moscow. 116pp.

Bend-Fort Rock District Project Surveys and Wildlife Sightings Records.

Bergoffen, W. W. 1976. 100 years of Federal forestry. USDA Forest Service Agriculture Information Bulletin 402.

Booser, J, and J. White. Calculating maximum stand density indexes (SDI) for Deschutes National Forest plant associations. Unpublished paper, on file, Deschutes National Forest Bork, J. 1984. Fire history in three vegetation types on the east side of the Oregon Cascades. Ph.D. Diss., Oregon State University, Corvallis.

Bormann, Bernard T., Homann, P.S., Darbyshire, R.L., Morrissette, B.A. 2008. Intense forest wildfire sharply reduces mineral soil C and N: the first direct evidence. Canadian Journal of Forest Research 38: 2771-2783 (2008).

Brown, James K., E.D. Reinhardt, K.A. Kramer; 2003. Coarse Woody Debris: Managing Benefits in the Recovering Forest. USDA Forest Service General Technical Report RMRS-GTR-105.

Brown, James K. 1974. Handbook for Inventorying Downed Woody Material. USDA Forest Service General Technical Report INT-16.

Bull, E.L. 1980. Resource partitioning among woodpeckers in northeastern Oregon. Doctoral thesis. Univ. of Idaho, Moscow. 109pp.

Bull, E.L., and M.G. Henjum. 1990. Ecology of the Great Gray Owl. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Bull, E.L., C.G. Parks, and T.R. Torgerson. 1997. Trees and logs important to wildlife in the interior Columbia River basin. Gen. Tech. Rep. PNW-GTR-39. USDA Forest Service. Pacific Northwest Research Station. 55pp.

Buskirk, S.W., and R.A. Powell. 1994. Habitat Ecology of Fishers and American Martens. In: Buskirk, S.W., A.S. Harestad, M.G. Raphael, comps. eds. Martens, Sables, and Fishers: Biology and Conservation. Cornell University Press, Ithaca, NY. p283-296.

Cafferata, Peter H. 1983. The Effects of Compaction on the Hydrologic Properties of Forest Soils in the Sierra Nevada. USDA Forest Service, Pacific Southwest Region Watershed Management Staff; Earth Resources Monograph 7.

Castellano, Michael, Jane Smith, Thom O'Dell, Efren Cazares and Susan Nugent. 1999. Handbook to Strategy 1 Fungal Species in the Northwest Forest Plant. USDA-USFS Pacific Northwest Research Station General Technical Report PNW-GTR-476.

Clark, B.S. et al. 1993. Foraging activity of adult female Ozark big-eared bats (Plecotus townsendii ingens) in summer. J. Mamm. 74(2):422-427.

Cline, E.T., J.F. Ammirati, and R.L. Edmonds. 2005. Does proximity to mature trees influence ectomycorrhizal fungus communities in Douglas-fir seedlings? New Phytologist 166(3):993-1009.

Cochran, P. H. 1992. Stocking levels and underlying assumptions for uneven-aged ponderosa pine stands. USDA Forest Service Pacific Northwest Research Station Research Note PNW-RN-509. 10 p.

Cochran, P. H.; Geist, J. M.; Clemens, D. L.; Clausnitzer, R. R.; Powell, D. C. 1994. Suggested stocking levels for forest stands in northeastern Oregon and southeastern Washington. USDA Forest Service Pacific Northwest Research Station Research Note PNW-RN-513. 21 p.

Copeland, J. P., J. M. Peek, C. R. Groves, W. E. Melquist, K. S. McKelvey, G. W. McDaniel, C. D. Long, and C. E. Harris. 2007. Seasonal habitat associations of the wolverine in central Idaho. J. Wildl. Manage. 71(7):2201-2212.

Cottrell, M. J. 1981. Resource partitioning and reproductive success of three species of hawks (Buteo spp.) in an Oregon prairie. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Courtney, S. P., A. C. Carey, M. L. Cody, K. Engel, K. E. Fehring, J. F. Franklin, M. R. Fuller, R. J. Gutierrez, J. F. Lehmkuhl, M. A. Hemstrom, P. F. Hessburg, S. L. Stephens, L. A. Sztukowski, and L. Young. 2008. Scientific Review of the Draft Northern Spotted Owl Recovery Plan and Reviewer Comments. Sustainable Ecosystems Institute. www.sei.org 150 pages.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, OR.

Covington, W. W., and M. M. Moore. 1994. Postsettlement changes in natural fire regimes and forest structure: ecological restoration of old-growth ponderosa pine forests. Journal of Sustainable Forestry 2:153-181.

Craigg, T.L., 2000. Subsoiling to restore compacted soils. In: "Proceedings, Twenty-first Annual Forest Vegetation Management Conference", January 2000; Redding, CA. Forest Vegetation Management Conference, Redding, CA.

Csuti Blair, Oneil T.A., Shaughnessy M.M., Gaines E.P., Hak J.C. 2001. Atlas of Oregon Wildlife Distribution, Habitat, and Natural History. Oregon State University, Corvallis Oregon. 525 pp.

Cushman, K. A. and C. A. Pearl. 2007. A Conservation Assessment for the Oregon Spotted Frog (*Rana pretiosa*). USDA Forest Service Region 6 and USDI Bureau of Land Management, Oregon and Washington. 46 pages.

Damiami, C., D.C. Lee, and S.L. Jacobson. 2007. Effects of noise disturbance on northern spotted owl reproductive success. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, California.

DeBano, Leonard F., Daniel G. Neary, Peter F. Folliott. 1998. Fire Effects on Ecosystem. John Wiley and Sons, Inc. New York. 332pp.

Delaney, D., T. Grubb, P. Beier, L. Pater, and M.H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63(1): 60-76.

Diebert, W. J., M. J. Griffith, and K. Zahl. 1970s. Fieldbook of Selected Wildlife. USDA Forest Service Pacific Northwest Region. 97pp.

Dixon, Rita Dianne. 1995. Ecology of white-headed woodpeckers in the central Oregon Cascades. Moscow, ID: University of Idaho. 148pp. M.S. thesis.

Dixon, Rita Dianne. 1995. Density, nest-site and roost-site characteristics, home-range, habitat-use, and behavior of white-headed woodpeckers: Deschutes and Winema National Forests, Oregon. Oregon Dept. of Wildlife Nongame Project No. 93-3-01. 71 pp and Appendices.

Dolph, K. L., S. R. Mori, and W. W. Oliver. 1995. Long-term response of old-growth stands to varying levels of partial cutting in the eastside pine type. Western Journal of Applied Forestry 10:101–108.

Duncan, N., T. Burke, S. Dowlan, and P. Hohenlohe. 2003. Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan V3.0. U.S. Department of Agriculture, Region 6, Portland, OR. 70pp.

Edelman, F. and J. Copeland. 1999. Wolverine distribution in the northwestern United States and a survey in the Seven Devils mountains of Idaho. Northwest Science, Vol. 73, No. 4.

Ehrlich, P. R., D. S. Dobkin, and Darryl Wheye. 1988. The Birder's Handbook: A Field Guide to the Natural History of North American Birds. Simon and Schuster Inc. New York, New York. 785 pp.

Erickson, J.L., and S.D. West. 1995. Managed forests in the western Cascades: the effects of seral stage on bat habitat use patterns. In: B.M.R. Barclay and R.M. Brigham, eds. Bats and Forests Symposium. Victoria, British Columbia. p.215-227.

Everett, R. L., R. Schellhass, D. Keenum, D. Spurbeck, and P. Ohlson. 2000. Fire history in the ponderosa pine/Douglas-fir forests on the east slope of the Washington Cascades. Forest Ecology and Management 129: 207-225.

Fettig, C. J., K. D. Klepzig, R. F. Billings, A. S. Munson, T. E. Nebeker, J. F. Negrón, and J. T. Nowak. 2007. The effectiveness of vegetation management practices for prevention and control of bark beetle outbreaks in coniferous forests of the western and southern United States. Forest Ecology and Management 238: 24-53.

Finney, Mark. 2001. Design of Regular Landscape Fuel Treatment Patterns for Modifying Fire Growth and Behavior. Forest Sciences 2001.

Finney, Mark A. 2006. An Overview of FlamMap Fire Modeling Capabilities. In: Andrews, Patricia L.; Butler, Bret W., comps. 2006. Fuels Management-How to Measure Success: Conference Proceedings. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Finney, Mark, Stuart Brittain, and Rob Seli. 2006. FlamMap Version 3.0. Joint Fire Sciences Program, Rocky Mountain Research Station, US Bureau of Land Management, Systems for Environmental Management.

Fitzgerald, S.A. 2002. Fire in Oregon's Forests: Risks, Effects, and Treatment Options A synthesis of current issues and scientific literature, Fitzgerald S.A., ed. Oregon Forest Resources Institute.

Fitzgerald, S.A. 2005. Fire Ecology of Ponderosa Pine and the Rebuilding of Fire-Resilient Ponderosa Pine Ecosystems. USDA Forest Service General Technical Report PSW-GTR-198, 2005, p. 197-225.

Fontaine, Barbara pers. communication (email) to Rob Rawlings (March 7, 2005) forwarded to Art Currier to Joanna Booser (March 31, 2005) to Barbara Schroeder, re: "Dialog Among Various Fuels Planners and Silviculturists" Big Tree Mortality and Spring Burning.

Forsman, E.D., C.E. Mellow, and H.M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs 87:1-64.

Forsman, E.D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E.C. Mellow, G.S. Miller, K.A. Swindle, J.A. Thrailkill, F.F. Wagner, and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. Wildlife Monographs 149:1–35.

Froehlich, H.A., D.E. Aulerich, R. Curtis, 1981. Designing Skid Trail Systems to Reduce Soil Impacts from Tractive Logging Machines, Research Paper 44, Forest Research Laboratory, Corvailis, Oregon. 13 pages.

Gabrielson, I. N., and S. G. Jewett. 1940. Birds of Oregon. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Garland, John J. 1983. Designated Skidtrails to Minimize Soil Compaction.

Geist, Michael J., J.W. Hazard, and K.W. Seidel; 1989. Assessing Physical Conditions of Some Pacific Northwest Volcanic Ash Soils After Forest Harvest. 5 pages.

Gilligan, J., M. Smith, D. Rogers, and A. Contreras. 1994. Birds of Oregon: status and distribution. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Goggans, R., R.D. Dixon, and L.C. Seminara. 1988. Habitat use by three-toed and black-backed woodpeckers, Deschutes National Forest, Oregon. Nongame Project # 87-3-02, Oregon Dept. Fish and Wildlife, Bend, OR. 84pp.

Graham, Russel T., Alan E. Harvey, Martin F. Jurgensen, Theresa B. Jain, Jonalea R. Tonn, Deborah S. Page-Dumroese. 1994. Managing Coarse Woody Debris in Forests of the Rocky Mountains. USDA Forest Service Research Paper INT-RP-477. Pages 1-13.

Graham, R.T., Alan E. Harvey, Threasa B. Jain, Jonalea R. Tonn. 1999. The Effects of Thinning and Similar Stands Treatments on Fire Behavior in the Western Forest. USDA Forest Service, Pacific Northwest Research Station. PNW GTR-463. 28pp.

Harrod, R. J., D. W. Peterson, N. A. Povak, and E. K. Dodson. 2009. Thinning and prescribed fire effects on overstory tree and snag structure in dry coniferous forests of the interior Pacific Northwest. Forest Ecology and Management 258 (2

Harrod, R. J., B. H. McRae, and W. E. Hartl. 1999. Historical stand reconstruction in ponderosa pine forests to guide silvicultural prescriptions. Forest Ecology and Management 114: 433-446.

Harvey, A.E., M.F. Jurgensen, and M.J. Larsen. 1981. Organic reserves: Importance to ectomycorrhizae in forest soils of western Montana. Forest Science 27(3): 442-445.

Hayes, J. L., and G. E. Daterman. 2001. Bark beetles (Scolytidae) in eastern Oregon and Washington. Northwest Science 75: 21-30.

Hemstrom, Thomas Spies, Craig Palmer, Ross Kiester, John Teply, Phil McDonald, and Ralph Warbington. Late-Successional and Old-Growth Forest Effectiveness Monitoring Plan for the Northwest Forest Plan. USDA Forest Service Pacific Northwest Research Station Portland, Oregon General Technical Report PNW-GTR-438 December 1998Henny, C. J. Cooper's Hawk. Pp 149-150 in Birds of Oregon: A General Reference. D. B. Marshall, M. G. Hunter, and A. L. Contreras, Eds. Oregon State University Press, Corvallis, OR.

Henny, C. J. Cooper's Hawk. Pp 149-150 *in* Birds of Oregon: A General Reference. D. B. Marshall, M. G. Hunter, and A. L. Contreras, Eds. Oregon State University Press, Corvallis, OR.

Hessburg, P. F., R. G. Mitchell, and G. M. Filip. 1994. Historical and current roles of insects and pathogens in eastern Oregon and Washington forested landscapes. USDA Forest Service General Technical Report PNW-GTR-327.

Hessburg, P.F., Agee, J.K. 2003. An environmental narrative of inland Northwest US forests, 1800–2000. For. Ecol. Manage. 178, 23–59.

Hessburg, P. F., J. K. Agee, and J. F. Franklin. 2005. Dry forests and wildland fires of the inland Northwest USA: contrasting the landscape ecology of the pre-settlement and modern eras. Forest Ecology and Management 211:117-139.

Holmes, A. L. and G. R. Geupel. 1998. Avian population studies at naval weapons systems training facility Boardman, Oregon. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Hood, S. 2009. Prescribed burning and big trees: Can we do it without killing the trees? Fire Science Brie Issue 31 6 pages.

Hopkins, B., S. Simon, M. Schafer, and T. Lillybridge. 1993. Region 6 Interim Old Growth Definitions for Grand fir/White fir series, Lodgepole series, and Ponderosa pine series.

Hornocker, M.G. and H.S. Hash. 1981. Ecology of the wolverine in northwestern Montana. Can. J. Zool. 59:1286-1301.

Isaacs, F. B. and R. G. Anthony. 2005. Bald eagle nest locations and history of use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 2005. Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, Oregon, USA.

Janes S. W. 1985a. Behavioral interactions and habitat relations among grassland and shrub steppe raptors. In Birds of Oregon: A General Reference, Marshall, M.G. Hunter, and A.L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Janes S. W. 1985b. Habitat selection in raptorial birds. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Jeffries, S. Deschutes Forest Biologist and D. Zalunardo, Ochoco Forest Biologist Letter dated June 19, 2003 to File Code: 2670; Subject: Canada lynx (Lynx canadensis) habitat mapping; To: District Wildlife Biologists, Deschutes and Ochoco National Forest and the Crooked River National Grassland).

Johnsgard, P. A. 1987. Diving birds of North America. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Johnsgard , Paul A. 1990. Hawks, Eagles, and Falcons of North America. Smithsonian Institution Press, Washington D.C. pp. 164-182.

Kolb, T. E. et al., Perpetuating old ponderosa pine, Forest Ecol. Manage. (2007), doi:10.1016/j.foreco.2007.06.002

Kranabetter, J.M. and P. Kroeger. 2001. Ectomycorrhizal mushroom response to partial cutting in a western hemlock-western redcedar forest. Canadian Journal of Forest Research: 978-987.

Krebs, J; E. C. Lofroth, and I. Parfitt. 2007. Multi-scale habitat use by wolverine in British Columbia Canada. J. Wildl. Manage. 71(7):2180-2192.

Littlefield, C. D. 1990. Birds of Malheur National Wildlife Refuge, Oregon. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Lundsten, J. 1996. Solitary Sandpiper nesting in Marion County, Oregon? In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Luoma, D.L. and J. Eberhart. 2005. Results from green-tree retention experiments: ectomycorrhizal fungi. In: Peterson, C.D. and D.A. Maguire (eds.). Balancing ecosystem values: innovative experiments for sustainable forestry. Proceedings of a conference. General Technical Report PNW-GTR-635. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Lyon, L.J. and C.E. Jensen. 1980. Management implications of elk and deer use of clear-cuts in Montana. J. Wildl. Manage. 44(2):352-362.

Maffei, H. and B. Tandy. 2002. Methodology for modeling the spatial and temporal effects of vegetation management alternatives on late successional habitat in the Pacific Northwest. USDA Forest Service Proceedings RMRS-P-25.

Marshall, D. 1992. Status of the Northern Goshawk in Oregon and Washington. Audubon Soc., Portland, Oregon. 34pp.

Marshall, D. 1992. Status of the black-backed woodpecker in Oregon and Washington. Audubon Society of Portland, Oregon. 32pp.

Marshall, D. B. 1996. Species at risk. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Marshall, D. B. 1997. Status of the white-headed woodpecker in Oregon and Washington. Audubon Society of Portland, Portland. 30 pages and appendices.

Marshall, D. B., M. G. Hunter, and A. L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 768 pp.

Maxwell, Wayne, Ward, F., 1980. Photo Series for Quantifying Natural Forest Residues in Common Vegetation Types of the Pacific Northwest. USDA Forest Service General Technical Report PNW-105.

McCullough, D. G., R. A. Werner, and D. Neumann. 1998. Fire and insects in northern and boreal forest ecosystems. Annual Review of Entomology 43: 107-127.

McCullough, D. R. ed. 1996. Metapopulations and Wildlife Conservation. Island Press, Washington DC. 429 pages.

McKenney, D. W., J. H. Pedlar, K. Lawrence, K. Campbell, and M. F. Hutchinson. 2007. Potential impacts of climate change on the distribution of North American trees. BioScience 57: 939-948.

McNabb, D.H., Froehlich, H.A., 1983. Conceptual Model for Predicting Forest Productivity Losses from Soil Compaction.

Mellen-McLean, K., B. G. Marcot, J. L. Ohmann, K. L. Waddell, S. A. Livingston, E. A. Willhite, B. B. Hostetler, C. Ogden, and T. Dreisbach. 2009. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 1.10. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon. http//wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf

Miller, J.C. and P.C. Hammond. 2007. Butterflies and moths of Pacific Forests and Woodlands: rare, endangered, and management-sensitive species. Forest Health Technology Enterprise Team Technology Transfer Species Identification FHTET-2006-07, September 2007.

Miller, J. C. 1995. Establishment of baseline data on populations of immature lepidoptera for reference to future spruce budworm control projects and components of bat diets. Oregon State University, Corvallis.

Miller, G. S.; R. J. Small, and E. C. Meslow. 1997. Habitat selection by spotted owls during natal dispersal in western Oregon. J. Wildl. Manage. 61(1): 140-150.

Mitchell, R. G., 1990. Effects of prescribed fire on insect pests. Pages 111-116 *in* J. D. Walstad, S. R. Radosevich, and D. V. Sandberg, editors. Natural and prescribed fire in Pacific Northwest forests. Oregon State University Press, Corvallis, Oregon, USA.

Moghaddas, Jason J. 2006. A fuel treatment reduces potential fire severity and increases suppression efficiency in a Sierran mixed conifer forest. In: Andrews, Patricia L.; Butler, Bret W., comps. Fuels management--how to measure success: conference proceedings; 2006 March 28-30; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 441-449. [65172]

Moldenke, Andrew, Pajutee, M., Ingham, E. 2000. The Functional Roles of Forest Soil Arthropods: The Soil Is a Lively Place. USDA Forest Service General Technical Report PSW-GTR-178. 16 Pages.

National Council for Air and Stream Improvement. 1999. Silviculture and Water Quality: A Quarter Century of Clean Water Act Progress. Special Report No. 99-06.

National Wildfire Coordination Group (NWCG). 2001. Smoke Management Guide for Prescribed and Wildland Fire 2001 Edition. NFES 1279. Boise, ID: U.S. Department of Agriculture, U.S. Department of the Interior, National Association of State Foresters. 226 p.

Natureserve. 2006. Natureserve Explorer: An online encyclopedia of life [web application]. Version 4.7 Natureserve, Arlington, VA. Available at http:www.natureserve.org/explorer

Natureserve. 2009. Natureserve Explorer: An online encyclopedia of life [web application]. Version 4.7 Natureserve, Arlington, VA. Available at http:www.natureserve.org/explorer

Oliver, W. W. 1995. Is self-thinning in ponderosa pine ruled by Dendroctonus bark beetles? Pages 213-218 *in* Proceedings of the 1995 national silviculture workshop. USDA Forest Service General Technical Report GTR-RM-267.

Omi, Philip N., Martinson, Erik J. 2002. Effectiveness of thinning and prescribed fire in reducing wildfire severity. Western Forest Fire Research Center, Colorado State University. Presented at Sierra Nevada Science Symposium, October 7-9, 2002, North Lake Tahoe, CA

Ormsbee, P.C. 1995. Characteristics, use, and distribution of day roosts selected by female Myotis volans (long-legged myotis) in forested habitat of the Central Oregon Cascades. In: B.M.R. Barclay and R.M. Brigham, eds. Bats and Forests Symposium. Victoria, British Columbia. p. 124-131.

Ottmar, R. D., and D. V. Sandberg. 2001. Wildland fire in eastern Oregon and Washington. Northwest Science 75: 46-54.

Page-Dumroese, D.S. 1993. Susceptibility of Volcanic Ash-Influenced Soil in Northern Idaho to Mechanical Compaction. USDA Forest Service Research Note INT-409, Ogden, Utah. 5 pages.

Pampush, G. J. 1981. Breeding chronology, habitat utilization, and nest site selection of the Long-billed Curlew in north central Oregon. *In* Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Peek James M., Korol, Jerome J., Gay Donald, Hershey Terry. 2000. Overstory-understory biomass changes over a 35-year period in south central Oregon. Forest Ecology and Management. 150:267-277.

Perlmeter, S. 1996. The 1996 Bat Project: Final Report. Deschutes National Forest, Oregon.

Perlmeter, S. 1998& 1999. Patterns of Roost Selection by Long-Legged Myotis Bat Year 1&2

Pollet, Jolie and Omi, Philip N. 1999. Effects of Thinning and Prescribed Burning on Wildfire Severity in Ponderosa Pine Forest. 5pp.

Popper, K.J. 2001. Abundance and Distribution of Yellow Rails in the Deschutes and Northern Great Basins of Southcentral Oregon. Unpubl. report to United States Fish and Wildlife Service, Oregon State Office.

Powers, R.F., T.M Alves, T.H. Spear. 1999. Soil Compaction: Can it be Mitigated? Reporting a Work in Progress. Proceedings, Twentieth Annual Forest Vegetation Management Conference, Redding, CA.

Reynolds, T. D., T. D. Rich, and D. A. Stephens. 1999. Sage Thrasher (*Oreoscoptes montanus*). *In* The Birds of North America, No. 463 (A. Poole and F. gill, eds.). The Birds of N. Am., Inc., Philadelphia, PA. *In* Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Richardson, D. M., P. W. Rundel, S. T. Jackson, R. O. Teskey, J. Aronson, A. Bytnerowicz, M. J. Wingfield, S. Proches. 2007. Human impacts in pine forests: past, present, and future. Annual Review Ecol. Evol. Syst. 38: 275-297.

Robinson, J. A., L. W. Oring, J. P. Skorupa, and R. Boettcher. 1997. American Avocet (*Recurvirostra Americana*). *In* The birds of North America, No. 275 (A. Poole and F. Gill, eds.). *In* Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Rochelle, James A. 1999. Forest Fragmentation: Wildlife Implications. Koninklijke Brill NV, Leiden, The Netherlands.

Rorig, M. L., and S. A. Ferguson. 1999. Characteristics of lightning and wildland fire ignition in the Pacific Northwest. Journal of Applied Meteorology 38: 1565-1575.

Rose, C. L., B. G. Marcot, T. K. Mellen, J. L. Ohmann, K.L. Waddell, D. L. Lindley, and B. Schreiber. 2001. Decaying wood in the Pacific Northwest forests: concepts and tools for habitat management. Pp 580-623 in D.H. Johnson and T. A. O'Neil, editors. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis, OR.

Rothermel, Richard C. 1983. How to Predict the Spread and Intensity of Forest and Range Fires. USDA Forest Service, Intermountain Forest and Range Experiment Station. Ogden, UT. Research Paper INT-143.

Rothermel, Richard C. 1991. Predicting Behavior and Size of Crown Fires in the Northern Rocky Mountains. USDA Forest Service, Intermountain Research Station. Ogden, UT. Research Paper INT-438. 46pp.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, J.L. Lyon, and W.L. Zielinski, tech eds. 1994. American marten, fisher, lynx, and wolverine in the western United States. USDA Forest Service, Gen. Tech. Rep. RM-254. 184pp.

Ruggiero, L. F., K. S. McKelvey, K. B. Aubry, J. P. Copeland, D. H. Pletscher, and M. G. Hornocker. 2007. Wolverine conservation and management. J. Wildl. Manage. 71(7): 2145-2146.

Saab, V. A. and J. G. Dudley. 1998. Responses of cavity-nesting birds to stand-replacement fire andsalvage 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.

Saab, V., R. Brannon, J. Dudley, L. Donohoo, D. Vanderzanden, V. Johnson, and H. Lachowski. 2002. Selection of fire-created snags at two spatial scales by cavity-nesting birds. In: Laudenslayer, William F., Jr.; Valentine, Brad; Weatherspoon, C. Philip; Lisle, Thomas E., technical coordinators. Proceedings of the symposium on the ecology and management of dead wood in western forests. 1999 November 2-4; Reno, NV. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. http://www.fs.fed.us/psw/publications/documents/gtr-181/062_Saab.pdf

Sartwell, C., and R. E. Dolph, Jr. 1976. Silvicultural and direct control of mountain pine beetle in second growth ponderosa pine. USDA Forest Service Research Note RN-PNW-268.

Sawyer, M. 1981. Solitary Sandpiper: probable nesting in Oregon. *In* Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Scott, Joe H., Burgan, Robert E. 2005. Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

Sibley, D. A. 2005. The Sibley Field Guide to Birds of Western North America. Alfred A. Knopf, Inc. New York. 474 p.

Stalmaster, M. 1987. The Bald Eagle. Universe Books, New York, NY. 227 pp.

Steele, R., S. F. Arno, and K. Geier-Hayes. 1986. Wildfire patterns change in central Idaho's ponderosa pine-Douglas fir forest. Western Journal of Applied Forestry 1: 16-18.

Stephens, S. L., and S. J. Gill. 2005. Forest structure and mortality in an old-growth Jeffrey pine-mixed conifer forest in north-western Mexico. Forest Ecology and Management 205: 15-28.

Sussmann P. 2005. 18 Fire Herbicide Treatment Environmental Assessment, Soil Specialist Report, Deschutes National Forest, Pacific Northwest Region.

Taylor, A. H., and C. N. Skinner. 1998. Fire history and landscape dynamics in a late-successional reserve, Klamath Mountains, California, USA. Forest Ecology and Management 111: 285-301.

Thomas, J.W., ed. 1979. Wildlife habitats in managed forests: The Blue mountains of Oregon and Washington. USDA Forest Service, Ag. Handbook 553.

Tyler, James. Personal communication. (email) to Barbara Schroeder, Silviculturist, Bend Ft Rock June 15, 2006 re: Large Tree Mortality/Burning.

Upper Deschutes Basin Fire Learning Network Technical Team. 2007. Historical Fire regimes, Natural Range of Variability and Fire Regime Condition Class (FRCC) Mapping Methodology.

U.S. Environmental Protection Agency. 1990. Air Quality Criteria for Particulate Matter Volume II of III. Office of Research and Development. EPA/600/P-95/00ibF. pp. 8-82 – 8-89.

U.S. Environmental Protection Agency. 1999. Handbook for criteria pollutant inventory development: a beginner's guide for point and area sources. EPA-OAQPS-454-99-037. Research Triangle Park, NC. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

USDA Forest Service, Deschutes and Ochoco National Forest. August 2006. Joint Aquatic and Terrestrial Programmatic BIOLOGICAL ASSESSMENT April 2006 – April 2009.

USDA Forest Service, Deschutes National Forest. 1994. Deschutes National Forest Wildlife Tree and Log Implementation Strategy.

USDA Forest Service, Deschutes National Forest. 1996. Final Interpretation of Forest Plan Standards and Guidelines SL-3 and SL-4, Document 96-01, Soil Productivity.

USDA Forest Service, Larsen. 1976. Soil Resource Inventory, Deschutes National Forest, Pacific Northwest Region.

USDA Forest Service, Region 6. 1995. Revised Environmental Assessment for the Continuation of Interim Management Direction Establishing Riparian Ecosystem and Wildlife Standards for Timber Sales.

USDA Forest Service. 1990. Deschutes National Forest Land Resource Management Plan. Bend, Oregon.

USDA Forest Service. 1994. The Scientific Basis for Conserving Forest Carnivores in the Western United States. American Marten, Fisher, Lynx, and Wolverine.

USDA Forest Service. 1995, 1996, 1997 and 1999. Soil Monitoring Reports. Deschutes National Forest, Pacific Northwest Region.

USDA Forest Service. 2008. Update of the Regional Forester's Sensitive Species Lists and Transmittal of Strategic Species List. Pacific Northwest Region. Portland, Oregon.

USDA Forest Service. 2007. Record of Decision To Remove the Survey and Manage Mitigation Measure Standards and Guidelines from Forest Service Land and Resource Management Plans Within the Range of the Northern Spotted Owl. 46 pages.

USDA Forest Service. 2005. Wildland Fire in Ecosystems, Effects of Fire on Soil and Water. USDA Forest Service General Technical Report RMRS-GTR 42-volume 4.

USDA Forest Service. 2005. Forest Service Manual 4000 – Research and Development. Chapter 4060 – Research Facilities and Areas. National Forest Headquarters, Washington D.C.

USDA Forest Service. 1998. FSM 2520, Forest Service Soil Quality Standards, Region 6, R-6 Supplement No. 2500-98-1.

USDA Forest Service. 1996. Cultus and Sheridan Late Successional Reserve Assessments. Bend/Ft. Rock Ranger District, Deschutes National Forest.

USDA Forest Service 1995. Revised Environmental Assessment for the Continuation of Interim Management Direction Establishing Riparian, ecosystem, and Wildlife Standards for Timber Sales (Eastside Screens).

USDA Forest Service. 1995b. Deschutes National Forest: A Late Successional Reserve Overview. Deschutes National Forest. Bend, OR.

USDA Forest Service, Deschutes National Forest. 1994. Deschutes National Forest Wildlife Tree and Log Implementation Strategy.

USDA Forest Service. 1988. General Water Quality Best Management Practices, Pacific Northwest Region.

USDA Forest Service. 1993. Protocol for surveying spotted owls in proposed management activity areas and habitat conservation areas.

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl; Standards and Guidelines for Management of Habitat for Late-Successional and Old-growth Forest Related Species within the Range of the Northern Spotted Owl.

USDA Forest Service and USDI Bureau of Land Management. 2006. Joint Aquatic and Terrestrial Programmatic Biological Assessment April 2006 – April 2009 For Federal Lands within the Deschutes Basin Administered by the Bureau of Land Management Prineville Office and for Federal Lands Administered by the Deschutes and Ochoco National Forests, August 2006 – August 2009.

USDA Forest Service, USFWS, ODFW. 2000. Conservation Agreement for the Oregon Spotted Frog Mink Lake Basin Population. 17 pp.

USDI Fish and Wildlife Service. 1989. The Northern spotted owl status review supplement. U.S. Fish and Wildlife Service, Portland, Oregon.

USDI Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; determination of threatened status for the northern spotted owl. Federal Register 55:26114–26194.

USDI Fish and Wildlife Service, ODFW. 2000. Conservation Agreement for the Oregon Spotted Frog Mink Lake Basin Population. 17 pp.

USDI Fish and Wildlife Service. 1998. Status Review of the Northern Goshawk in the Forested West. Office of Technical Support – Forest Resources. Portland, OR. Unpublished report. 250 pages. http://www.fws.gov/pacific/news/gh_sr.pdf

USFWS. 2003. Biological opinion and letter of concurrence for effects to bald eagles, marbled murrelets, northern spotted owls, bull trout, and designated critical habitat for marbled murrelets and northern spotted owls from Olympic National Forest program of activities for August 5, 2003 to December 31, 2008.

USDI Fish and Wildlife Service. 2007. Federal register June, 2007. 50 CFR Part 17. Endangered and Threatened Wildlife and Plants; Proposed Revised Designation of Critical Habitat for the Northern Spotted Owl (*Strix occidentalis caurina*); Proposed Rule. pp 32450-32516.

USDI Fish and Wildlife Service. 2008. Final recovery Plan for the Northern Spotted Owl, *Strix occidentalis caurina.* U.S. Fish and Wildlife Service, Portland, Oregon. xii + 142 pp.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA. 85 pp. http://www.fws.gev/migratorybirds/

Van Wagtendonk, J.W. 1996. Use of a deterministic fire growth model to test fuel treatments. In: Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II. Assessments and Scientific Basis for Management Options. University of California, Davis. Centers for Water and Wildland Resources, pp. 1155±1165.

Waring, R.H., Pitman G.B. 1985. Modifying Lodgepole Pine Stands to Change Susceptibility To Mountain Pine Beetle Attack. Ecology. 66(3):889-897.

Waters, J.R., K.S. McKelvey, C.J. Zabel, and W.W. Oliver. 1994. The effects of thinning and broadcast burning on sporocarp production of hypogeous fungi. Canadian Journal of Forest Research 24: 1516-1522.

Watkins, W. 1988. Population density and habitat use by Red-necked Grebes on Upper Klamath Lake, Klamath County, Oregon. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Weatherspoon, C.P. 1996. Fire-silviculture relationships in Sierra forests. In: Sierra Nevada Ecosystem Project, Final Report to Congress, II: Assessments, scientific basis for management options, ed., vol. II: Assessments and scientific basis for management options. Centers for Water and Wildland Resources, University of California, Davis, Water Resources Center Report No. 37, pp. 1167–1176.

Weldon, A. 2006. How corridors reduce Indigo bunting nest success. Conservation Biology Vol 20 (4) 1300-1305.

White Scheuering, R. and G. McAtee. Sharp-shinned Hawk. Pp 146-148 *in* Birds of Oregon: A General Reference. D. B. Marshall, M. G. Hunter, and A. L. Contreras, Eds. Oregon State University Press, Corvallis, OR.

Wickman, B. E. 1992. Forest health in the Blue Mountains: the influence of insects and disease. USDA Forest Service General Technical Report PNW-GTR-295.

Wiens, J. A., and J. T. Rotenberry. 1981. Habitat associations and community structure of birds in shrub-steppe environments. In Birds of Oregon: A General Reference, Marshall, M. G. Hunter, and A. L. Contreras. Eds. 2003. Oregon State University Press, Corvallis, OR. 768 pp.

Winkler, H., D. A. Christie, and D. Nurney. 1995. Woodpeckers: An identification guide to the woodpeckers of the world. Houghton Mifflin Co., New York, New York. 406 pp.

Woodbridge, B. and C. D. Hargis (Vojta). 2005. Northern Goshawk Inventory and Monitoring Technical Guide. USDA Forest Service, Washington Office, Ecosystem Management Coordination Staff, Wildlife Fish Watershed Air Staff. pp 31-53.

Wright, C. S., and J. K. Agee. 2004. Fire and vegetation history in the eastern Cascade Mountains, Washington. Ecological Applications 14: 443-459.

Youngblood, A., T. Max, and K. Coe. 2004. Stand structure in eastside old-growth ponderosa pine forests of Oregon and northern California. Forest Ecology and Management 199: 191-217.

Youngblood, A., K. L. Metlen, and K. Coe. 2006. Changes in stand structure and composition after restoration treatments in low elevation dry forests of northeastern Oregon. Forest Ecology and Management 234: 143-163.