United States
Department of
Agriculture

Forest
Service

January 2014

Draft Environmental Impact Statement

Wolf Fuels and Vegetation Management Project

Paulina Ranger District, Ochoco National Forest
Wheeler and Crook Counties, Oregon

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Wolf Fuels and Vegetation Management Project
Draft
Environmental Impact Statement
Wheeler and Crook Counties, Oregon

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Abstract: This Draft Environmental Impact Statement (DEIS) describes the effects of implementing vegetation management strategies and fuel reduction in the Wolf project area. The project area is located on the Paulina Ranger District of the Ochoco National Forest approximately 50 miles east of the City of Prineville, Oregon. Proposed fuel and vegetation treatments reduce the risk of stand loss due to overly dense stand conditions, increase the resistance of forest stands to insects and diseases, and change the distribution of fire regimes.

This EIS assesses the effects of four different alternatives: Alternative 1, No Action; Alternative 2, Proposed Action, Alternative 3 and Alternative 4. All three action alternatives would treat fuels and vegetation through the use of harvest, noncommercial thinning, juniper removal, hardwood restoration, and prescribed burning. The Responsible Official has identified Alternative 3 as the preferred alternative.

Reviewers should provide the Forest Service with their comments during the review period of the 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 reviewers' 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, l986) 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).

Send Comments to: **Sandra Henning, District Ranger**
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Date Comments Must Be Received: **45 days following the publication of the Notice of Availability in the Federal Register**

Summary

The Forest Service has prepared this Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act and other relevant Federal and State laws and regulations. This EIS analyzes a proposal to use commercial timber harvest, noncommercial thinning, hardwood planting and prescribed fire in the Wolf project area for vegetation management and treatment of fuels. This EIS analyzes three additional alternatives (including the No Action Alternative); the significant issues associated with the proposal; and the direct, indirect, and cumulative effects of implementing any of the alternatives.

The Wolf project area is located on the Paulina Ranger District of the Ochoco National Forest, about 50 miles east of Prineville, Oregon. The approximately 24,506-acre project area incorporates three subwatersheds of the Lower Beaver Creek watershed; Wolf Creek, North Wolf Creek and a small section of Drift Canyon-Beaver Creek.

Why is the action being proposed?

Based upon direction from the Ochoco National Forest Land and Resource Plan (Forest Plan) (USDA Forest Service, 1989) and opportunities identified in the Wolf Creek Watershed Analysis (WA), the Paulina Ranger District has determined that within the Wolf project area:

1. There is a need to manage vegetation towards to the historic range of variability to provide a range of forest conditions and habitats that support historic disturbance processes, native wildlife, and plant species.

2. There is a need to reduce forest vegetation density and fuel loadings to reduce the risk that disturbance events such as insect, disease and wildfire will lead to a loss of desired forest conditions.

3. There is a need to increase or maintain large tree structure; especially single-strata LOS and maintain and increase the abundance of early-seral and fire tolerant species

4. There is a need to improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Area (RHCAs) and maintain and enhance hardwood communities.

5. There is a need to contribute to the local and regional economies by providing timber and other wood fiber products now and in the future.

What action is proposed?

Table 1. Activities proposed in Alternative 2.

Activity	Quantity (approximate)
Commercial thinning (would be followed by noncommercial thinning and prescribed burning)	4,706 ac
Noncommercial thinning (outside of harvest units; would be followed by prescribed burning)	988 ac
Juniper removal (would be followed by jackpot and prescribed burning)	481 ac
Underburning (outside of harvest units)	5,000 ac
Hardwood enhancement	75.5 ac
Road closure	2.0 miles
Road decommission	2.7 miles

Table 2. Actions connected to the activities proposed in Alternative 2.

Connected Action	Quantity
Stream restoration	1 mile
Headcut repair	5 locations
Temporary roads	1.8 miles
Temporary roads on existing disturbance	18 miles
Expansion of Six Corners Material Source	up to 3 acres

What would it mean not to meet the need?

Forest Vegetation

Stands in the project area would continue growing in a manner determined by existing vegetation and site condition. The amount of Late and Old Structure (LOS) would increase; however, the rate at which stands develop large tree characteristics would be hampered by over-stocked conditions. On drier sites, such as the ponderosa pine and Douglas-fir plant association groups, stand stagnation may preclude the attainment of additional large trees. Existing large trees would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insect, disease, and wildfire. Acres dominated by ponderosa pine and western larch (early-seral species) would steadily decrease.

Hardwood communities would continue to decline in vigor and abundance. Juniper dominance and conifer cover would increase with a resulting decrease in grass and shrub cover. The proportion of juniper on ponderosa pine, Douglas-fir and grand fir sites would continue to increase.

No treatments to maintain or increase riparian plant communities would occur. Specifically, some aspen stands would continue to decline as conifer encroachment continues.

Fuels

Stands that are currently in a low-severity fire condition as a result of being thinned and burned in the 1980s and 1990s would not be maintained, and would transition into mixed and high-severity fire conditions over time. The amount of forested acres within the mixed and high-severity fire conditions are expected to increase as fuel accumulates faster than it decomposes and the number of trees per acre in the understory increases. Limited vegetation management, aggressive wildfire suppression, and insect and disease mortality would continue the trend of fuel loadings accumulating in the form of dead and down trees, small diameter trees growing into the overstory, and dense crown conditions. These changes would increase the risk of landscape-scale crown fire, and associated severe effects to fish and wildlife habitat, soil productivity, late and old structured habitat, and air quality.

Fire in these stands could be intense, stand replacing events, which could result in the loss of late and old structure, wildlife habitat cover, and consumption of large woody material and structure in riparian areas.

Are there other alternatives that would meet the need?

Two other alternative were identified that would meet the need for the project. Alternative 3 was developed to respond to Key Issues #1, #2 and #3 as discussed in Chapter 1, while also meeting the stated purpose and need. Alternative 4 was developed to respond to Key Issues #2, #3 and #4 as discussed in Chapter 1 of the EIS, while also meeting the stated purpose and need.

Table 3. Activities proposed in Alternative 3.

Activity	Quantity (approximate)
a) Commercial thinning (would be followed by noncommercial thinning and prescribed burning) b) Commercial thinning Trees >21" dbh	a) 4,322 ac b) 384 ac Total: 4,706
Noncommercial thinning (would be followed by prescribed burning)	988 ac
Juniper removal (would be followed by jackpot and prescribed burning)	481 ac
Underburning only	5,000 ac
Hardwood enhancement	90.2 ac
Road closure	7.8 miles
Road decommission	2.7 miles

Table 4. Actions connected to the activities proposed in Alternative 3.

Connected Action	Quantity
Stream restoration	2.2 miles
Culvert replacement	1 location
Headcut repair	6 locations
Temporary road construction	1.8 miles
Temporary road on existing disturbance	17.6 miles
Expansion of Six Corners Material Source	up to 3 acres

Table 5. Activities proposed in the Alternative 4.

Activity	Quantity (approximate)
Commercial thinning (would be followed by noncommercial thinning and prescribed burning)	3,394 ac
Noncommercial thinning (would be followed by prescribed burning)	1,177 ac
Juniper removal (would be followed by jackpot and prescribed burning)	481 ac
Underburning	5,853 ac
Hardwood enhancement	92.3 ac
Road closure	7.8 miles
Road decommission	2.7 miles

Table 6. Actions connected to the activities proposed in Alternative 4.

Connected Action	Quantity
Stream restoration	2.2 miles
Culvert replacement	1 location
Headcut repair	6 locations
Temporary road	1.6 miles
Temporary road on existing disturbance	14.1 miles
Expansion of Six Corners Material Source	up to 3 acres

What are the effects of the alternatives?

Forest Vegetation

Historic Range of Variability, Late and Old Structure and Stand Vigor

Under all action alternatives, stands would move toward HRV but at different rates. Under all alternatives, the amount of LOS would increase over time. Activities in each of the action alternatives would remove understory trees to reduce stand density, to maintain existing large trees, and to enhance the development of additional large trees. Harvest and noncommercial thinning would encourage the development of large structure at an accelerated rate. Activities would generally move stands from multi-strata conditions to or towards single-stratum conditions. The abundance of early-seral species would be maintained and enhanced in the long-term; however, late-seral species would continue to be present in stands where they exist prior to treatment. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The proposed activities (commercial harvest and noncommercial thinning) included in each of the action alternatives are designed to reduce tree density and improve growth and vigor of the residual trees and reduce susceptibility to insects and disease. These activities would more quickly restore historic seral/structural stage conditions and improve growing conditions for larger trees than either no action or prescribed fire alone. The abundance of early-seral species would be maintained and enhanced in the long term; however, late-seral species would continue to be present in stands where they exist prior to treatment.

Hardwood Communities

Harvest and noncommercial thinning in and around aspen stands, and other hardwood sites, would improve hardwood vigor and allow aspen stands to expand. Immediately after treatment, the aspen sites would have reduced cover until the aspen and other broadleaf shrubs can respond. Response time and amount would vary by current aspen condition, post treatment fencing and intensity of treatment, but generally would be apparent within three years.

Upland Grass and Shrub Communities

Proposed treatments in the uplands, including the cutting of juniper, would open the canopy and allow increased grass and shrub development. Better overall forage conditions would encourage more dispersed grazing and browsing with potentially less pressure in riparian areas. Furthermore, the removal of slash and thinning of thickets will allow more access for livestock into the uplands and potentially lower grazing pressure in riparian areas.

Prescribed fire treatments would reduce stocking of seedling and sapling junipers. As a result of decreased stand density, shrub and grass cover would increase from recruitment of new plants and growth of existing plants.

It is anticipated that the proposed treatments in this project would also rejuvenate mountain mahogany. Survival of mountain mahogany seedlings would increase in treated stands in response to reduced conifer cover and exposed mineral soil. Other types of shrubs would increase from more vigorous sprouting and from recruitment of new seedlings.

Fuels

All three action alternatives would modify fuels in the project area to move stands in Condition Class 3 toward Condition Class 1; basically, they would move stands from a condition of high fuel hazard to a condition of lower fuel hazard.

What factors would be used in making the decision between alternatives?

The Responsible Official for this proposal is the Forest Supervisor of the Ochoco National Forest. The Responsible Official will decide whether to:

- Select the proposed action;
- Select an action alternative that has been considered in detail;
- Modify an action alternative;
- Select the no action alternative;
- Identify what mitigation measures and monitoring will apply.

The Responsible Official will decide whether to conduct commercial harvest, noncommercial thinning, hardwood treatments, and fuels reduction activities in the Wolf project area. The decision will be determined by how well each alternative provides the best mix of prospective results in regard to the purpose and need, the significant issues, and public comments.

Factors that the Responsible Official will consider include effects of the alternatives on forested vegetation, on fuels, on aquatic species and water quality, and on wildlife species and habitats. The Responsible Official will also consider the ability of each alternative to contribute to local and regional economies.

What monitoring is necessary?

Implementation monitoring is necessary to ensure the selected alternative and mitigation measures are implemented as designed and achieve the desired results. Monitoring that is necessary includes:

- Post-project surveys and monitoring of noxious weed infestations, including mineral sources, would be conducted to evaluate the effects of the project on noxious weeds and to continue eradication treatments. Post-project surveys would identify new noxious weed infestations while they are small.
- Occupancy and reproduction in mapped raptor territories would be monitored during and after project implementation.
- Snag levels would be surveyed in selected areas during project preparation and after implementation.
- Temperature monitoring would be accomplished in identified stream reaches using temperature recorders.
- Post-project road closure/temporary road decommissioning would be evaluated for effectiveness and compliance with Best Management Practices (BMPs).

Which alternative is preferred?

Alternative 3 has been selected by the Responsible Official as the preferred alternative. This alternative includes the harvest of trees over 21” dbh. Designation of these trees would follow the draft decision making guide for the removal and retention of grand-fir that was developed by the Ochoco Forest Restoration Collaborative (see Appendix G).

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CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

Document Structure

The Forest Service has prepared this Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by [insert topic (i.e., resource area, significant issues, environmental component)].
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental impact statement.
- *Index:* The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Paulina Ranger District, Prineville, Oregon.

Background

The Wolf Fuels and Vegetation Management project area (Wolf project area) is approximately 50 miles east of the city of Prineville (see Map 1). The project area covers 24,506 acres and incorporates three subwatersheds of the Lower Beaver Creek watershed; Wolf Creek (15,659 acres), North Wolf Creek (8,830 acres) and part of Drift Canyon-Beaver Creek (18 acres).

The general purpose of entering this project area is to contribute to the resiliency of the landscape and to promote vegetative conditions that are similar to what occurred historically. The Wolf project is proposing management activities that would promote and sustain Late and Old Structure (LOS); increase resistance of forested vegetation to insects, disease and high intensity wildfire; enhance hardwood communities, improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Areas (RHCAs), and contribute to the health of local and regional economies.

The project area is home to a variety of fish, wildlife, and plant species; including northern goshawk, bald eagle, pileated woodpecker, redband trout, Columbia spotted-frog, deer, elk, and Peck's Mariposa lily. The area is also popular for recreation; the project area contains 2 developed recreation sites and approximately 50 dispersed camping areas. Other recreational uses includes wildlife viewing, hunting, sightseeing, hiking, biking, horseback riding, snowmobiling, and off-road vehicle use.

The Crook County Community Wildfire Protection Plan (2005) identified 3,294 acres of wildland urban interface (WUI) within the Wolf project area. There are two 320 acre parcels of private property within the project boundary and approximately 5 miles of private property that borders the southern portion of the project area. High fuel loads and the presence of ladder fuels create a risk of high intensity wildfire in the Wolf project area; such a fire could negatively impact a variety of species, habitats, and activities.

Purpose and Need for Action

The existing condition of the Wolf project area was evaluated in 2012 and documented in the Wolf Creek Watershed Analysis (WA). The WA was developed with input from the Ochoco Forest Restoration Collaborative (OFRC). The watershed analysis determined that conditions in the planning area have departed from the historic condition in several ways:

- Tree species compositions are outside the historic range of variability.
- A reduction in Late and Old Structured forest (LOS); especially single-strata LOS.
- A reduction in open-canopy stands accompanied by an increase in stand densities and multi-storied stands.
- An increased risk of large-scale loss of forest to wildfire.
- An increased risk of insect infestation and/or disease that can impact forested stands.
- A decline in riparian/aquatic conditions and hardwood communities.

Based upon direction from the Ochoco Forest Plan and recommendations identified in the Wolf Creek WA, the Paulina Ranger District has determined that within the Wolf project area:

1. There is a need manage vegetation towards to the historic range of variability to provide a range of forest conditions and habitats that would support historic disturbance processes, native wildlife, and plant species.

2. There is a need to reduce forest vegetation density and fuel loadings to reduce the risk that disturbance events such as insect, disease and wildfire will lead to a loss of desired forest conditions.

3. There is a need to increase or maintain large tree structure; especially single-strata LOS and maintain and increase the abundance of early-seral and fire tolerant species composition, i.e. ponderosa pine, and western larch.

4. There is a need to improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Area (RHCAs) and maintain and enhance hardwood communities.

5. There is a need to contribute to the local and regional economies by providing timber and other wood fiber products now and in the future.

Forest Plan Direction and Other Guidance

The Ochoco National Forest Land and Resource Management Plan (Forest Plan) was approved in 1989, and has since been amended by several decisions. The Forest Plan, as amended, provides guidance for management activities on the Ochoco National Forest. The Forest Plan establishes goals, objectives, and desired future conditions, identifies management areas within the Forest, and provides standards and guidelines for each management area as well as Forest-wide standards and guidelines. This proposal is tiered to the Final Environmental Impact Statement (FEIS) for the Forest Plan, as amended.

Forest Plan Management Areas

The major Ochoco National Forest management areas in the project area include (see Map 2):

Old Growth (MA-F6) 595 acres - Habitat will be provided for wildlife species dependent upon old-growth stands with pileated woodpecker as the management indicator species. The desired conditions for these areas are stands of mixed conifer and ponderosa pine with multi-layered canopy with shaded conditions and a large number of snags. Prescribed fire may be evident if natural fuels accumulate to dangerous levels, threatening the existence of the old-growth stand, or where vegetation manipulation is needed to maintain stand structure and species composition (Forest Plan, p. 4-58). Under standards and guidelines for the practice of Habitat Management, vegetative management will not be allowed, until further research is available on the needs of the dependent species (Forest Plan, p. 4-251). The Forest Plan (p. 4-58) also identifies that additional acres of pileated woodpecker "feeding areas" averaging 300 acres in size be located in areas adjacent to allocated old-growth stands.

Summit Historic Trail (MA-F7) 434 acres –The emphasis of this management area is to protect the existing integrity of the Summit Trail and enhance and interpret significant segments for public enjoyment and education. Pristine segments of the trail will be managed to protect, interpret and preserve their historic qualities (Forest Plan, p. 4-61).

Eagle Roosting Area (MA-F12) 261 acres- The management emphasis is to provide winter roosting habitat for migrating bald eagles annually during the period December through April (Forest Plan, p. 4-70).

Developed Recreation (MA-F13) 91 acres-The management emphasis is to provide safe, healthful, and aesthetic facilities for people to utilize while they are pursuing a variety of recreational experiences within a relatively natural outdoor setting (Forest Plan, p. 4-71).

Winter Range (MA-F20) 7,504 acres-The management emphasis is to provide winter cover and forage to big game species such as elk and deer (Forest Plan, p. 4-82).

General Forest (MA-F22) 13,002 acres - The emphasis for this area is to produce timber and forage while meeting the Forest-wide standards and guidelines for all resources. In ponderosa pine stands, management will emphasize production of high-value (quality) timber (Forest Plan, p. 4-86).

General Forest Winter Range (MA-F21) 701 acres - The emphasis for this area is to manage for timber production with management activities designed and implemented to recognize big game habitat needs (Forest Plan, p. 4-84).

Visual Management Corridors (MA-F26; Retention) 1,919 acres - The emphasis is to maintain the natural appearing character of the Forest along major travel routes, where management activities are usually not evident or are visually subordinate to the surrounding landscape. The outer boundary of this area will generally not exceed 600 feet on each side of the road. Vegetation will be manipulated but will reflect a natural forest setting where stands of trees exist in multiple age classes (Forest Plan, p. 4-95).

Eastside Screens

The Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales amended the Ochoco National Forest Land and Resource Management Plan in 1995. The direction only applies to the design and preparation of timber sales on eastside Forests and is often referred to as "Regional Forester's Forest Plan Amendment #2" or as the "Eastside Screens." The Eastside Screens contain guidelines for management of timber sales in late and old structured stands relative to the historical range of variability (ecosystem screen), wildlife corridors, snags, coarse woody debris, and goshawk management. All other noncommercial vegetative management treatments are exempt from the Eastside Screens. On June 11, 2003, the Regional Forester issued supplemental guidance for implementing Eastside Screens.

The Regional Forester encouraged the consideration of Land and Resource Management Plan amendments in cases where the proposed treatments would move landscape conditions towards historic range of variability and providing LOS for the habitat needs of associated wildlife species.

Inland Native Fish Strategy

The Inland Native Fish Strategy (INFISH) was intended to be interim direction to protect habitat and populations of resident native fish and to provide for options for management. The INFISH delineated Riparian Habitat Conservation Areas (RHCAs) where riparian-dependent resources receive primary emphasis. These RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems. These areas will be managed to maintain or restore water quality, stream channel integrity, channel processes, sediment regimes, instream flows, diversity and productivity of plant communities in riparian zones, and riparian and aquatic habitats to foster unique genetic fish stocks that evolved within the specific region. RHCAs run through and overlay other allocations (see Map 3, for RHCAs and distribution of redband trout).

Wolf Creek Watershed Analysis

The Wolf Creek Watershed Analysis was completed by an interdisciplinary team in January 2013 with input from the Ochoco Forest Restoration Collaborative. The interdisciplinary team focused largely on describing the existing condition by compiling and analyzing available information. Additionally, the interdisciplinary team developed a set of management recommendations, intended to guide future planning efforts in the project area by comparing the existing condition of the analysis area to the desired future conditions; identification of the desired future condition was largely guided by the planning direction conveyed in the Ochoco National Forest Land and Resource Management Plan, as amended.

Wolf Roads Analysis

In January 2013, an interdisciplinary team completed a roads analysis for the Wolf Creek and North Wolf Creek subwatersheds. The team reviewed existing roads in the Wolf Creek planning area then compared the current road system with what is desirable or acceptable, and described options for modifying the road system that would advance achievement of desirable or acceptable conditions. The team developed a set of recommendations that included designating 2 miles of Operational Maintenance Level (M/L) 2 Open Roads as M/L 1 Closed Roads. In addition, the team recommended decommissioning 2.8 miles of Operational M/L 1 Closed Roads. The recommendations were based on the degree of impact that motor vehicle use would have on soils, aquatic and riparian systems, and wildlife populations. During the Wolf project planning process, the Wolf roads analysis was revised to reflect concerns (big game security) raised during the NEPA scoping process; as a result, the team decided to recommend designating an additional 5.8 miles of Operational M/L 2 Open Roads as Operational Level M/L 1 Closed Roads; this is reflected in Alternatives 3 and 4.

Proposed Action

The action proposed by the Forest Service to meet the purpose and need is to implement commercial thinning on 4,706 acres, noncommercial thinning on 988 acres, juniper cutting on 481 acres, underburning on 5,000 acres, and hardwood enhancement on 75.5 acres. The total area on which activities would be implemented would be about 11,252 acres. Alternative 2 also proposes closing 2 miles of roads, and decommissioning 2.8 miles of roads, as recommended though the Wolf Roads Analysis process. Actions connected to the proposed action would include stream restoration on Wolf Creek, headcut repair at five locations, 1.8 miles of temporary road, 18 miles of temporary roads on existing disturbance, and the expansion of Six Corners Material Source by up to 3 acres. Temporary roads would be closed and hydrologically stabilized following treatment (see Maps 4, 5 and 6 for location of proposed activities).

Decision Framework

The Responsible Official for this proposal is the Forest Supervisor of the Ochoco National Forest. The Responsible Official will decide whether to:

- Select the proposed action;
- Select an action alternative that has been considered in detail;
- Modify and an action alternative;
- Select the no action alternative;
- Identify what mitigation measures and monitoring will apply.

The Responsible Official will decide whether to conduct commercial harvest, noncommercial thinning, hardwood treatments, and fuels reduction activities in the Wolf project area. The decision will be determined by how well each alternative provides the best mix of prospective results with regard to the purpose and need, the significant issues, and public comments.

Factors that the Responsible Official will consider include effects of the alternatives on forested vegetation, on fuels, on aquatic species and water quality, and on wildlife species and habitats. The Responsible Official will also consider the ability of each alternative to contribute to local and regional economies.

Public and Intergovernmental Involvement

The Wolf Fuels and Vegetation Management project was announced in the Ochoco National Forest's Schedule of Proposed Action on July 1, 2013. Letters announcing the proposed action and inviting comment were mailed to Paulina Ranger District's mailing list on April 1, 2013. The Notice of Intent (NOI) was published in the Federal Register on April 5, 2013. The NOI asked for public comment on the proposal from April 5, 2013 through May 20, 2013.

Letters announcing the proposed action and inviting comment were mailed to the Burns Paiute Tribe, the Klamath Tribes, and the Confederated Tribes of the Warms Springs Reservation of Oregon, as part of government-to-government consultation. The Paulina Ranger District received nine comments from individuals, organizations and agencies. In addition, the Wolf project Proposed Action was presented to the Ochoco Restoration Collaborative.

Using the comments from the public and other agencies, the interdisciplinary team developed a list of issues to address.

Issues

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-significant issues and reasons regarding their categorization as non-significant may be found at the Paulina Ranger District office, Prineville, Oregon, in the project record.

The Forest Service identified the following Issues as significant during scoping:

1. The proposed action does not adequately protect old growth trees, improve forest health, and decrease the risk of stand replacement fires.
2. The opening of forested stands through commercial thinning may decrease elk security cover for big game species.
3. The proposed action does not address declining riparian conditions on North Fork Wolf Creek (This was a result of internal scoping).
4. Commercial activities within RHCAs may reduce stream shade and cause an increase in sediment delivery to streams.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes and compares the alternatives considered for the Wolf Fuels and Vegetation Management project (Wolf project). It includes a description of and map references for each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. 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, social and economic effects of implementing each alternative.

Alternatives Considered in Detail

The Forest Service developed four alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public.

Alternative 1 -No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. No vegetation management, fuels reduction or riparian hardwood enhancement would be implemented to accomplish project goals.

Alternative 2 - Proposed Action

Table 7 summarizes the activities that are included in the proposed action for the Wolf project area. Please refer to Maps 4, 5, and 6 for locations of activities. Table 8 summarizes the connected actions, which are actions necessary for the implementation of Alternative 2.

Table 7. Activities proposed in Alternative 2.

Activity	Quantity (approximate)
Commercial thinning (would be followed by noncommercial thinning and prescribed burning)	4,706 ac
Noncommercial thinning (outside of harvest units; would be followed by prescribed burning)	988 ac
Juniper cutting (would be followed by jackpot and prescribed burning)	481 ac
Underburning only	5,000 ac
Hardwood enhancement	75.5 ac
Road closure	2.0 miles
Road decommission	2.7 miles

Table 8. Actions connected to the activities proposed in Alternative 2.

Connected Action	Quantity
Stream restoration	1.0 miles
Headcut repair	5 locations
Temporary roads construction	1.8 miles
Temporary roads on existing disturbance	17.6 miles
Expansion of Six Corners Material Source	up to 3 acres

Explanation of Proposed Activities and Connected Actions:

Commercial Thinning: This prescription would be used in overstocked stands with a surplus of merchantable sized trees between 7 and 20.9 inch DBH. Current stand conditions often include multiple canopies, a component of large (21+" DBH) trees, and dense stocking and may include all seral stages. The stands would be thinned, on average, to recommended stocking levels while retaining variable densities across the unit. Merchantable trees up to 20.9 inch DBH removed in a commercial thinning would be sold and removed from the stand. Following the commercial thinning, most stands would be non-commercially thinned and the thinning slash would be treated, in most cases by prescribed fire. All of these treatments work together to attain the desired stand condition where future prescribed burning can safely be used as a forest management tool that mimics the role that fire historically had in these forests.

Noncommercial Thinning: The objective of this treatment is to reduce the amount of small non-merchantable trees (generally less than 9 inches DBH). The number of small trees to be left varies by stand conditions, depending on the overall stocking objectives and the amount of existing overstory. Where the objective in the stand is to have single-storied LOS stand and many large diameter trees exist, then few small understory trees would be retained (40 or less per acre). Where few overstory trees exist, such as in young plantations, then the noncommercial thinning could retain 135 or more small trees per acre. Species selection usually retains ponderosa pine, western larch, and sometimes Douglas-fir, or removes species infected with or susceptible to insects/disease. Noncommercial thinning can occur either following a commercial entry or as the only treatment. Trees cut during this activity are usually left on site and the slash treated by a variety of fuels treatments.

Juniper removal: This treatment is primarily proposed within the juniper woodland/steppe Plant Association Groups (PAGs) to reduce juniper density. Younger junipers up to 20.9 inch DBH would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size (Miller et al. 2005). Concentrations of slash would be burned. Burning is expected to occur in patches as a continuous fuel bed of slash is not anticipated due to the low density of juniper. The objectives of this treatment are to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation.

Prescribed Burning: This activity includes a variety of treatments designed to reduce natural fuels and fuels created by other activities while retaining desired vegetation. These treatments occur under prescribed conditions and include broadcast underburning, piling and burning, and spot burning of fuels accumulations (jackpots).

Hardwood Treatments: These treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. This includes planting of hardwoods where they are absent or sparse, reducing conifer competition by cutting down and/or girdling conifers that have encroached into hardwood communities and are both shading out hardwoods and occupying their growing space. Conifers up to 15 inch DBH may be felled or girdled so long as they do not qualify as old trees. Thinning would take place for an approximate distance of 75 feet from hardwoods to allow for sufficient sunlight, water, nutrient and growing space to be available.

Slash generated from this non-commercial activity would be left intact to provide protection to the hardwoods, lopped and scattered, or handpiled. Cut trees may also be felled or placed into stream channels for stream restoration purposes. Handpiles within 50 feet of a stream would not be burned; handpiles outside of the 50 foot zone may be burned. To prevent browsing on hardwood seedlings and saplings, fencing or individual cages may be installed. In some stands livestock fencing may be installed, in others big game fencing may be required. The type of fence needed would be determined on a site specific basis. Fences could be wire, plastic or wooden.

When aspen clones are encountered in stands that are planned for commercial harvest or non-commercial thinning, the silvicultural prescription would be modified within and adjacent to the clone similarly to the above description.

Road Closure and Road Decommissioning: These actions are designed to improve riparian conditions, which would subsequently benefit riparian hardwood communities, by both decreasing road densities and hydrologically stabilizing identified road surfaces through decompaction, water barring and relief ditches. Decompaction reduces direct delivery of sediment into surface water bodies by reducing or eliminating surface flow on the road surface, thereby decreasing or eliminating the volume of erosive strength of that surface flow. Also, decompaction of the roadbed increases both roughness and infiltration rate on the road surface, both of which dramatically reduce flow rate, volume, and sediment transport capacity.

Road system density in a subwatershed directly relates to the amount of impervious surface area that effectively serves as surrogate stream channels, speeding up the passage of water though the subwatershed and presenting an effect to aquatic systems. This can directly influence stream flow routing and affect the peak, timing, and duration of higher discharge events that can occur as a result of rain-snow or high-intensity rainfall events. These sorts of increased discharge rates contributed to by the artificial stream network the road system represents serve to increase the risk of channel-changing events, particularly in aquatic/riparian systems that are not in properly functioning condition.

Temporary Roads: Temporary roads are sometimes needed to facilitate the economical harvest of trees. Temporary roads would be constructed on flat ground (slope less than 20%); excavation and construction of embankments would be negligible; they would be constructed in such a way as to minimize disturbance and impacts to adjacent resources (see section titled “Transportation” in Chapter 3 of this document). Following completion of Wolf project activities, all temporary roads would be barricaded to prevent motorized access, rehabilitated and decompacted (depending on soil type) to return them to vegetative productivity.

Six Corners Material Source Expansion: The Six Corners Material Source is located in the General Forest Management Area in T14S, R24E, Section 32, on Road 4200-790. Existing mineral reserves at the site will not meet needs associated with the Wolf project. The purpose for expanding the material source is to provide pit-run rock for implementation of projects under the Wolf decision, which may include road maintenance and reconstruction, and road closure. The site would be expanded from its current size of about nine acres to no greater than 12 acres. Expansion of the Six Corners Material Source would require removal of timber on up to three acres.

Stream restoration activities, Wolf Creek: Riparian restoration activities would be designed to arrest continued stream channel downcutting and therefore stabilize and/or restore water tables which are a contributing factor to hardwood and riparian vegetation decline; as stated earlier, there is need to enhance and maintain hardwood communities within the Wolf project area. Additional goals include the advancement of Riparian Management Objectives (RMOs) and recovery of habitat for R6-listed sensitive aquatic species such as redband trout and Columbia spotted frog and other riparian dependent species.

Stream and riparian restoration activities would occur on 1 mile of Wolf Creek from the Forest boundary to FS Road 42. In-stream work would include a combination of channel reconstruction and placement of stream structures (rock and trees) including small-to medium sized debris jams. Channel reconstruction would occur in sections of the stream, or immediately adjacent to the stream, that is considerably incised and has lost contact with the floodplain. Stream structure placement would occur in areas where stream function and habitat conditions can be improved without significant channel manipulations. Stream structure placement would be intermittent and discontinuous along the linear length of the project. Work would be conducted with a mix of track hoes (channel reconstruction) and low impact ground based equipment, i.e., walking excavator (stream structure placement).

A rubber tired skidder and front end loader may be used infrequently at intermittent access points to deliver and move trees, rocks and soil to, and at, construction areas.

Trees for large woody debris would include the collection of approximately 110 whole trees for instream restoration projects from three units. Approximately 40 trees would be taken from the outside portion of the RHCA (300') from within stream and riparian restoration unit (253). Trees would primarily be ponderosa pine up to 20" dbh. An additional 70 trees would come from adjacent unit 204 and would primarily be ponderosa pine up to 18" dbh. No trees that exhibit old growth characteristics, regardless of size, would be used.

Headcut Repair: Headcut repair projects have been proposed in conjunction with hardwood restoration units to stop continued stream channel down-cutting and stabilize water tables. It is anticipated that stabilizing water tables would benefit aspen and other hardwood communities. Headcut repair units may include channel reconstruction and filling of gullies with soil, and or construction of grade control structures including placement of rock and woody debris and geo-textile fabrics. Work would be conducted with a mix of track hoes (channel reconstruction) and low impact ground based equipment, i.e., walking excavator (stream structure placement). A rubber tired skidder and front end loader may be used infrequently at intermittent access points to deliver and move trees, rocks and soil to, and at, construction areas. Depending upon the size of the project, headcut repair/meadow restoration work would take up to 2 weeks to implement.

Projects would include the collection of whole trees to be used as material for headcut repair. A variety of tree sizes/diameters would be utilized, the majority of trees selected would be between 12"-18"in diameter; none would be over 21" in diameter. Approximately 10-15 trees would be collected at each site. Noncommercial thinning material may also be incorporated into project design. No commercial harvest activities would occur in any units. Tree selection would be coordinated with the wildlife biologist and silviculturist so that wildlife habitat needs and silvicultural objectives are met or enhanced.

Planting and restoration of disturbed areas would occur. This would involve planting and seeding with native plants (rooted, potted, sticks or bundles) by manual techniques (shovel, auger, etc.) and a small portion of larger trees/shrubs (5-10 gallon pots) with the heavy equipment at the time of implementation. A revegetation plan would be prepared in coordination with the project design

Vegetation Management Strategy within RCHAs

Under INFISH, timber harvest (including fuel wood cutting) is prohibited within Riparian Habitat Conservation Areas (RHCAs) except to acquire desired vegetation characteristics where needed to attain Riparian Management Objectives (RMOs) (INFISH, A-7). The treatments described in table 14 (see Chapter 2, Project Design Features) were designed to protect RHCAs while carefully managing to attain RMOs. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs; site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be protected (see analysis in Chapter 3).

Forest Plan Amendments

Implementation of Alternative 2 would require two Forest Plan amendments:

1. Commercial harvest within about 10 acres of an LOS stage that is currently below historic abundance (Douglas-fir multi-strata).

2. Establish a new, site-specific Riparian Management Objective to guide vegetative treatments in RHCAs.

Alternative 3

Alternative 3 was developed to respond to Issues #1, #2 and #3 (see page 22).

Issue #1 indicated a concern on the part of two commenters that the Proposed Action does not go far enough in meeting the purpose and need of the project, and indicated a desire for the Responsible Official to consider additional activities to increase restoration in the Wolf project area. Due to economic reasons, the project ID team did not look at any ground that could not be accessed by a tractor logging system (see "Alternatives Considered but Eliminated from Detailed Study"), but did identify restoration opportunities with the development of a Forest Plan Amendment that increases the harvest diameter limit above 21' dbh; this would allow for an increase in restoration objectives identified in the purpose and need, while maintaining the economic viability of the project.

Issue #2 indicated a concern on the part of the commenter that the Proposed Action, through commercially thinning dense stands of forested vegetation, may decrease security cover for big game species. In order to address Issue #2, Alternative 3 proposes to close an additional 5.8 miles of roads so as to reduce road densities and improve security for big games species.

Issue #3 indicated a concern on the part of the Wolf IDT that the proposed action does not address declining riparian conditions in North Fork (NF) Wolf Creek; subsequently, there is likelihood that the existing hardwood communities on NF Wolf Creek would continue to degrade and may eventually be lost. In order to address Issue #3, Alternative 3 proposes 1.2 mile of stream restoration on NF Wolf Creek; the activities would be similar to those proposed on Wolf Creek except Alternative 3 would include the replacement of a culvert on FS Road 4260.

Table 9 summarizes the activities that are included in Alternative 3. Please refer to Maps 7, 8 and 9 for locations of activities. Table 10 summarizes the connected actions required for the implementation of Alternative 3.

Table 9. Activities proposed in Alternative 3.

Activity	Quantity (approximate)
a) Commercial thinning (would be followed by noncommercial thinning and prescribed burning)	a) 4,322 ac b) 384 ac
b) Commercial thinning trees >21" dbh	Total: 4,706
Noncommercial thinning (would be followed by prescribed burning)	988 ac
Juniper removal (would be followed by prescribed burning)	481 ac
Underburning only	5,000 ac
Hardwood enhancement	90.2 ac
Road closure	7.8 miles
Road decommission	2.7 miles

Table 10. Actions connected to the activities proposed in Alternative 3.

Connected Action	Quantity
Stream restoration	2.2 miles
Culvert replacement	1 location
Headcut repair	6 locations
Temporary road construction	1.8 miles
Temporary road on existing disturbance	17.6 miles
Expansion of Six Corners Material Source	up to 3 acres

Explanation of Proposed Activities and Connected Actions:

The explanations of the activities common to the other action alternatives are explained under Alternative 2; additional activities include:

***Commercial thinning with 21+ trees*:** This prescription is similar to commercial thinning except that harvest would include the removal of some trees 21" DBH or larger. This treatment is proposed to help restore historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where there are old ponderosa pine that are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Removal of large young trees from the vicinity of old trees for approximately twice the canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013). The prescription would also follow the draft decision marking guide for removal and retention of grand-fir and Douglas-fir that was developed by the Ochoco Forest Restoration Collaborative (see Appendix G).

Stream Restoration Activities, NF Wolf Creek: Stream and riparian restoration activities would occur on 1.2 miles of N. Wolf Creek from the Forest boundary to FS Road 4260. In-stream work would include a combination of channel reconstruction and placement of stream structures (rock and trees) including small-to medium sized debris jams. Channel reconstruction would occur in sections of the stream, or immediately adjacent to the stream, that is considerably incised and has lost contact with the floodplain. Stream structure placement would occur in areas where stream function and habitat conditions can be improved without significant channel manipulations. Stream structure placement would be intermittent and discontinuous along the linear length of the project. Work would be conducted with a mix of track hoes (channel reconstruction) and low impact ground based equipment, i.e., walking excavator (stream structure placement). A rubber tired skidder and front end loader may be used infrequently at intermittent access points to deliver and move trees, rocks and soil to, and at, construction areas.

Trees for large woody debris would include the collection of approximately 135 whole trees for instream restoration projects from three units. Approximately 40 trees would be taken from the outside portion of the RHCA from within stream and riparian restoration unit 350 (14.7 acres). Trees would be primarily ponderosa pine. A variety of tree sizes/diameters would be utilized, the majority of trees selected would be between 12"-18"in diameter; none would be over 21" in diameter. An additional 70 trees would come from adjacent units 52 (50 trees), 203 (25 trees) and 4 (20 trees); trees from all units would primarily be ponderosa pine up to 18" dbh. No trees that exhibit old growth characteristics, regardless of size, would be used.

The existing culvert on FS Road 4260 would be replaced to improve stream structure and complement other stream restoration activities proposed for NF Wolf Creek. The existing culvert is subject to topping and plugging in storm events and is not wide enough to accommodate the bankfull channel width or 100-year flood event. The existing culvert would be replaced with a bottomless pipe arch or similar structure that would provide Aquatic Organism Passage (AOP) and meet current standards for passing peak flows.

Vegetation Management Strategy within RCHAs

The RCHA strategy would be the same as in Alternative 2 (see Table 14).

Forest Plan Amendments

Implementation of Alternative 3 would require the following Forest Plan amendments:

1. Allow a timber sale to cut and remove trees greater than 21" in diameter in limited, specific locations.
2. Commercial harvest within about 10 acres of an LOS stage that is currently below historic abundance (Douglas-fir multi-strata).
3. Establish a new INFISH Riparian Management Objective to guide vegetative treatments in RHCAs.

Alternative 4

Alternative 4 was developed to respond to Issues #2, #3 and #4 (see page 22).

Issue #2 indicated a concern on the part of the commenter that the Proposed Action, through commercially thinning dense stands of forested vegetation, may decrease security cover for ungulates. In order to address Issue #2, Alternative 4 proposes to close an additional 5.8 miles of roads so as to reduce road densities and improve security for big games species.

Issue #3 indicated a concern on the part of the Wolf IDT that the proposed action does not address declining riparian conditions in NF Wolf Creek; subsequently, there is likelihood that the existing hardwood communities on NF Wolf Creek would continue to degrade and may eventually be lost. In order to address Issue #3, Alternative 4 proposes 1.2 mile of stream restoration on NF Wolf Creek; the activities would similar those proposed on Wolf Creek except Alternative 4 would include the replacement of a culvert on FS Road 4260.

Issue #4 indicated a concern on the part of the commenter that the Proposed Action both reduces stream shade and contributes sediment to streams; the commenter recommends that there be no commercial activities within 300 feet of sediment delivery zone and only hand-thinning be allowed. In response to Issue #4, Alternative 4 proposes to prohibit commercial harvest in RHCAs while allowing for noncommercial treatments, underburning, and riparian restoration efforts.

Table 11 summarizes the activities that are included in the Alternative 4 for the Wolf project area. Please refer to Maps 10, 11 and 12 for locations of activities. Table 12 summarizes the connected actions that would be necessary for implementation of Alternative 4.

Table 11. Activities proposed in Alternative 4

Activity	Quantity (approximate)
Commercial thinning (would be followed by noncommercial thinning and prescribed burning)	3,394 ac
Noncommercial thinning (would be followed by prescribed burning)	1,177 ac
Juniper removal (would be followed by jackpot and prescribed burning)	481 ac
Underburning	5,853 ac
Hardwood treatment	92.3 ac
Road closure	7.8 miles
Road decommission	2.7 miles

Implementation of the proposed action would require the following connected actions.

Table 12. Actions connected to the activities proposed in Alternative 4.

Connected Action	Quantity
Stream restoration	2.2 miles
Headcut repair	6 locations
Culvert Replacement	1 location
Temporary road construction	1.6 miles
Temporary road on existing disturbance	14.1 miles
Expansion of Six Corners Material Source	Up to 3 acres

Explanation of Proposed Activities and Connected Actions:

These would be the same as described for Alternatives 2 and 3.

Vegetation Management Strategy within RCHAs

The RCHA strategy would not include the commercial harvest of trees within the RHCA, but would include noncommercial thinning, hardwood enhancement, riparian restoration, and underburning.

Forest Plan Amendments

Alternative 4 does not require any Forest Plan Amendments.

Project Design Features Common to All Alternatives

The Forest Service developed the following project design features (PDFs) to be used as part of all of the action alternatives. These design elements were developed to reduce the environmental effects of the proposed activities or to comply with the standards and guidelines in the Forest Plan. Many of the design elements for Water Quality/Aquatic Habitats are intended to meet the requirements for protection of water quality in the State of Oregon through planning, application, and monitoring of Best Management Practices (BMPs). PDFs developed for riparian restoration activities can be found in Appendix D.

Water Quality and Aquatic Habitats (Riparian Habitat Conservation Areas)

Table 13 identifies RHCA boundaries that were applied during unit design for the Wolf project. The following Project Design Features (PDF) were developed to minimize adverse environmental effects of the proposed activities to streams, wetlands, and RHCAs and would be used in all of the action alternatives. These PDFs comply with the standards and guides outlined in the Ochoco National Forest Plan, INFISH, as well as requirements for protection of water quality in the State of Oregon in accordance with the Clean Water Act.

Table 13. RHCA boundaries by stream class, as defined in INFISH.

Stream Class	Description	Width Each Side (feet)
1 and 2	Fish-bearing streams	300
3	Perennial (and select intermittent), non-fish bearing streams Ponds, lakes, reservoirs, and wetlands greater than 1 acre Unstable areas near waterbodies	150
4	Intermittent streams Wetlands less than 1 acre Landslides and landslide-prone areas	50
INFISH uses the term *stream category*. These categories have been converted to *stream class*, which is a more commonly used term. These are only RHCA boundaries and do not indicate vegetation treatments within them.		

Commercial Thinning

The following table (Table 14) describes unit specific treatments within RHCAs for Alternatives 2 and 3. If Class IV streams are encountered that are not accounted for in Table 14 and 16, the design features in Tables 15 and 17 would be used. The stream data used to support these recommendations is located in the Wolf project record.

Table 14. Unit-specific RHCA Treatments for Stream Classes I, II, and III in Alternative 2 and 3.

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
Prescribed Burn	All prescribed burn units	No specific treatment recommendations beyond the Project Design Criteria
Commercial Harvest	4	Class 1: No commercial harvest within 70’ of stream
	5	Class 3: No commercial harvest within 50’ of spring Class 4: No commercial harvest within 20” of stream; fell trees until large wood RMO is met
	12	Class 4s: No commercial harvest within 5’ of streams; fell trees until large wood RMO is met
	13	Class 3: No commercial harvest within 50’ of stream; fell trees until large wood RMO is met
	16	Class 3: No commercial harvest within 50’ of stream and spring; no equipment in the buffer
	18	Class 3: No commercial harvest within 50’ of spring; within remainder of unit, no commercial harvest within 25’ of stream; no commercial harvest within 5’ of stream in west side of unit; fell trees until large wood RMO is met
	20	Class 4: No commercial harvest within 25’ of stream
	21	Class 4: No commercial harvest within 25’ of stream; no commercial harvest within 50’ of spring.
	22	Class 4: No commercial harvest within 25’ of stream; fell trees until large wood RMO is met
	24	Class 4: No commercial harvest within 75’ of stream; fall and leave to meet RMO
	26	Class 1: No commercial harvest within 75’ of stream, or to the fence; no wetland buffer; fell trees until large wood RMO is met
	27	Class 1: No commercial harvest within 75’ of stream; fell trees until large wood RMO is met
	28	Class 1: No commercial harvest within 75’ of stream; fell trees until large wood RMO is met Class 3: No commercial harvest within 50’ of spring
	29	Class 3: No commercial harvest within 50’ of stream Class 4: No commercial harvest within 5’ of stream
	31	Class 1: No commercial harvest within 150’ of stream; fell trees until large wood RMO is met
	32	Class 2: No commercial harvest or equipment within 25’ of stream; fall trees until large wood RMO is met.
	41	Class 2: No commercial harvest within 50’ of stream; fell trees until large wood RMO is met
	43	Class 4: No commercial harvest within 10’ of stream; fell trees until large wood RMO is met
	45	Class 2: No commercial harvest within 75’ of stream
	47	Class 2: No commercial harvest within 75’ of stream
	50	Class 1: No commercial harvest 100’ below road. Class 3: No commercial harvest within 50’ of spring
	51	Class 2: No commercial harvest within 75’ of stream; fell trees until large wood RMO is met
	55	Class 2: No commercial harvest within 50’ of stream; fell trees until large wood RMO is met
	56	Class 2: No commercial harvest within 100’ of stream; fell trees until large wood RMO is met

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
	61	Class 4: No commercial harvest within 25’ of stream in the south end of unit; no commercial harvest within 10’ of stream in rest of unit (coordinate with aquatics personnel)
	63	Class 2: No commercial harvest within 50’ of stream
	70	Class 4: No commercial harvest within 25’ of stream; no commercial harvest within 50’ of stream on slopes > than 20%.
	72	Class 2: No commercial harvest from road to the stream
	77	Class 2: No commercial harvest from road to stream
	78	Class 4: No commercial harvest within 25’ of stream
	80	Class 1: No commercial harvest within 75’ of stream, by dispersed campground. Class 2: No commercial harvest from terrace to stream or within 75’ of stream, whichever is greater. Upstream of raptor nest, no commercial harvest within 125 of stream- up to spring in the unit lobe. Above spring, no commercial harvest from terrace to stream or within 50’ of stream, whichever is greater. Class 4: No commercial harvest within 20’ of stream
	82	Class 1: No commercial harvest within 200’ of stream Class 4: No commercial harvest within 50’ of stream
	83	Class 3: No commercial harvest from the slope bank to stream; fell trees to meet large wood RMO.
	84	Class 3: No commercial harvest within 25’ of stream; no equipment within the buffer.
	85	Class 3: No commercial harvest 50’ below spring; no commercial harvest 30’ above spring. No equipment in buffers within 50’ of channel; fell 10-12 trees to meet large wood RMO.
	86	Class 3: No commercial harvest to slope break or 50”, which is greater; no equipment in the buffer, except for crossing stream. Class 4: No commercial harvest within 25’ of stream; fell trees until large wood RMO is met
	87	Class 3: No commercial harvest from road to stream
	88	Class 3: No commercial harvest within 50’ of stream; cut and leave until large wood RMO is met
	89	Class 3: No commercial harvest from road to stream
	90	Class 2: No commercial harvest within 50’ of stream or to terrace; fell 6 trees to meet large wood RMO
	91	Class 2: No commercial harvest within 50’ of stream or to terrace; fell 10 trees to meet large wood RMO
	93	Class 4: No commercial harvest within 25’ of stream; fell trees to meet large wood RMO
	94	Class 2: No commercial harvest within 100’ of stream
	95	Class 2: No commercial harvest from terrace to stream
	100	Class 2: No commercial harvest within 100’ of stream
	102	Class 2: No commercial harvest within 75’ of stream; fell trees to until large wood RMO is met
	103	Class 2: No commercial harvest within 75’ of stream; fell trees until large wood RMO is met
	106	Class 2: No commercial harvest within 75’ of stream
	112	Class 2: No commercial harvest within 100’ of Clear Spring
	125	Class 3: No commercial harvest in RHCA (spring). Class 4: No commercial harvest within 50’ of stream
	137	Class 4: No commercial harvest within 10’ of stream; fell trees until large wood RMO is met
	142	Class 2: No commercial harvest from road to creek; fell trees until large wood RMO is met
	148	Class 2: No commercial harvest within 100’ of stream; fell trees until large wood RMO is met
	149	Class 2: No commercial harvest from road to creek Class 4/swale: Stay on existing skid trail to south and east of unit; remainder of unit, no commercial harvest within 25’of stream; fall and leave until large wood RMO is met (coordinate with aquatics personnel)

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
	150	Class 2: No commercial harvest from road to creek; in eastside unit lobe, no commercial harvest within 25' of channels (stream channels shall be identified by aquatic specialist); fell trees until large wood RMO is met
	154	Class 2: No commercial harvest south of road; in remainder of unit, no commercial harvest within 100' of stream
	155	Class 2: No commercial harvest within 100' of stream; fell trees until large wood RMO is met
	156	Class 2: No commercial harvest within 100' of stream
	158	Class 2: No commercial harvest within 50' of stream Class 3: No commercial harvest within 50' of spring Class 4: No commercial harvest within 50' of stream
	159	Class 2: No commercial harvest within 50' of stream
	160	Class 4: No commercial harvest within 20' of stream in north-side of unit
	162	Class 2: No commercial harvest within 50' from stream
	166	Class 2: No commercial harvest from road to stream; remainder of unit, no commercial harvest within 25' of stream
	168	Class 2: No commercial harvest above the road; fell trees until large wood RMO is met
	170	Class 4: No commercial harvest within 50' of wetland
	172	Class 2: No commercial harvest from road to stream
	173	Class 3: No commercial harvest from road to stream
	174	Class 4" No commercial harvest within 35' of stream
	175	Class 2: No commercial harvest from road to stream
	176	Class 4: No commercial harvest within 100' of stream; no commercial harvest 10' from swales; fell trees until large wood RMO is met
	177	Class 4: No commercial harvest within 50' of stream
	179	Class 4: No commercial harvest within 20' of stream

Table 15. Category IV RHCA Design Features

Distance From Channel/Feature (Feet)	Treatment
0 – 5	No Treatment
Slope %	**Treatment**
0-10	No commercial harvest within 25' of stream; fell trees until large wood RMO is met
11-35	No commercial harvest within 50' of stream
Exceptions may be possible after review by Fishery Biologist and/or Hydrologist.	

- Trees felled to meet large wood RMO would be felled into or towards stream channels to increase large woody material and to reduce livestock access. Felling trees may involve either cutting trees or pushing trees, dependent on ground conditions. If trees are felled by pushing, the same equipment, or its equivalent, used during commercial harvest would be utilized.
- Hazardous trees that are felled within RHCAs would be left on site or used for in-stream large wood structures.
- Where slash generated from thinning is handpiled, avoid burning handpiles within 50 feet of all waterbodies. Exceptions may be possible after review by fisheries biologist or hydrologist.
- Tractor skidding of trees within RHCAs is prohibited on slopes greater than 35%.
- No ground-based equipment would be allowed within "no commercial harvest "buffers except on system and temporary roads (existing and new temporary roads).

Noncommercial Thinning

For noncommercial treatments, follow unit-specific design features in Table 16. For the remainder of the RHCA units, follow the treatments outlined in Table 17.

Table 16. Unit specific noncommercial thinning treatments for all alternatives.

Noncommercial Thinning	12	Class 4: Cut and leave whole trees up to 9 dbh ” within RHCA
	13	Class 3: No treatment within 10’ of stream; cut and leave whole junipers within RHCA
	32	Class 2: Cut and leave whole trees 9 to 16” dbh to meet large wood RMO
	47	Class 2: Cut and leave whole trees 9 to 16” dbh to meet large wood RMO
	61	Class 4: Cut and leave whole trees 9 to 16” dbh to meet large wood RMO
	70	Class 4: Cut and leave whole trees 9 to 12” dbh to meet large wood RMO
	78	Class 4: Cut and leave whole trees up to 12” dbh to meet large wood RMO
	84	Class 3: Cut and leave whole trees up to 18” dbh to meet large wood RMO
	91	Class 2: Cut and leave whole trees within 50 feet of channel to provide roughness
	162	Class 2: Cut and leave whole trees within 50 feet of channel to provide roughness
	175	Class 2: Cut and leave whole trees within 50 feet of channel to provide roughness
	179	Class 4: Cut and leave whole trees within RHCA

Table 17. Noncommercial thinning RHCA design features

Distance From Channel (Feet)	Treatment
0 – 5 (All Stream Classes)	No Treatment
6 – 12 (Class 1, II, III)	Hand cutting (drop and leave or girdling) of conifers up to 15” to remove competition from existing hardwoods or to provide growing space for hardwood plantings.
13 – 28 (Class 1, II, III)	Noncommercial thinning of conifers up to 6” dbh using hand tools
29 – 50 (Class 1, II, III)	Noncommercial thinning of conifers up to 9” dbh using hand tools
*Exceptions may be possible after review by Fisheries Biologist and/or Hydrologist.	

- Trees cut during noncommercial thinning would be felled toward designated stream channels, where available, to increase woody structure and roughness and to reduce livestock access.

Stream Crossings

- Locate stream crossings where the channel is narrow, straight, and uniform, and has stable soils and relatively flat terrain to the extent practicable. Select a site where erosion potential is low. Orient the stream crossing perpendicular to the channel to the extent practicable. Keep approaches to stream crossings to as gentle a slope as attainable.
- Temporary and reconstructed roads with stream crossings would have adequate relief drainage installed prior to runoff reaching the stream channel. Filter strips below drainage structures would be of sufficient size to catch sediment before runoff enters streams. If adequate filter strips are not available, slash, rock aprons, or other filtering structures would be installed. A stable structure would be constructed across all streams when crossed by new temporary roads. Reconstructed stream crossings should be constructed to accommodate a 100-year flood if the crossing structure is anticipated to remain in place during the winter or spring. As needed, temporary and reconstructed road stream crossings would be coordinated with the fisheries biologist or hydrologist.
- To protect morphology of dry stream channels and banks, temporary road crossings would be constructed by laying logs in the channel and covering with a layer of geotextile cloth (to prevent migration of soil/mud to the channel bed) prior to placement of soil to create a drivable travel surface. These “log culvert” crossing structures would be removed at the end of hauling activities.

- At dry stream crossing locations (either summer or winter haul) where low bank height (less than 1 foot) and broad channel width would make a "log culvert" structure an impracticable choice, rock fords would be constructed to protect the bank and channel from damage by hauling equipment. All temporary road crossings would be removed unless they are determined to be hydrologically beneficial.
- When practical, large woody debris would be placed in the stream channel after the removal of stream crossing.
- When practical, native riparian-associated vegetation would be planted or seeded at new and reconstructed stream crossings.
- For dry streams whose bed and banks are well armored by large cobble, boulders and/or bedrock, and whose bank angle and bank height are low enough to provide a smooth transition through the channel, skidding may proceed without a constructed crossing.
- Stream crossings would be installed when channel is dry, either naturally or by diverting and dewatering the site. Exceptions may be made for winter harvest activity.

Skid Trails, Landings, and Roads

- When practical, avoid new skid trails, landings, and temporary roads within RHCAs (including wetlands and springs) and up ephemeral draws. When using existing skid trails, landings, and temporary roads within RHCAs of Class 3 and 4 waterbodies and within 200 feet of Class 1 and 2 streams, minimize disturbance and subsequent impacts. Exceptions may be possible after review by the fisheries biologist or hydrologist.
- Maintenance level 1 closed roads (see Chapter 3, Transportation) used for project implementation shall be hydrologically stabilized and physically closed to vehicular traffic upon project completion.
- Temporary road construction would be limited to sustained grades of 20% of less, allowing shorter lengths of no more than 100 feet which would not exceed sustained grades of greater than 30%.
- All temporary roads, within 200 feet of a stream, would not receive large vehicular use in support of post-harvest activities. Exception may be made to support post-harvest activities on a short-term basis through the use of smaller vehicles such as ATVs, UTVs, and small farm tractors.
- At the completion of harvest and post-harvest activities requiring their use, temporary roads utilized by this project would be blocked to eliminate motor vehicle access, hydrologically stabilized, and scarified or otherwise de-compacted (as soil conditions allow) to facilitate their return to proper hydrologic function and vegetative productivity .

Other Activities

- In channel work on Class I-III streams would be accomplished during low flow conditions in accordance with "Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources, June 2008." For the project area, the timing for in-water work is July 1 to October 31. The appropriate permit and/or authorizations would be obtained from the Division of State Lands and the Army Corp of Engineers.
- In channel work on Class IV streams would occur when the channel is dry. This would include the installation and removal of crossing structures (culverts, fords, log crossings, etc.) as well as the actual fording of dry channels during timber operations. As needed, the fisheries biologist or hydrologist would coordinate specifications and locations.

- New industrial camps would not be located in RHCAs.
- Develop or use existing fuel and chemical management plans (e.g., Spill Prevention Control and Countermeasures [SPCC], spill response plan, and emergency response plan) when developing the management prescription for refueling and servicing sites.
- Screen water pump intakes with appropriate size mesh screen to prevent entrapping fish. Draft hoses used to withdraw water from ponds or streams shall be screened with appropriate size mesh to prevent entrapping fish.
    - Woven Wire Screen or Perforated Plate: 3/32 in. (2.38mm)
    - Profile Bar Screen: 0.0689 in. (1.75mm).

If conditions are such that winter activities extend through March, avoid activities (including haul) in the Columbia Spotted Frog channel migration zone between March 1- May 31st. Post-harvest activities such as noncommercial thinning and prescribed fire within RHCA Class I-III would also not be allowed unless waived by the fisheries biologist. It is improbable that conditions for winter activities would be the same conditions suitable for frog migration. Reference the fisheries report for further specificity.

Prescribed Fire Activities (General)

- Prescribed burning activities shall be coordinated with the Department of Environmental Quality through the State of Oregon smoke management program.
- Burn plans (unit-specific prescriptions) shall be developed as an on-the-ground, interdisciplinary process.
- Burn plans would be developed using the Interagency Prescribed Fire Planning and Implementation Procedures Guide.
- Range improvements such exclosures, exposed water lines, and other improvements would be protected during implementation.
- On slopes where erosion in firelines could occur, waterbars would be dug into the fireline. On slopes from 0 to 30 percent, waterbars would be placed approximately every 60 feet. On slopes over 30 percent, waterbars would be placed approximately every 25 feet.
- Private landowners within the project area would be notified approximately 5 days in advance of any burning activities adjacent to their lands.

Prescribed Fire Activities in RHCAs

The intent is that where these criteria are applied, retention of in-stream down wood would be retained at 100%; percent shade and sediment delivery to streams would not be measurably changed. The intent of INFISH and Forest Plan standards would be met.

- Burn plans (unit-specific prescriptions) would be developed through an interdisciplinary process.
- Generally in RHCAs, there would be no intentional ignition within 100’ of Class I, II, and III stream channels and within 50’ of Class IV stream channels. Fire would be allowed burn into the RHCAs and burn in a mosaic pattern. This criterion may be modified on a site-specific basis if:
    - There is a road or other existing fuel break within no ignition zone of the stream channel that would provide a logical boundary to the burn unit; in this case, ignition may take place up to the fuel break, but not between the fuel break and the stream channel.
    - Site-specific conditions exist such that intentional ignition within no ignition zone of the stream channel would be desirable.

        - EXAMPLE: Excessive amounts of conifer seedlings within 100' of a stream channel are detrimental to the development of riparian hardwoods and fire is determined to be the tool of choice to remove them.
        - EXAMPLE: Heavy fuel accumulations within no ignition zone of the stream channel exist and fire is determined to be the tool of choice to reduce them.
- Where necessary, fireline (a fuel break to mineral soil, 12-24 inches wide) would be constructed within RHCAs with the following guidelines:
    - Fireline in RHCAs would not be constructed within 25' of streambanks.
    - Fireline in RHCAs would be dug by hand. Exceptions, such as fire-line plow, may be possible after review by fisheries biologist or hydrologist.
    - The end of the line would fishhook away from the stream channel and stop on the contour.
    - Fireline would be rehabilitated following completion of activities; waterbars would be constructed on hand line, and sod would be replaced where possible.
- Sensitive areas within RHCAs would be identified and site-specific plans to protect each area during burn operations would be developed; site-specific plans would become part of each burn plan, and would be completed prior to approval of the burn plan.
    - EXAMPLE: A particular reach may contain down wood that is acting to prevent the progress of a headcut; barrier to livestock trailing; site-specific plan would be developed to ensure retention of that piece of wood.
- Prescribed burning activities used to treat slash created from mechanical treatments in RHCAs would follow the elements established in the noncommercial Thinning in RHCA project design features.

Cultural Resources

- Coordination with the project archaeologist would take place for implementation of activities that overlap with known sensitive cultural resource sites. Coordination would occur with the relevant specialists to ensure the protection of cultural sites and features to accomplish heritage objectives. Activities include road construction, maintenance and road closures, commercial harvest, noncommercial thinning, and stream restoration and prescribed fire.

- If human remains or heritage resources (historic or prehistoric) are discovered during implementation, all activities within the immediate vicinity of the discovery area would cease until the area is assessed by a professional archaeologist. Site specific mitigation would be determined and consultation with the Oregon State Historic Preservation Office, Oregon State Police and local Tribal Governments, as appropriate, would occur prior to resuming ground disturbing activities.

- If undocumented historic stock driveway signs, General Land Office bearing trees, or physical remains of other historic features are discovered within treatment units, activities would cease in their immediate vicinity and their location would be made known to the project archaeologist for recording. After recording, project activities would continue.

- Archeological sites would be protected from ground disturbing activities by establishing a 100 foot buffer around sites to avoid damage. During prescribed fire activities, firelines would be established around, or fuels pulled away from, sites to avoid damage.

- Any project proposal included in the Wolf project EIS after submission of the Heritage Resources report to the State Historic Preservation Office (SHPO), or any area in the Wolf project EIS project boundary not adequately assessed by the heritage program for a proposed undertaking, would be subject to Section 106 review and/or survey prior to implementation of that proposed project.
- Establishment of staging areas for motorized vehicles and equipment of any kind would not be permitted within buffered areas of known ground-based cultural resource sites.

Historic Summit Trail

This National Register of Historic Places-identified travel route is managed as a historic travel corridor (Ochoco Forest LRMP) within a general border of six hundred feet (three hundred feet from the center of the road on both sides). The historic Summit Trail under consideration during the Wolf EIS project is that portion of the road now identified as Forest Service road 090.

- Coordination with the project archaeologist would occur on a unit by unit basis for all proposed treatments within the Summit Trail corridor.

***Non-Commercial Treatments**:*

- Stumps would not exceed eight inches in foreground areas. Slash would be hand piled no closer than 150 feet of the road.
- Slash piles would be no larger than eight feet in diameter and height and would be burned within two years.
- Light, fast burning flames are permitted across the length of the road.

***Commercial Treatments**:*

- Log truck and equipment travel over the 090 road would be limited to that time of year when the ground is frozen to diminish impacts to the road lens during logging operations.
- Log-hauling over the historic road would, to the greatest extent possible, stay within the existing lens of the historic trail.
- The re-use of established log landings within foreground areas would be permitted. The establishment of new log landings adjacent to the road would occur in coordination with the project archaeologist.
- Stumps would not exceed 12 inches in foreground areas.
- Slash from landings within the foreground areas would be burned as part of project activities within two years of project completion.
- Trees with historic blazes, signs or telephone insulators would be left standing; exceptions include hazard trees.
- Log skidding would not cross the road and trucks and equipment, to the greatest extent possible, would not park along the road to avoid affecting the integrity of the historic road width. Any new areas considered for vehicle or equipment parking along the road would be coordinated with the project archaeologist.

- Blading, widening, installing culverts or modifying the road would be coordinated with the project archaeologist. Adding gravel or rock to cap the road lens during project activities and the placement of barricades to close user created roads during post project activities would be permitted.

Sensitive Plants and Scablands

- No mechanized slash piling or ground-based equipment would be used within 50 feet of areas identified as containing Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*) moonwort (*Botrychium spp.*), or Deschutes milkvetch (*Astragalus tegetariodes*) populations or habitat. Exceptions would be reviewed by the botanist. Exceptions may include:
    - Pulling cable (winch lining) from an existing road;
    - Using existing roads as landings;
    - Constructing spur roads to access landings within units
    - Aspen treatments
- Commercial timber harvest units in or near Peck's lily (*Calochortus longebarbatus* var. *peckii*), moonwort (*Botrychium spp.*) and Deschutes milkvetch (*Astragalus tegetariodes*) populations would be coordinated with the district botanist.
- Noncommercial thinning in units within or adjacent to rare plant populations or habitat would occur after the growing season when the plants are dormant. (Sept-March)
- Fuel treatments within or adjacent to rare plant populations would occur in the fall when the plants are dormant, there would be no prescribed fire in sensitive plant habitat in the spring.
- Units with proposed hand piling in or adjacent to rare plant populations or habitat and pile placement would be coordinated with the botanist before treatment.
- Vehicles, including off-highway or all-terrain vehicles, would not be operated within areas identified as Peck's lily, or moonwort populations or habitat, except on existing roads.
- To reduce impacts to unique scabland habitat (lithosol soils), and associated sensitive needlegrass (*Achnatherum hendersonii* and *A. wallowaensis*) habitat, avoid ground-disturbing activities, including piling of slash, on scablands. Exceptions can occur on existing roads, landings or other areas that have been reviewed by the District botanist.
- If any new species or populations of sensitive plants are found during project implementation, these species would be considered as described in the policy guidelines found in FSM 2670, regardless of the date of sale or other contract.

Noxious Weeds

- To reduce the potential for transport or spread of noxious weeds by road construction or logging equipment, all equipment shall be required to be washed before entering Forest Service lands.
- Skid roads, temporary roads, landings, parking and fueling areas would be reviewed by the District Weed Coordinator in cooperation with the Timber Sale Administer.

- To reduce the potential for weed spread through mineral material (i.e. gravel and rock) used on roads and landings, Ochoco NF material sources would be inspected to ensure materials are weed-free. Additionally, the sale contract would include provisions requiring any material from other sources is weed-free. Post-project monitoring, including mineral material sources, would occur to identify new noxious weed infestations so treatments could be implemented while infestations are small.

- Pre- and post-project surveys would be conducted to document existing infestations and to evaluate the effects of the project on noxious weeds.

- Re-vegetate temporary roads, primary skid trails, and log landing areas in as part of the final sale contract work. Use locally collected native species recommended by the District Botanist. All seed would be certified as "All States Noxious Weed Free" by an approved testing laboratory, such as the Oregon State University Seed Lab.

- If straw bales are used for sediment traps or seeding mulch, they would be certified weed-free or be acquired from certified fields that produce weed-free seed for the grain or grass seed industry.

- New road construction or reconstruction through non-native invasive plant sites would be avoided, unless provisions are made through the district weed coordinator. An example would be placement of clean fill over the weed site prior to use by vehicles.

- Water for prescribed fire control, watering roads, or other activities would be obtained from weed free sites or by methods that reduce the risk of spreading invasive plant parts or seeds from infested areas near water sources. Fire engines and water tenders would avoid driving over invasive plants on the banks of water sources, or other measures taken, such as covering with clean mineral material, to reduce risk.

Soils and Geology

Refer to Appendix B, Soil Condition Analysis for specific units with mitigations.

- For tractor logging units, the leading end of logs would be suspended during skidding to limit soil displacement. Ground-based equipment would not be operated on slopes greater than 35 percent in tractor units to minimize detrimental impacts.
- Skid trails would be designated and approved prior to logging by the timber sale administrator and would be located on already disturbed areas where available. Where practical, skid trails would avoid the flow-line of ephemeral draws. Crossings would be perpendicular to ephemeral draws.
- In harvest units where detrimental soil conditions occur on less than 20 percent of the area, plan activities so that detrimental soil conditions do not exceed 20 percent. This includes designating skid trails, landings, and roads.
- In units where detrimental soil conditions exceed 20 percent of the area, if tillable, allow no more than 5 percent increase over existing conditions and then till so that there is no net increase in the percentage of detrimental soil conditions. If tillage is not feasible, stay on existing disturbed areas and allow no increase in detrimental soil conditions.

- Waterbars on skid trails would be installed at regular intervals (varies by slope class), preferably with a crawler type tractor with an angled blade. On slopes from 0 to 30 percent, waterbars would be placed at a minimum of every 60 feet. On slopes over 30 percent, waterbars would be placed at a minimum of every 25 feet. Where waterbars are not feasible, use slash and other woody debris.
- Infiltration buffering is required along the scab/forest interface to mitigate alteration of sensitive hydrologic conditions. Maintain a buffer of 50-66 feet in which the number of crossings, landings and road impacts would be kept to a minimum.
- In Winter Harvest conditions where mechanized equipment is used, ground conditions shall meet at least one of the following criteria. 1) Six inches of frozen ground, 2) Four inches of frozen ground with one foot of snow and 3) over two feet (>24 inches) of snow.
- Any evidence of recent landslide slope movement requires consultation with the geologist.

Wildlife

Goshawk

- A 30 acre nest stand and a 400-acre post fledging area have been established around each known nest site. No management activities, including underburning activities, would occur inside the 30-acre nest stand. Burning activities within the post fledging areas would be designed to protect overstory trees, large down wood, and large snags. For example, burning would occur during the lower end (cooler/wetter) of the prescription window.
- There would be a seasonal restriction (March 1 to August 31) on commercial harvest, noncommercial thinning, and underburning within 0.5-mile of an active nest. A seasonal restriction (March 1 to August 31) would also apply (within 0.25 mile of active nests) to hauling, new road construction, and road reconstruction. Haul restrictions would not apply to arterial or collector roads.
- Seasonal restrictions (March 1 to August 31) on hauling would be applied within 0.25 mile of known nests.
- Total treatment activities, including commercial, noncommercial, and burning would be limited to 50% of the PFA. Commercial treatments would leave 10% of the treatment area in un-thinned patches. Noncommercial thinning would leave 15% of the treatment area in un-thinned patches unevenly distributed.

Bald Eagle, Golden Eagle and Osprey Nests

- If active eagle or osprey nests are discovered during implementation, efforts would be made to avoid any further disturbance. Site-specific measures would be determined by the wildlife biologist. These would include:
    - Activities would be restricted within 0.5 miles of nest sites from March 1 to August 15 for golden eagles. Activities would be restricted within 0.25 mile of nest sites (0.5 mile line of sight, 1 mile for blasting) from January 1 to August 31 for bald eagles.
    - Activities within ½ mile of the mapped bald eagle roost areas are restricted from December 1 to May 1. Activities including the use of haul routes within ½ mile of the winter roost are restricted to the following use period: one hour after sunrise to one hour prior to sunset from December 1 to April 1. Haul restrictions would not apply to arterial or collector roads.
    - Activities would be restricted within 0.25 mile of active osprey nests from March 1 to August 1.

- Restrictions on haul would not apply to arterial and collector roads but site specific measures would be developed to reduce disturbance; for example restrict compression braking or avoid parking near nest site.

Other Raptors

- No management activities (including underburning) would occur within 330 feet of nest site (primary zone). Between 330 and 660 feet around a nest site (secondary zone), habitat-modifying treatments are permitted. Modified treatments are intermediate treatments between that required in the primary zone and that normally prescribed outside the whole protection zone. Operations would be restricted for both primary and secondary zones between March 1 and August 1. Exceptions would be evaluated on a case by case basis by the wildlife biologist.

Deer and Elk

- Activities within elk calving areas would be seasonally restricted from May 15 to June 30.
- No activities allowed within big game winter range (MA-20 and MA -21) from December 1-May 1.
- Where wire fence is used, utilize fencing guidelines from Wyoming Game and Fish Department Habitat Extension Bulletin No. 53 (Karhu 2004) **or** A Landowner's Guide to Wildlife Friendly Fences (Paige 2012)
- Utilize water development guidelines from Water for Wildlife; a Handbook for Ranchers and Range Managers (Taylor & Tuttle 2007). This methodology would ensure that native species utilizing water developments as drinking sources, such as bats and birds, would not incur injury.

Snags/Down Logs

- Retain all snags not considered a danger to operations. Within RHCAs, snags considered a danger to all operations would be felled and left onsite or utilized as large woody debris in adjacent stream restoration units. Harvest activities would not remove existing down logs. Burn crews would be briefed to avoid direct ignition of large snags and down wood. Down logs are defined as logs that are 12 inches in diameter or greater at the small end and greater than 6 feet in length.
- Burning within goshawk post-fledging areas, pileated feeding habitat, and connective corridors would be designed to minimize loss of mid and overstory cover, snags and large down wood by avoiding the hot end of the prescription. The wildlife biologist would be notified when prescribed burning is scheduled in these habitat areas so that implementation and effectiveness monitoring can be coordinated.

Range

- All activities would be designed to not damage or negatively affect range improvements; i.e. fences, spring developments, cattleguards, stock ponds, etc. If damage or negative affects cannot be avoided, the operation undertaking the activities must repair or replace the damaged improvement.
- When a fence needs to be cut, it must be attended when livestock are within the action area. If livestock are not in an area, the fences would be repaired prior to livestock entering the area. Prior to any fence cutting all locations must be reported to the range specialist to determine if or when livestock would be in or near the project area, and to determine if fences are mended adequately.
- No gates would be left open if actions are taking place where livestock grazing is occurring.

- Any exclosure would need to have at least one gate installed to allow for removal of any inadvertent livestock entry. Also, if an exclosure would restrict the use of water resources, alternate water sources would be needed to be provided prior to construction. Any exclosure should be designed in coordination with the responsible range specialist. Maintenance responsibility of any exclosure must be determined prior to construction. Also, a removal plan for any exclosure should be outlined prior to construction.

Recreation

Developed Recreation

- Restrict commercial timber haul on the following holidays: Memorial Day, 4th of July, Labor Day, and also during the weekends of deer rifle hunting season. Restriction applies on the Holiday date and/or contained within the weekend from Friday noon through Monday noon.

Dispersed Recreation:

- Forest Plan designated dispersed recreation sites located on existing landings may be reused for log decks, piling slash, or storing road rock. The site would be rehabilitated after use.
- Activities adjacent to dispersed recreation sites identified in Forest Plan would be designed to retain visual screening within 50 feet. If a Forest Plan dispersed recreation site is utilized as a landing, haul back or chipping of slash would be required of logging debris to a usable condition.
- Hand piling of noncommercial generated slash would be required within 50 feet of Forest Plan dispersed campsites.

Visual/Scenic Resources

- When marking trees to be left, mark side of tree facing away from road within 75 feet of visual corridor.
- Boundary tags, flagging, and markers would be removed from visual foreground areas in treatment units after completion of activities.
- In Foreground areas or within 75 feet of the travel corridor, stumps would not exceed 8 inches in height.
- Where practical, in Foreground retention areas, where practical, design and locate new skid trails and landings outside of visual foreground areas.
- Existing landings and skid trails within visual foreground areas may be reused, but not increased in size. When reusing existing landing within foreground areas, reduce potential landing size by using logging methods such as but not limited to; prohibiting whole tree yarding, hot loading or requiring slash to be hauled into the unit on haul-back.
- Landing slash would be burned within two years.
- Landings in visual foreground areas would be reseeded or replanted.

Monitoring

- Post-project surveys and monitoring of noxious weed infestations, including mineral sources, would be conducted to identify new noxious weed infestations while they are small and more easily controlled.
- Occupancy and reproduction in mapped raptor territories would be monitored during and after project implementation.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of the proposed action, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Three alternatives were considered, but were dismissed from detailed consideration for reasons summarized below.

1. Based on public comments, a “no commercial harvest” or “restoration only” alternative was considered for the Wolf project. Such an alternative has been considered during several previous environmental analyses, which analyzed similar stand conditions to those in the Wolf project area, on the Ochoco National Forest (see Jackson Vegetation Management and Spears Vegetation Management project EIS for examples). Previous analyses have determined that the “no commercial harvest” alternative would do little to increase the amount of LOS stands within the project area and would not accelerate the restoration of seral structures toward HRV because the level of treatment would not maintain a sufficient amount of open, single-stratum stands. Treated stands would return to dense, stagnated conditions sooner. As a result of no commercial thinning, this alternative would limit the ability to restore aspen and other broadleaf trees and shrubs. This alternative would not produce forest wood products and the jobs associated with commercial harvest. Small tree thinning by itself would not move the project area towards the desired condition in a meaningful manner and would not meet the purpose and need of the project.
2. Based on public comments, a “no temporary road construction” alternative was considered for the Wolf Vegetation Management project. A Wolf project IDT analysis determined that, because of reduced access to only the existing road system, this alternative, as compared to the proposed action, would reduce the commercial thinning acreage by approximately 2,530acres or 53%. As a result, this alternative would not appreciably increase the abundance of late and old structure (LOS) stands within the project area, nor move seral structures towards HRV because the level of treatment would not maintain a sufficient amount of single-stratum stands; especially early, fire tolerant seral species such as ponderosa pine and western larch. Under this alternative, untreated stands would continue to be vulnerable to mortality from competition with understory trees and the accompanying increase in risk to loss owing to insect, disease and stand replacing wildfire. This alternative would decrease the restoration of some aspen stands and other hardwood communities. This alternative would considerably reduce merchantable forest wood products and the jobs associated with commercial thinning. In summary, this alternative would not demonstrably move the project area towards the future desired condition and would not meet the purpose and need.

3. Based on public comments, an alternative with decreased diameter limits on commercial thinning was considered (commenters proposed a range of diameter limits of 15 inches). Removal of trees with an upper diameter limit of up to 15 inches would not demonstrably change the outcomes determined for smaller diameter treatments. Development of LOS and maintenance and enhancement of existing large trees and LOS requires the reduction of density in treated stands to the recommended stocking level for a given site.

   In some locations, stocking level recommendations may be met by removing smaller-diameter commercial-sized material, while in other areas site objectives may require removing some larger trees. In stands with dwarf mistletoe, small upper diameter limits inhibit reduction of disease problems. Species composition objectives would not be met in some stands if lower diameter limits are required. This would impede the maintenance and restoration of early seral species such as ponderosa pine. Applying a 15 inch upper diameter limits cannot be relied upon to move the project area towards the desired condition, and therefore would not meet the Purpose and Need of the project.

Comparison of Alternatives

Table 18 provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 18. Comparison of alternatives.

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Commercial Thinning from below (acres)	0	4,706	4,322	3,394
Commercial Harvest Trees >21" dbh (acres)	0	0	384	0
Total Acres of Commercial Thinning (acres)	0	4,706	4,706	3,394
Volume (mmbf)	0	11.7	12.52	8.5
Noncommercial Thinning (acres outside of harvest units)	0	988	988	1,177
Juniper cutting (acres)	0	481	481	481
Hardwood Enhancement (acres)	0	75.5	90.2	92.3
Hand-piling (activity slash)	0	126	126	137
Underburning (acres outside of harvest units)	0	5,000	5,000	5,853
RHCA Treatments	0	Commercial: 589 PCT thinning only: 253 Underburn only: 1,122	Commercial: 589 PCT thinning only: 253 Underburn only: 1,122	Commercial: 0 PCT thinning only: 347 Underburn only: 1,529
Temporary Road Construction (mi)	0	1.8	1.8	1.6

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Temp road on Existing disturbance (miles)	0	17.6	17.6	14.1
Stream Restoration	0	1 mile	2.2 miles	2.2 miles
Culvert Replacement	0	0	1 location	1 location
Headcut repair	0	5 locations	6 locations	6 locations
Road Closure (miles)	0	2	7.8	7.8
Road Decommissioning	0	2.7	2.7	2.7
Acres of Dense Structural Stages (Acres) projections at Year 0, 20, 30, and 50 (HRV: 1,821 – 4,673 ac)	0: 9,651 20: 11,547 30: 12,196 50: 13,134	0: 6,463 20: 8,947 30: 9,851 50: 10,583	0: 5,867 20: 8,540 30: 9,504 50: 10,967	0: 6,744 20: 9,245 30: 10,137 50: 11,477
Total Late and Old Structure (LOS) (Acres) projections at Year 0, 20, 30 and 50 (HRV: 6,980 – 13,000)	0: 2,291 20: 4,454 30: 5,317 50: 6,725	0: 2,341 20: 4,595 30: 5,479 50: 6,989	0: 2,348 20: 4,609 30: 5,474 50: 6,998	0: 2,359 20: 4,649 30: 5,643 50: 7,075
Single-Strata LOS (Acres) projections at Year 0, 20, 30 and 50 (HRV: 4,829-9,024)	0: 24 20: 287 30: 372 50: 481	0: 793 20: 1,120 30: 1,217 50: 1,317	0: 954 20: 1,276 30: 1,367 50: 1,456	0: 673 20: 986 30: 1,078 50: 1,174
Multi-Strata LOS (Acres) projections at Year 0, 20, 30 and 50 (HRV: 941-2,258)	0: 2,330 20: 3,542 30: 4,041 50: 4,870	0: 1,561 20: 2,897 30: 3,458 50: 4,411	0: 1,400 20: 2,781 30: 3,362 50: 4,348	0: 1,682 20: 3,005 30: 3,558 50: 4,490
High Risk to Insects and Disease (Acres) – projections at year 0, 20, 30 and 50 (HRV: 1,821-4,856)	0: 9,690 20: 11,588 30: 12,222 50: 13,119	0: 6,500 20: 8,964 30: 9,848 50: 11,180	0: 5,877 20: 8,549 30: 9,498 50: 10,919	0: 6,754 20: 9,258 30: 10,136 50: 11,437
Change in Fuels Condition (acres)	CC1: 5,640 CC2: 9,100 CC3: 6,157	CC1: 8,609 CC2: 7,518 CC3: 4,771	CC1: 9,470 CC2: 7,204 CC3: 4,224	CC1: 8,643 CC2: 7,488 CC3: 4,766
Activities in Connective Corridors	No activities would occur in connective corridors.	Activities would include 136 acres of commercial thinning, 108 acres of noncommercial thinning, and 283 acres of underburning.	Activities would include 136 acres of commercial thinning, 108 acres of noncommercial thinning, and 283 acres of underburning.	Activities would include 91 acres of commercial thinning, 120 acres of noncommercial thinning, and 311 acres of underburning.

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Goshawk reproductive habitat	Existing condition includes 9,124 acres of reproductive habitat. No activities would occur in the PFA or its nest core.	Post Treatment: 6,026 acres of reproductive habitat; above HRV	Post Treatment: 5,642 acres of reproductive habitat; above HRV	Post Treatment: 6,711 acres of reproductive habitat; above HRV
Pileated Woodpecker Primary Nesting Habitat	Existing condition includes 3,977 acres of primary nesting habitat. No activities would occur in pileated woodpecker habitat.	Post Treatment: 2,704 acres of primary nesting habitat; above HRV	Post Treatment: 2,610 acres of primary nesting habitat; above HRV	Post Treatment: 3,005 acres of primary nesting habitat; above HRV
Elk (Habitat Effectiveness Index)(Forest Plan Standards: General Forest: 7 Winter Range: 7 GF Winter Range: 7	General Forest: 89 Winter Range: 24 GF Winter Range: 43	General Forest: 38 Winter Range: 25 GF Winter Range: 9	General Forest: 38 Winter Range: 25 GF Winter Range: 11	General Forest: 77 Winter Range: 26 GF Winter Range: 11
Open Road Density (Forest Plan Standards: GF: 3 mi/mi^2; Winter Range: 1 mi/mi^2 winter, 3 mi/mi^2 summer; GF Winter Range: 1 mi/mi^2 winter, 3 mi/mi^2 summer	General Forest: 1.86 Winter Range: 1.28 GF Winter Range: 2.84	General Forest: 1.82 Winter Range: 1.15 GF Winter Range: 2.84	General Forest: 1.73 Winter Range: 0.97 GF Winter Range: 1.99	General Forest: 1.73 Winter Range:0.97 GF Winter Range: 1.99

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This Chapter includes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

Forested Vegetation

This section discloses the analysis of forest vegetation changes expected as a result of implementation of alternative vegetation management activities proposed in the Wolf project area; it includes the silviculturist specialist report in its entirety. Background information can be found in the Wolf Watershed Analysis (1998).

The Watershed Analysis included an extensive look at forest vegetation conditions, and the relationships between those conditions and changes in fire hazard, insect and disease dynamics, and wildlife habitats. Vegetation patterns and occurrence within the project area are different now than what existed historically. Changes to the health, structure, composition, distribution, and function of forest stands have altered the natural processes such as fire that maintained the ecosystem. These changes have affected watershed resiliency, wildlife habitat diversity and amount, and fuel loadings and potential fire behavior.

Currently, more area is covered by dense stands of smaller trees than was present historically. Stands dominated by large trees are fewer than were present historically. Species composition of many forest stands has shifted from ponderosa pine to Douglas-fir and grand fir. Hazards associated with insects and disease are above the levels that were present historically.

Plant Association Groups

The upland forest areas within the Wolf project area have been characterized using the plant association concept. Plant associations are a method of land classification which is based on the probable, or projected, plant community which will occupy a site given enough time and an absence of disturbance influences. The plant associations for the entire Ochoco National Forest have been mapped using the classifications described in “Plant Associations of the Blue and Ochoco Mountains” (Johnson and Clausnitzer 1992). The mapping was based on 1:12000 aerial photography and intensive fieldwork.

The Ochoco National Forest has defined eight plant association groups (PAGs) for upland forest and woodland/steppe sites. These groups contain plant associations of similar biophysical environments, productivity, and disturbance regimes. Seven PAGs of upland forest and woodland/steppe occur within the Wolf project area, as well as areas described as non-forest which includes meadows, shrublands, and rock.

There are no distinct elevation zones that limit where a plant association may be found in the planning area. Plant associations are highly related to the soil type as it’s been sculptured by water and air across the landscape. This patchwork of vegetation types is quite common in scabland stringer country that is prevalent on the Paulina Ranger District, and found across much of the Wolf project area. The following is a brief description of the PAGs and more common plant associations found in the Wolf project area.

Moist grand fir PAG sites support the most diverse flora and in general are the most productive sites on the Ochoco National Forest. Very little of this PAG (60 acres) is present in the Wolf project area, with most of it found in the far northern portion of the planning area adjacent to East Wolf Creek and near the top of Wolf Ridge. In this PAG, grand fir and Douglas-fir are common, and Engelmann spruce can be found. Ponderosa pine, western larch and lodgepole pine are common early seral species following disturbance.

Dry grand fir is the most common PAG in the project area encompassing about 30 percent of the acres. These sites occur on moderately deep soils, with or without volcanic ash deposits. This PAG is found primarily in the northern half of the planning area in large contiguous blocks. The grand fir/pinegrass plant association is the most common association in this PAG. Historically, low intensity fires maintained much of this PAG with ponderosa pine, western larch and to a lesser degree Douglas-fir in an open park-like condition. On most sites grand fir was a minor component historically. In the absence of fireshade tolerant species – grand fir and Douglas-fir have increased in abundance.

The Douglas-fir PAG occurs on soils with depths less than those in the dry grand fir groups often on southerly facing slopes. It is found in fairly discontinuous patches and mostly in the northern two-thirds of the area. Douglas-fir/pinegrass (ash soils) and Douglas-fir/elk sedge (residual soils) are the two most prevalent plant associations for this PAG in the Wolf area. Historically, ponderosa pine was the major species in the PAG, and was commonly maintained in an open park-like condition by frequent low intensity fire.

Mesic ponderosa pine PAG occurs mainly in the southern half of the planning area. Ponderosa pine/pinegrass (ash soils) and ponderosa pine/elk sedge (residual soils) are the two most common prevalent plant associations for this PAG in the Wolf area. Ponderosa pine is the major species and was commonly maintained in open park-like stands by frequent ground fires. The exclusion of fire has allowed western juniper to become more abundant on these sites.

Xeric ponderosa pine PAG sites are found on shallow soils and commonly border scablands or juniper PAGs. Usually ponderosa pine and western juniper are the only tree species present. In the Wolf project area these sites tend to be in the southern third of the area, interspersed with scabland and mesic pine. Like the Douglas-fir and Mesic Pine PAGs, ponderosa pine was historically the major species and was maintained in an open park-like condition by fire.

Western juniper steppe and western juniper woodland PAGs make up about 18 percent of the project area. Juniper is the most common tree species on these sites and it occurs on very shallow soils, often adjacent to shrub scablands and xeric ponderosa pine PAG. Historically, tree densities were kept quite low by frequent fires and much of these areas were dominated by grasses, forbs, and shrubs.

Table 19. Plant Association Group & Non-Forested Lands for the Wolf Project Area

Plant Association Group	Total Acres	Percent of the Watershed
Moist Grand fir	60	<1
Dry Grand fir	7,287	29.7
Douglas-fir	3,282	13.4
Mesic Ponderosa Pine	3,446	14.1
Xeric Ponderosa Pine	2,236	9.1
Western Juniper Woodland	581	2.4
Western Juniper Steppe	3,866	15.8
Non-Forested Lands	3,725	15.2

Existing Forest Vegetation

The Ochoco National Forest's Viable Ecosystem Management Guide (VEMG) (Simpson et al 1994) describes a seral/structural matrix for characterizing forest vegetation within each of the plant association groups. This matrix is a departure from the classic linear succession models, which typically describe succession as a progression through different stages, i.e. early, mid, late, climax. The Ochoco NF matrix has three seral stages based on species composition (early, mid, late), and each of these is subdivided into five size/structural conditions (grass/forb/shrub, seedling/sapling, pole, small trees, large trees). Thus, the matrix can accommodate up to fifteen cells, each representing a different seral (E, M, L) and size/structural (1-5) condition.

The grass/forb/shrub condition is only reflected in the early seral condition. Matrix cells can be further subdivided to reflect relative differences in tree density. Subscripts "a" and "b" are used to denote high and low density respectively. For example, L4a describes a late-seral species composition, small-sized trees, at a high-density level. An example matrix is shown in Table 20.

Table 20. Viable Ecosystem seral/structural matrix.

Structure Class	Species Composition		
	Early	Mid	Late
Grass, forb, shrub (trees may be present but not dominant)	E1		
Seedling, sapling (less than 4.9 inches DBH)	E2	M2	L2
Pole (between 5 and 8.9 inches DBH), high density	E3a	M3a	L3a
Pole, low density	E3b	M3b	L3b
Small (between 9 and 20.9 inches DBH), high density	E4a	M4a	L4a
Small, low density	E4b	M4b	L4b
Medium/large (21 inches DBH and larger), high density	E5a	M5a	L5a
Medium/large, low density	E5b	M5b	L5b

The VEMG describes the array of conditions, which may exist within each matrix cell, as well as descriptions of predominant natural processes such as insects/disease and fire. The seral/structural matrix is applied to each PAG for consideration of existing and historic condition.

Vegetation polygons for the entire Wolf project area were delineated using eCognition object-based image analysis software. These polygons were then populated with forest structure and density information obtained from 2011 LiDAR imagery (Hudak et al 2009). Species composition was obtained from Gradient Nearest Neighbor (GNN; Ohmann and Gregory 2002). These data sets, along with field reconnaissance completed in 2012 and 2013, were used to determine existing vegetative conditions within the analysis area.

Past Silvicultural Activities

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions. Records from the Paulina Ranger District indicate the following amount of past harvest treatments on Forest Service lands since 1986:

1. Regeneration Harvest Total – 1,298 acres
   - Clearcut/Clearcut with Reserve Trees – 895 acres
   - Shelterwood/Seedtree– 402 acres
2. Overstory Removal/Final Removal – 2,550 acres.
3. Partial Removal (commercial thinning, selection/improvement cutting) – 1,011 acres

Past timber sales in the area are: Brer Rabbit, Yuma, Sugar, EP, Connally, Potter, Morgan, Dippy Beaver, Aqua, and Powell. Additional harvest prior to 1986 is known to have occurred in the area, but it is not recorded in the District database. In general, prior to 1986 the harvest was primarily focused on harvesting individual trees, often removing large diameter, high value trees that were deemed at risk to insect mortality. The Keen's Tree Classification system was often used for this risk rating and ground based logging was used.

Since 1999, there have been some minor salvage sales which removed individual danger trees along major travel routes (for example, Road 42 salvage in 2010). The ongoing Powell timber sale in the southeast portion of the area includes 3 units or parts of units that total 43 acres, all of which are partial removal commercial thinning. Timber sale harvest units have some spatial overlap. An example of this is Aqua timber sale unit 1 which was commercially thinned in 1999 and is being commercially thinned again in the Powell timber sale.

Noncommercial thinning of smaller trees has been occurring in the area since 1985. Thinning has often occurred following harvest (improvement cutting, commercial thinning, or overstory removal cutting) as a post-sale activity to reduce tree density to desired levels. To date, approximately 1,649 acres of noncommercial thinning have occurred. Over half of it, 985 acres, has been in harvest units. Slash generated by noncommercial thinning has typically been loped into smaller pieces and then underburned.

Existing versus Historic Vegetative Conditions

It is widely documented and supported in the scientific literature that 100-plus years of management, including the exclusion of frequent, low and mixed-severity fire, intensive grazing, and widespread harvest of large fire-tolerant trees has increased the density of small trees, elevated fuel loads, increased the risk of crown fire, accelerated mortality of large, old trees, and homogenized fire-prone/fire-adapted forests compared to historic conditions. As a result, the fire-adapted forests of the inland Pacific Northwest are at high risk of uncharacteristically large, severe fires (Hessburg and Agee 2003, Hessburg, Agee & Franklin 2005, Spies et al. 2006). Across the entire interior Columbia Basin, the change in fire-severity classes (e.g. low, mixed, and high) between 1800 and today is dramatic: a decrease by more than half in the area of low-severity fire conditions and a doubling in the area of high-severity fire conditions (Hann et al. 1997, Quigley et al. 1996, Hessburg et al. 2005).

Our knowledge of historically resilient forest conditions in Central Oregon is further informed by local forest history and demographic research. In Hagmann et al. (2013) and Merschel, Spies & Heyerdahl (2013, *in review*), researchers used historical survey data and forest reconstruction plot data (respectively) to reconstruct historic forest conditions in the East Cascades (Hagmann et al. 2013) and Ochoco Mountains (Merschel, Spies & Heyerdahl 2013, *in review*). Both studies utilized intensively sampled datasets and found large discrepancies between historic forest composition and structure data (both survey and reconstructed) and the conclusions and landscape extrapolations made by other studies (Baker 2012) across some of the same forested regions in Central Oregon. Collectively, this work supports and is supported by the majority of other forest reconstruction work across the inland West, documenting the widespread eruption of young shade tolerant species (principally white fir/grand fir and Douglas-fir) following euro-American settlement, grazing, the exclusion of fire, and the harvest of large fire-tolerant species. Hagmann concludes, “The historical inventory of Reservation lands provides strong evidence that forests on mixed-conifer sites were predominantly low-density, pine-dominated, and have undergone massive changes in composition and density (Hagmann et al. 2013).”

Within the Wolf project area, six of the PAGs have been analyzed and compared to their ranges of historic abundance or HRV. The moist grand fir PAG has not been analyzed as the amount of area is so small (60 acres, about ¼ of one percent of the watershed) that a meaningful comparison is not possible. The departures from HRV within the project area are consistent with the discussion of broader scale departures discussed above.

Important departures from the historic condition are listed below:

1. The exclusion of fire as a disturbance agent, along with past harvest practices, has resulted in changes in species composition. Fire intolerant understories have been allowed to develop and fire tolerant overstory trees have been removed. In many stands today there is relatively more western juniper, Douglas-fir, and grand fir and less ponderosa pine and western larch than what occurred historically.
2. Overall, stands dominated by large trees (size class 5) are deficient on the landscape. Stands of large trees with an open "park-like" nature were abundant historically, being maintained by frequent low intensity fires in most of the PAGs. Today, open "park-like" stands of large trees are relatively scarce and below their historic levels of abundance. Multi-story dense stands dominated by large trees are overall slightly above their historic levels of abundance.
3. Fire exclusion (which allowed understory development) and past harvest (which removed large trees) have been the major causes of change. Many stands, which were once dominated by large trees, have been replaced by stands in which pole and/or small sized trees (size classes 3 and 4) are the dominant feature.
4. Increases in stand densities have created more multi-storied stands than occurred historically. Fire exclusion has allowed the development of shade tolerant understories while at the same time selective harvest and overstory removal have decreased the abundance of fire tolerant large tree overstories.

The current trends within the area indicate that, without active management, many of these departures from the desired conditions will continue to increase. The vegetation across the landscape has been altered to the point that many natural disturbance agents can no longer function within their historic roles. Today, there is an elevated risk of experiencing disturbances such as stand replacement wildfire and insect and disease. Successional trends, in the absence of disturbance, will tend to favor a continued increase in late-seral and/or fire-intolerant species. Many of the vegetative components are so far out of balance that it may take 100 years or more to return all of them to their former ranges of abundance. However, the fundamental capability of the system is still largely intact, and with careful management, the system can support most historic vegetative conditions.

The following tables display the existing condition of each PAG and the historic range for each seral/structural stage:

Table 21. Dry Grand Fir PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	2	7	Below
E2a	0	0	0	Within
E2b	10.7	3	8	Above
E3a	0.1	1	3	Below
E3b	1.3	4	12	Below
E4a	4.2	2.4	4	Above
E4b	9.1	9.6	16	Below
E5a	0	2.4	4	Below
E5b	0	9.6	16	Below
M2a	0	0	1	Within
M3a	0	0	2	Within
M3b	3.1	3	8	Within
M4a	30.3	3	5.6	Above
M4b	18.9	12	22.4	Within
M5a	5.6	2	5	Above
M5b	0	8	20	Below
L2a	0	0	2	Within
L2b	0.5	0	0	Above
L3a	0	0	2	Within
L3b	0	0	0	Within
L4a	11.2	1.6	4	Above
L4b	1.1	0.4	1	Above
L5a	3	3.2	6.4	Below
L5b	0	0.8	1.6	Below

Table 22. Douglas-fir PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	20	Below
E2a	0	0	0	Within
E2b	4.3	0	10	Within
E3a	0	0	2	Within
E3b	1.4	0	8	Within
E4a	5.6	4	8	Within
E4b	27.5	15	32	Within
E5a	0.5	7	10	Below
E5b	0	28	40	Below
M2a	0	0	0	Within
M2b	1.6	0	10	Within
M3a	0	0	0	Within
M3b	1.6	0	5	Within
M4a	24.7	1	4	Above
M4b	24.3	4	16	Above
M5a	7.5	1	3	Above
M5b	0	4	12	Below
L2a	0	0	1	Within
L2b	0.1	0	4	Within
L3a	0	0	4	Within
L3b	0.3	0	1	Within
L4a	0.6	3.2	6.4	Below
L4b	0	0.8	1.6	Below
L5a	0	3.2	6.4	Below
L5b	0	0.8	1.6	Below

Table 23. Mesic Ponderosa Pine PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	25	Below
E2a	0	0	0	Within
E2b	0	0	5	Within
E3b	0	0	4	Within
E4a	0.1	0	2	Within
E4b	0	0	8	Within
E5a	0	0	2	Within
E5b	0	0	8	Within
M2a	0	0	0	Within
M2b	0	0	5	Within
M3a	0	0	1	Within
M3b	0	0	4	Within
M4a	4.8	0	2	Above
M4b	1.2	0	8	Within
M5a	1	0	3	Within
M5b	0	0	12	Within
L2a	0	0	0	Within
L2b	0.9	0	10	Within
L3a	0	1	3	Below
L3b	1.4	4	12	Below
L4a	30.3	0	4	Above
L4b	34.3	20	36	Within
L5a	25.3	0	4	Above
L5b	0.7	50	66	Below

Table 24. Xeric Ponderosa Pine PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0.1	5	25	Below
E2a	0	0	0	Within
E2b	1.8	0	5	Within
E3a	0	0	0.5	Within
E3b	0	0	4.5	Within
E4a	1.0	0	1	Within
E4b	1.6	5	9	Within
E5a	0	0	1	Within
E5b	0	5	9	Within
M2a	0	0	0	Within
M2b	0.1	0	5	Within
M3a	1.3	0	0.5	Within
M3b	1.2	0	4.5	Within
M4a	14	0	2	Above
M4b	0.6	5	18	Within
M5a	0.1	0	1.5	Within
M5b	0	5	13.5	Within
L2a	1.1	0	0	Within
L2b	1.2	5	10	Within
L3a	1	0	2	Below
L3b	0.2	5	18	Below
L4a	53	0	3.5	Above
L4b	1.3	15	32.5	Within
L5a	20.2	0	4	Above
L5b	0	15	36	Below

Table 25. Western Juniper Steppe PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	44.8	50	70	Below
M2a	0	0	0	Within
M2b	12.2	5	10	Above
M3a	0.2	0	0	Above
M3b	22.4	5	10	Above
L4a	9.9	0	0	Above
L4b	10.6	15	30	Below
L5a	0	0	0	Within
L5b	0	5	12	Below

Table 26. Western Juniper Woodland PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	3.9	50	70	Below
L2a	0	0	0	Within
L2b	18	5	10	Above
L3a	0	0	0	Within
L3b	5.1	5	10	Within
L4a	57.7	0	0	Above
L4b	15.3	15	30	Within
L5a	0	0	0	Within
L5b	0	5	12	Below

Effects Common to all Action Alternatives

Successional and structural changes due to the proposed treatments and projections through time were estimated using the Viable Ecosystems model. This model accounts for multi-directional change (multiple pathway succession) through time, but does not include future disturbances after the proposed treatments have been implemented.

There are two primary processes that affect the movement of one seral structural stage to another. Species composition changes due to succession tend to favor shade tolerant species and move stages from early seral to late seral. Growth moves stages from smaller structure to larger structural stages. Although some insects and disease disturbances are species specific and can move early seral to mid or late seral, natural disturbance processes (including fire, insects and diseases, and flooding) tend to move stages backward from mid or late seral to early seral. The magnitude of movement depends on the intensity of the disturbance. Some disturbances, such as low intensity fire, may not affect the dominant stand character, but serve to maintain the existing stage.

Differing growth rates were applied to the two density categories ("a" and "b" densities) within the grand fir, Douglas-fir, and ponderosa pine PAGs. These growth rates directly correspond to rates of change in structure in the Viable Ecosystem seral/structural stages. Less dense "b" stages received an average 20% growth rate bonus over stands which have high "a" densities. This estimate corresponds with density and spacing studies (Oliver 1979, Barrett 1982, Cochran and Barrett 1993, Cochran and Barrett 1999b) where growth rate increases from thinning varied between 15 to 25% depending on stand density and little gains were realized when canopy closure was not reduced below 50 to 60%.

The projected future abundance of each stage is based on stand development assumptions for the various seral structural stages. The 20, 30, and 50-year time intervals were chosen to demonstrate vegetation development over time. The projections that follow later in this report do not include future disturbance events such as widespread insect and disease occurrences, fire, or management activities other than continued fire suppression.

Proposed treatments (both commercial and noncommercial) are designed to reduce tree density and improve growth and vigor of the residual trees and reduce susceptibility to insects and disease. Thinning would be conducted to move towards historic seral/structural stage conditions. Restoration of the mosaic of these conditions is thought to improve resiliency and lessen susceptibility to future fire and other disturbances (Fulé et al. 1997, Taylor and Skinner 2003, Stephens et al. 2008, Moritz et al. 2011, Perry et al. 2011).

Thinning also decreases the probability of crown fires, reducing the potential area burned by unwanted fires, and decreases potential fire severity (Peterson et al. 2005). Thinning followed by fuels treatment has been shown to be effective at mitigating wildfire severity in dry western forests (Prichard 2010).

Numerous studies have shown increased growth and vigor of remaining trees following density management treatments (Oliver 1979, Barrett 1981, Barrett 1982, Barrett 1989, Larson et al. 1983, Cochran and Barrett 1999a, and Cochran and Barrett 1999b). Growth response to thinning has been shown to occur in all size classes of trees, including large old ponderosa pine (McDowell et al. 2003, Latham and Tappeiner 2002, Fajardo et al. 2007, Kolb et al. 2007).), although their response is not guaranteed and can take four to twenty years to manifest (Skov et al. 2005, Roccaforte et al. 2010). Other studies have shown reduced susceptibility to many insect and diseases that are density related (Roth and Barrett 1985, Filip and Schmidt 1990). Further studies show moderated fire hazard and lower crown fire potential as a result of thinning and fuel treatment (Omi and Martinson 2002, Pollet and Omi 2002).

Expansion of the Six Corners material source is proposed in all action alternatives. This activity would have the effect of removing approximately 1.8 acres from the dry grand fir PAG and converting it to non-forest land. This would not have a meaningful effect on the overall PAG as the area is so small it represents about .02 percent of the PAG area.

Table 27. Summary of Proposed Silvicultural Treatments in Wolf Project Area (acres)

Proposed Treatment	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Commercial thinning	0	4,706	4,322	3,394
Commercial thinning with 21”+ trees	0	0	384	0
Noncommercial thinning outside of commercial units	0	988	988	1,177
Juniper cutting	0	481	481	481
Hardwood treatments	0	75	90	92

Table 28. Acres of Silvicultural Treatment by PAG – Alternative 2*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21”+ Trees	Non-Commercial Thinning	Juniper Cutting	Hardwood Treatment
Moist Grand Fir	18	0	1	0	2
Dry Grand Fir	1,617	0	348	0	26
Douglas-fir	682	0	165	0	7
Mesic Ponderosa Pine	1,250	0	104	0	17
Dry Ponderosa Pine	855	0	146	84	0
Juniper Woodland	66	0	20	98	0
Juniper Steppe	137	0	160	97	0
Non-Forest	78	0	45	202	23

* Totals do not match Table 27 due to rounding.

Table 29. Acres of Silvicultural Treatment by PAG – Alternative 3*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21”+ Trees	Non-Commercial Thinning	Juniper Cutting	Hardwood Treatment
Moist Grand Fir	18	0	1	0	2
Dry Grand Fir	1.276	341	348	0	26
Douglas-fir	658	24	165	0	7
Mesic Ponderosa Pine	1,243	7	104	0	31
Dry Ponderosa Pine	855	0	146	84	0
Juniper Woodland	66	0	20	98	0
Juniper Steppe	136	0	160	97	0
Non-Forest	68	11	45	202	23

* Totals do not match Table 27 due to rounding.

Table 30. Acres of Silvicultural Treatment by PAG – Alternative 4*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21"+ Trees	Non-Commercial Thinning	Juniper Cutting	Hardwood Treatment
Moist Grand Fir	18	0	1	0	2
Dry Grand Fir	1,147	0	384	0	28
Douglas-fir	490	0	167	0	7
Mesic Ponderosa Pine	872	0	177	0	31
Dry Ponderosa Pine	659	0	203	84	0
Juniper Woodland	48	0	23	98	0
Juniper Steppe	97	0	170	97	0
Non-Forest	63	0	52	202	23

* Totals do not match Table 27 due to rounding.

The acres displayed in Tables 28, 29, and 30 were determined by overlaying the proposed units with the Ochoco National Forest PAG GIS layer. All three action alternatives indicate that about 18 acres of harvest would occur in the moist grand fir PAG. However, stand conditions in these areas (units 37, 44, and 65) indicate that they should more appropriately be considered dry grand fir sites. All three units occur on or near the top of Wolf Ridge, have southern facing aspects, are dominated by ponderosa pine and Douglas-fir with a lesser component of grand fir, and have numerous indicators of repeated low intensity historic fire regimes (fire scars).

Departure from Historic Conditions - Direct and Indirect Effects

Alternative 1, No Action

No treatments would occur. Vegetation would continue to develop within the project area in a manner determined by existing stocking and species composition. Many of the future stages, which develop through natural growth and succession, would tend towards mid or late-seral species composition and multi-strata characteristics. The rate at which many stands would develop large tree character would be hampered by overstocked conditions. The density of most stands would continue to increase and individual tree growth rates are expected to decline. On drier sites, such as ponderosa pine PAGs, stand stagnation would become more common. Existing trees would continue to be weakened by competition in overly dense stands.

In the absence of stand treatments, the presence of Douglas-fir in the understory of Douglas-fir PAG stands would increase as would the grand fir in dry grand fir PAG stands. Western juniper seedlings would continue to become established in dry and mesic ponderosa pine PAG stands and grow into saplings and pole sized trees that will compete with the ponderosa pine. The establishment of these seedlings and saplings in the understory aids in the development of ladder fuels. Increasing and sustained high stand densities would result in high shade levels and reduce the amount of understory vegetation that is important for soil protection and forage.

Density related tree mortality is expected to increase and would result in increased amounts of dead and down wood in these same stands. Increased ground and ladder fuels and high crown closure would maintain a higher risk of intense fire behavior. High intensity wildfires have the greatest potential to create rapid, large scale change to stand structure and density. In the event of such a fire, more early seral stand structures dominated by shrubs, herbaceous plans and tree seedlings/saplings would be created.

Dense structural stages are above their historic abundance and would continue to increase, reaching the highest levels of all alternatives. Acres dominated by grand and Douglas-fir would steadily increase, while acres dominated by ponderosa pine and western larch would steadily decrease. Tables 31, 32 and 33 and Figures 1, 2, and 3 display the effects of the alternatives on species composition and dense conditions.

Alternative 2

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999). This would result in more large trees being maintained over time, as well as encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained in the overstory (all trees $\geq$21" dbh) and in lesser amounts in the understory.

Treatments are also proposed in single-strata conditions but where stocking density is currently considered to be too high. Treatment would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by over 3,200 acres and move closer to the historic range. After 20 years and beyond, the amount of dense conditions increases as succession and growth continue in the absence of additional disturbance, however it stays below the levels in Alternative 1. Acres dominated by grand and Douglas-fir would be reduced by about 330 acres, and are projected to remain with the historic range for 50 years. The amount of area dominated by ponderosa pine and western larch would be increased, but not to the extent of Alternative 3. Acres dominated by ponderosa pine and western larch would be maintained within the historic range for 50 years.

Alternative 3

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999). This would result in more large trees being maintained over time, as well as to encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained in the overstory (all old trees) as well as in the understory but at lesser amounts.

Treatments are also proposed in single-strata conditions where stocking density is currently considered to be too high. Treatments would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of additional large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by almost 3,800 acres. This alternative moves the closest to the historic range. After 20 years and beyond, the amount of dense conditions increases above the historic range as succession and growth continue in the absence of additional disturbance. Over the 50 year period it stays the lowest of all alternatives. Acres dominated by grand and Douglas-fir would be reduced by about 440 acres, yet would remain within the historic range for the next 50 years. Over time this alternative retains the most acres with ponderosa pine and larch dominance.

Alternative 4

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999).

This would result in more large trees being maintained over time, as well as to encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained both in the overstory (all trees ≥21" dbh) as well as in the understory but at lesser amounts.

Treatments are also proposed in single-strata conditions where stocking density is currently considered to be too high. Treatments would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of additional large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by about 2,900 acres. This alternative moves the project area closer to the historic range but less than Alternatives 2 and 3. After 20 years and beyond, the amount of dense conditions increases as succession and growth continue in the absence of additional disturbance. Over the 50 year period, it develops the most dense stages of the three action alternatives but is still less than Alternative 1. Acres dominated by grand and Douglas-fir would be reduced by about 220 acres, and would remain within the historic range for the next 50 years. The amount of area dominated by ponderosa pine and western larch would be increased over time, but not to the extent of Alternatives 2 or 3.

Table 31. Acres of Dense Structural Stages

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	9,651	11,547	12,196	13,134	1,821	4,673
Alt 2	6,463	8,947	9,851	10,583		
Alt 3	5,867	8,540	9,504	10,967		
Alt 4	6,744	9,245	10,137	11,477		

Figure 1. Dense Structural Stages

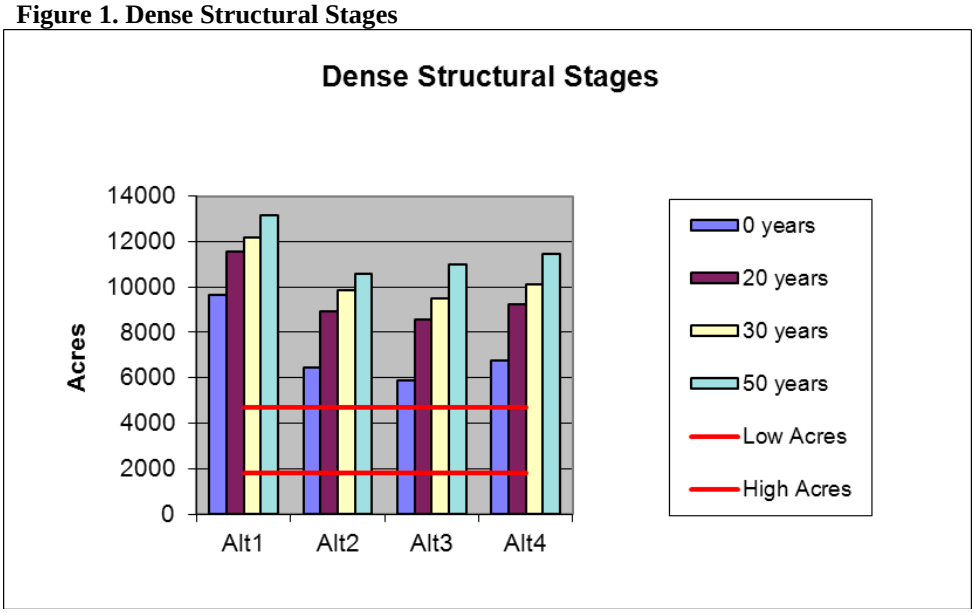


Table 32. Acres dominated by grand and Douglas-fir.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	1,264	1,714	1,952	2,434	717	2,135
Alt 2	930	1,256	1,438	1,819		
Alt 3	822	1,151	1,333	1,713		
Alt 4	1,036	1,392	1,585	1,986		

Figure 2. Grand and Douglas-fir Dominated Stages by Alternative and Historic Range

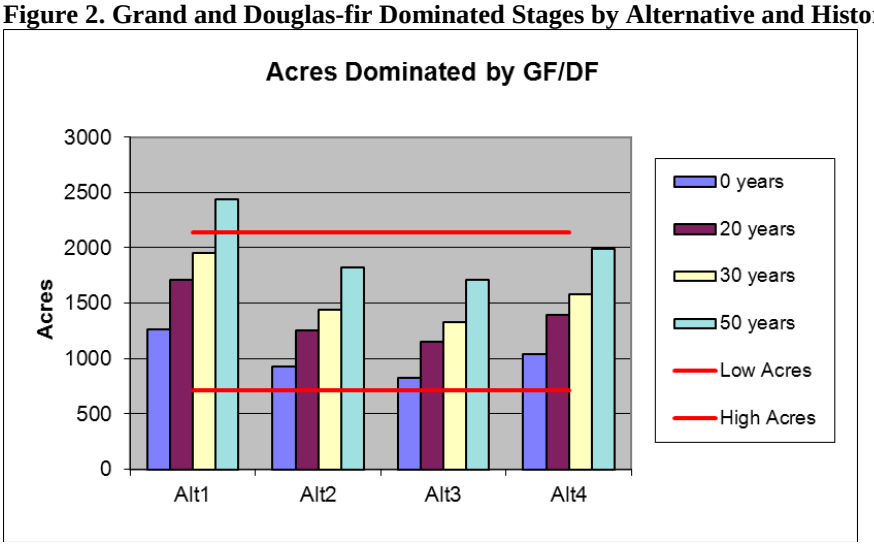
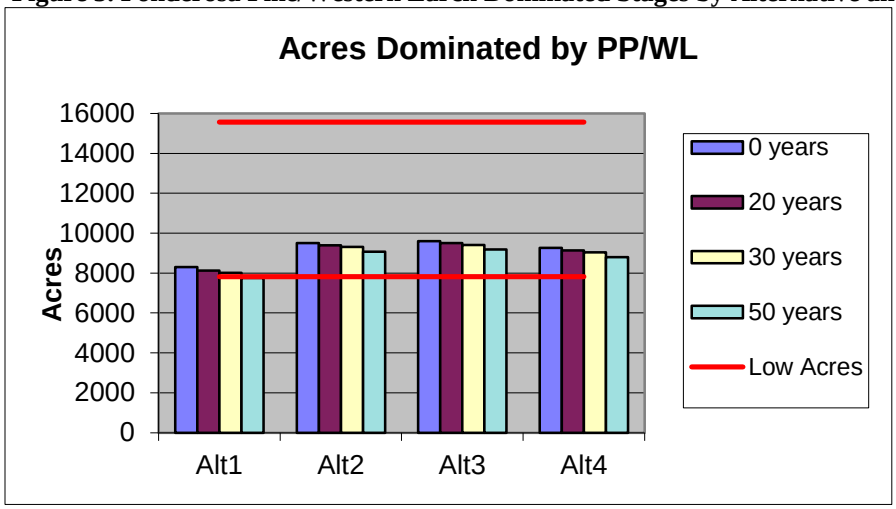


Table 33. Acres dominated by ponderosa pine and western larch.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	8,304	8,129	8,017	7,756	7,825	15,571
Alt 2	9,510	9,397	9,306	9,071		
Alt 3	9,594	9,499	9,410	9,175		
Alt 4	9,258	9,142	9,046	8,804		

Figure 3. Ponderosa Pine/Western Larch Dominated Stages by Alternative and Historic Range



Cumulative Effects – Departure from Historic Conditions

The cumulative effects boundary includes Forest Service lands within the Wolf project area, private lands located within and bordering the project area, and adjacent BLM lands within the North Fork Wolf Creek subwatershed. There is one timber sale (Powell TS) currently active in the Wolf project area. One harvest unit and portions of two other units occur within the project area (43 acres total). These units will all be commercially thinned and are scheduled for follow up noncommercial thinning and underburning similar to the activities proposed in the Wolf project. No trees 21"+ DBH will be harvested. The net effect of these units will be to reduce the amount of dense conditions and to favor ponderosa pine.

In addition to the Powell timber sale, there are an additional 142 acres of noncommercial thinning which were included in the Upper Beaver EIS (2010). The noncommercial thinning will have results similar to those described for the Wolf project but the magnitude of these acres is so small it will not meaningfully change the effects analysis previously discussed.

The adjacent private and BLM lands within the watershed are predominately juniper, non-forest sage communities, and agricultural lands. An unknown amount of juniper cutting has occurred on these lands and at least one landowner has indicated that they plan to continue with juniper thinning projects. Activities such as these will help move the landscape towards less dense conditions and favor more historic species compositions.

The Ochoco Summit system project is a proposed project that that would implement 4x4, ATV and motorcycle trails, partially within the project area in the vicinity of Six Corners material source and along the northwest edge of the project area. Portions of the proposed trail system are located on existing road beds of both open and closed roads. This project proposes to convert some of the closed roads to motorized trails up to 24 inches wide. This conversion would involve narrowing the road by placing material like soil, rocks and logs on the roadbed. The roadbed would remain in place and could be used for future timber sale activities, including log trucks. Segments of the proposed trails would be closed for public safety when the trail is an area of timber sale activity, non-commercial thinning or prescribed burning or when the trail is located on a road being used by logging traffic. Because of the limited acres affected, the overall effect of these trails on upland forest vegetation is expected to be minimal.

Insects and Disease

Past management practices, including fire suppression and selection harvest, have favored the development of stands which are now considered to be out of balance when compared to their historic conditions. Historically (100+ years ago), many stands in the planning area would have commonly had more ponderosa pine and western larch and less grand fir, Douglas-fir and western juniper. There would have been more open and single storied stands rather than the multi-storied stands of today. These stand conditions were maintained by frequent low-intensity fires, which prevented them from becoming overcrowded. Natural disturbance agents have always been present in the planning area, however, the degree to which they now affect the area can be considered to be a reflection of the decline in the ecosystem's health and resiliency.

According to "America's Forest Health Update 2009" published in June 2009 by the Forest Service, "much of the Interior West was significantly drier during the period from 1996 to 2005, compared to the 110-year average". "Periods of below normal precipitation, often coupled with above normal temperatures, can lead to increased tree stress, reduced tree resistance to insects and pathogens, accelerated insect life cycles, and insect abundance, resulting in high levels of tree mortality and increased wildfires". These observations along with the current stand conditions point towards an un-sustainable situation for many overstocked forest stands in the Wolf project.

Bark Beetles: Aerial insect and disease surveys for years 2003 through 2012 show numerous mortality centers due to bark beetle feeding. Field reconnaissance has verified ongoing bark beetle activity and susceptible stand conditions within the project area. A primary concern is the loss of large diameter mature ponderosa pine and, to a lesser extent, Douglas-fir.

Mountain pine beetle (*Dendroctonus ponderosae*) and western pine beetle (*Dendroctonus brevicomis*) occur in the project area. Ponderosa pine is a susceptible host to both beetles in overstocked stands, and mature lodgepole pine stands attract mountain pine beetles. Bark beetle mortality is symptomatic of over-stocked stand conditions which create competition stress and reduce tree vigor (Schmidt et al.1994, Graham and Knight 1965). Thinning (density reduction) has been shown to be effective in reducing bark beetle susceptibility in stands (Fettig et al. 2007, Shaw et al. 2009). Drought conditions and root disease can also contribute to a tree's susceptibility to a bark beetle attack; that combination of factors may result in the tree dying.

Mortality caused by the western pine beetle tends to occur in scattered locations where large, overstory ponderosa pines are crowded by dense conditions. Pockets of large pine mortality can also be found following prescribed burning where dense stand conditions have weakened the overstory trees and additional stress from the burning has put the individual trees at risk.

Also occurring in the project area are Douglas-fir beetle (*Dendroctonus pseudotsugae*) and the fir engraver (*Scolytus ventralis*). Both of these insects are regarded as secondary pests because they attack trees that are weakened and stressed. Factors such as drought, defoliation, overstocking and disease can result in outbreaks of these insects that can cause increased mortality within a stand. Managing stands within recommended stocking levels, removing low vigor/high susceptibility trees, and favoring non host species such as pine and larch are recommended management strategies for reducing susceptibility to these insects (Fettig et al. 2007, Shaw et al. 2009). Aerial surveys in 2003 through 2005 detected that the fir engraver population was elevated in the project area; however it quickly fell the following year.

Foliage Insects: A group of insects called defoliators are also present in the area. The western spruce budworm is the most notable. From approximately the mid-1980s to the early 1990s the western spruce budworm was at an outbreak level in the planning area, along with the rest of the Ochoco, which caused large amounts of trees damage and/or mortality in nearly all stands in which grand fir and Douglas-fir were major components. Attributes, that contribute to high susceptibility to defoliating insects, are: 1) increased amount of late seral host species, 2) increased stand densities, and 3) the development of multi-storied stand structure (Carlson and Wulf 1989). The trend without vegetative treatments would be for these characteristics to increase until insect population dynamics and climatic conditions combine to generate another outbreak of epidemic proportions.

The Douglas-fir tussock moth is another defoliating insect present in the project area. Douglas-fir and grand fir are the preferred hosts for this species. Stands dominated by these species that have multiple canopy layers are at the highest risk to defoliation during an epidemic outbreak. Management activities that reduce the canopy layers to two or fewer layers and promote the stand composition of non-host species (ponderosa pine, western larch, lodgepole pine) can reduce the effects from the Douglas-fir tussock moth during an epidemic outbreak (Shaw et al. 2009).

Another defoliator that was detected in 2007 and 2008 is the larch casebearer (*Coleophora laricella*). It was found in small patches on the northern boundary of the project area and has not been detected since. Since larch produces new foliage every spring, the impacts of the casebearer is only for a year at a time. However, repeated heavy defoliation for five years or more by the casebearer can retard growth and occasionally stress a tree enough that is succumbs to other factors. Dwarf mistletoe and overstocked stand conditions are the other factors that contribute to tree stress. Treatments that manage stand stocking levels and reduce the presence of mistletoe can promote healthy and vigorous larch that are less affected by the casebearer (Shaw et al. 2009).

Dwarf mistletoe: Ponderosa pine dwarf mistletoe (*Arceuthobium campylopodum*) decreases tree vigor, reduces growth, and increases susceptibility to other pathogens (Hawksworth and Shaw 1987). Infections in upper canopy trees spread readily to trees in the lower canopies. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) and larch dwarf mistletoe (*Arceuthobium laricis*) cause growth loss, reduce wood quality, and result in top kill and eventually mortality. Larch dwarf mistletoe is common in larch throughout the project area and is the most damaging disease-caused parasite for the species (Burns 1990). Observations by District foresters confirm that severe dwarf mistletoe infections are the main contributor to larch mortality. When present in Douglas-fir, the Douglas-fir dwarf mistletoe can also be severe and lead to top kill and tree mortality. Ponderosa pine dwarf mistletoe is also present in the planning area. It is not widespread, but in selected stands the infection level is severe.

Dwarf mistletoes accelerate the movement to mid and late seral species compositions by reducing the vigor of infected early seral species and increasing the competitive advantage of later seral species. Dwarf mistletoes cause branch "brooms" creating nest and hiding sites for many animals. Some animals forage on dwarf mistletoe plants.

Dwarf mistletoes are probably more common at present than historically due to the reduction of normal fire events. Dwarf mistletoe spreads from infected trees to adjacent trees that are close enough to catch mistletoe seeds as they are released from the plant. Historically more stands in the project area were open with fewer understory trees. Frequent low ground fire would have scorched lower branches thus killing infected branches and preventing mistletoe spread. As stands have become more dense and multi-strata, dwarf mistletoes have been able to spread more readily. As height growth slows due to infected branches, dwarf mistletoe moves more quickly into the higher tree crown. Branches with mistletoe brooms may contribute to ladder fuels that allow wildfire to reach tree crowns, increasing the risk of crown fire initiation (Hessburg, 1994).

Dwarf mistletoe management can be directed at either prevention or reduction. The most effective treatment for dwarf mistletoe control is to remove infected overstory trees. However, large scale removal of large trees is not part of the proposed treatments in this project. Harvest or non-commercial thinning do, however, reduce stocking and can effectively reduce some growth loss, improve vigor and reduce re-infection (Roth and Barrett 1985). Favoring of non-host tree species can also reduce mistletoe infestation as can increasing tree spacing which removes susceptible species from the seed dispersal area of an infected overstory tree (Shaw et al. 2009).

Indian Paint Fungus: This stem decay (*Echinodontium tinctorium*) is common in late seral stands in the grand fir PAGs in the project area. Trees infected with this disease develop heart rot and are prone to breakage as they have less strong heartwood to support them. Grand fir is commonly infected with Indian paint fungus, and a minor wounding of the tree can activate the dormant fungus (Mallams et al. 2010). In stands were grand fir is abundant today, this disease is most likely present. Across the interior west this decay pathogen has become prevalent as past timber harvest and fire suppression have resulted in stands that are composed of more grand fir and less ponderosa pine and western larch (Filip et al. 2009). To reduce tree wounding and subsequent decay from Indian paint fungus while thinning stands, implementation practices such as leave tree marking, designating skid trails and avoiding spring or early summer activities near host trees are recommended (Filip et al. 2009).

Root disease: Annosus root disease has been identified in the project area. The S-Group Annosus, which affects grand fir and Engelmann spruce, has been observed throughout the project area in old grand fir stumps. The presence of this disease is often associated with past timber harvest of large diameter trees. Future spread from timber harvest can be prevented through the use of borax (registered product name Sporax) applied to freshly cut stumps. Most trees to be removed in this proposed timber sale are of small diameter (<18 inches) and do not function as a host to the disease. Borax treatment is also not required if grand fir is not to be the favored species for long term management.

As a precautionary measure, in select stands, grand fir stumps that are 18 inches in diameter and larger may be treated (Shaw et al. 2009). Favoring tree species that are resistant to the specific root disease is another management strategy to manage root disease (Shaw et al. 2009).

Armillaria root disease and laminated root rot are two other root diseases of concern for the project area although disease centers have not been located. They are most evident in stands of high density and stands with a major component of late seral species. Vigorously growing trees can be infected but can often confine the fungi and limit the extent of the infection (Hadfield et al. 1986, Shaw et al. 2009). Favoring tree species that are resistant to the specific root disease, such as ponderosa pine and western larch, is an important management strategy (Shaw et al. 2009).

The grand fir PAGs are where most of the root disease activity can be found, especially in areas where stands conditions combine to reduce stand vigor. These diseases can kill trees directly, and often work in conjunction with insects to create pockets or patches of mortality (Hagle and Shaw 1991). Historically, these disease centers were usually small and contributed to stand diversity. With the changes over time in species composition, the incidence of and susceptibility to root disease infection is increasing (Schmitt 2001). The tendency, without disturbance or management, is for infection centers to be repopulated with host tree species and for infections to perpetuate and intensify.

Direct and Indirect Effects – Insects and Disease

The susceptibility of the landscape to disturbance agents has been evaluated by examining the abundance of those vegetative stages that have a high risk factor associated with them. Table 34 indicates the stages that are considered to be at high risk to insects and disease.

Table 34. High risk stages by PAG.

PAG	High Risk Stages
Moist GF	E4a, E5a, M5a, L3, L4a, L5a
Dry GF	E3a, E4a, E5a, M4a, M5a, L3, L4, L5
Doug-fir	E3a, E4a, E5a, M4a, M5a, L3, L4a, L5a
Mesic PP	M4a, M5a, L4a, L5a
Xeric PP	M3, M4a, M5a, L4a, L5a

Alternative 1, No Action

Currently, there are about 9,690 acres within the project area that are in stages rated as high risk. This is about twice as high as the historic range. Under this alternative, no actions are proposed that would reduce susceptibility. Vegetative development would continue dependent on the conditions and successional trends that currently exist. Many of the stages, which become more prevalent in the future, have high risk factors associated with them (high density, abundance of late-seral species, etc.) In 20 years the amount of high risk area is projected to increase to about 11,600 acres and continues to increase through the projection period.

Table 35 and Figure 4 display the amount of high risk area associated with each alternative.

Alternative 2

The actions proposed in this alternative reduce the high-risk stages by almost 3,200 acres and brings it within about 1,600 acres of the historic range. The proposed treatments would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents. This alternative reduces the acres of high risk condition the second most of all the alternatives. This trend continues through the 50 year projection period

Alternative 3

The actions proposed in this alternative reduce the high-risk stages by about 3,800 acres, and bring the amount of area to within about 1,000 acres of the range at which it historically occurred. This alternative reduces the acres of high risk condition the most of all the alternatives.

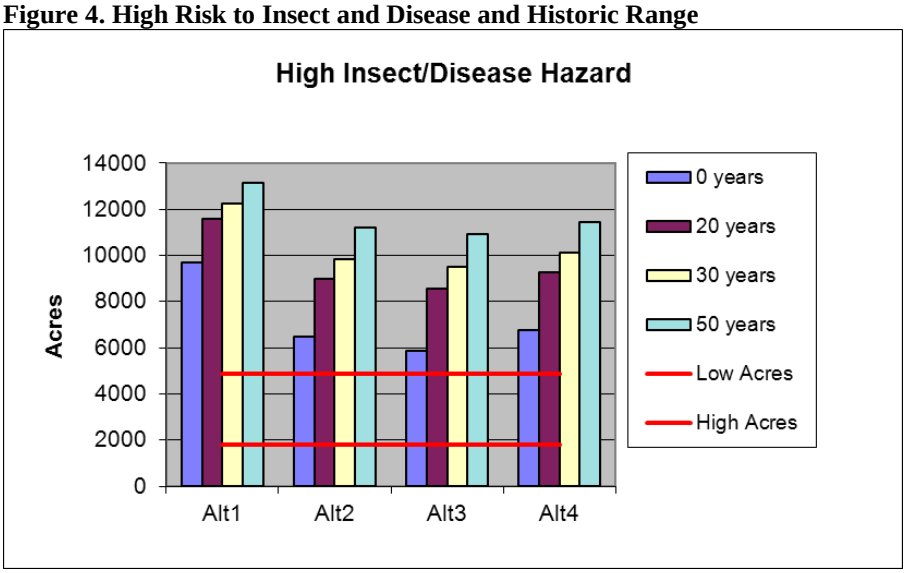
Alternative 4

The actions proposed in this alternative reduce the high-risk stages by about 3,800 acres, and bring the amount of area to within about 1,000 acres of the range at which it historically occurred. This alternative reduces the acres of high risk condition the most of all the alternatives.

Table 35. Acres in a condition of high risk to insects and disease.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	9,690	11,588	12,222	13,119	1,821	4,856
Alt 2	6,500	8,964	9,848	11,180		
Alt 3	5,877	8,549	9,498	10,919		
Alt 4	6,754	9,258	10,136	11,437		

Figure 4. High Risk to Insect and Disease and Historic Range



Cumulative Effects

The 20, 30 and 50-year projections include only the proposed actions associated with each alternative and continued fire suppression. They do not include any future management such as continued underburning, thinning, or other stand tending activities. Thus, the acres of high risk increase with time as succession and stand growth continue uninterrupted. If stand density continues to be managed in the future, it would continue to lessen the amount of high risk stages.

The Powell timber sale and other noncommercial activities from the Upper Beaver EIS discussed previously all have the effect of reducing density and favoring disease resistant species. These will lessen susceptibility to insects and disease in a manner similar to the treatments proposed in this project. The amount of acres treated in those projects is small in comparison to the activities currently proposed and will not meaningfully change this analysis.

Late and Old Structure

Late and old structure (LOS) is an important vegetative condition specifically identified in the Regional Forester's Forest Plan Amendment #2 (June 1995). The amendment defines LOS as those vegetative structures in which large trees are a common feature. It goes on to identify two different structural conditions, multi-strata and single-strata.

The amendment provides guidance to analyze LOS in relation to historic condition, and sets different scenarios for interim management. LiDar imagery was used as the landscape analysis tool to estimate the existing amount of LOS. The amount of each LOS type by PAG has been compared to its corresponding HRV. This comparison determines which of the scenarios outlined in the amendment are applicable to the Wolf project.

Existing LOS Condition

There are currently an estimated 2,354 acres of LOS within the dry grand fir, Douglas-fir, and ponderosa pine PAGs. The majority **(**2,330 acres**)** of the LOS is in a multi-strata condition. Historically, the overall total amount of LOS would have ranged between about 5,770 and 11,280 acres, with the bulk of it in a single strata condition due to frequent low-intensity fires which were the dominant disturbance regime in the area. Examination of each PAG reveals that all PAGs except Douglas-fir are within or above the historic range for the multi-strata condition. All PAGs are below the historic range for the single strata condition. Across all PAGs, the total amount of multi-strata LOS is above the combined historic ranges, while single stratum LOS is below.

There is no LOS within the moist grand fir PAG portion of the project area. The moist grand fir PAG accounts for only about 60 acres within the project area and, with such a small amount, a meaningful HRV analysis cannot be conducted.

Table 36. Existing LOS and historic ranges by PAG.

PAG	LOS Type	Existing Acres	Historic Low Acres	Historic High Acres	HRV Status
DGF	multi	677	594	1,204	Within
	single	0	1,439	2,941	Below
	Total	677	2,034	4,145	Below
DF	multi	247	347	582	Below
	single	0	1,015	1,659	Below
	Total	247	1,362	2,241	Below
M Pine	multi	960	0	329	Above
	single	24	1,826	3,141	Below
	Total	984	1,826	3,470	Below
X Pine	multi	446	0	143	Above
	single	0	548	1,283	Below
	Total	446	548	1,426	Below
Total	multi	2,330	941	2,258	Above
	single	24	4,829	9,024	Below
	Total	2,354	5,770	11,282	Below

Table 37. Summary of Existing LOS Status by PAG

Plant Assoc. Group	Multi-strata LOS	Single-strata LOS	RF Amend. #2
Dry Grand Fir	Within Historic	Below Historic	Scenario A
Douglas-fir	Below Historic	Below Historic	Scenario A
Mesic ponderosa pine	Above Historic	Below Historic	Scenario A
Xeric ponderosa pine	Above Historic	Below Historic	Scenario A

Under Scenario A of the RF Amendment #2, the Interim Wildlife Standard directs that no harvest activities will occur within LOS stages that are below HRV and that all live trees 21 inches DBH or larger will be maintained. Silvicultural treatments outside LOS stands should maintain or enhance late and old structure components. Open, park-like stand conditions will be maintained where they occurred historically. A memo from the Regional Forester dated June 11, 2003 encourages site-specific Forest plan amendments to treat LOS stands to help meet LOS objectives.

Most previous timber sales within this project area included the harvest of large trees. However, many previously harvested stands still have a component of large trees that can be maintained and augmented over time. Some areas nearly meet the large tree criteria for LOS and present opportunities for expanding the size of existing LOS stands and developing new LOS.

Due to the current multi-strata, dense conditions within most LOS stands, large trees within them are at risk of mortality from insects and disease. As discussed previously, there is evidence that density reduction treatments have shown increased diameter growth rates and improved vigor of large residual trees thus helping to maintain them over time. Alternatives 2, 3, and 4 propose harvest and non-harvest treatments within LOS stands to help maintain the existing large tree structure, enhance the development of additional large trees, lessen the risk of loss due to insects, disease, or fire, and to move towards historic species compositions and structures. Implementation of Alternatives 2 and 3 would require a site specific Forest Plan Amendment to implement as they propose commercial harvest within about 10 acres of an LOS stage that is currently below historic abundance (Douglas-fir multi-strata). Alternative 3 would also require an additional Forest Plan Amendment to harvest live trees 21 inches DBH or larger on about 380 acres.

Direct and Indirect Effects – LOS Stands

Part of the purpose and need in this project area is development and maintenance of late and old structure. Alternatives 2, 3, and 4 include harvest and non-harvest treatments within LOS. Alternative 1 does not propose any treatment in LOS. The following tables show the amount of LOS treated by alternative and harvest in LOS by plant association group

Table 38. Acres of mapped LOS treatment by alternative.

	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4
Acres LOS treated	0	1,398	1,398	1,334
Commercial thinning with non-commercial thinning and fuel treatment	0	769	639	446
Commercial thinning that includes trees 21”+ DBH with non-commercial thinning and fuel treatment		0	130	0
Non-commercial thinning and fuel treatment*	0	203	203	258
Prescribed burning only	0	426	426	630

* Noncommercial thinning also includes non-harvest thinning for hardwood enhancement and juniper cutting.

Table 39. Acres of proposed harvest within LOS Stands by Alternative and Plant Association Group.

Alternative	Moist Grand Fir	Dry Grand Fir	Douglas-fir	Mesic Pine	Xeric Pine	Total
1	0	0	0	0	0	0
2	0	201	10	305	254	769
3	0	201	10	305	254	769
4	0	135	0	159	151	446

Predictions have been made for each alternative that display future amounts of LOS occurring within the planning area at 20, 30, and 50 years as a result of the proposed alternatives. These projections include changes from natural growth and succession, as well as endemic levels of disturbance (insects and disease). These projections do not include widespread events such as stand replacement wildfire, western spruce budworm, or bark beetle epidemics. They also do not include assumptions about future management except for continued fire suppression.

Table 40. Existing and Post-treatment Total LOS by PAG (acres).

PAG	LOS Type	Existing	Alt 2	Alt 3	Alt 4	Historic Low Acres	Historic High Acres
DGF	multi	677	476	474	540	594	1,204
	single	0	201	203	138	1,439	2,941
DF	multi	247	237	234	247	347	582
	single	0	10	13	0	1,015	1,659
M Pine	multi	960	655	570	687	0	329
	single	24	329	414	298	1,826	3,141
X Pine	multi	446	192	122	208	0	143
	single	0	254	324	238	548	1,283
Total	multi	2,330	1,561	1,400	1,682	941	2,258
	single	24	793	954	673	4,829	9,024
	Total	2,354	2,354	2,354	2,354	5,770	11,282

Table 41. Projected Acres of Total LOS by Alternative.

		Year 20	Year 30	Year 50
Alternative 1	multi	3,542	4,041	4,870
	single	287	372	481
	Total	3,829	4,413	5,352
Alternative 2	multi	2,897	3,458	4,411
	single	1,120	1,217	1,317
	Total	4,017	4,675	5,728
Alternative 3	multi	2,781	3,362	4,348
	single	1,276	1,367	1,456
	Total	4,057	4,729	5,804
Alternative 4	multi	3,005	3,558	4,490
	single	986	1,078	1,174
	Total	3,991	4,636	5,664

Figure 5. Projected Acres of Multi-strata LOS by Alternative

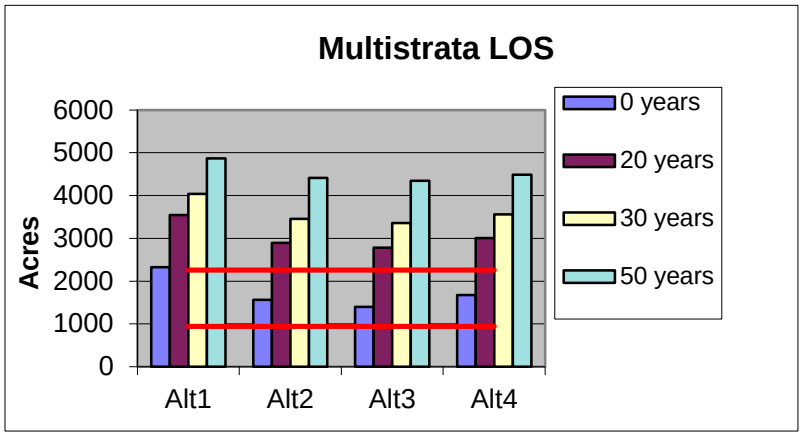


Figure 6. Projected Acres of Single Strata LOS by Alternative

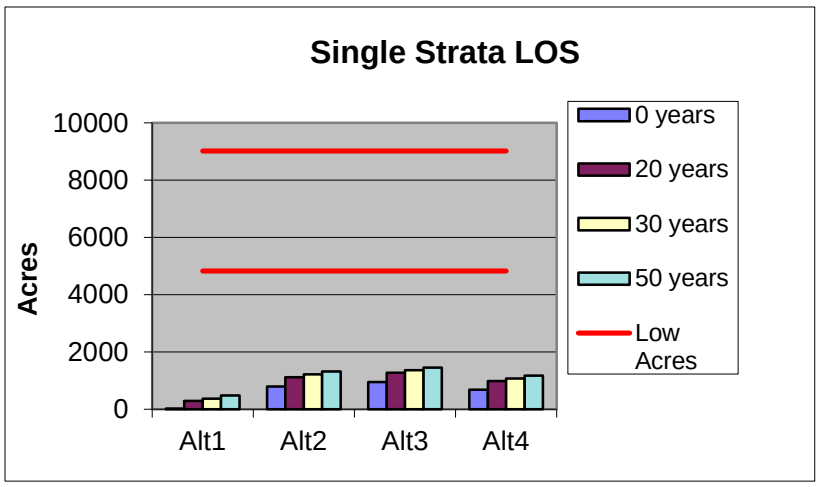
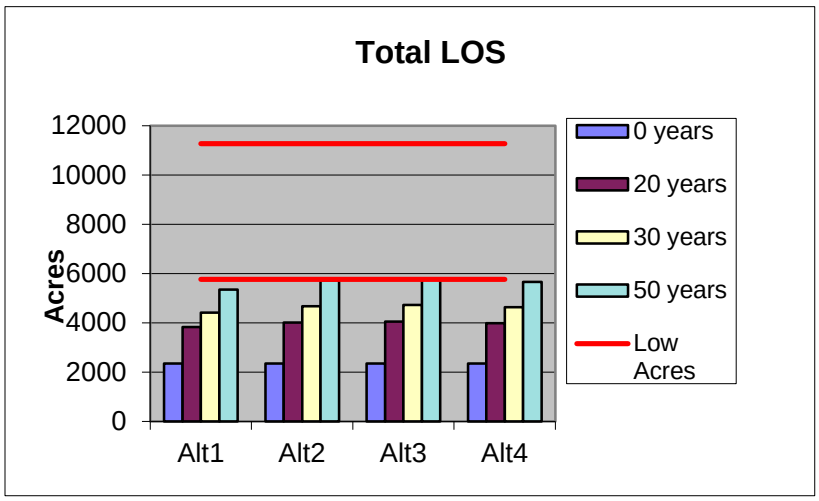


Figure 7. Projected Total Acres of all LOS by Alternative



Alternative 1

No proposed activities would occur. LOS development within the planning area would be in a manner determined by existing stocking and species composition. Much of the future LOS that develops through natural growth and succession would tend towards shade tolerant/ fire intolerant species compositions and dense multi-strata characteristics. These conditions are currently within or above HRV for all of the PAGs except the Douglas-fir PAG, which is below HRV by about 100 acres. The rate at which stands would develop large tree character would be hampered by over stocked conditions. On drier sites, such as the ponderosa pine and Douglas-fir PAGs, stand stagnation may preclude the attainment of additional large trees. Large trees within existing LOS stands, especially old ponderosa pine, would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insects, disease, and wildfire.

Alternative 2

Treatments would remove understory trees to reduce stand density, maintain existing large trees, and enhance the development of additional large trees. No live trees 21 inches dbh or larger, except those trees considered hazardous to the logging/hauling operation, would be cut. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. This would result in more large trees being maintained over time as opposed to Alternative 1, as well as encourage the development of additional large trees. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early seral/fire-tolerant species would be maintained and enhanced in the long term.

Implementation of this alternative results in the following:

1. The 769 acres of commercial harvest in existing multi-strata LOS would move these stands to single strata LOS. The total amount of multi-strata LOS would remain within HRV.
2. Dry grand fir multi-strata LOS would move from within HRV to below HRV by about 120 acres. Within 20 years this stage would increase to be back within HRV.
3. Douglas-fir multi-strata LOS would continue to be below HRV, although by year 20 it would also increase to be within HRV.
4. Multi-strata LOS in both pine PAGs would remain above HRV.
5. Over the 50 year projection period, the total amount of LOS would increase by about 375 acres over the amount predicted for Alternative 1. The amount of single strata LOS, however, would be increased by over 800 acres.

Alternative 3

Treatments would remove understory trees to reduce stand density, to maintain existing large trees, and to enhance the development of additional large trees. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. Selected individual large/old ponderosa pine would receive additional release from competition by the removal of large, young (<150 years), grand fir and Douglas-fir that are competing with them. This would result in more large pine being maintained over time, as well as encourage the development of additional large trees.

It would also better help maintain historic species compositions than any of the other alternatives. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early-seral/fire tolerant species would be maintained and enhanced in the long term.

Implementation of this alternative results in the following:

1. The 769 acres of commercial harvest in existing multi-strata LOS would move these stands to single strata LOS.
2. Dry grand fir multi-strata LOS would move from within HRV to below HRV by about 120 acres. Within 20 years this stage would increase to be back within HRV.
3. Douglas-fir multi-strata LOS would continue to be below HRV, although by year 20 it would also increase to be within HRV.
4. Multi-strata LOS in the mesic pine PAG would remain above HRV.
5. Multi-strata LOS in the xeric pine PAG would move from above to within HRV.
6. Over the 50 year projection period, the total amount of LOS would increase by about 450 acres over the amount predicted for Alternative 1. The amount of single strata LOS, however, would be increased by 975 acres. These are the largest increases of all the alternatives.

Alternative 4

Treatments would remove understory trees to reduce stand density, maintain existing large trees, and enhance the development of additional large trees. No live trees 21 inches dbh or larger, except those trees considered hazardous to the logging/hauling operation, would be cut. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. This would result in more large trees being maintained over time as opposed to Alternative 1, as well as encourage the development of additional large trees. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early seral/fire-tolerant species would be maintained and enhanced in the long term.

Implementation of this alternative results in the following:

1. The 446 acres of commercial harvest in existing multi-strata LOS would move these stands to single strata LOS. The total amount of multi-strata LOS would remain within HRV.
2. Dry grand fir multi-strata LOS would move from within HRV to below HRV by about 50 acres. Within 20 years this stage would increase to be back within HRV.
3. Douglas-fir multi-strata LOS would continue to be below HRV, although by year 20 it would also increase to be within HRV.
4. Multi-strata LOS in both pine PAGs would remain above HRV.
5. Over the 50 year projection period, the total amount of LOS would increase by about 310 acres over the amount predicted for Alternative 1. The amount of single strata LOS, however, would be increased by almost 700 acres. These are the smallest increases of the action alternatives.

Cumulative Effects

The cumulative effects boundary includes Forest Service lands within the Wolf project area, private lands located within and bordering the project area, and adjacent BLM lands within the North Fork Wolf Creek subwatershed.

Powell timber sale is currently active in the Wolf project area. One harvest unit and portions of two other units occur within the project area (43 acres total). Approximately four acres of one unit occurs within xeric pine multi-strata LOS. This unit will be commercially thinned, non-commercially thinned, and eventually underburned. No trees 21”+ DBH will be harvested in this unit. The net effect of this unit will be to reduce the amount of xeric pine multi-strata LOS by four acres and increase the amount of single-strata LOS by four acres. The remaining 39 acres of the Powel timber sale occur in dense small sized pine (size class 4) that are high density. Commercial thinning with the follow-up treatments will move these acres to less dense conditions and help them move towards LOS at a faster rate than if they were not treated.

The amount of area included in the Powell timber sale is so small that it will not meaningfully change the results discussed in the above analysis.

In addition to the Powell timber sale, there are an additional 142 acres of noncommercial thinning which were included in the Upper Beaver EIS (2010). These activities have not yet been implemented. Twenty-nine of the 142 acres occur within xeric pine multi-strata LOS. Non-commercial thinning of these acres will reduce density and risk associated with insects and disease but is not expected to be intense enough to change the LOS from multi-strata to single strata. The noncommercial thinning outside of LOS will have results similar to those described for the Wolf project but the magnitude of these acres is so small it will not meaningfully change the effects analysis previously discussed.

The adjacent private and BLM lands within the watershed appear to have little if any LOS currently. It is probable that management on the private lands will neither favor the development of additional LOS nor result in any meaningful loss of existing LOS. The vast majority of private ownership is nonforest sage lands or agricultural. It is foreseeable that future management of BLM lands could result in a long term increase in LOS, although the amount of forest land contained in that ownership is small (less than 300 acres) and appears to be primarily xeric ponderosa pine. Examination of aerial photography indicates that the area is primarily dense, small or pole sized, and primarily ponderosa pine. There are no known proposals to conduct vegetative treatments on this parcel at this time.

Connective Corridor Treatments

The Interim Wildlife Standard contained within the Regional Forester’s Forest Plan Amendment #2 (1995) provides guidance to maintain connectivity between LOS stands and between all Forest Plan designated old growth habitats. Connective corridors have been mapped for the project area and various treatments, including timber harvest, have been proposed within them. Approximately 954 acres within the project area are mapped as connective corridors (see Map 13).

The Interim Wildlife Standard provides stand criteria relating to structure and density which should be met within connective corridors when proposing harvest activities. The Interim Wildlife Standard does not apply to activities such as non-commercial thinning and fuels reduction which are not timber sales. The described condition is: “Stands in which medium diameter and larger trees are common, and canopy closures are within the top one-third of site potential”. Medium and large trees are not defined, but for the purposes of this analysis it is assumed that an average tree diameter of 16 inches at breast height would meet this criterion. To meet the density criteria it would be necessary to retain enough trees to maintain between 66 percent and 100 percent of full stocking.

Full stocking is the density level at which inter-tree competition is occurring and resulting in mortality (in other words the stand is self-thinning). Stand densities above full stocking are not sustainable due to competition related mortality and resultant susceptibility to attack by insects and disease (Powell 1999).

The Wildlife Standard allows for timber harvest within connectivity corridors so long as these two criteria (tree size and canopy density) can be met, as well as criteria relating to corridor width. It also directs that some amount of understory (if any exists) be left in patches or scattered to assist in supporting stand density and canopy cover.

The upper limit of the management zone is set at 75 percent of full stocking, while the lower limit of the management zone is set at 50 percent of full stocking. Retaining trees at these densities would result in a corresponding canopy closure ranging from 50 to 75 percent of site potential. Retaining additional understory trees during non-commercial thinning will add to the amount of canopy closure retained. These understory trees may be retained in clumps or scattered as mentioned previously. The table below displays representative canopy closures which would be retained in various plant association groups for a stand of primarily ponderosa pine with an average stand diameter of 16 inches (Powell 1999). The plant associations selected as examples are those common within the project area.

Table 42. Example Canopy Closures at Various Densities.

Plant Association Group (Plant Association)	Full Stocking Canopy Closure (%)	Upper Limit Management Zone Canopy Closure (%)	Lower Limit Management Zone Canopy Closure (%)
Xeric Ponderosa Pine (Ponderosa pine/Idaho fescue)	52	39	26
Mesic Ponderosa Pine (Ponderosa pine/pinegrass)	68	51	34
Douglas-fir (Douglas-fir/pinegrass)	68	51	34
Dry Grand fir (Grand fir/pinegrass)	73	55	37

Thinning to densities within the management zone would reduce canopy cover to between 50 and 75 percent of site potential. This does not include additional canopy contributed by any understory that would be retained during non-commercial thinning. Thinning to the lower level of the management zone within connective corridors would result in a canopy closure that is lower than the top one-third of site potential and would require a Forest Plan Amendment. Thinning to the midpoint of the management zone and leaving additional understory, as proposed in this project, would retain canopy closure in the top third of site potential and not require a Forest Plan amendment. In Alternatives 2, 3, and 4 about half of the harvest that is proposed within connective corridors occurs within the dry grand fir plant association group.

Alternative 1

No proposed activities would occur. Stand development within the connective corridors would be in a manner determined by existing stocking and species composition. Current stocking levels are above the upper limit of the management zone. Corridors would continue to increase in density until a disturbance agent such as insects or wildfire causes tree mortality. Once this mortality occurs, it is likely that density would be reduced below the top third of site potential since insects and wildfire in densely stocked stands tend to remove entire patches of live trees as opposed to selectively thinning them. The rate at which stands would develop large tree character would be hampered by over stocked conditions.

On drier sites, such as the ponderosa pine and Douglas-fir PAGs, stand stagnation may preclude the attainment of additional large trees. Existing large trees would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insects, disease, and wildfire.

Alternatives 2, 3, and 4

The commercial harvest proposed within Alternatives 2, 3, and 4 would selectively thin stands to reduce density thereby increasing tree growth and reducing susceptibility to insects, disease, and fire. Thinning would reduce densities to be within the management zone as determined by site productivity and tree size (Powell 1999). The management zone is that range of stand density between full utilization of the site resources (on the lower end) and the onset of competition induced mortality (at the upper end). Alternatives 2 and 3 include the same portions of harvest units within connective corridors encompassing approximately 136 acres. Alternative 4 proposes harvest within approximately 91 acres of connective corridors. Prescriptions in the connective corridors would be modified to retain density in the upper half of the management zone (63 percent of site potential). This level of density, in addition to retained understory, would maintain canopy closure in the top one third of site potential and meet the Interim Wildlife Standard. Thinning would also maintain or enhance the large tree component.

Alternatives 2, 3, and 4 propose other treatments in addition to the harvest units discussed above (see table 42). While the Interim Wildlife standards do not apply to these treatments they would have an effect of reducing canopy cover by thinning or killing smaller trees. Changes in stand density are expected to retain canopy cover in the top half of site potential since stocking would be maintained within the management zone (minimum of 50% of full stocking) and only smaller understory trees would be affected. The effect of these treatments is to: 1) cause a reduction in tree density and encourage the growth of the remaining trees, 2) reduce competitive stress on the remaining trees, especially the larger trees, and reduce the risk of insect mortality, and 3) reduce the risk of wildfire causing the loss of tree structure. Non-commercial thinning prescriptions within these units would be modified to retain clumps of understory as described previously. Non-harvest treatments would meet the intent of the Interim Wildlife standards.

The connective corridors pass through three young conifer plantations within the project area. All three of these have been proposed for noncommercial thinning to promote tree growth and begin the development of variable structure and density. The prescriptions within these plantations (units 200, 201, and 232) would be modified to incorporate skips (leave patches) and gaps (small openings).

Cumulative Effects to Connective Corridors

There are no other proposed vegetative treatments within the planning area which would affect mapped connectivity corridors. Past harvest and other treatments that have occurred within connectivity corridors were considered when the corridors were delineated. Powell timber sale and the Upper Beaver activities discussed previously do not overlap with connective corridors.

Hardwood Treatments

Quaking aspen can be found sparsely scattered within the planning area. They are located along streams, at springs, rock outcrops, within meadows and some are located in upland forest stands. The Paulina District GIS database has six mapped aspen locations in the planning area encompassing about 5 acres but others are known to exist such as at Quicksand Spring, Bull Spring, and adjacent to road 38 in the northern portion of the planning area. All the aspen stands are small in size with the largest one mapped at less than 1.5 acres. Historically, many of these stands were larger as evidenced by dead aspen corpses and unsuccessful suckers. Aspen stands are struggling in the area for many reasons, with one main reason being the encroachment of conifers into the aspen stands. Aspen needs full sunlight to thrive (Burns and Honkala 1990).

As the presence of conifers has increased the aspen have become shaded. Conifer competition along with other factors: livestock grazing, big game browsing, lowered water tables through stream down-cutting, fire suppression, and aspen diseases, have combined to a rapid decline of the species (Bartos, et al. 1998, Bates et al. 2010, Shepperd et al. 2001). Conifers compete for not only sunlight, but also for limited site factors, nutrients and water. In most aspen stands, the majority of the conifers present are young trees less than 21 inch DBH.

Hardwood species that are much more common in the planning area include mountain alder, bitter cherry, and various species of willow. These commonly occur in riparian areas and areas near springs and seeps. These plants do well in full sunlight and most produce rhizomatous root systems which help provide streambank stability. Similar to aspen, the vigor of these species declines under heavy shade from overtopping conifers and they can also suffer from the detrimental effects of browsing and lowered water tables.

Table 43. Proposed Hardwood Treatments

Unit	Acres*	Treatment	Additional Protection Measures
42	N/A	Commercial thinning unit with aspen, underburn	Individual cages
108**	2.1	Commercial thinning unit with aspen, underburn	Two ¼ acre exclosures, plus individual cages
121	N/A	Commercial thinning unit with aspen, hand pile slash	One ¼ acre exclosure
213	3.8	Noncommercial cutting of conifers and headcut repair, hand pile	Individual cages
214	2.9	Noncommercial cutting of conifers, hand pile	Two ¼ acre exclosures
215	2.6	Noncommercial cutting of conifers, hand pile	Individual cages
216	1.1	Noncommercial cutting of conifers, hand pile	Individual cages
217	1.0	Noncommercial cutting of conifers, hand pile	None needed, already fenced
218	1.0	Noncommercial cutting of conifers, hand pile	One acre exclosure
219**	5.7	Noncommercial cutting of conifers and headcut repair, hand pile	Up to five ¼ acre exclosures plus individual cages
234	3.0	Noncommercial cutting of conifers, hand pile	Three ¼ acre exclosures
240	1.7	Hardwood planting	Individual cages
241	1.7	Hardwood planting	Individual cages
242	1.8	Hardwood planting	Individual cages
243	1.2	Hardwood planting	Individual cages
244	1.8	Hardwood planting	Individual cages
245	2.8	Hardwood planting	Individual cages
246	4.3	Hardwood planting	Individual cages
247	3.4	Hardwood planting	Individual cages
250	3.2	Headcut repair and hardwood planting	Individual cages
251	3.6	Headcut repair and hardwood planting	Individual cages
252	2.3	Hardwood planting	Individual cages

* N/A – aspen acres are < 1 acre within a larger unit, total is estimated at approximately ½ acre
** Unit 108 is not included in Alternative 4; unit 219 expands to include it
*** Unit 350 is only in Alternatives 3 and 4

Direct and Indirect Effects

Alternatives 2, 3, and 4 include non-harvest treatments (non-commercial thinning, fencing/caging for protection, and planting) to promote aspen and other hardwood species. There are also aspen clones known to exist in commercial harvest units 42, 108, and 121. If aspen are encountered in other commercial harvest units the prescriptions would be modified to make enhancement of the aspen a treatment objective.

Planting is proposed where hardwoods are sparse or absent adjacent to streams and is also proposed in conjunction with stream restoration/headcut repair to help stabilize and restore these sites. Willow species would typically be the species planted and then protected at these sites.

Table 44. Hardwood treatment by Alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Commercial harvest units with a known aspen component.	0	Units 42, 108, 121	Units 42, 108, 121	Units 42, 121
Acres of noncommercial conifer reduction.	0	21.1	12.7	14.7
Number of units with hardwood planting	0	12	13	13

Alternative 1

No treatments would occur. Aspen stands that are currently struggling to regenerate due to conifer competition, big game and livestock grazing, and stream down cutting would continue to decline with a high risk of aspen mortality and conversion of the site to be fully occupied by conifers. Stream-side sites where hardwoods are lacking would not be planted under this alternative and regeneration of hardwood species would be dependent on natural processes only. This alternative does the least to benefit hardwood vegetation of all the alternatives.

Alternative 2

Commercial harvest and noncommercial thinning would reduce conifer competition, providing more growing space, sunlight, water and nutrients for aspen and other hardwoods. This alternative non-commercially removes conifers from about 21 acres and commercially removes conifers from another 2.6 acres. Hardwoods would be planted at another 12 sites where they are currently absent or sparse. Repair of headcuts and stream restoration to stop channel down cutting and provide for stable water tables would occur at 5 sites and help ensure that hardwood release and planting projects would be successful. Protection from big game browsing and livestock grazing would aid regeneration to grow above browse height and persist on the site. These treatments should lead to the restoration of aspen stands, aiding to maintain the genetic diversity of the different stands across the watershed.

Alternative 3

Commercial harvest and noncommercial thinning would reduce conifer competition, providing more growing space, sunlight, water and nutrients for aspen and other hardwoods. This alternative includes the same hardwood/restoration treatments as Alternative 2 except in the three commercial harvest units (42, 108, and 121). In these units young grand fir and Douglas-fir that are 21 inches DBH and larger can be removed. Removing these larger conifers that are shading and competing with aspen clones would do a better job of releasing them from competition than Alternative 2. Large ponderosa pine and all trees with old tree characteristics would still be retained at these sites. This alternative also includes an additional stream restoration project on North Wolf Creek (unit 350) which is not included in Alternative 2; additional stream restoration would result in added hardwood restoration. Overall, this alternative results in the most hardwood restoration of all the alternatives.

Alternative 4

Commercial harvest and noncommercial thinning would reduce conifer competition, providing more growing space, sunlight, water and nutrients for aspen and other hardwoods. This alternative is the same as Alternative 3 except that no trees 21 inches DBH or larger would be removed and commercial harvest unit 108 is not included. The area covered by unit 108 would instead become part of the noncommercial treatment unit 219. This alternative is more beneficial to hardwood restoration than Alternative 2 but less so than Alternative 3.

Cumulative Effects

The Paulina Ranger District has performed various hardwood enhancement projects within the project area over the past several years. Noncommercial conifer removal has occurred at Quicksand Spring, Bull Spring, and at an aspen clone along road 38. Fencing has been performed at Quicksand and Bull Springs and both aspen clones have responded positively to the conifer removal/protection. The clone adjacent to road 38 has not responded as well but is proposed for additional conifer removal and protection as part of this project (unit 42). Hardwood planting has also been successful along Wolf Creek and Clear Creek. As with conifer removal, planting has been most successful when the planted hardwoods have received protection, either from cages or fencing. There are no other proposed restoration projects within the area at this time which would affect hardwood vegetation.

Silvicultural Treatments within RHCAs

Riparian Habitat Conservation Areas (RHCAs) were established with the adoption of the Native Inland Fish Strategy (1995). INFISH also established interim Riparian Management Objectives (RMOs) which provide the target toward which managers aim as they conduct activities across the landscape. The RMOs described in INFISH are focused on specific habitat features (pool frequency, water temperature, large woody debris, bank stability, lower bank angle, and width/depth ratio). None of the RMOs apply directly to vegetation within RHCAs. Timber harvest within RHCAs is prohibited under INFISH standard TM-1 unless silvicultural practices can be applied to attain RMOs and adverse effects to inland native fish can be avoided.

During the completion of the Wolf watershed analysis it was recognized that vegetation within RHCAs in the project area was not in a desired condition due to past timber harvest, fire exclusion, and other factors. RHCAs within the Wolf project area lack natural vegetative complexity, species compositions, and resiliency. Vegetative conditions exist which are not as resistant to disturbance as they were historically and there is an elevated risk of unwanted loss from stand replacement wildfire and/or insects and disease. Hardwoods have decreased in abundance or are completely lacking from areas where they occurred historically. For this reason a site specific RMO has been developed for the Wolf project which addresses the vegetative component of RHCAs. INFISH encourages the establishment of site specific RMOs based on watershed analysis or site specific analysis.

The majority of this project area, including RHCAs outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition that was often dominated by large trees of fire tolerant species. Today large trees are less abundant, stands are denser, within stand spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. In many areas hardwoods have declined due to competition from conifers, big game and livestock grazing, and stream down-cutting. Currently, about 64 percent of the area within RHCAs is in a condition considered to be at high risk to insects and disease.

Various silvicultural activities are proposed within RHCAs to meet the RMO of maintaining and restoring the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency. Specific objectives of these treatments are to:

1. Retain and increase the abundance of large trees by reducing competition and increasing tree vigor.
2. Restore fire tolerant species compositions.
3. Reduce risk to high severity wildfire.
4. Increase the abundance and vigor of hardwoods.
5. Restore meadow habitats that have become stocked with encroaching conifer species.

To meet these objectives, site specific prescriptions have been developed on a unit by unit basis (see Table 15) based on slope, aspect, stream condition, soil conditions, and existing vegetation. These include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMOs already identified in INFISH as well as provide for no increase in the potential for sediment delivery.

Direct and Indirect Effects on RHCA Vegetation

Alternative 1

Under this alternative no activities would occur that would improve resiliency. The amount of area that is at high risk to unwanted disturbance would remain unchanged and increase over time as fire intolerant understories continue to develop and large fire tolerant trees are lost due to within stand competition. Tree mortality would potentially contribute to large down wood but over time inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. Existing shade would be maintained at current levels; however shade generated by hardwood species is expected to decline as these species are replaced by conifers. In the event of high intensity wildfire or insect epidemic, high amounts of existing shade would be lost. High intensity wildfire could also contribute to loss of existing down wood. Loss of ground cover and roughness due to high severity wildfire could also cause high inputs of sediment to stream systems.

Alternative 2

This alternative includes both commercial and noncommercial activities designed to improve vegetative resiliency and lessen the likelihood of high severity events occurring. Overall, approximately 860 acres of silvicultural activities would occur with RHCAs. The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term but would increase the likelihood of a long term supply of large trees. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH down wood RMO (see table 14). In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. Potential tree heights in the project area range from about 150 feet in the more productive lower reaches of Wolf Creek to approximately 75 to 100 feet in some of the upstream ponderosa pine sites. Within the driest pine and juniper zones, potential tree height are limited to 75 feet or less. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width. These widths encompass roughly one third to the entire potential wood recruitment zone (see unit specific project design features).

Reducing stand densities, managing for more historic and fire tolerant species compositions, and reducing fuel loads would lessen the risk of a high intensity event such as a stand replacement wildfire or insect epidemic occurring. Unit specific prescriptions were developed so that no loss of shade would occur to streams that flow during summer months. Reducing the likelihood of a stand replacement event would help ensure that shade in the long term would be maintained or increased.

Shade currently provided by hardwood species would be maintained and increased in the future as areas where they are absent or lacking becomes populated through restoration projects. Maintaining and increasing hardwoods can also help improve bank stability as many of these species have rhizomatous root systems.

Table 45. Acres of Silvicultural Treatment by RHCA Class – Alternative 2.

	Stream Class			
	1	2	3	4
Commercial harvest and noncommercial thinning	42	341	91	115
Noncommercial thinning outside of harvest units*	23	193	34	19

* Noncommercial thinning also includes juniper cutting.

Alternative 3

This alternative includes the same commercial thinning and noncommercial thinning units as Alternative 2 with the additional treatment of harvesting young grand fir and Douglas-fir 21 inches DBH and larger in eight units which overlap with RHCAs (about 42 acres of overlap). None of the units where this would occur are located adjacent to stream sections which flow water during summer months. There is also an additional stream restoration project on North Fork Wolf Creek that is not included in alternative 2.

Harvest of young trees 21” DBH and larger would only occur where the removal of those trees would contribute to the retention of aspen and/or old growth ponderosa pine. It is estimated that, on average, 1 to 2 trees of this size would be removed across the eight units. Removal of these trees is anticipated to have minimal additional effects to RHCAs as compared to Alternative 2. Retention of aspen and fire tolerant old growth ponderosa pine would be consistent with the RMO of restoring resiliency to the landscape.

Table 46. Acres of Silvicultural Treatment by RHCA Class – Alternative 3.

	Stream Class			
	1	2	3	4
Commercial harvest and noncommercial thinning	42	299	89	111
Commercial harvest with 21+” trees and noncommercial thinning	0	42	2	4
Noncommercial thinning outside of harvest units*	23	193	34	19

* Noncommercial thinning also includes juniper cutting.

Alternative 4

This alternative avoids commercial harvest within RHCAs. Approximately 360 acres of silvicultural activities would occur with RHCAs. The amount of noncommercial thinning is increased over Alternatives 2 and 3, but overall there would be about 500 fewer acres of silvicultural activities occurring within RHCAs. Areas treated non-commercially under this alternative would have some density and species composition objectives met, but not as well as if they were commercially thinned as in the other two action alternatives.

Table 47. Acres of Silvicultural treatment by RHCA Class – Alternative 4.

	Stream Class			
	1	2	3	4
Commercial harvest with noncommercial thinning	0	0	0	0
Noncommercial thinning outside of harvest units*	41	223	65	34

* Noncommercial thinning also includes juniper cutting.

Cumulative Effects

The cumulative effects boundary includes Forest Service lands within the Wolf project area, private lands located within and bordering the project area, and adjacent BLM lands within the North Fork Wolf Creek subwatershed.

The hardwood treatments discussed previously occur, for the most part, within RHCAs. Treatments are designed to increase the vigor of existing hardwoods and establish them where they are currently absent. No loss of shade is anticipated to stream sections which have summer water flow. Planting of hardwoods where they are currently absent and increasing existing hardwood vigor should result in an increase in shade over time as hardwood abundance increases. As mentioned previously, many hardwood species have rhizomatous root systems which can contribute to bank stability

The Powell timber sale discussed previously did not coincide with any stream RHCAs. There are approximately four acres of a Class 4 RHCA that are inside of units proposed for noncommercial thinning in the 2010 Upper Beaver EIS. These units have not been implemented to date. The Upper Beaver EIS design features included five foot no treatment buffers on all Class 4 stream RHCAs as well as minimum density retention requirements in the remainder of the RHCA. The amount of treatment proposed in the Upper Beaver EIS is so small, and given the project design features, there are no anticipated additional effects to RHCAsthat would meaningfully change this analysis.

There are no other silvicultural projects proposed at this time that are expected to have a meaningful effect on vegetation within RHCAs. Underburning outside of commercial and noncommercial thinning projects is also proposed within this project. This activity is primarily focused on the reduction of existing ground fuels and includes design features which are intended to meet INFISH RMOs. It is anticipated that there would a minor amount of understory conifer mortality resulting from underburning. Reducing unwanted density of understory trees would complement the silvicultural activities and improve landscape resiliency but is not expected to be of a magnitude that would meaningfully change this analysis.

Forest Wood Products and Jobs

Affected Environment

For the purposes of describing socio-economic effects on the economy, this analysis focuses on the economy of central and southeastern Oregon. The effects to the local economies are based on the estimated number of jobs created. The bulk of the area and communities potentially influenced by actions on the Ochoco National Forest lie within Deschutes, Crook, and Jefferson, the southernmost part of Wheeler, eastern most part of Grant, and the northern most sections of Harney and Lake counties. This is referred to as the Zone of Influence. The major population centers within the Zone of Influence and their population figures based on the 2000 census and 2010 estimates are displayed in table 48. Populations and change for the region and by each individual county are displayed in table 48.

Table 48. Population data in the seven Zone of Influence counties for the Wolf Fuels and Vegetation Management project.

County	Population		Change	Percent Change
	2000 Census Data	2010 Census Data		
Crook	19,182	20,987	1,805	8.6
Deschutes	115,367	157,733	42,266	26.8
Grant	7,935	7,445	-490	-6.1
Harney	7,609	7,422	-187	-2.5
Jefferson	19,009	21,720	2,711	12.5
Lake	7,422	7,895	473	6.0
Wheeler	1,547	1,441	-106	-6.8
Total	**178,071**	**224,643**	**46,572**	**20.7**
Information obtained from reports generated in November 2013, from the census.gov website				

Future population projections are expected to mimic that of the past decade. Deschutes, Crook, and Jefferson Counties are expected to continue with growth, whereas the more rural counties, Wheeler, Grant, Harney, and Lake are projected to grow quite slowly, if at all.

Table 49 summarizes the changes in the civilian labor force in Central Oregon.

Table 49. Changes in civilian labor force in Central Oregon.

County	Civilian Labor Force		Change	Percent Change
	2000 Census Data	2010		
Crook	8,764	9,252	488	5.5
Deschutes	58,836	72,837	14,001	23.8
Grant	3,792	3,135	-657	-17.3
Harney	3,765	3,313	-452	-12.0
Jefferson	8,918	8,571	-347	-3.9
Lake	3,371	3,373	2	0
Wheeler	662	614	-48	-7.2
Total	88,108	103,105	14,997	17.0
Information obtained from reports generated in December, 2013, from the "Economic Profile System-Human Dimensions Toolkit."				

The following information comes from a report generated by the "Economic Profile System-Human Dimensions Toolkit" in December, 2013. In Crook County, the three largest sectors were education, health care and social assistance, (1,494), manufacturing (1,400), and retail trade (1,355). In Deschutes County the three largest sectors were education, health care, and social assistance (13,364), retail trade (9,219) and construction (8,539). In Grant County the three largest sectors were education, health care and social assistance (695), agriculture, forestry, fishing, hunting, and mining (469), and retail trade (294).

In Harney County, education, health care and social assistance was tied with agriculture, forestry, fishing, hunting and mining for largest sector (618), followed by arts, entertainment, recreation, accommodation, and food (430) and retail trade (363). In Jefferson County the three largest sectors were education, health care and social assistance (1,629), manufacturing (1,552), and retail trade (989). In Lake County the three largest sectors were agriculture, forestry, fishing, hunting and mining (710), education, health care and social assistance (520), and retail trade (376). In Wheeler County the three largest sectors were arts, entertainment, recreation, accommodation, and food (163), agriculture, forestry, fishing, hunting and mining (110), and education, health care and social assistance (107). Overall, the number of jobs in most sectors has declined in recent years; in Deschutes County, however, jobs increased in all sectors.

As of October, 2013, the unemployment rate in Oregon as a whole was 7.1 percent; while unemployment rates in the individual counties were:

- Crook, 10.9 percent;
- Deschutes, 8.8 percent;
- Grant, 10.2 percent;
- Harney, 12.5 percent;
- Jefferson, 9.1 percent;
- Lake, 9.7 percent; and
- Wheeler, 5.6 percent.

Environmental Effects

Alternative 1

There would not be any activities implemented; therefore, no jobs would be created. As a result there would be no direct benefits to the local or regional economies. The No Action Alternative would have negative impacts to local and regional economies because forest product jobs would not be maintained. The ability to substitute this material from another source is questionable given the current availability of timber, especially from Federal lands. As noted in the affected environment section, Crook County no longer has any primary manufacturing capacity and more than half of the direct jobs supported by the harvesting, transporting, and processing of timber are associated with primary manufacturing. However since the activities would take place in Crook County, it is likely that many of the logging jobs that would be supported under Alternatives 2 and 3 would in fact be associated with Crook County's logging industry. It is also unlikely that many of these local logging jobs would be supported by another harvest activity on the Ochoco National Forest or within the Zone of Influence. This would result in some downward pressures on all facets of Crook County's economy.

The economic activity associated with road work, and vegetation and fuel treatments, would not occur under this alternative. Except for the prescribed fire treatments (these are usually accomplished with local Forest resources), many of the jobs associated with these activities, are accomplished through the use of contracting and many of the resources needed, including workers, are from outside the Zone.

Alternatives 2, 3 and 4

Timber harvest (lumber and wood products) would affect employment and income in three ways: (1) direct effects attributable to employment associated with the harvesting, transportation, and manufacturing; (2) indirect effects attributable to industries that supply materials, equipment, and services to these activities; and (3) induced effects attributable to personal spending by the owners, employees, families, and related industries. Employment and personal income impacts were made from estimates derived from Gebert et al. (2002). The jobs associated with prescribed fire and noncommercial thinning are based on local observations and do not include indirect and induced jobs.

Table 50 shows the estimated annual job and income by alternative. No attempt has been made to value what has been termed ecosystem service values. This type of analysis, if done at all, is more appropriate at the Forest Plan level, not at the project level (Bartuska, 2000, and a United States Court of Appeals, 9th circuit Memorandum, 2006).

Timber harvest jobs and income shown in Table 50 are based on State-wide relationships and are not necessarily the expected impact in any one county. Because of this, the estimated jobs and income figures are likely to be higher than what one would expect in a less developed rural economy. For example, the indirect and induced jobs described above would be less in a rural economy such as Crook's as money "leaks" out of the local economy to Redmond, Bend, and the Willamette Valley. The jobs and income associated with the road work are directly tied to Crook County's economy.

However, they are based on all road work within the County. Because the road work on the Forest is generally less intensive, the number of jobs portrayed in Table 50 is likely overstated.

Over half of the timber jobs displayed in Table 50 are associated with primary manufacturing (sawmills), and since there is no certainty on where this manufacturing would occur, as materials may not be processed within the Zone of Influence; it is therefore not possible to predict where many of these jobs would exist.

Table 50. Projected annual employment and income.

	Alternative 2	Alternative 3	Alternative 4
Jobs (Direct), commercial harvest	177	190	129
Jobs (Indirect), commercial harvest	18	19	13
Total Jobs commercial harvest	195	209	142
Personal Income (Direct), timber harvest ($1000)	$3,708	$3,962	$2,694
Jobs, pre-commercial thinning	15	15	13

Alternatives 2, 3 and 4 propose commercial harvest activities and would contribute to the local, regional, and State economies. The estimated jobs would occur over several (3 to 7) years as timber is harvested and processed. Given the major restructuring of the wood product industries over the past 10 to 15 years, it is likely that these would not be new jobs but jobs needed to maintain current levels of employment in the forest products industry. As noted in the affected environment section, Crook County no longer has any primary manufacturing capacity. Over half of the direct jobs supported by the harvesting, transporting, and processing of timber are associated with the primary manufacturing. Although many of the logging activities may be associated with Crook County, the most likely location for processing is in either Grant or southern Deschutes County.

In addition to the employment and income figures from harvesting and manufacturing of wood products, the vegetation, fuel treatments, and road work, would also generate jobs and income over the next 3 to 10 years.

It is reasonable to expect a good proportion of the noncommercial thinning work would go to minority-based small businesses, as they have in the past. The vast majority of these businesses and their employees are based along the I-5 corridor, so most of the disposable income from these activities would not flow into local communities. There would be some local economic activity generated from these activities. 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. Some businesses may need to increase their employment, either by temporarily adding employees, or giving present employees more hours. This would likely result in increased local household incomes during implementation of project activities. Since these businesses have supported similar workforces in the past, capitol expansion would probably not be required.

What was not estimated for this DEIS is the amount of restoration-related jobs that would be created by each action alternative. However, the Ochoco National Forest routinely accomplishes restoration work using service contracts. Because Alternative 3 and 4 includes additional restoration work associated with Wolf and North Wolf Creek, it is assumed that Alternative 3 and 4 would result in the creation of several additional jobs for the duration of the restoration work.

Within the social context presented above, the action alternatives have the potential to bring in workers from the outside to perform logging and related activities. 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 any of the action alternatives.

Cumulative Effects

Overall, the economic influence from implementation of any of the alternatives is likely to be small within the economic context of the zone as a whole. Trends in employment indicate increased employment, primarily in construction, services, and trade. This would help ameliorate any adverse economic impacts under Alternatives 1. Alternatives 2, 3 and 4, which provide commercial wood products in addition to economic activities associated with the other management activities, along with these same overall economic trends, would help strengthen local, particularly Crook's, and regional economies. In the context of larger economies, regional or State-wide scales, the amount lost under Alternative 1, or the amount provided in Alternatives 2, 3 and 4, would not be measurable.

Fuels and Fire

This section summarizes the fuels specialists' report; the entire report is located in the Wolf project file in Prineville, Oregon.

Affected Environment

Fire History

Fires have burned through Pacific Northwest forests for thousands of years. (Agee, The Historical Role of Fire in Pacific Northwest Forests, 1990) Prior to 1900, an estimated 6 million acres burned annually in the northwestern United States. Four million of those acres burned in dry grasslands and sagebrush. The remaining two million acres burned in the forest – more than half of that being low severity fire in forests dominated by ponderosa pine. (Barrett, Arno, & Menakis, 1997)

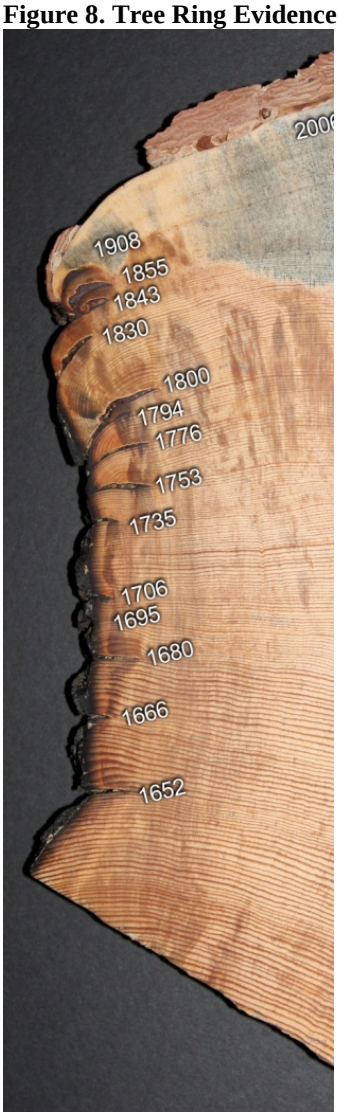
Fire exclusion over the past 90 – 120 years has reduced the acres burned by naturally-occurring fires and has resulted in the buildup of surface fuels, the development of ladder fuels, and an increase in fire intolerant species such as grand fir. Stands have become denser and the potential for high severity fires has increased.

In the Wolf project area, from 1987 thru 2006, there were 55 wildfires for a total of 20 acres, an average of 1 acre per year. Of these fire, 80% were .1 acre or smaller. The largest fire was 10 acres in 1997 and accounted for half of the total 20-year acres burned. Based on a 15 year mean fire return interval for the 20,781 forested acres within the project area, the average burned area would historically have been 1,385 acres per year.

A fire history analysis was recently conducted in three areas on 93 plots across the Ochocos. (Heyerdahl, Falk, & Loehman, 2012) The analysis was conducted in areas that have seen little disturbance from logging or large fires in the last 60 years. Fire history was reconstructed from two types of tree-ring evidence: (1) fire scars, which are formed during a surface fire that does not kill the scarred tree, and (2) dates of tree establishment, which postdate forest stands killed during a mixed or high severity fire.

At each plot, a chain saw was used to remove partial cross sections from up to 10 fire-scarred trees. Crossdating allowed for accurately dating wood from trees that were dead when sampled (stumps, logs, or snags). Small partial cross sections were also removed from live fire-scarred trees if dead ones are not present or had poorly preserved scars. All samples were dated (i.e., crossdated) using existing master ring-width chronologies that are already publicly available for the region. (NCDC, updated 2013).

Figure 8. Tree Ring Evidence of Fire History.



Fire-scarred partial cross section collected from a ponderosa pine (Pinus ponderosa) snag in 2010 near McKay Creek, Ochoco National Forest, Oregon. UTM (NAD 83, zone 10): 686694E 4928182E

Exact calendar years determined with crossdating by Emily Heyerdahl, Rocky Mtn Research Station

The average fire return interval, 14 fires between 1652 and 1908, is 18 years

The longest interval, 53 years between 1855 and 1908, coincides with the introduction of livestock grazing on the Ochocos in the 1880s.

The absence of fire after 1908 also coincides with the beginning of organized fire suppression by the U.S. Forest Service.

At the Lytle Creek site, which best represents the Wolf project area, data was taken from a 1,925 acre area between 5,054 and 5,798 feet in elevation. 1,115 fire scars were identified, dating from 1519 to 1890, showing an average fire return interval of 11 years on ponderosa pine sites, 18 years on dry mixed conifer sites, and 23 years in wet mixed conifer sites.

The Hash Rock Fire provides an example of the changes in fire effects caused by the exclusion of fire as a natural process. In August of 2000, the Hash Rock fire burned almost the entire 18,000 acre Mill Creek Wilderness. Prior to the Hash Rock fire, the proportion of the Wilderness where vegetation and fuels conditions would have supported a low severity fire had been altered from a historic range of 45-100 % to 21% The vegetative conditions that would have supported a high severity fire had increased from a historic range of 6-14 % to 45% of the Wilderness.

Fire severity mapping of the Hash Rock Fire was completed in October 2000. The fire severity mapping was compiled from aerial and ground reconnaissance and post-fire photography. This mapping identified 43% of the Wilderness as having experienced high severity, stand replacement fire. By 2002, 70% of the forested stands in the Wilderness were dead, including a high percentage of old growth ponderosa pine.

According to a synthesis of more than 1,000 scientific studies as part of the National Climate Assessment, "The fastest and most significant effects on forest ecosystems will be caused by altered disturbance regimes. A warmer climate will increase the area burned by wildfire and the area affected by bark beetles and other insects. These two factors, individually, in combination, and as components of broader stress complexes, may lead to permanently altered species composition, distribution of forest age and structure, and spatial patterns across large landscapes.

An increase in wildfire throughout the United States, which will likely include at least a doubling of area burned by the mid-21st century, will challenge government agencies and social institutions. Expanded efforts to reduce hazardous fuels can reduce the severity of wildfire on a local basis, but if the current investment in reducing stand densities and fuels does not increase significantly, it will be impossible to mitigate the effects of increasing crown fires.

Although uncertainty exists about the magnitude and timing of climate change effects on forest ecosystems, sufficient scientific information is available to begin taking action now. Land managers who are currently managing forest ecosystems in a sustainable manner are often already using "climate smart" practices. For example, thinning and fuel treatments implemented to reduce fire hazard also reduce intertree competition and increase resilience in a warmer climate." (Vose, Peterson, & Patel-Weynard, 2012)

Fire Regime Condition Class (FRCC)

Fire Regime

The five natural fire regime groups are classified based on the average number of years between fires (fire frequency or mean fire interval [MFI]) combined with characteristic fire severity reflecting percent replacement of dominant overstory vegetation. (Schmidt, Menakis, Hardy, Hann, & Bunnell, 2002) (Barrett, et al., 2010).

Table 51. Fire Regime Groups Used in FRCC Methodology.

Group	Frequency	Severity
I	0-35 years	Low/Mixed
II	0-35 years	Replacement
III	35-200 years	Mixed/Low
IV	35-200 years	Replacement
V	200+ years	Replacement/Any

In FRCC methodology, fire severity is the effect of fire in terms of upper layer canopy replacement and is described by three levels; Low – up to 25% replacement, Mixed – 25%-75% replacement and Replacement – 75%-100% replacement. (Barrett, et al., 2010)

Replacement may or may not cause a lethal effect on the plants. For example, replacement fire in grassland simply removes the leaves, which usually resprout from the basal crown, whereas replacement fire in most conifers causes total tree mortality. Other fire severity indicators include fuel consumption, ash color, soil composition and soil temperatures.

Table 52. Fire Severity Classification (Robichaud, Beyers, & Neary, 2000).

	Surface Fire	Mixed Severity Fire	Crown Fire
Litter	Scorched, charred, consumed	Consumed	Consumed
Duff	Intact, surface charred	Deep charred	Consumed
Woody debris – small, < 3 in. diameter	Partly consumed - charred	Consumed	Consumed
Woody Debris – large, > 3 in. diameter	Charred	Deep charred, consumed	Consumed
Ash color	Black	Light gray	Reddish orange
Mineral soil	Unchanged	Unchanged	Altered structure, hydrophobic
Soil temp at 0.4 in	< 120 F	210-390 F	> 490 F

For the Wolf project, Fire Regime I is characterized by ponderosa pine, Douglas-fir, and dry grand fir vegetation types. It has a fire frequency of 0-35 years with low to mixed fire severity. These fires generally replaced less than 25% of the dominant overstory (low severity), but could have replaced as much as 75% of the overstory during a mixed severity fire event.

The western juniper vegetation type that exists within the watershed is best described by fire regime II. Historically fire regime II also had relatively short periods of time between fire events, 0-35 year fire frequency; however these fires typically resulted in 75%-100% replacement of the dominant overstory vegetation (stand replacement severity).

Condition Class

Condition class describes changes in stand conditions and fire effects (e.g. potential for uncharacteristic high severity fire) which are caused in part by fire exclusion. The change in a stand compared to its reference condition is referred to as the stand's degree of departure. Departure is based on a *central tendency* (or mean) metric that represents a composite estimate of the reference condition vegetation and fire regime characteristics. The three condition classes are generally equivalent to low, moderate and high departure from historic conditions at a stand level. Using FRCC methodology in tandem with examined vegetation data to describe stand conditions and resulting potential fire effects makes condition class a good representation of fire hazard. (National Interagency Fuels, Fire, & Vegetation Tech Transfer, 2010) Changes in condition class result from changes in successional stage, and stand density. When fire is excluded from a forested environment, surface fuels accumulate, ladder fuels (small trees) accumulate, and crown base heights (the distance from the ground to the crowns of the trees) decreases, making the stand more susceptible to high intensity/high severity fire. Some of the general characteristics used to describe the 3 condition classes are found in Table 53. The three fire regime condition classes have been defined (Barrett, et al., 2010) as follows:

1) <33 percent (low) departure from reference conditions,

2) 33-66 percent (moderate) departure,

3) >66 percent (high) departure.

Table 53. Characteristics of Condition Classes.

	FRCC 1	FRCC 2	FRCC 3
Description	**0-33% departure from reference conditions.** Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	**34-66% departure from reference conditions.** Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	**67-100% departure from reference conditions.** High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.
Potential Risks	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) is low.	Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate. Risk of loss of key ecosystem components is moderate.	Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components is high.

Measuring the Current Condition and Alternatives

Hazard is defined as a source of danger. (Merriam-Webster, 2013) Forest fuels are considered hazardous when they could result in damage to a value. Some of the values identified in this document that could be damaged by wildfires that are carried by forest fuels are:

Late and Old Structure trees (LOS), wildlife habitat, soils and fisheries habitat, and air quality. Reducing the hazard – the amount of fuel in a stand – lowers the risk, or probability, of high severity fire in that stand (see Purpose and Need in Chapter 1).

Methods

Potential fire behavior for the Wolf project area was analyzed utilizing FlamMap, version 5 (Finney, Seli, Brittain, & McHugh, 2006). Modeling was used to predict various fire behavior characteristics for Alternative 1 (no action) to assess the current condition as well as Alternatives 2, 3, and 4 to assess the changes anticipated as a result of proposed activities. Fire behavior attributes assessed include flame length and potential crown fire activity. This analysis is landscape-based and provides an assessment of the entire project area as opposed to condition class which was determined at the stand level for this project. This analysis considers adjacency of various fuel conditions and utilizes topographic and weather influences to model fire behavior.

Three fire behavior levels define the likelihood of effective fire suppression actions while also considering the ecological effects of the fire itself and the associated suppression actions that the fire would require. Low fire behavior areas could be effectively suppressed using hand crews and direct fireline construction with minimal negative impacts. Moderate and high fire behavior areas would require increasingly heavier equipment such as dozers, and/or aerial methods to effectively suppress a wildfire. Moderate and high fire behavior areas have an increased likelihood of negative resource effects from wildfire: overstory tree mortality, soils impacts, smoke production, etc. For this analysis the fire behavior level is determined using a matrix combining flame length and crown fire potential as displayed in Table 54.

Table 54. Fire Behavior Levels.

Flame Length (feet)	Crown Fire Potential		
	Surface	**Passive**	**Active**
0	Low	Low	Low
0 - 2	Low	Low	Moderate
2 - 4	Moderate	Moderate	Moderate
4 - 6	Moderate	Moderate	High
6 - 8	Moderate	High	High
8 - 11	High	High	High
11 – 20	High	High	High
20+	High	High	High

The FlamMap model (Finney, Seli, Brittain, & McHugh, 2006) was used to generate the outputs for flame length and fire type (crown fire) for the Wolf landscape. In this analysis, fuel models are assigned to existing vegetation and the proposed action in order to predict fire behavior under 97th percentile conditions (National Fire Danger Rating System) as recorded by the Brer Rabbit Remote Automated Weather System (RAWS 352208).

Table 55. 97th Percentile Weather Conditions.

Weather Parameter	97th Percentile Value
Temperature	85° F
Relative Humidity	11%
Wind Direction	SW
Wind Speed	12 MPH
Energy Release Component (ERC)	23
1 Hour Fuel Moisture	2%
10 Hour Fuel Moisture	3%
100 Hour Fuel Moisture	5%
1000 Hour Fuel Moisture	6%
Live Herbaceous Fuel Moisture	< 30%
Live Woody Fuel Moisture	60%

Environmental Effects

No Action Alternative

According to the Wolf Watershed Analysis (2012), more of the watershed is covered by dense stands of small trees than were present historically. Stands that were thinned and burned in the 1980s and 90s are in need of thinning and burning to maintain low surface fuels and ladder fuels, or the risk of crown fire would increase.

Under the no action alternative, low hazard/Condition Class 1 stands would not be maintained in that condition, and would transition into moderate hazard/Condition Class 2 within the next 5 - 10 years as surface fuels accumulate, ladder fuels fill in the understory and raise the fuelbed, and the forest canopy closes. Wildfires would tend to be more severe.

Without treatment, the amount of high hazard/Condition Class 3 forest stands would increase. Limited vegetation management, wildfire suppression, and insect and disease mortality would continue the trend of fuel accumulating in the form of dead and down trees, small diameter trees growing into the overstory, and dense crown conditions. These conditions would increase the potential for a surface fire to transition to a crown fire, which could result in the loss of late and old structure, wildlife cover and large woody debris in riparian areas.

Action Alternatives (2, 3, 4)

Under the action alternatives Condition Class 1 stands would be maintained and high and moderate hazard areas would be converted to low hazard conditions resulting in decreased risk to late & old structure trees, riparian habitat, and the private landowners adjacent to the forest.

Objective: Reduce the potential for uncharacteristic high severity wildfire.

Unit of measure: Change in fire hazard/condition class by acres.

Many of the characteristics of forested stands that estimate condition class are also inputs that help determine potential fire hazard for those areas. With this in mind, a comparison of alternatives was completed using changes in condition class as a measure for the changes in fire hazard. The three action alternatives would reduce the potential for uncharacteristic high severity wildfire (high and moderate hazard/Condition Classes 2 & 3) by opening the forest canopy, and reducing surface and ladder fuels. They would also maintain conditions that support frequent, low severity wildfire (low hazard/Condition Class 1) by reducing surface and ladder fuels.

A hazard level/condition class was assigned to every stand (Barrett, et al., 2010) in the Wolf project area based on FRCC methodology in tandem with examined data from Field Sampled Vegetation (FSVeg) analysis, Lidar data, and site visits. Table 56 below represents the changes in hazard/condition class for forested stands after treatment for each alternative. Alternative 3 would move the most acres of Condition Class 2 and 3 into Condition Class 1.

Table 56. Comparison of Alternatives for Fire Hazard/Condition Class.

Alternative 1						
Hazard/Condition Class	**Existing**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L/CC1	5,640	27%	5,640	27%	0	0%
M/CC2	9,100	44%	9,100	44%	0	0%
H/CC3	6,157	29%	6,157	29%	0	0%
Alternative 2						
Hazard/Condition Class	**Existing**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L/CC1	5,640	27%	8,609	41%	2,969	14%
M/CC2	9,100	44%	7,518	36%	-1,582	-8%
H/CC3	6,157	29%	4,771	23%	-1,386	-6%
Alternative 3						
Hazard/Condition Class	**Existing**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L/CC1	5,640	27%	9,470	45%	3,830	18%
M/CC2	9,100	44%	7,204	35%	-1,896	-9%
H/CC3	6,157	29%	4,224	20%	-1,933	-9%
Alternative 4						
Hazard/Condition Class	**Existing**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L/CC1	5,640	27%	8,643	41%	3,003	14%
M/CC2	9,100	44%	7,488	36%	-1,612	-8%
H/CC3	6,157	29%	4,766	23%	-1,391	-6%

Effects Common to Action Alternatives

Changes in condition class would result from reductions in surface fuels, ladder fuels and stand density. The activities would reduce the potential for high severity fire by 1) reducing surface fuels, which would shorten the flame lengths of surface fires, 2) by increasing crown base heights, the distance from the ground to the base of the canopy, requiring longer flame lengths to initiate tree torching, and 3) by decreasing crown density, making it harder for fire to travel from tree to tree.

Fine Fuel Increase

Thinning would increase the amount of sunlight and moisture that reaches the forest floor, which would increase the quantity and vigor of native grasses, forbs and shrubs (fine fuels). The average temperature and windspead would increase, and average humidity decrease. This would lower fine fuel moisture, the amount of moisture in dried grass and timber litter (pine needles and small sticks).

The average windspeed in thinned stands would also increase. Open stands have higher surface wind speeds than closed stands. A fully-sheltered, dense stand has a wind reduction factor of 0.1; a fully-sheltered, open stand has a wind reduction factor of 0.2, and a partially-sheltered open stand has a wind reduction of 0.3. With a wind speed of 15 mph at 20 feet above the canopy, the wind speed in the dense stand is 1.5 mph, the wind speed in the fully-sheltered, open stand is 3 mph, and the wind speed in the partially-sheltered open stand is 4.5 mph. (NWCG Training Working Team, 1992)

Lower fine fuel moisture and higher wind would facilitate the spread of surface fire. More frequent surface fires in treated stands would maintain historically low levels of surface fuels and ladder fuels, which would decrease the risk of crown fire.

Thinning Slash Hazard

Thinning can cause a short-term increase in fuel hazard if the fuel load is heavy and continuous, the slash has dried out, and a fire occurs during hot and dry conditions. The heat generated by the increased fuel load has the potential to cause undesired effects to the surrounding stand, soils and other resources.

Recent commercial thinning operations on the Ochoco have used whole tree yarding, which means the entire tree is brought to a landing where it is limbed and topped, and the limbs and tops are piled. Whole tree yarding does not significantly increase fire hazard because the increase in surface fuels is minimal.

However, the noncommercial thinning of trees less than 9” dbh could result in a short-term increase in hazard. The hazard from untreated slash is reduced by either lopping (cutting) the slash to reduce the height of the fuel bed to under 24 inches (the lower the fuel bed, the lower the flame length), or by piling the slash. In units that have been lopped, the slash gets further compacted by winter snows and after 2 or 3 years is compacted to less than 12 inches and can be burned with a low intensity underburn. Leaving slash in place during this time allows for the redistribution of nutrients from the slash back into the soil. (Graham, Harvey, Jain, & Tonn, 1999)

Fire Behavior Effects

The maps below display potential fire behavior before and after treatment. Changes are based on elevation, aspect, slope, surface fuel loading and arrangement, canopy height, canopy closure, crown base height and crown bulk density (the amount of fuel in the crowns of the trees). (Finney, Seli, Brittain, & McHugh, 2006)

Figure 9. Wolf Fire Behavior Existing Condition (green is low, yellow is moderate, and red is high).

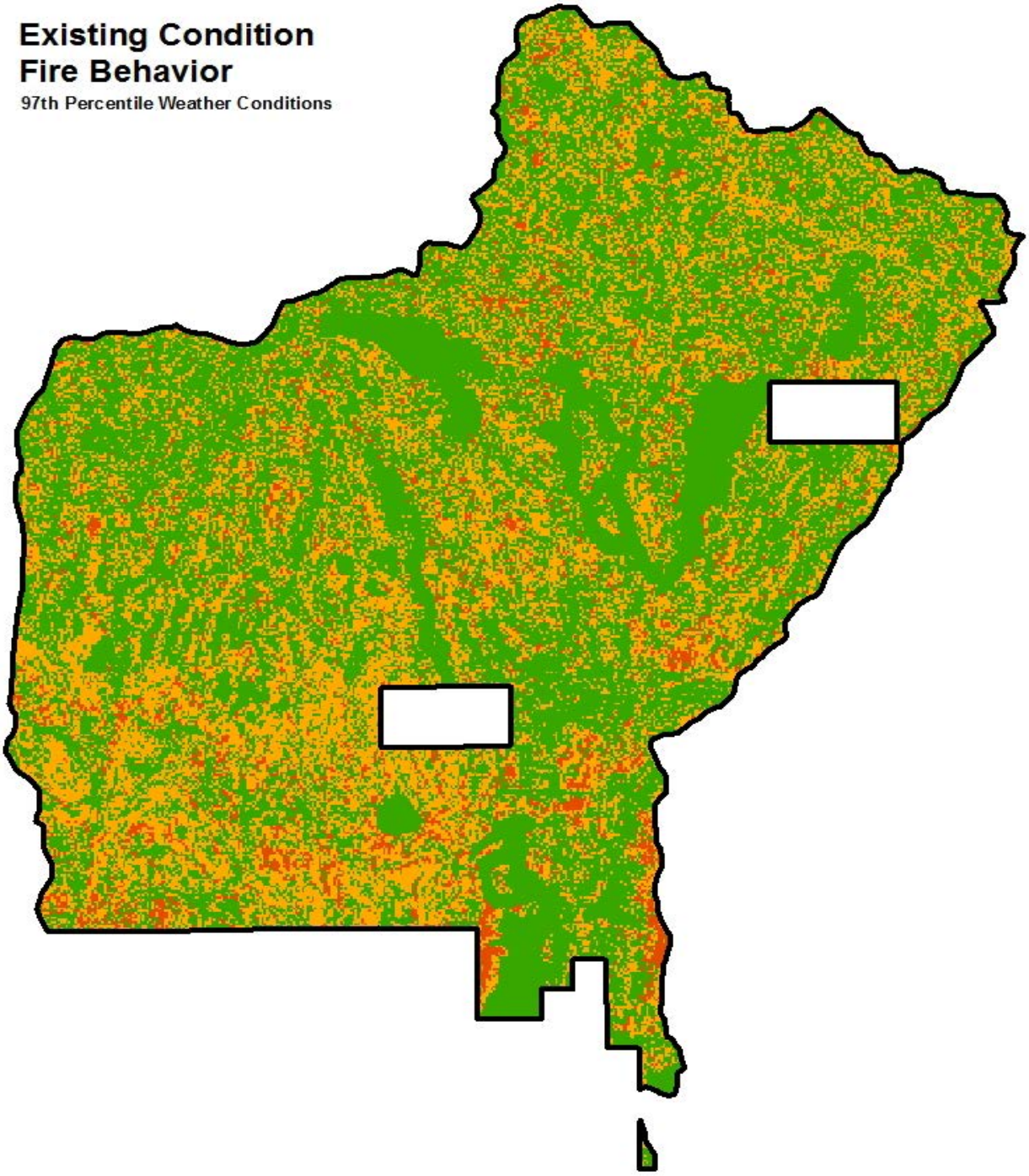


Figure 10. Fire Behavior for Units in Alternatives 2 and 3 (green is low, yellow is moderate, and red is high; white outside Wolf project units).

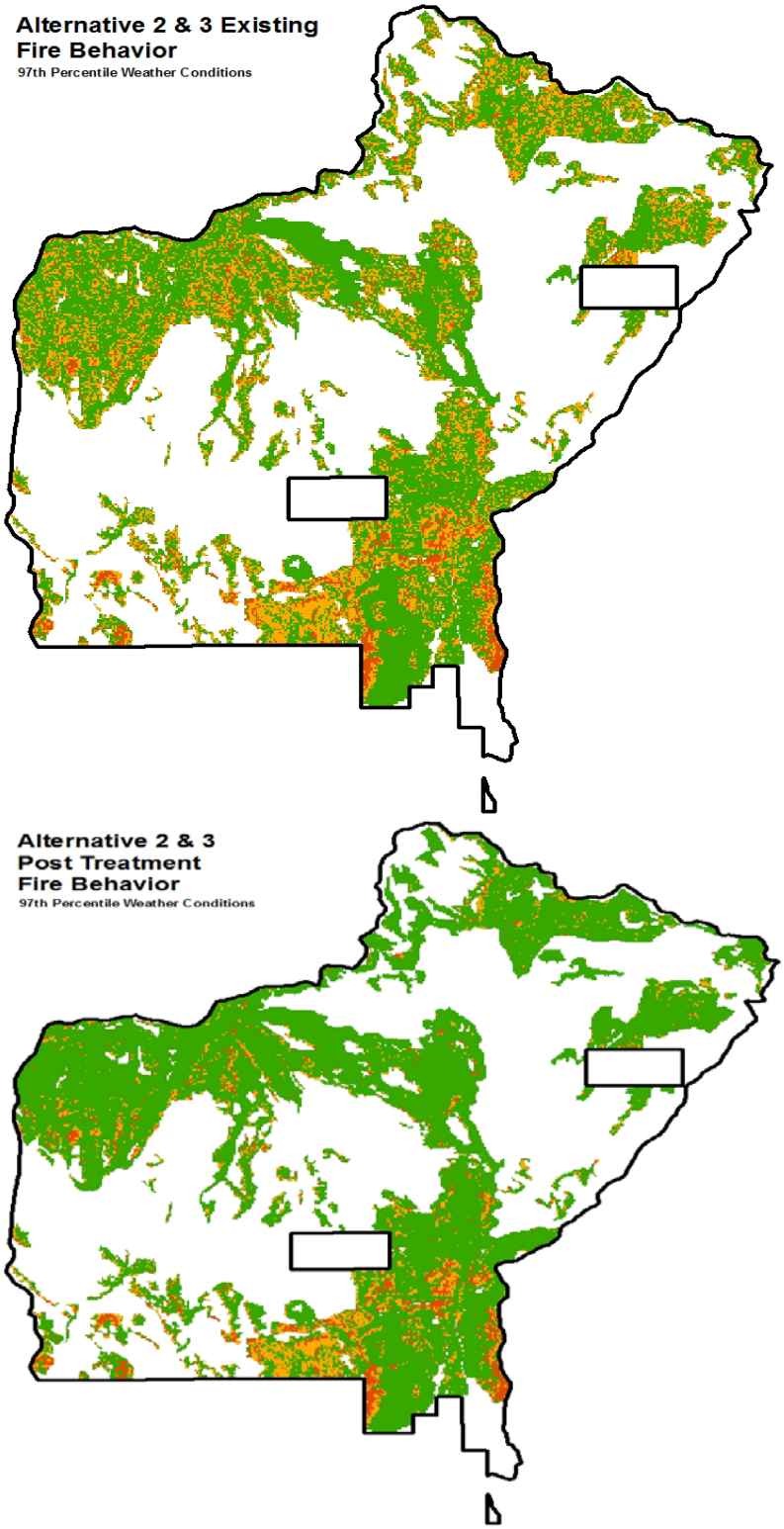
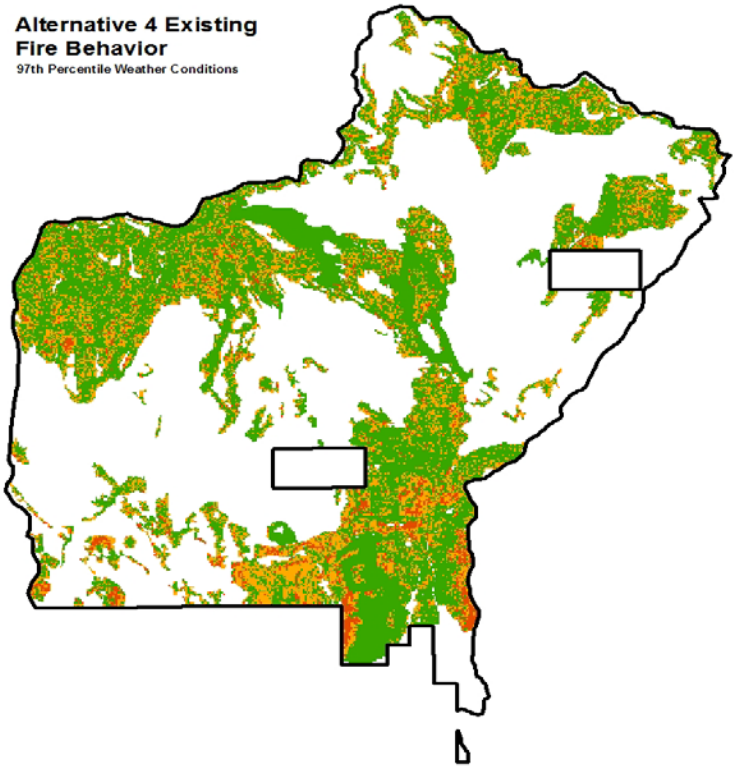
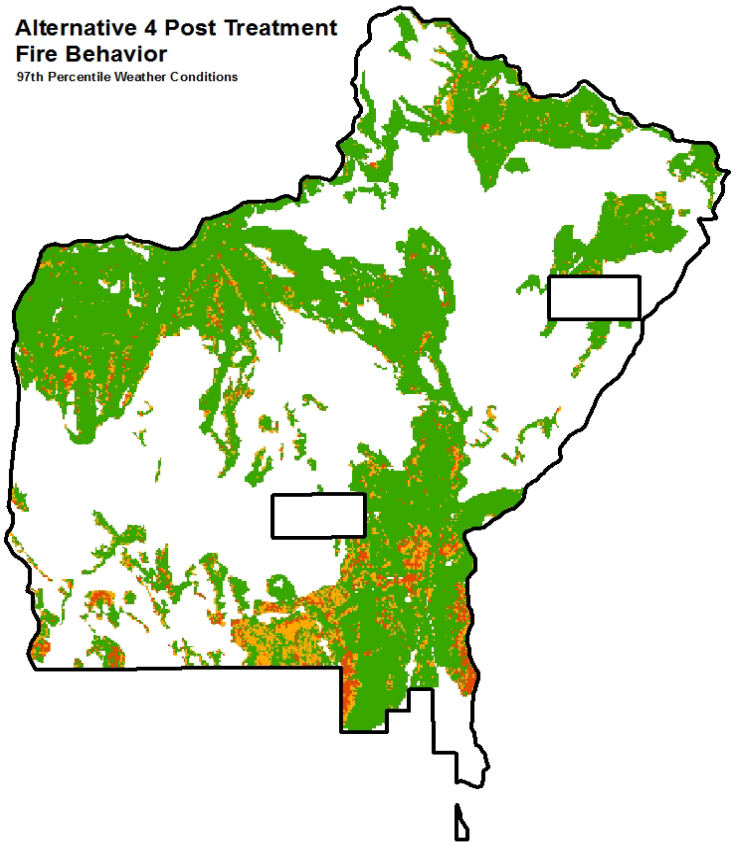


Figure 11. Fire Behavior for Units in Alternative 4 (green is low, yellow is moderate, and red is high; white outside Wolf project units).





As stated earlier, this method assesses potential fire behavior by combining projected flame lengths and crown fire potential. The results of the action alternatives compared to the no action alternative were similar. Each action alternative would effect the project area by reducing high fire behavior acres by 1%, reducing moderate fire behavior acres by 8% and increasing low fire behavior acres by 9% across the project area. Project area totals* are shown in Table 57.

Table 57. Changes in Fire Behavior Within Treatment Units.

Alternative 2 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,498	59.1%	16,755	68.3%	2,256	9.2%
M	8,309	33.9%	6,249	25.5%	-2,060	-8.4%
H	1,707	7.0%	1,512	6.2%	-196	-0.8%
Alternative 3 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,498	59.1%	16,755	68.3%	2,256	9.2%
M	8,309	33.9%	6,249	25.5%	-2,060	-8.4%
H	1,707	7.0%	1,512	6.2%	-196	-0.8%
Alternative 4 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,498	59.1%	16,687	68.1%	2,189	8.9%
M	8,309	33.9%	6,308	25.7%	-2,001	-8.2%
H	1,707	7.0%	1,520	6.2%	-187	-0.8%

*Project area total size shown in this table is slightly smaller due to the $30m^2$ pixel count conversion to acres.

Treatment Effects on Fire Hazard

An example of treatment effects on fire hazard is displayed in the table below. The outputs were calculated using Forest Veg Simulator (FVS) model which uses stand exam data as inputs for the current condition. The stand chosen currently has a high hazard fuel condition; closed canopy, heavy surface fuels, and heavy ladder fuels. A low hazard is the condition in the unit after harvest, which would open the canopy; after thinning, which would reduce ladder fuels, and; after underburning, which would reduce surface fuels. The table below compares fire effects with treatment (action alternatives) and without treatment (alternative 1), from a wildfire under the extreme conditions when large fires typically occur. (USFS, 2005)

Table 58. Fire Effects from a Wildfire in 2020 by Alternative.

	Alternative 1 – Stands without Treatment (High Hazard)	Alternatives 2,3 & 4 After treatment (Low Hazard)
Flame Length	16 feet	3 feet
Scorch height on trees	108 feet	7 feet
Percentage of trees with consumed crowns	46%	0%
Basal Area	From 120 square feet to 3	From 69 square feet to 50
Smoke Production, tons per acre of pm 2.5	0.16 tons per acre	0.08 tons per acre

Effects to Large Old Pine after Prescribed Fire

While all action alternatives reduce the risk of losing large old pine to wildfire, some mortality of large pine is expected after prescribed burning. Trees are more at risk in stands that have missed several fire entries (condition classes 2 and 3). Mortality from prescribed fire is less than 5%. (Scholz, 1986-2013) By contrast, 48% of the 18,000 acre Hash Rock fire in the Mill Creek Wilderness in 2000 had 100% mortality from a high severity fire.

Factors that could contribute to mortality in large pine include:

- depth of duff collar around the base of the tree
- diameter of tree
- age of tree
- health of tree
- age of surrounding stand
- health of surrounding stand
- presence of a catface
- live fuel moisture
- effects of long-term drought
- moisture profile of duff collar
- duration of heat pulse
- type of heat - radiant or conductive (a function of moisture profile)
- soil type

As ponderosa pine trees grow, they shed bark chips. Fire exclusion has allowed large piles of chips to accumulate around their base. These duff collars are often more than a foot deep, and are sometimes 2-3 feet deep. There has been mortality associated with the complete consumption of these collars when they burn. Frequent low severity fires would have prevented these collars from accumulating. Using fire around these trees when there is moisture in the collars could reduce the collars with less risk to the trees than wildfire.

In August of 2010, monitoring was initiated on a 105-acre prescribed fire unit in advance of a summer-condition burn. The objective was to track survival of large trees. Trees greater than 19"dbh were tagged and measured at each of seven plots throughout the unit. A total of 48 trees were measured. The average dbh was 24" and average height was 70 feet. Two trees were snags and two appeared unhealthy; all the rest were healthy before the fire. (Unhealthy here is defined as less than vigorous, but likely to survive the next ten years.)

The burn was conducted on September 7, 2010 with temperatures between 60-65 degrees F and relative humidity ranging from 35 to 43 percent with partly cloudy skies. There was 90% consumption of fine fuels and flame lengths were generally less than one foot high. Re-measurement was done one year following the burn.

At one year post-burn, all living trees had survived, both snags were still standing, and four trees appeared unhealthy. One of the unhealthy trees and three of the healthy trees had developed catfaces. Average char height was 3 feet and average percent canopy scorch was zero.

Riparian Habitat Conservation Areas (RHCAs)

Fire would be used in RHCAs to promote the growth of riparian vegetation by reducing conifer encroachment, and to reduce the risk of high severity fire by reducing small diameter surface fuels (less than 3 inches in diameter) and ladder fuels (trees less than 1 inch dbh).

"The narrow stringers of forest bordering streams that flow through the ponderosa pine zone owe their lush diversity of trees, shrubs, and herbaceous plants to the mixed fire regime. These strips of moist riparian habitat evidently burned at intervals comparable to the adjacent dry upland forests in some areas and somewhat longer intervals in other areas. Fires thinned the conifers, leaving a mixed open growth of large ponderosa pine, western larch, and Douglas fir. Broadleaved trees and shrubs prospered in the openings. Most of these species sprout after fire and grow rapidly." (Arno & Allison-Bunnell, 2002)

Prescribed fire usually burns the litter layer and upper part of the duff layer over 10-50% of the surface area within RHCAs, with less than 5% mineral soil exposure, and hydrophobic soil formation occurring on less than 1% of the area, usually where old punky logs are completely consumed. (Scholz, 1986-2013)

Post-fire Monitoring of Large Woody Debris in Dick Creek- effects of burning in RHCAs

In October 2008, a 388-acre underburn was conducted in Bull units 17 and 45, in T12S, R18E, Sec 3, 4, 9, and 10. Within those units is two miles of Dick Creek, a 2.5-mile-long intermittent tributary to Trout Creek. By the standards set forth in the Inland Native Fish Strategy (INFISH) EA (USDA FS, 1995), Dick Creek is a Category 4 Riparian Habitat Conservation Area, which includes "the intermittent stream channel and the area to the top of the inner gorge … and the area to the outer edges of the riparian vegetation." Here the inner gorge would be the floodplain, which is up to 20 feet across where there is no stream incision, and as narrow as 2 feet where the channel is incised.

On August 14, 2009, a survey was conducted of Dick Creek from where it enters the burned area at Forest Road 2730, past where it leaves the burn at the 300 road, to where it crosses the 2725 road just above its junction with Trout Creek; the last quarter mile is below the burned area and will be considered a control reach. Logs that meet the INFISH criteria for Large Woody Debris (LWD = 12" x 35') were tallied and assigned them to one of four categories based on their interaction with fire (see Table 59).

Root wads and logs in smaller size classes that are considered Large Organic Debris by the American Fisheries Society (1985) were also tallied. INFISH does not specify a range of stream discharges for which its LWD criteria are designed, but given an estimated bank-full flow of 10 cfs for this stream (Gordon, McMahon, & Finlayson, 1992), Large Organic Debris would function the same as LWD for purposes of channel stabilization and shading. In mid-August, in stream segments where there was flowing water, the discharge was at most 0.1 cfs; much of the streambed was dry. Riparian vegetation consisted of sedges lining the channel for most of its length and scattered alders along the control reach. Conifers and junipers grow in and adjacent to the channel.

Table 59. Tally of LWD and LOD along Dick Creek within the Burned Units.

Log Size	Unburned	Burned	Burned, now too small	Fallen due to fire
≥ 12” x ≥ 35’	26	6	3	5
6-12” x ≥ 35’	17	5	1	9
≥ 12” x ≥ 25’	9	6		
6-12” x ≥ 25’	8	3		1
≥ 12” x ≥ 15’	11	4		
6-12” x ≥ 15’	16	4	1	3
≥ 18” x 5-15’ (rootwads)	10	5		
4-6” x ≥ 35’	13	3		4

Table 60 compares the LWD count for the stream segment within the burned area to the control reach, and standardizes both counts to pieces of LWD per mile.

Table 60. Tally of LWD in Burned (B) and Unburned Control (C) Reaches of Dick Creek.

Log Size	Unburned (per mile)		Burned (per mile)		Burned, now too small (per mile) B/C		Fallen due to fire (per mile) B/C	
	B	C	B	C	B	C	B	C
≥ 12” x ≥ 35’	13	8	6		1.5		2.5	
6-12” x ≥ 35’	8.5		2.5		0.5		4.5	
≥ 12” x ≥ 25’	4.5	4	3					
6-12” x ≥ 25’	4	4	1.5				0.5	
≥ 12” x ≥ 15’	5.5		2					
6-12” x ≥ 15’	8	8	2	8	0.5		1.5	
≥ 18” x 5-15’ (rootwads)	5	4	2.5					
4-6” x ≥ 35’	6.5	8	1.5				2	

The presence of burned wood in the control reach indicates an earlier natural or prescribed fire in the sub-watershed just north of the reach. Similarly, some of the burned pieces within the Bull units had been burned in a prior event, not during the 2008 burn.

The majority of LWD that was in the channel before the burn has decayed to the point of losing structural soundness, meaning turbulent flood flows could break it apart. Also, most of these deteriorated pieces have sawed ends, indicating they originated in a logging operation, not with natural tree mortality. While three large logs (≥ 12” x ≥ 35’) were consumed in the prescribed burn, five new logs were added to Dick Creek, suggesting that maintenance burns are a mechanism for restoring LWD.[1]

[1] A. Dean – Fire Effects Monitor, Central Oregon Fire Management Service, 8/17/2009

High severity fires in RHCAs where fire has been excluded have occurred on the Ochoco, including in the East Fork of Mill Creek in the Mill Creek Wilderness in 2000. This can detrimentally affect fish habitat: "Some vulnerable fish populations are restricted to small, isolated segments of streams. If a wildfire and subsequent erosion damages their remaining habitat, some of these populations may have nowhere to go and will not be able to recover. This problem is compounded by fuel buildup in forests formerly in understory or mixed fire regimes. If these forests burn in severe wildfires, damage to stream habitat is likely (Agee, 1998)." (Arno & Allison-Bunnell, 2002) High severity fires followed by heavy runoff flows can harm streams and their aquatic food chains. (Minshall & Brock, 1991)

High severity fires can also detrimentally affect other species in RHCAs: "Broadleaved species (in RHCAs) provide critical nesting habitat for many songbirds. (Wheeler, Redman, & Tewksbury, 1997) However, with continuing protection from lightning fires and restrictions on prescribed burning, many riparian forests are now dominated by conifer thickets." (Arno & Allison-Bunnell, 2002)

Figure 12. High Severity Fire in RHCA.

Photo: water03.jpg Description: Hash Rock Fire, Ochoco National Forest.
East Fork Mill Creek Watershed
Headwater 1st order class 4 drainage feeding into East Fork Mill Creek.
High intensity burn.

Date: 09/2000

The photos below are of a Class 3 stream inside the perimeter of the Hash Rock Fire in the Mill Creek Wilderness (August 2000). During this mostly high severity fire, a mixed severity fire front backed down through the RCHA, causing effects similar to that of a prescribed fire; small diameter conifers were removed, surface fuels reduced, and most large downed logs retained. The duff collar surrounding the old growth pine was reduced, increasing its chance of survival during the next fire event.

The vegetation and fuels treatments proposed in the action alternatives reduce both the potential intensity and severity of a wildfire. Other indicators of effects of wildfire on riparian and water related factors include change in crown cover (shade), change in fuel loading and other vegetation changes. The following table and figures are included as an example to display pre-fire and post-fire conditions for three stands within or near RHCAs. (USFS, 2005)

Figure 13. Mixed Severity Fire in RHCA.

Cost Comparison

Reducing the fuel load in a stand changes the fuel model in that stand, so the cost effectiveness of fuels reduction can be measured by the difference in suppression costs before and after the activity. The following costs are for a 10-100 acre fire, which has the highest suppression cost per acre.[2]

- H = suppression cost-per-acre for NFDRS fuel model H (short needle conifers, closed canopy, Condition Class 3)
- C = suppression cost-per-acre for NFDRS fuel model C, **the desired condition**, open pine w/ grass, Condition Class 1)

Table 61. Suppression Costs per Acre by Fuel Model.

NFDRS Fuel Model	Fire Behavior Fuel Model	2007 Suppression Cost-per-acre
C – Open Pine	9	$3906
H – Short Needle, normal dead	8	$6086

The cost-per-acre of noncommercial thinning and underburning is $250. Should a fire occur on a treated acre:

- the potential suppression cost savings per acre that is gained from thinning and burning to change from fuel model H / Condition Class 3 to a fuel model C / Condition Class 1 = (6086 - 3906) – 250 = $1930

Wildland Urban Interface (WUI) and Property Boundaries

The 2005 Crook County Community Wildfire Protection Plan (CWPP) identified 3,294 acres of WUI in the Wolf project area. The WUI area is located in the south-east corner of the project area including areas around Salter's Cabin and surrounding campgrounds. There are two 320 acre parcels of private property within the project boundary and approximately 6 miles of private property that borders the southern portion of the project area. Reducing surface fuels, ladder fuels and stand density in these areas would reduce the risk to the private property and other developments in the event of a wildfire.

Cumulative Effects

The Wolf project boundary plus a .25 mile buffer was used for the cumulative effects analysis. This boundary was used in order to identify treatments associated with the Jackson EIS (2012) and the Upper Beaver EA (2010) that are directly adjacent to, or included within, the Wolf project boundary. The additional treatments within this boundary include 205 acres of commercial thinning with associated follow up treatments of noncommercial thinning and prescribed burning, 705 acres of noncommercial thinning with associated follow up prescribed fire treatment, and 72 acres of prescribed fire. The treatments themselves would have effects similar to those proposed in the Wolf project and have been analyzed in the previously mentioned NEPA documents. These treatments, in addition to the ones proposed by the Wolf project, would reduce the fire hazard on a larger area, increase firefighter and public safety, and reduce the effort needed to successfully implement prescribed fire treatments.

The effects of past thinning and burning projects in the Wolf project area are measured by hazard and have been incorporated into the description of existing condition.

[2] Fire suppression costs from the National Fire Management Analysis System (NFMAS), Bell 2001, NFDRS see Deeming et al 1978

Livestock grazing in the project area could reduce fire spread in open stands with light fuels by reducing grass, which helps carry fire through a stand. The amount of reduction would depend on how intensely an area is grazed, how productive the grass is in any given year, and how extreme fire conditions are on any given day. Livestock grazing does not have a measurable effect on fire behavior in closed canopy, multi-storied stands with heavy surface fuel loading.

Transportation

This section summarizes the Transportation report; the entire report can be found in the Wolf project file in Prineville, Oregon.

Road Management Objectives

The existing management objectives for roads within the analysis area generally call for roads to be managed for administrative and land management purposes, with varying degrees of consideration given to public access. The majority of the road system is managed primarily for administrative access and is only secondarily managed to facilitate public usage, although many routes see a great deal of public usage during hunting season. Beyond that, arterial and collector routes (the two and four digit roads) are generally managed to allow for a mix of commercial and public traffic.

The seven-digit roads in the transportation system are generally managed, when open, to be primarily used by high clearance vehicles. While passenger car operation is possible on some of these routes, no special consideration or effort is devoted to allowing their use. During periods of log haul, these seven-digit roads are intended to be single-user facilities, given that their narrow travel ways and lack of frequent, intervisible turnouts preclude opportunities to safely provide for mixed commercial/public traffic.

Desired Transportation System Conditions (Management Direction)

The desired condition is to provide a road system that is safe, affordable, has minimal ecological impacts, and meets immediate and projected long-term public and resource management needs.

The current direction for management of the road system is found in the Ochoco National Forest Land and Resource Management Plan (LRMP). According to the LRMP, the goal of the Forest's transportation system is "to plan, design, operate, and maintain a safe and economical transportation system providing efficient access for the movement of people and materials involved in the use and protection of National Forest Lands." (LRMP)

Existing Condition

Location and Distribution

Within the Wolf analysis area there are approximately 161 miles of roads, with all but roughly 2 miles of that amount being under Forest Service jurisdiction. The existing road system is relatively evenly distributed throughout the analysis area.

The majority of roads within the analysis area are located on moderate terrain, with ground slopes rarely exceeding 30%. Scattered roads can be found in midslope positions on slopes at or beyond 30% and a few, such as Roads 3810 and 4290, have segments residing on slopes exceeding 50% along reaches of Wolf Creek and an unnamed tributary.

Age and Development History of the Transportation System

The majority of roads within the analysis area have been in existence for better than 40 years, with some additions having been constructed in the recent past. While a few of the primary roads within and adjacent to the analysis area have existed as travel routes to and through the forest since early in the 20th Century, most of the secondary and tertiary road system has been constructed to provide access for vegetative management purposes.

Road Use Patterns

The roads within the analysis area generally have a pattern of use common to low-standard roads in the Ochoco National Forest. The use is moderate in the spring after snow melt with various recreational users and wood cutters clearing trees that felled on roads over winter. With the exception of roads that access areas of recreational interest - where off-highway vehicle (OHV) use can be extensive – or of the arterial roads and major through-routes such as Roads 38, 3810, 42, 58, and 5810, most roads see low to moderate public use and administrative traffic through the course of the spring and increasing recreational traffic through the summer. Peak use occurs in the late summer and fall with the commencement of deer and elk hunting seasons. Timber sale activity can contribute substantially to daily traffic values, but the pattern of such activity is usually isolated to one particular area at any given time.

Grazing allotments are located within the analysis area that also create a small usage component provided by permittee vehicles and isolated short term higher usage during spring and fall for movement of livestock on and off of the forest.

The anticipated future use patterns will most likely reflect current trends, with the majority of summer usage being comprised of recreational traffic with occasional isolated increases resulting from timber sale and grazing allotment activity, followed by large increases in late summer/fall traffic due to hunting activity.

Primary Destinations of Road System Users

The majority of the roads within the project area do not serve any particular destinations. Rather, they provide access to areas of interest for various users. For land managers, these roads serve as access to areas where vegetative management activities are ongoing or planned. For hunters, they provide access to popular hunting areas.

Existing Maintenance Levels and Road Surface Types

Maintenance Levels define the degree of maintenance required for a specific road and the level of service which that road provides, consistent with road management objectives and maintenance criteria (FSH 7709.58, Transportation System Maintenance Handbook). The five maintenance levels are:

> **Maintenance Level 1**: Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resource to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are “prohibit” and “eliminate.” Roads receiving level 1 maintenance may be of any type, class or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are physically closed to vehicular traffic, but may be open and suitable for non-motorized uses.

Maintenance Level 2: Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either (1) discourage or prohibit passenger cars or (2) accept or discourage high clearance vehicles.

Maintenance Level 3: Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Roads in this maintenance level are typically low speed, single lane with turnouts and spot surfacing. Some roads may be fully surfaced with either native or processed material. Appropriate traffic management strategies are either "encourage" or "accept" passenger cars. "Discourage" or "prohibit" strategies may be employed for certain classes of vehicles or users; unless otherwise specifically authorized, non-street-legal OHV use is prohibited.

Maintenance Level 4: Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated. The most appropriate traffic management strategy is "encourage" passenger cars. However, the "prohibit" strategy may apply to specific classes of vehicles or users at certain times; unless otherwise specifically authorized, non-street legal OHV use is prohibited.

Maintenance Level 5: Assigned to roads that provide a high degree of user comfort and convenience. Normally, roads are double-lane, paved facilities. Some may be aggregate surfaced and dust abated. The appropriate traffic management strategy is "encourage" except that, unless otherwise specifically authorized, non-street-legal OHV use is prohibited.

The distribution of roads by Maintenance Level within the analysis area is displayed in Table 62.

The majority of roads within the project area, almost 64%, are native surface roads. Those under Forest Service jurisdiction are variously managed as either being open for high clearance vehicle traffic (Maintenance Level 2) or as being physically closed or designated as closed so that traffic is eliminated or prohibited and the roads are in a basic custodial status (Maintenance Level 1). The native surface roads in Maintenance Level 2 status are not maintained on a recurring basis but are instead periodically reviewed to determine whether maintenance needs to protect adjacent resource values are present. A very few of the native surface roads in the analysis area are on private land and generally closed to public access.

An additional 30% of the roads are categorized as being surfaced with either crushed aggregate or pit run material. With the exception of Roads 12 and 42 along the northern boundary of the analysis area, these roads aren't specifically maintained for passenger car use but are generally readily traversed by such vehicles under most circumstances.

The remaining 6% of roads, primarily consisting of Roads 42 and 58, are asphalt or bituminous-surfaced facilities.

Within the analysis area, there are approximately 62 miles of Operational Maintenance Level 1 roads, as shown in table 62 below, that are designated closed routes but that are open and drivable owing to breached closure devices and other reasons. The effect that this has on open road density is shown in table 63

Table 62. Miles of road by maintenance level.

Operational Maintenance Level	Miles
Unclassified Other Jurisdiction	15.9
M/L 1 (Closed)	58.6
M/L 2 (High Clearance Vehicles Allowed)	26.9
M/L 3 (Passenger Car Allowed; Low Speed)	4.8
M/L 4 (Passenger Car Accepted; Moderate Speed)	2.6
M/L 5 (Passenger Car Encouraged; High Speed)	8.3

Road Densities

Open road densities within the analysis area can be expressed as either objective or operational owing to the difference between previously made access management decisions and the degree to which those decisions have been implemented. In essence, the objective open road density is the desired density that would be achieved if all roads were in their desired opened or closed status; the operational road density is a reflection of the current opened or closed status of roads within a given sixth field subwatershed. The current open road density represents the actual status on the ground. There are a number of roads that, while being classified as M/L 1, are open to motor vehicle for a variety of reasons. Table shows the effect on density.

The analysis area covers two separate subwatersheds. The following table displays the overall road densities within those subwatersheds and includes roads under all ownership.

Table 63. Road Density - Subwatershed Basis (Mile/Square Mile)

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
North Wolf Creek (Objective Road Density)	13.80	3.93	0.91	3.93	0.91
North Wolf Creek (Current Road Density)	13.80	3.93	3.74	3.93	3.74
Wolf Creek (Objective Road Density)	24.47	4.39	2.25	4.32	2.18
Wolf Creek (Current Road Density)	24.47	4.39	2.90	4.32	2.86

Environmental Effects

Alternative 1

Under Alternative 1 the existing road system would experience no changes to its current status and condition. Roads that are currently in custodial status (Maintenance Level 1) would remain closed and open roads would continue to provide access for recreational, commercial, and administrative functions in the same manner that they currently do. Open roads would receive no maintenance beyond that which is normally scheduled, which is generally devoted to the higher standard roads within the project area.

Effects Common to Action Alternatives

As a function of use during harvest activities, road maintenance activities would be conducted on roads designated for use. As a direct effect, some roads that do not receive recurring maintenance, primarily low standard roads in the Maintenance Level (M/L) 2 category, would see some improvements in both safe drivability and in their ability to handle surface runoff and the resultant sediment. Native surface M/L 2 roads, as a result of use and infrequent blade maintenance, tend to develop shallow ruts in their wheel tracks, which can concentrate shallow flow and lead to increased sediment rates (Foltz, 1991). Post-haul maintenance that would occur on these roads would restore flat road surfaces (without ruts) that would be capable of producing less sediment than their rutted counterparts; post-haul waterbarring would also remove surface runoff from the erosive road surfaces.

The type of work that would be expected to be performed as maintenance in timber sale contracts includes:

- Brushing for improved sight distances
- Removal of hazard trees
- Blading and shaping of traveled way
- Restoring existing surface drainage features, such as drain dips or outlet ditches
- Cleaning culverts and ditches
- Installing water bars after periods of haul
- Dust abatement, primarily using water as the dust palliative, would be performed as necessary to maintain safe driving conditions.

Maintenance Level 1 roads used for implementation activities would be hydrologically stabilized and physically closed to eliminate vehicular traffic upon the completion of project activities for which these roads would be needed.

Reconstruction

In the contractual setting, commercial haulers of forest products are required to perform or pay for the performance of their commensurate share of road maintenance resulting from the individual operator's use. These routine maintenance items can include road blading and dust abatement, minor roadside brushing, and maintenance of drainage structures. This work is governed by road maintenance specifications and work exceeding the requirements or intent of those specifications can be included in contracts as reconstruction items, even though such work does not improve a given road beyond its intended level of service. The preliminary recommendations displayed in Table 64 represent work that would provide for protection of road travel surfaces, provide for sediment mitigation to protect adjacent resource, and sustain travel way surfaces that can be maintained,. The action alternatives may implement approximately 21 miles of reconstruction activity of varying intensity.

The majority of this work is considered moderate level road reconstruction, including such items as placing additional crushed aggregate on major haul roads that have exposed soft soils, installation of surface and in-road drainage features in areas that show erosional problems or have stream crossings, roadside brushing beyond that intended to be performed with maintenance specifications, and placing spot rock in heavily rutted sections or soft spots in local roads to provide for roadbed stabilization.

Road	Estimated Distance (Miles)	Description	Rough Order of Magnitude
12	1	Place surface rock in deficient areas	$14,000
38	2	Place surface rock in deficient areas	$17,500
3810500	0.1	Reconstruct drainage at FSR 3810 junction	$1.500
42	8	Place surface rock in deficient areas	$111,500
4200800	2	Reblade roadbed, spot rock.	$7,500
4200809	2	Spot rock, construct drainage features	$5,000
4260600	0.2	Spot rock	$2,500
4260700	0.1	Reconstruct drainage crossing	$2,500
4260750	1.5	Reblade/reshape roadbed	$5,000
4260756	0.1	Reconstruct drainage crossing	$2,500
5810	1	Place surface rock in deficient areas	$10,00
5810360	.1	Brush, reblade/reshape roadbed	$2,000
Various	3	Brush/reblade/spot rock	$10,000

Table 64. Cost of Reconstruction

Temporary roads

Temporary road construction is sometimes required to facilitate the economical harvest of trees from a particular harvest unit. Within the Wolf analysis area, implementation of one of the three action alternatives would result in the construction of temporary roads to aid in completing silviculture treatments, and would result in the temporary commitment of acreage to use as road beds. Mileage and acres per alternative are shown in Table 65 below.

Table 64. Temporary Road Estimate, By Alternative

Alternative	Estimated Mileage On Previously Disturbed Ground	Estimated Mileage On Undisturbed Ground	Estimated Acres
Alternative 2	17.97	1.79	31.1
Alternative 3	17.97	1.79	31.1
Alternative 4	14.38	1.52	25.1

Temporary roads would be constructed primarily on flat ground (slopes less than 20%) and excavation and construction of embankments would be negligible; in all possible situations, existing areas of past ground disturbance such as old temporary or other roadbeds and skidtrails would be used to minimize the additive effect of additional new disturbance. These temporary roads would be built to low construction standards, with constraints of grade, curve radius, compaction, surfacing, and width being tailored to the minimum capabilities of the intended user vehicles. By doing so, they would be constructed in a manner that would minimize disturbance and impacts to adjacent resources.

Temporary roads, by their nature, are not intended for mixed vehicle use, nor are they intended to remain as identifiable facilities after the administrative need for their use has ended. At the completion of harvest activities all temporary roads would be barricaded to eliminate motor vehicle access, would have their surfaces decompacted by various means depending on soil type, and would be treated with erosion control measures such as waterbarring and/or slash placement as part of post-harvest soil remediation activities to facilitate their return to vegetative productivity and minimize sediment production from surface runoff.

Effects of temporary roads stem directly from compaction include loss of infiltrative capacity, increased erosion potential, and dramatically reduced vegetative productivity. Compaction results in increased bulk density and reduced porosity, primarily through the loss of macropores, leading to reduced aeration and drainage, as well as disruption to microbial populations that causes reduced productivity and increased erosion potential (Elliot et al., 1999). Bulk density has been show in several studies to reduce tree growth not only within the compacted area itself, but also for trees adjacent to the compacted area because of root zone compaction (Froehlich, 1979; Heilman, 1981; Helms and Hipkin, 1986; Conlin and van den Driessche, 1996) as a result of increased root impedance and disrupted microbial processes. Natural recovery from compaction can be variable, with the more dramatic reduction in bulk density coming near the surface of the soil profile, but in general the rate of natural, unassisted recovery is slow (Froehlich et al., 1985). These effects would be reduced by decompaction methods such as subsoiling so that they generally apply only over the short term – five years or less. Because of the moderate ground slopes and moderate to high infiltration rates of the soils adjacent to these temporary road beds, sedimentation effects would be localized to upland areas immediately adjacent to the roads.

Alternatives 2

Commercial haul activities and other vegetative treatments proposed in this Alternative would result in the use within the Wolf project area of approximately 114 miles of system roads under U.S.D.A.-Forest Service jurisdiction. This alternative proposes to use approximately 20 miles of temporary roads, with nearly 18 miles of that amount being temporary roads on existing disturbed ground. During the course of treatment activities, 60.7 miles of roads currently in custodial status as M/L 1 roads would be used for hauling activity. While this would result in some short-term increase in open-road densities, the exact magnitude of the increase would be impossible to predict because not all roads would be open at any given time. All Maintenance Level 1 roads used would be closed when such use was completed. The majority of maintenance work would be performed on the 104 miles of M/L 1 and 2 roads used for commercial activities, in particular blading and brushing, along with erosion control work.

Table 65. Haul Road Miles (Forest Service Jurisdiction) by Maintenance Level – Alternative 2

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	60.72
2 – High Clearance Vehicles	43.55
3 – Suitable For Passenger Cars	3.01
4 – Moderate Degree of User Comfort	7.27

Table 66. Haul Road Miles (Forest Service Jurisdiction) by Surface Type – Alternative 2

Surface Type	Length
Asphalt/Bituminous Surface Treatments	8.80
Crushed Aggregate	34.08
Improved Native Material (Cinders)	7.07
Native Material	64.60

Implementation of the original recommendations of the Travel Analysis for this project would result in a reduction in road density as measured by route designation as displayed as "Designated Road Density" in Table 68 below. Physical closure of Maintenance Level 1 haul routes that are currently physically open would contribute to a further reduction in density; additional changes to road density resulting from the post-implementation closure of such routes are displayed below as "Physical Road Density".

Table 67. Alternative 2 Road Density - Subwatershed Basis (Mile/Square Mile)

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
North Wolf Creek (Designated Road Density)	13.80	3.92	0.84	3.92	0.84
North Wolf Creek (Physical Road Density)	13.80	3.92	1.32	3.92	1.32
Wolf Creek (Designated Road Density)	24.47	4.28	2.21	4.22	2.14
Wolf Creek (Physical Road Density)	24.47	4.28	2.20	4.22	2.16

Alternative 3

Under this alternative, which would use the same set of roads within the Wolf project area as would Alternative 2, 117 miles of system roads would be used for commercial haul activities and other vegetative treatment proposals. The amount of temporary road used in Alternative 3 would be approximately 20 miles, with nearly 18 miles of that amount being temporary roads on existing disturbed ground. Treatment activities would result in the use of 60.7 miles of M/L 1 roads, resulting in a short-term increase in open road density, but – as with Alternative 2 – not all of those roads would be opened at the same time and all would be closed at the end of treatment activities. Under this alternative, approximately 104 miles of M/L 1 and M/L 2 roads would receive the majority of maintenance effort, in particular the native surface roads.

Table 68. Haul road miles (Forest Service jurisdiction) by maintenance level – Alternative 3.

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	60.72
2 – High Clearance Vehicles	43.55
3 – Suitable For Passenger Cars	3.01
4 – Moderate Degree of User Comfort	7.27

Table 69. Haul road miles (Forest Service Jurisdiction) by surface type – Alternative 3.

Surface Type	Length
Asphalt/Bituminous Surface Treatments	8.80
Crushed Aggregate	34.08
Improved Native Material (Cinders)	7.07
Native Material	64.60

The original changes to road status recommended in the Wolf Travel Analysis and the additional road closures proposed to reduce open road density in Winter Range allocations would result in reduced open road density in both subwatersheds in the analysis area. Open road density as defined by designation as open or closed routes is displayed as "Designated Road Density" in table 71, while

physical closure of Maintenance Level 1 haul routes used in the implementation of this alternative are shown below as "Physical Road Density".

Table 70. Alternative 3 Road Density - Subwatershed Basis

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
North Wolf Creek (Designated Road Density)	13.80	3.92	0.84	3.92	0.84
North Wolf Creek (Physical Road Density)	13.80	3.92	1.32	3.92	1.32
Wolf Creek (Designated Road Density)	24.47	4.28	1.95	4.22	1.88
Wolf Creek (Physical Road Density)	24.47	4.28	2.14	4.22	2.10

Alternative 4

Since Alternative 4 proposes to treat a lesser number of areas than does Alternatives 2 and 3, vegetative management activities and commercial haul proposed in this alternative would result in the use of a lesser number of miles of system roads and temporary roads than would be used in implementation of the other action alternatives. Under this alternative, approximately 107 miles of system roads would be used for hauling within the analysis area; see Table 72 below. Approximately 16 miles of temporary roads would be employed for harvest activities, with roughly 14.5 miles of that total being located on previously disturbed ground. During the course of treatment activities, 53.6 miles of roads currently in custodial status as M/L 1 roads would be used for hauling activity and would result in some short-term increase in open-road densities. Because not all roads would be open at any one time during implementation, the exact magnitude of the increase would be impossible to. All Maintenance Level 1 roads used would be closed when implementation activities were completed. The majority of maintenance work would be performed on the 97 miles of M/L 1 and 2 roads used for commercial activities, in particular blading, brushing, and post-haul erosion control work.

Table 71. Haul Road Miles (Forest Service Jurisdiction) by Maintenance Level – Alternative 4

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	53.60
2 – High Clearance Vehicles	43.30
3 – Suitable For Passenger Cars	3.01
4 – Moderate Degree of User Comfort	7.27

Table 72. Haul Road Miles (Forest Service Jurisdiction) by Surface Type – Alternative 4

Surface Type	Length
Asphalt/Bituminous Surface Treatments	8.80
Crushed Aggregate	33.93
Improved Native Material (Cinders)	7.07
Native Material	57.38

As with Alternative 3, the original changes to road status recommended in the Wolf Travel Analysis and the additional road closures proposed to reduce open road density in Winter Range allocations would result in reduced open road density from existing conditions in both subwatersheds in the analysis area. Open road density as defined by designation as open or closed routes is displayed as "Designated Road Density" in Table 74. Since fewer roads are being used for access for vegetative management activities in Alternative 4 than in Alternatives 2 or 3, a lesser amount of Maintenance Level 1 route miles would be closed as a post-harvest activity than in the other Alternatives. This would result in a smaller reduction in density of physically open roads. Those density values are shown below as "Physical Road Density".

Table 73. Alternative 4 Road Density - Subwatershed Basis (Mile/Square Mile)

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
North Wolf Creek (Designated Road Density)	13.80	3.92	0.84	3.92	0.84
North Wolf Creek (Physical Road Density)	13.80	3.92	1.70	3.92	1.70
Wolf Creek (Designated Road Density)	24.47	4.28	1.95	4.22	1.88
Wolf Creek (Physical Road Density)	24.47	4.28	2.26	4.22	2.22

Table 74. Comparison of Route Mileage for Existing Condition and Alternatives

Route Status	Existing Condition Miles	Alternative 2 (Miles)	Alternative 3 (Miles)	Alternative 4 (Miles)
North Wolf Creek Subwatershed				
Total Miles of Road	**54**	**54**	**54**	**54**
a) Miles designated as open	14	12	12	12
b) Miles designated as closed	42	42	42	42
Total Miles of Roads in RHCAs	**16**	**15**	**15**	**15**
a) Miles designated as open	2	1	1	1
b) Miles designated as closed	14	14	14	14
Wolf Creek Subwatershed				
Total Miles of Road	**106**	**103**	**103**	**103**
a) Miles designated as open	54	52	46	46
b) Miles designated as closed	52	51	57	57
Total Miles of Roads in RHCAs	**29**	**27**	**27**	**27**
c) Miles designated as open	17	17	16	16
d) Miles designated as closed	12	9	11	11

Cumulative Effects

Transportation System/Travel Management

The geographic boundary for consideration of cumulative effects on the transportation system can be considered to be larger than the defined boundary of the Wolf project area. Implementation of the Ochoco National Forest Travel Management Plan, in particular the designation of numerous routes as being closed to motorized vehicles by prohibition, results in a reduction of road mileage on which motor vehicles can operate, such that the effective cumulative effects area expands to a size that could be driven in a day by hunters and other recreational forest users. The defined boundary for cumulative effects analysis of the Transportation System can be roughly described as being bounded by Forest Service Roads 12, 38, 42, 4250, 5810 and 5820, along with the southern Forest Boundary of central Paulina Ranger District.

The combination of route designations through implementation of the Travel Management Plan and proposed road closure and decommissioning activities in the action alternatives would result in reduction in the number of road miles open to motorized vehicles. During certain time periods, in particular various hunting seasons, this would result to some degree of increase in traffic by both highway-legal vehicles and off-highway vehicles (OHV's) on the remaining tertiary portions of the road system that would remain designated open and available for use. This would result in a potential need for increased maintenance on those roads. With implementation of the Forest Travel Management plan and any particular action alternative, those remaining open roads would be the sole means of vehicular access to the further reaches of the National Forest Land within and adjacent to the analysis area.

Temporary Roads

Some of the primary effects of note accruing from the construction, use, and remediation/decommissioning of temporary roads are related to surface and groundwater hydrology and sediment production; because of this, the effects boundaries for analysis of the cumulative effects of temporary roads are the subwatershed boundaries that define the hydrologic system and the analysis area. The relatively moderate topography within the two subwatersheds that make up the analysis area has led to a tradition of employing ground-based yarding systems to remove logs to landings. Temporary roads have customarily been constructed to provide access to those landings that were within the interior of units or otherwise not immediately adjacent to existing portions of the transportation system. Older temporary roads that had not revegetated were added to the transportation system in the late 1970's in response to a directive that all existing wheeltracks be inventoried. With the advent of the requirement in 1976's National Forest Management Act that temporary roads be revegetated within 10 years, more attention has been paid to improving circumstances for revegetation on compacted temporary road surfaces, and within the last decade they have been aggressively treated by decompaction with tractor-mounted winged subsoiling tools.

Under Alternative 1, there would be no treatments within the analysis area and no temporary roads would be built. Previously constructed temporary roads that were not treated by subsoiling and have not naturally recovered would continue to provide some effect to vegetative productivity, surface/groundwater hydrology, and sediment production; although the moderate ground slopes and the nature of the surrounding soil types would localize these effects. Such effects would be slowly diminishing as these compacted roadbeds slowly de-compact.

Under Alternatives 2, 3, and 4 there would be, over time, a baseline of untreated temporary roads having been constructed within the Wolf project area as individual units were harvested by various timber sales with a certain degree of erosion potential and reduced vegetative productivity. As temporary roads receive post haul de-compaction treatments, erosion potential would decline.

The productive capability would increase over time subsequent to de-compacting as subsidence returned the soil profile to a more natural ratio of macroporosity and microporosity.

Geology and Soils

This section summarizes the Geology and Soils specialists' reports; the entire reports are located in the Wolf project file in Prineville, Oregon.

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.

Forest soils are considered to be a non-renewable resource, as measured by human life spans, and 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.

Target Landscape Condition

The primary goal for managing the soil resource is to maintain or enhance soil conditions at acceptable levels without impairment of the productivity of the land. The extent of detrimental soil disturbances is minimized through the application of project design criteria, management requirements and mitigation measures designed to minimize, avoid or eliminate potentially significant effects, or rectifying effects in site-specific areas by restoring the affected environment. The land effectively takes in and distributes water, and erosion rates are controlled to near-natural levels. The biological productivity of soils is ensured by management prescriptions that retain adequate supplies of surface organic matter and coarse woody debris without compromising fuel management objectives.

Management Direction

Ochoco Forest Plan

The Ochoco Forest Plan provides forest-wide standards and guidelines for the soil resource on pages 4-195 through 4-198. The following text comes directly from the Forest Plan.

Soil Compaction and Displacement

The threshold level of detrimental compaction is defined as any bulk density increase of 15% (20% on ash soils per the R6 supplement; see below) or more, or any macro pore space reduction of 40% or below 15%. These values are critical changes over the natural state in the top 12 inches of soil.

In order to maintain site productivity, all project activities will be planned to reduce soil compaction and displacement to the lowest reasonable level. Strive to reduce compaction and displacement to get as close to 90 percent of the total activity area (including permanent, rocked, and non-surface roads) remaining in a non-compacted/non-displaced condition, as realistically possible, one year after any land management activity. The minimum will be 80 percent of the total activity area. Existing areas exceeding these standards will be scheduled for rehabilitation as soon as possible.

Surface Soil Erosion

Land management activities will be planned to achieve effective ground cover as indicated in Table 76.

Table 75. Erosion hazard class and effective ground cover.

Erosion Hazard Class	Minimum % effective ground cover, first year	Minimum % effective ground cover, second year
Low	20-30	30-40
Moderate	30-40	40-50
Severe	50-60	60-75
Very Severe	60-75	75-90

Effective ground cover is defined as the basal area of perennial vegetation, plus litter and coarse fragments (greater than 2mm sizes), including tree crowns and shrubs that are in direct contact with the ground. Exceptions may occur where specific projects meet erosion control objectives without meeting the ground cover objectives stated above.

Soil Mass Wasting

When a project could result in an increased potential for mass wasting, which could cause significant soil loss or sedimentation, hazards to property, loss of fish habitat, or damage to other resource values, alternative project proposals will be evaluated and documented through the project's environmental analysis.

Fragile Areas

Recognize the sensitivity and potential of certain areas and/or situations to be adversely affected by management activities and plan accordingly to minimize those effects. Fragile areas include scablands (shallow soil areas), elk wallows, and other isolated soil areas which exhibit sensitivities that require special care.

Forest Service Region 6 Supplement

Guidelines (FSM 2500, R-6 supplement 2500-98-1) describe conditions detrimental to soil productivity and outlines Soil Quality Standards to limit the extent of these conditions to less than 20% of an activity area. Detrimental soil conditions are described in the Soil Quality Standards as follows:

- Detrimental soil compaction in volcanic ash/pumice soils is an increase in soil bulk density of 20 percent or greater over the undisturbed level.
- Detrimental puddling occurs when the depth of ruts or imprints is six inches or greater.
- Detrimental displacement is the removal of more than 50 percent of the A horizon from an area greater than 100 (10' x 10') square feet and at least 5 feet in width.
- Detrimental burn damage requires significant color change of the mineral soil surface in an area greater than 100 (10' x 10') square feet to an oxidized reddish color, with the next one-half inch below blackened from organic matter charring as a result of heat conducted from the fire.
- Detrimental erosion requires visual evidence of surface loss over an area greater than 100 (10' x 10') square feet, rills or gullies, and/or water quality degradation from sediment or nutrient enrichment.

The Forest Service Region 6 Supplement also includes policy direction for designing and implementing management practices which maintain or improve soil and water quality. An emphasis is placed on protection over restoration. Specifically, under 2520.3 – Policy, the narrative reads:

"When initiating new activities:

- Design new activities that do not exceed detrimental soil conditions on more than 20 percent of an activity area (this includes the permanent transportation system).
- In areas where less than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 20 percent.
- In 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 toward a net improvement in soil quality."

Affected Environment

Lower Beaver watershed is within the Columbia Basin ecological region, Blue Mountain Physiographic Province. More specifically, the watershed is in the low elevation Scab Stringer (85%) and South Slope Ochoco (15%) Level 4 eco-regions for the Ochoco National Forest; it is characterized by less effective moisture, less ash depth overall and dissected montane terrain. Annual precipitation ranges from 15 to 33 inches per year. Elevation ranges from 2,920 feet to 5,840 feet. The soils report will further discuss the Scab Stringer and South Slope concerns.

The Wolf project area is primarily underlain by Picture Gorge Basalt (Swanson, 1969 and Walker & MacLeod, 1991) with minor amounts of Quaternary Alluvium, Quaternary and Tertiary Basalts, Tertiary Rattlesnake Tuff, and Tertiary Sedimentary. Landslides played a major role in the shaping of the watershed, creating small areas of hummocky terrain, seeps, ponds and springs throughout the planning area. Present day erosion processes are primarily channel, sheet and rill with minor mass wasting in the form of landslides, rock topple and slope creep. The watershed is a recharge collection area for regional and local groundwater aquifers.

Physical Environment

The Wolf project area is located on the western corner of the Blue Mountains physiographic province, which also includes the Wallowa, Elkhorn and Strawberry Mountains. The shaping of the landform in the subwatersheds is a reflection of the past geologic history of the area. The tectonic movement, combined with the uplift of the Blue Mountain anticline and mass wasting processes have created the dissected ridges and steep draws. Mass wasting, sheet and rill are some of the physical processes currently in action.

During the last 60 million years before present (Ma), the central Oregon area has been the scene of major episodes of volcanic activity interspersed by periods of sedimentation (Walker, 1990). According to Walker, the area was under compression for the majority of the Mesozoic to early Cenozoic eras (250 to 50 Ma), slowly raising the land elevation, building mountains. A northeast trending structural uplift began forming the base of the Ochoco, Elkhorn and Wallowa mountains. This compressional trend continued, forming the Blue Mountain anticline (uplift) around 35 million years ago. Extensional tectonism with local compression occurred from mid-Miocene (15 Ma) to the present, deforming and fracturing the brittle young tuffs and basalts.

Lithology

The Lower Beaver watershed sub-watershed is underlain by five distinct geologic formations (see Table 77).

Table 76. Lithology (acres) in the Wolf project area.

Sub-watershed	**Lithology (acres)**					**Total Acres**
	Quaternary Alluvium (Qal) (Weak)	**Quaternary and Tertiary Basalts (QTb) (Resistant)**	**Tertiary Picture Gorge Basalt (Tcp),(Resistant)**	**Tertiary Rattlesnake Tuff (Tat) (Intermediate)**	**Tertiary Sedimentary (Ts) (Intermediate)**	
Drift Canyon-Beaver Creek (18 acres)		18 (100%)				18 acres
N. Wolf Creek (8,830 acres)			8,692 (98%)	138 (2%)		8830 acres
Wolf Creek (15,659 acres)	92 (0.6%)		14,590 (93%)	284 (2%)	693 (4%)	15659 acres
Total	**92 (0.4%)**	**18 (0.1%)**	**23,282 (95%)**	**422 (1.7%)**	**693 (2.8%)**	**24507 acres**

The oldest lithology, the Tertiary basalts (Tcp), underlies the majority of the analysis area. This unit, underlying 95 percent of the subwatersheds, is resistant to mechanical and chemical weathering processes.

The Picture Gorge Basalt (Tcp) (Walker and MacLeod, 1991) (Brown and Thayer, 1966 and Swanson, 1969) was deposited between 15 to 16.4 Ma (Million Years). The unit underlies the majority of Wolf Creek subwatershed and most of the North Fork Wolf Creek subwatershed. The formation consists of olivine-bearing basalt flows with thin ashy sedimentary beds between the lower flows. The thin sedimentary beds between the flows often allow subsurface groundwater flow to express on the surface as springs and seeps.

They often are reflected by 'stringers' of timber and shrubs running parallel to the contours, scribing the contact between the lava flows.

The slightly younger units (Ts and Tat) (table 77) of intermediate susceptibility to mechanical and chemical weathering processes underlie 4.5 percent of the 3 watersheds. Direct deposition and reworking of the tuffs by wind, streams and sheet wash formed the volcano-clastic rocks (Swanson, 1969 and Walker, Peterson and Greene, 1967). These units underlie the southern edge of the analysis area.

Tuffaceous sedimentary rocks and tuff (Ts) (Pliocene and Miocene) of the Deschutes Formation consist of semiconsolidated to well-consolidated mostly fluviatile tuffaceous sandstone, siltstone, mudstone, concretionary claystone, conglomerate, pumicite, air-fall and water-deposited vitric ash, palagonitic tuff and tuff breccia (Walker, Peterson and Greene, 1967). It underlies the southern end of Wolf Creek subwatershed (2.8%).

The welded tuff of the Rattlesnake Formation (Tat), a silicic ash-flow tuff of lower Pliocene and upper Miocene age (6 Ma) (Greene, Walker and Corcoran, 1972), underlies the southwestern edge of North Fork Wolf Creek subwatershed and the southeast edge of Wolf Creek subwatershed. This formation underlies 1.7 percent of the watershed and is composed of ash-flow tuff and associated pumiceous air-fall tuff of mostly rhyolitic and rhyodacitic composition (see table 77). It ranges in thickness from 50 to 200 feet. The unit also includes minor tuffaceous sedimentary rocks. From field observation, the welded tuffs tend to exhibit large joint fractures within the flows, generating 5 to 6 foot diameter boulders. The flows have a high percentage of pumice fragments which may retain more moisture than the dense basalts, providing additional moisture for roots.

The high percentage of pumice fragments within the tuff may act as a groundwater reservoir, providing a source of moisture for the vegetation in an otherwise low precipitation zone. The crystalline formation tends to show an intermediate resistance to chemical and mechanical weathering processes.

The Quaternary basalts, andesites and vent rocks (QTb) underlie less than 0.1 percent of the analysis area, in the Drift Canyon-Beaver Creek subwatershed and is resistant to mechanical and chemical weathering processes. Thin flows and minor flow breccia of open-textured (diktytaxitic) olivine basalt (QTb) (Pleistocene and Pliocene) underlie the southwest corner of the analysis area (see table 77) (Walker and MacLeod, 1991). The unit may contain thin interbeds of sedimentary rocks. The crystalline flows tend to show a resistance to mechanical and chemical weathering processes.

Quaternary alluvium (Qal), the youngest lithology (20,000 years to Present), underlies 0.4 percent of the analysis area (see table 77) (Brown and Thayer, 1966 and Swanson, 1969). It is composed of sand, gravel, and silt forming flood plains and filling channels of present streams (Walker and MacLeod, 1991). In places this includes talus and slope wash. The unit is primarily along Wolf Creek, forming the valley bottom. The clastic unit tends to be highly susceptible to chemical and mechanical weathering processes.

Ninety-five (95.1) percent of the underlying formations within the analysis area are predominantly resistant to chemical and mechanical weathering processes, 4.5% has an intermediate susceptibility to chemical and mechanical weathering processes and 0.4 percent are highly susceptible to mechanical and chemical weathering processes.

Capping the erosion surfaces of the Ochoco Mountains is the Mt. Mazama ash fall. The ash fall occurred roughly 6,900 years ago. The axis of the ash fall lies from Crater Lake (Mt. Mazama) to Lewiston, Idaho (Walker and MacLeod, 1991). The Ochoco Mountains received 1 1/2 feet of fine volcanic ash. Through time and weathering processes the ash has moved to the draws on the leeward slopes. The ash-laden soils have a tendency toward developing debris flows and torrents on slopes greater than 30 percent where the shallow saturated soils slide on the underlying lithologies. The ash is weathering to clay. The soil, which has formed on all the formations, combined with the ash, provides the majority of the natural stream sediment due to processes like sheet and rill erosion. The ash, primarily from Mt. Mazama, has collected in the draws, increasing the fertility of the drainages, allowing development of the tree/shrub component of the vegetation in an otherwise thin soil bedrock dominated terrain.

Landscape and Soil Patterns

The landtype is the basic unit of landscape stratification. It delineates and identifies naturally occurring bodies on the landscape consisting of unique characteristic features such as: soil mantle, bedrock, vegetation, climate, hydrology and landform which are significant to management use and interpretations (Paulson, 1977, et al).

The major landtypes are the P (75%) and Y (21%) landtypes. Additional minor landtypes are the X (4%) and A (0.7%) landtypes. An acreage summary by major landtype is provided below:

Table 77. Acreage by landtype group with acreage and percent of NFS land.

Landtype Group	Acreage	Percent of Watershed	Parent Material
P Landtypes	18,230	75	Picture Gorge Basalts and Andesites
Y Landtypes	5115	21	Colluvial Basalts
X Landtypes	942	4	Tertiary Basalts
A Landtypes	180	0.7	Alluvium-meadows

Existing Condition

The existing condition of soils in the Wolf project area was determined by the Forest soil scientist and other members of the interdisciplinary team. A combination of local knowledge, walk-through transecting, and aerial photo interpretations was used to determine existing soil disturbance classes for each proposed harvest unit. The regional standards and guidelines in relation to these proposed activities apply at the individual unit level. Existing disturbance was quantified to the nearest ten percent bracket (0-10, 10-20, etc.), estimates were made as to tillage potential, and unit specific mitigations identified where needed to ensure compliance with the soil standards.

Livestock: Grazing produced severe impacts to effective ground cover, bank stability, infiltration resulting in high levels of sheet/rill erosion and channel erosion. As documented by Buckley (1992), most of the impacts occurred in the 20 to 30 years before 1900. The main stems of streams such as Wolf and North Wolf Creeks have been impacted also. Formerly hydric soils have been drained and the drainage has been channelized. Large amounts of sediment have moved from these areas. Current conditions have improved in many areas in the past 25 years with additional wood placement, some limited beaver recovery, reduced grazing pressure, stream structural improvements and natural recovery.

Table 79 summarizes the effects of current livestock management on soils in and around the Wolf project area. See the section titled “Range” in Chapter 3 of this document for summaries of actually allotment/pasture acreage that falls within the Wolf project area. All allotments and pastures identified in Table 79 meet Forest and Regional Standards and Guides for detrimental soil conditions with the average contribution due to grazing and grazing improvements ranging from 0.5 to 1.0 percent.

Table 78. Summary of livestock grazing effects as they related to current soil condition in the Wolf project area.

Allotment/Pasture	**Acres Grazed**	**Class 1-4 Stream mils/ac Grazed-10% detrimental**	**Structures with acres**	**Fence Miles/Ac**	**Salting/Mineral supplement sites; stock driveways**	**Logging and Roading Impacts Acres (Rds are 2% of acres on average)**	**Total acres/% of detrimental soil conditions by allmt**
Wolf Allmt	Total = 42,092 ac	Total= 157.6 mi= 381 ac, 10% = 38 ac	12 springs 16 st. ponds = 28 acres	46.5 mi x 1.2 ac/mi= 56 ac	40 sites = .092 ac.	2116 ac	2238 ac = 5.5 % Meets S/Gs
Sugar Pasture	6505	2.7mi=0.65 ac det.	4 ponds = 4 acres	12	6 sites = 0.012 ac	356	Meets S/Gs
Miles Pasture	2445	2.89mi= 0.7 ac det.	5 ponds = 5 ac	9	3 sites = 0.007 ac	152	Meets S/Gs
Riparian Pasture	3606	2.8mi= 0.68 ac det,	3 ponds = 3 ac 3 spgs = 3 ac	9	4 sites = 0.009 ac	198	Meets S/Gs
Bull Pasture	5980	0	2 spgs = 2 ac	14	6 sites = 0.014 ac	329	Meets S/Gs
Nichol Pasture	12935	4.9mi= 1.2 ac det	6 ponds= 6 ac 5 spgs = 5 ac	19	13 sites= 0.03 ac	729	Meets S/Gs
Widow Pasture	8697	6.3mi = 1.5 ac det	1 pond = 1 ac 2 spgs = 2 ac	15	9 sites = 0.021 ac	478	Meets S/Gs
Airstrip Pasture	27	0	1 pond ?	0.5	1 site = 0.0023 ac	1.5	Meets S/Gs
Wolf Creek Rip. Corridor	1436	0 ?	0 creek	11	2 sites= 0.005 ac	79	Meets S/Gs

Assumptions:

Structures: ponds, springs and troughs = approximately 1 acre per site.

Fences: = approximately 1.2 acre/ mile (both vehicle and cattle trailing impacts)

Stream Miles/Acres grazed: Assume a 20 foot (2.42 acres/mile) influence zone with 10 percent of the acres in a detrimental soil condition = (0.10 x 2.42 ac/mi= 0.242 ac/mile average).

Salting and Supplementing: assume 100 sq. ft (= 0.0023 acres) per salt site with approx. 2 to 10 sites per pasture, depending on size.

Stock Driveways: simply a cleared unimproved path for cattle and riders to expedite cattle movement- cleared to 6 feet wide, would comprise 0.727 acres per mile of driveway.

Logging Activities including fuels treatment: In the Wolf project area, it is estimated that 5,039 acres of forest have been commercially harvested since 1986; another 9,572 acres are estimated to have been harvested from the 1950s to 1986. Given this assumption, it is estimated that 10 to 35% of the tractor harvested acres (depending on the type of treatment) or approximately 2,109 acres have been detrimentally compacted and/or displaced (see table 80). These 2,109 acres comprise 8 percent of the total FS project area acreage of 24,406 acres. The project area is at the 8 percent compaction level which is near the 10% level which may produce significant changes in runoff and timing of peak flows.

In this project area there is a mixture of ash capped soils and clay soils. The deeper ash soils are found largely on north and east exposures (i.e. P1, P12, P2, P9 and Y2 landtypes). The south and west exposures have less ash and are much shallower to the smectitic high shrink swell subsoils. Compaction is less of a problem here due to the clay but displacement of the ashy surface soil can still be a concern. No reduction in the estimate for existing damage was made, although it is predicted that some of the older compaction (from the 1950's and 1960's) on thinner soils has naturally recovered through the freeze/thaw process and natural biopedoturbation via soil organisms such as nematodes, mites, worms, insects and rodents.

Table 79. Summary of the effects of past vegetation management on current soil condition in the Wolf project area.

Approximate Timeframe of Activity	Management Prescription	Acres and Logging System	Detrimental disturbance Estimates
1986 - Present	HCC/HSH, HCR, HSD	200 ac. /tractor	35%= 70 ac
	HOR, HFR	2,550 ac./ tractor	25% = 639 ac
	HSL/HPR, HIM, HTH	1,011 ac./ tractor	15% = 152 ac
Between 1950s and 1986	Salvage and Selective Cutting	9,572	10% = 957 ac
	Private land	640 ac.	20% =128 ac.
	Juniper/Non Forest	8,172 ac.	2%=163 ac.
			Grand Total= 2,109=8%

Harvest Types:
HCC =Harvest Clear Cut
HCR = Harvest Clear Cut with Reserve
HFR = Harvest Final Overstory Removal
HOR = Harvest Overstory Removal
HPR = Harvest
HSD = Harvest Seed Tree Leave
HSH = Harvest Shelter Wood
HSL = Harvest Selection Harvest
HTH =Harvest Thin from Below

Roading Impacts: total road mileage is 216 miles. Road acreage (1.82 acres/mile for average. 15 ft.
Environmental Effects

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. For analysis of the soil resource, an activity area is defined as "the total area of ground impacted activity, and is a feasible unit for sampling and evaluating" (FSM 2520). The Ochoco Forest Plan reiterates this definition on page 4-196: "An activity area is the total area for which a ground-impacting activity is planned, for example, a unit for a timber sale, slash disposal project, or grazing allotment. The area would also include transportation systems within and directly adjacent to the project."

For this project proposal, activity area boundaries are considered to be the smallest identified area where the potential effects and soil quality standards will be focused on the units proposed for silvicultural and fuel reduction treatments.

Quantitative analyses and professional judgment were used to evaluate the proposed alternatives by comparing existing conditions to the anticipated conditions that would result from implementing the proposed actions. 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) that are designed to avoid, minimize or reduce potentially adverse impacts to soil productivity.

Effects of Proposed Activities

Commercial Thinning, Group Selection and Sanitation Harvest via Ground-Based (Tractor) Harvest

Proposed harvest activities have a moderate amount of soil impacts associated with them and can result in exceeding the soil standards if not carefully designed and actively monitored.

Classic, rubber-tired skidders and skidding crawler-type tractors are used on an average 100 foot skid trail spacing to skid logs to the landings, which are accessed by roads. The main skid trails comprise the majority of the detrimental disturbance, which is largely compaction and displacement. The same applies to landings with the addition of more soil puddling and charring from burning landing piles. Skid trails on an average of 100-foot spacing contribute roughly 10-15 percent disturbance in an average unit with landings and roads making up an additional 5 and 2 percent, respectively. For instance, if the disturbance for the current entry is confined to existing skid trails, landings and roads then there would be no net increase in detrimental soil conditions.

Past harvest practices have often led to some degree of soil damage. Current individual unit design criteria are helping to keep the overall percentage of net detrimental impacts to a minimum. The use of equipment such as the Timbco tracked feller buncher with an approximate 22-foot reach will help to further reduce impacts. These are some of the least impacting harvest machines for the proposed harvest treatments. Wider tracks on these machines would help even more. When the number of passes is kept to no more than two, then detrimental conditions are less likely to result from an entry (on previously undisturbed ground). In several studies of mechanized equipment, one pass did not appear to significantly change bulk density in the soils (Froese, 2004; Han 2005). Subsequent passes of the skidding or forwarding equipment did increase bulk densities, but compaction was limited to the percent of the area in major trails or just in the ruts of well-defined forwarder trails (in USDA, RMRS, 2007).

Local monitoring results show that detrimental soil conditions can be kept within acceptable levels using ground-based equipment (Timbco tracked feller bunchers). This requires that design criteria be carefully followed and that tillage opportunities are carefully evaluated.

Forwarder / Harvester machines such as the older Valmet models 546H and 646F have been used on the ONF and monitored as to disturbance levels. Boom reaches on the harvesters and forwarders ranges from 23 to 31 feet. Local monitoring has shown the following:

1. Data illustrate the cumulative impacts with ground based harvest machinery. Multiple entries coupled with the need to cover more ground to harvest smaller material can result in impacts exceeding local and regional guidelines. This situation has been worsened by fire exclusion with subsequent higher numbers of stems per acre.

2. Skid trail spacing and slash cover on skid trails. These data illustrate two things: The skid trail spacing needed for thinning from below is less than standard specifications of 100 to 120 feet which has the potential to result in more ground in a detrimentally compacted state. However, the single or double pass traffic by the harvester is not impacting enough to be classified as detrimental compaction. The detrimental displacement percentage is lower, however, than standard crawler tractor or rubber tired skidder operations.

The commonly held perception that forwarder/ processors can successfully mitigate compaction by running over slash placed in front of them is not accurate for this forest (Ochoco National Forest) under these types of treatments. As the above slash cover figures illustrate, there was not enough slash cover to provide much overall mitigation. To further compound the problem, the slash in these units was largely from small trees often with many smaller dead branches. This factor further reduces any possible mitigative effect. The forwarder tracks were almost exclusively in the high category (detrimental) level of compaction even in the presence of this largely light, small slash cover. (David, J.; 1998)

Harvest Timing: Winter logging discussion

Winter Logging Specifications: Logging over various combinations of frozen ground and snow must meet one of the below criteria: 6 inches of frozen ground, 4 inches of frozen ground and one foot of snow or more than 24 inches of snow. These specifications have helped reduce impacts to soils, cultural heritage resources and sensitive plant populations. However, they are not a panacea. Effectiveness can vary considerably according to snow texture for instance. Conditions vary from winter to winter and can even vary from morning to afternoon. Regular presence of harvest inspectors is critical.

In the winter of 2011 and 2012, the Ochoco Forest Soil Scientist and Kathy Schrage, Timber Sale Administrator, monitored winter logging units in the Slide and Willow Pine timber sale. Regional guidelines for soil distrurbance were being met by logging over frozen ground and snow.

Roading

Temporary roads are specified to be tilled via brush blades and waterbarred in the timber sale contract. If tillage is not possible or feasible then slash or large woody debris is specified to be used. Seeding may be used depending on availability of seed, slope and adjacency to stream courses. Soils effects of temporary roads will be detrimental compaction and displacement. The specified tillage will help decompact these areas and help encourage effective ground cover via vegetation establishment.

Non-harvest Treatments

Noncommercial thinning (PCT) activities would be occurring both inside and outside of areas that are also being commercially harvested. See differences between Proposed Action, Alternative 3 and Alternative 4. The hardwood enhancement is primarily focused at removing encroaching conifers from aspen stands, but also includes fencing. These activities are conducted with hand tools and do not involve the use of heavy equipment.

No measureable detrimental effects to the soil resource are expected from noncommercial thinning or hardwood enhancement. Soil disturbance that may occur is limited in scale, and of such a light intensity, that no detrimental compaction or displacement is expected.

Fuels Treatments

These include a mixture of harvest fuels treatment, pre-commercial thinning fuels treatment, and prescribed burning of natural fuels.

Underburning (RXF) includes both underburning of natural fuels as well as disposal of harvest or noncommercial thinning generated slash. It is the least impacting fuels treatment on the soils resource. Burn severities are minimized due to the largely dispersed impacts of the burn itself. These types of burns most closely emulate natural processes as to nutrient volatilization and nutrient dispersal. Very little, if any, detrimental soil impacts are expected with this treatment. Predicted fire treatment severities are low to mixed (see section titled "Fire and Fuels" in Chapter 3 of this document).

Hand Piling (HP) results in small concentrations of fuels dispersed across an area. The soil may be detrimentally charred immediately under a pile, depending on burning conditions, slash size, and overall pile size. For the Wolf project, only small (<12") diameter material would be piled, and the piles would be small in size (< 100 square feet). These factors, combined with burning under cooler conditions, result in less intense/shorter residence fires and such a small area of soil charring that the disturbance is not considered detrimental. Since only piles are burned, soil impacts are not continuous.

Yard Tops Attached (YTA): treatment of slash differs from others in that it concentrates more slash at each landing; this help reduce overall fuel loadings throughout a particular harvest unit. The larger fuel concentrations require larger landings however. The larger piles also burn hotter and produce more charred soil at the landing site. Since the landings are situated most often on old landings, from prior entries and on existing disturbed areas, this impact does not usually result in a large net increase in detrimental soil conditions. For tractor harvested units, yard top attached skid trails are somewhat wider due to the sweeping action of the branches which results in more displacement of the surface organic matter.

Whole Tree Yarding (WTY): Landing size is increased with whole tree yarding, even more so than yard tops attached. Instead of the majority of slash being left on site, the majority of the needles and branches on harvested trees are taken to the landing. With the larger volumes of slash at the landings there is also an increased need for piling (piling with the log loaders) and/or tractor piling with tractors/skidders. Piling at the landings is less disturbing with the log loaders with long booms (over 30 foot boom length).

With the whole trees being drug along the skid trails there is some increase in detrimental displacement of topsoil on the edges of the skid trails due to additional tree length (versus log removal only) and additional width (the full width of the crown is being dragged). The most significant impact is the sweeping action of the crowns being dragged and the resultant lack of roughness in the trails themselves (few branches left to protect surface of trail). On ash capped soils with heavy clay subsoils (such as occurs on much of the Wolf project area), the clay is left exposed and puddled. This has the potential to direct runoff at an accelerated rate. The required waterbarring would help prevent this from being a major impact. Leave tops attached (LTA) would potentially allow for more branches and subsequent effective ground cover throughout the trail system.

Thin with Fire (TWF): Prescribed natural fire can produce high intensity fires depending on fuel loading and distribution. If burned under drier conditions, especially with high slash loadings, this type of treatment may be similar to stand replacement types of fire intensities. Hydrophobic soil conditions can result from the cooked waxes and resins in the surface ash layer. Detrimental soils disturbance can range up to five percent of an area. The fuels loadings for the Wolf project are such that less than 5 percent damage is projected. Prescriptions would be tailored to further reduce intensities so that detrimental effects are minimized.

Jackpot burning (JKP) and Leave Tops Jackpot burning (LTJP) may or may not be any different than broadcast burning (TWF) depending on fuel loadings and distribution. Through jackpotting the heavier concentrations are burned as the primary focus and if burned under wetter conditions can be less impacting than broadcast burning.

Restoration of Aspen and other Hardwood Communities

Alternative 2 proposes 75.5 acres and Alternatives 3 and 4 propose 90.2 and 92.3 acres respectively. This activity is prescribed to reduce conifer competition in hardwood stands (aspen, cottonwood, alder, and various willow species) by cutting down and/or girdling conifers that have encroached into these areas. In general, conifers up to 15 inches dbh would be cut. Most, if not all, conifers within 75 feet of a hardwood would be cut down and left in place, or girdled and left standing.

Slash generated from these activities would be lopped or hand piled; the slash would treated by underburning and prescribed fire.

When hardwoods are encountered within commercial harvest or noncommercial thinning units the prescription would be modified to favor hardwoods as described above.

Effects to soils: Effective ground cover would be increased through more basal cover in hardwoods. The lopped slash would also help maintain cover levels. Since these areas are often along streambanks, there would be more protection along banks which would reduce erosion. These treatments would comply with the soils standards.

Juniper Thinning

For Alternative 2, 3, and 4, his treatment is proposed on 481 acres within the juniper woodland/steppe plant associations and the dry pine, moist pine and dry Douglas fir plant association groups (PAGs) to reduce juniper density. Junipers up to 20.9 inches dbh would be cut using chain saws and the slash lopped into smaller pieces. Juniper cutting would be followed by burning of slash concentrations. Effects of treatment on the juniper woodland and steppe plant associations have not been incorporated into the Viable Ecosystem analysis as this model was developed to predict changes on more productive sites. The effect however would be to increase the abundance of the grass/forb/shrub stage which is currently deficient while retaining existing large juniper tree structure. Mountain mahogany would be emphasized in the uplands through reduction of juniper competition.

Effects to soils: Effective ground cover is often increased by approximately 10 percent when the juniper canopy is reduced. Grass and brush cover increase in the absence of juniper competition. Increased effective ground cover would help reduce potential sheet and rill erosion. Juniper thinning in conifer stands would reduce competition for water and light. These treatments would comply with the soils standards.

Silvicultural Treatments in RHCAs

Effects to soils would be minimal (as compared to more intensive tree removals) under dry soil or frozen/snow covered conditions. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs. Site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be protected. Bank stability would be maintained and the slash would help increase floodplain hydraulic roughness and effective ground cover. Bank stability trees would be left intact. Ground disturbance activities in the RHCAs have a higher potential to create delivered sediment. Project design features such as leaving and/or back hauling slash on to skid trails, installation of water bars and re-using old skid trails and roads would help to reduce potential delivered sediment. The removal of 10 percent of the conifer cover is roughly equivalent to the old salvage logging treatments where high risk trees were removed resulting an approximate 10 percent detrimental soil disturbance level due mainly to skid trails.

Stream Restoration Activities on Wolf and North Wolf Creek

Up to 10 percent additional disturbance would be realized in the proposed treatment reaches. This would consist of equipment tracks, two track routes for rock and wood delivery, channel excavation for stream realignment and construction of the stream structures themselves. Seeding and planting would occur after project completion. Short term (1 to 5 year) increases in sediment may be evident, but in the long term (6 to 25 years) total sediment production potential would be decreased due to lessened entrenchment and reconnection to the floodplain. Water tables would be raised such that more productive vegetation such as sedges and hardwoods can further colonize the sites.

Alternative 1

This alternative proposes no management actions which would affect the soil resource in the short term. Existing natural processes would continue. No soil restoration tillage would be performed. Recovery of existing soil (compaction) would occur through natural processes. These processes include frost heaving in the top 4 to 6 inches of soil and biopedoturbation. These natural processes can take 10 to 50 years or more to fully restore damaged ash soils, while clayey residual soils may recover in 1-2 years due to shrinking and swelling actions. Fuels reductions would not occur thereby increasing the risk of increased oxidation and mineralization of nutrients such as nitrogen and potassium. This may result in increased fire intensity and severity which can reduce site productivity (Harvey et al. 1991). No road decommissioning would occur. This alternative would comply with the regional soil standards in the short term but may exceed regional standards and guidelines in the long term if stands are not thinned and large tonnage is produced, burned by wildfire and then re-burned (Shank 2004).

Alternative 2

This alternative proposes 4,706 acres of commercial thinning harvest. This alternative also proposes 481 acres of juniper thinning (JUT) and 988 acres of noncommercial thinning (PCT) to be accomplished with hand felling via chainsaws. Hand piling of activity slash would occur on 126 acres. Underburning only treatment would occur on 5,000 acres. Harvest in RHCAs would consist of 589 acres of commercial thinning (HTH); (see unit-specific project design criteria in Aquatics Report). Noncommercial thinning would occur on 253 acres in RHCAs and underburning would occur on 1,122 acres in RHCAs.

This alternative proposes the second most harvest overall. This alternative has proposed the second greatest number of acres for management, and therefore a potential to increase the amount of detrimental soil compaction, displacement, and charring. This alternative also has unit specific project and practices identified which would ensure that all activity units meet the soil standards (see Appendix B). Temporary road construction on existing disturbance would entail approximately 1.8 miles (1.82 acres/mile, 15 feet wide) = 3.2 acres of road impacts. New temporary road construction would entail approximately 17.6 miles (1.82 acres/mile, 15 feet wide) = 32acres of road impacts. The total road disturbance proposed in this alternative is ca. 19.4 miles (35.3 acres). Implementation of this alternative would result in approximately 82 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 47 of the units listed in Appendix B.

One stream restoration location is proposed on Wolf Creek (1 mile). The restoration would consist of channel reconstruction and the building of grade control structures, side vanes, j-hooks, flood plain benches, debris jams and plug and fill operations. Some temporary vehicle access routes would be constructed to supply rock and wood to the structure sites. Disturbance would be approximately 10 percent of the floodplain. Project design features such measures such as waterbarring, seeding, planting of hardwoods and additions of wood on the floodplain would help reduce short term

sediment delivery potential. In the long term, sediment would be reduced due to reduction of near bank stream velocities and improved access to the floodplain.

Implementation of this alternative would comply with the regional soil standards.

Alternative 3

This alternative proposes 4,706 acres of commercial thinning harvest, of which, 384 acres would thin trees greater than 21 inch DBH. This alternative also proposes 5,000 acres of underburning (UB) only treatments and 988 acres of juniper thinning (JUT). Hardwood treatments would occur on 90.2 acres. Hand piling and burning would occur on 126 acres. RHCA treatments would consist of 589 acres of commercial thinning (HTH), 253 acres of noncommercial thinning (PCT) and 1,122 acres of underburn only treatment.

This alternative proposes the most harvest overall. Potential to increase the amount of detrimental soil compaction, displacement, and charring exists with this alternative. This alternative also has unit specific design features and practices identified which would ensure that all activity units meet the soil standards (see Appendix B). New temporary road construction on existing disturbance would entail approximately 1.8 miles (1.82 acres/mile, 15 feet wide) = 3.2 acres of road impacts. Temporary road construction on existing disturbance would entail approximately 17.6 miles (1.82 acres/mile, 15 feet wide) = 32acres of road impacts. The total road disturbance proposed in this alternative is ca. 19.4 miles (35.3 acres). Implementation of this alternative would result in approximately 82 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 48 of the units listed in Appendix B.

Two stream restoration locations are proposed (one on Wolf= 1 mile and one on North Wolf Creek= 1.2 miles) for a total of 2.2 miles and would consist of channel reconstruction and the building of grade control structures, side vanes, j-hooks, flood plain benches, debris jams and plug and fill operations. Some temporary vehicle access routes would be constructed to supply rock and wood to the structure sites. Disturbance would be approximately 10 percent of the floodplain. Project features and measures such as waterbarring, seeding, planting of hardwoods and additions of wood on the floodplain would help reduce short term sediment delivery potential. In the long term, sediment would be reduced due to reduction of nearbank stream velocities and improved access to the floodplain.

Implementation of this alternative would comply with the regional soil standards.

Alternative 4

This alternative proposes 3,394 acres of commercial thinning harvest. This alternative also proposes 1,177 acres of noncommercial thinning (PCT) and 481 acres of juniper thinning (JUT) to be accomplished with hand felling via chainsaws. Fuels treatments proposed are 5,853 acres of underburning (UB) only and 137 acres of hand piling (HP) Treatments in RHCAs would consist of 347 acres of noncommercial thinning (PCT) and 1,529 acres of underburning (UB) only treatments.

This alternative proposes the least harvest overall. Potential to increase the amount of detrimental soil compaction, displacement, and charring exists with this alternative. This alternative also has unit specific project design criteria and practices identified which would ensure that all activity units meet the soil standards (see Appendix B). New temporary road construction would entail approximately 1.6 miles (1.82 acres/mile, 15 feet wide) = 2.9 acres of road impacts. Temporary road construction on existing disturbance would entail approximately 14.1 miles (1.82 acres/mile, 15 feet wide) = 25.7 acres of road impacts. The total road disturbance proposed in this alternative is 15.7 miles (28.6 acres). Implementation of this alternative would result in approximately 75.5 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 39 of the units listed in Appendix B.

Two stream restoration projects are proposed; Wolf Creek (1 miles), and North Wolf Creek (1.2 miles). The effects would be the same for Alternatives 3 and 4.

Implementation of this alternative would comply with the regional soil standards.

Mass Wasting

Portions of headwaters of Wolf and North Wolf Creek drainages are underlain by dormant landslide terrain. When there is a change in the ground water flow through the unstable terrain, the potential is increased for slope movement. Rapid shallow debris flows and deeper rotational slides can result, altering the vegetation potential and possibly releasing sediment into the stream systems, depending on proximity to the riparian areas. Effects of the alternatives on the landslide terrain will be measured by:

- Acres of dormant landslide terrain and mapped landslide debris (Qls)
- Miles of road within dormant landslide terrain and mapped landslide debris (Qls)

Alternative 1

The No Action alternative would allow the dormant landslide terrain to continue the natural process of erosion under the current precipitation pattern.

Alternatives 2, 3 and 4

Direct Effects: For all the units in the action alternatives, primary concern from a mass wasting standpoint is for those units on dormant landslide terrain. Mapped landslide debris underlies 21 commercial units. Landslide terrain tends to develop unusual subsurface drainage patterns. The intensity and style of management activity on landslide terrain, in the vicinity of seeps and springs, could potentially change the drainage pattern, possibly increasing the risk for instability.

The proposed harvest thinning (HTH, HTH_21) does not generally alter groundwater movement measurably, except in the vicinity of seeps and springs. The treatment should not reduce the amount of water taken up by the trees through evapo-transpiration substantially. More aggressive prescriptions have been known to reduce the amount of evapo-transpiration which leaves more groundwater in the slope, which has the potential to increase instability.

The acres of dormant landslide terrain are denser in the northern 2/3rd's of the planning area. The affected area varies slightly based on the proposed managed acres for each alternative (see table 81).

Tractor logging systems tend to compact the soil, changing groundwater flow patterns, potentially altering slope stability. Alternative 4 proposes management of fewer acres in dormant landslide terrain with the tractor method than Alternatives 2 or 3.

Table 80. Dormant landslide terrain within proposed logging systems for each alternative (acres).

Logging System	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Tractor	496	496	434
Total Treated Acres within Dormant Landslide Terrain	496	496	434
Total Treated Commercial Acres	4706	4706	3394
Percent of Treated Acres in Dormant Landslide Terrain	11%	11%	13%

Those units located on the upper slopes of dormant landslide scarps have a slightly increased potential for reactivating the landslide debris on the lower slopes when combined with a higher precipitation or a rain on snow event like the forest experienced in 1997, due to the potential increase flow of groundwater to the lower slopes.

The dormant landslide terrain acres by unit are listed for each action alternative in Table 82. Through the design elements, the units identified would have seeps and springs buffered and any evidence of recent motion evaluated by the geologist. The tractor method used to harvest those units does have a tendency to compact the ground. The units, generally located on the upper slopes, may have a slightly increased risk for indirectly destabilizing the lower slopes if there should be a continued weather pattern of higher precipitation.

Table 81. Units with dormant landslide terrain by alternative.

Prescription	Harvest Method	Unit	Alternative 2 (PA)	Alternative 3	Alternative 4
	Tractor (ALL Units)		Dormant Landslide Terrain acres	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres
HTH_21					
		42	0	17.5	0
		43	0	3.2	0
HTH					
		22	11.3	11.3	0
		37	0.1	0.1	0.1
		42	17.5	0	15.5
		43	3.2	0	0
		44	3.9	3.9	3.9
		45	29.4	29.4	21
		60	64.8	64.8	64.8
		61	1	0	0
		66	27	27	25.2
		69	17	17	17
		70	44.2	44.2	0
		71	14.2	14.2	0
		73	10.7	10.7	10.6
		112	1	1	1
		113	7.8	7.8	7.8
		119	7.7	7.7	7.7
		120	1	1	1
		124	10	10	7.1
		127	4.8	4.8	4.8
		128	2	2	2
		355	0	0	1
Total Acres of Dormant Landslide Terrain			496	496	433

There are 12 units, based on steeper slopes and presence of landslide indicators that are more sensitive than others. The units on steeper slopes (greater than 25%), in common with all action alternatives are: Units 45, 60, 66, 70, 73, 113, 124, 127 and 128. Unit 71 is only in Alternative 2 and Alternative 3. If there is any evidence of recent slope movement, the geologist should be consulted.

Alternatives 2 and 3 propose roughly the same amount of tractor harvest method acres (see table 82), with the least acres in Alternative 4. The slight difference lies in the slope of the units, the prescription, method of harvest and total acres to be harvested. There are 1,097 acres of dormant landslide terrain within the planning unit boundary. Alternative 2 proposes to commercially treat 45 percent (496 acres), Alternative 3 proposes treatment of 45 percent (496 acres) and Alternative 4 proposes treatment of 39 percent (433 acres). Alternatives 2 and 3 propose treating slightly more acres of dormant landslide terrain, the actual acres at risk is less in Alternative 4, by 63 acres.

For all the units in all the subwatersheds:

If seeps or springs are found, an adequate buffer around the wet area to protect from additional compaction would be accomplished. With the design elements, the riparian corridors would be protected with vegetation left on the stream banks; the landslide debris should remain stable, reducing the risk for increasing sediment production. The riparian vegetation would maintain the stability of the landslide debris toeslopes. Protection of springs and seeps by providing a buffer is important. The additional compaction of ground surrounding wet areas could alter the subsurface water flow, increasing the risk for reactivation of landslide debris, depending on the steepness of the slope.

This is in compliance with the Regional Forester's Eastside Interim Management Direction, Forest Plan Amendment No. 2, Alternative 2, as adopted (USDA Forest Service, 1995a) for the interim riparian standard. Springs and landslide-prone area less than 1 acre would be protected by a slope distance of 50 feet (INFISH, 1995). Unstable terrain and springs greater than 1 acre will be protected by a buffer of 150 feet (INFISH, 1995). If there is any indication of recent landslide activity, the area would be evaluated by the geologist and the buffer may be increased.

Transportation System

There is a low to moderate for risk for reactivation of landslide terrain through road related activity for the proposed temporary road construction for the action alternatives (see table 83). Although Alternative 3 has the least percentage of road length on dormant landslide terrain, all three alternatives have the same length of road at risk.

Table 82. Proposed road miles on dormant landslide terrain for each alternative.

Operational Maintenance. Level	Wolf Roads on Dormant Landslide Terrain (miles)	Total miles	Percentage
Existing template	1.37	38	3.6
Level 1 - Closed	3.98	94.1	4.2
Level 2 - Open	1.27	56.3	2.3
Level 3 – Open, Suitable	0.05	3	1.7
Level 4 – Open, Moderate	0	7	0
Level 5 – Open, High	0	0.41	0
	6.66	199	3.4

Wildlife

This section summarizes the Wildlife specialists' report; information has been included almost verbatim, but some appendices were not included. The entire report and appendices are located in the Wolf project file, Prineville, Oregon. See Map 13 for key wildlife areas.

Regulatory Framework

Biological Evaluations (BE) provide a process to review all Forest Service planned, funded, executed or permitted programs and activities for possible effects on threatened, endangered, proposed or sensitive species (FSM 2672.4). BE's are intended to help ensure that Forest Service actions do not contribute to a loss of viability on any native or desired non-native plant or animal species, or contribute to trends toward Federal listing of any species. They provide a process and standard by which to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision-making process (FSM 2672.41).

The effects analysis in the BE is required to address any direct, indirect, and cumulative effects of an action on threatened or endangered species or their critical habitat (50 CFR 402.02) and on sensitive species or their habitat (FSM 2672.42). This BE also complies with Section 7 of the Endangered Species Act (ESA), which requires all Federal Agencies, in consultation with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), to insure that their actions are not likely to jeopardize the continued existence of threatened, endangered or proposed species or adversely modify their habitat. Management policy and direction for threatened, endangered, proposed, and sensitive species is also contained in Forest Service Manual 2670 and under Forest Plan standards and guidelines for threatened or endangered species.

Current management direction on desired conditions for threatened, endangered, proposed and sensitive species on the Ochoco National Forest can be found in the following documents:

- Forest Service Manual and Handbooks (FSM/H 2670/2609)
- National Forest Management Act (NFMA)
- Endangered Species Act (ESA)
- Migratory Bird Treaty Act (MBTA)
- National Environmental Policy Act (NEPA)
- Ochoco National Forest Land and Resource Management Plan (USDA 1989) as amended
- Recovery Plans (species specific)
- Regional Forester policy and management direction

The principle policy document relevant to wildlife management on the Forest is the 1989 Ochoco National Forest Land and Resource Management Plan, referred to as the Forest Plan.

In 1995, the Regional Forester's Forest Plans Amendment #2, hereafter referred to as Amendment #2, established Interim Direction for timber sale planning and established interim wildlife standards for old growth, old growth connectivity, snags, large down logs, and northern goshawks for timber sales. The Regional Forester has periodically distributed letters clarifying direction in Amendment #2 (Regional Forester, October 2, 1997; October 23, 1997; June 11, 2003).

Additional management direction is provided for conservation of migratory landbirds. This direction is consolidated in the Forest Service Landbird Strategic Plan and further developed through the Partners in Flight Program.

The Oregon-Washington Partners in Flight Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000) identifies priority bird species and habitats for the Blue Mountains in Oregon.

Regional Forester's Sensitive Species List (Update): On December 9, 2011, Regional Forester Kent Connaughton released an updated Sensitive Species list that includes federally listed, federally proposed, and sensitive species lists (USDA Forest Service 2011a).

Conflict Determination (Effects):

Determination effects for all terrestrial Threatened, Endangered, Proposed, and Sensitive species listed on the Ochoco National Forest are assessed below. Aquatic and botanical species are addressed in separate biological evaluations.

Alternative 1, the no action alternative, is used as a benchmark to compare and describe the differences and effects between taking no action and implementing action alternatives. Effects on species will be determined by assessing how the alternatives affect the structure and function of vegetation relative to current, projected, and historical distributions. Effects on habitats are discussed, with the assumption that if appropriate habitat is available for a species, then that species occupies or could occupy the habitat. Cumulative effects have been analyzed in respect to past, ongoing and foreseeable future activities that overlap the project area in time and space. The duration of effects on the wildlife resource is described according to the following terms and definitions:

- Immediate – Approximately one growing season or several months or less
- Short-term – 0 to 5 years
- Mid-term – 5 to 25 years
- Long-term – 25+ years

Management Indicator Species (Terrestrial)

Management indicator species (MIS) are species selected because their welfare is presumed to be an indicator of the welfare of other species using the same habitat or whose condition can be used to assess the impacts of management actions on a particular area, or other species of selected major biological communities. Management indicator species are selected from several categories including State or Federal Threatened or Endangered species lists; species commonly hunted, fished, or trapped; non-game species of special interest; and species with special habitat needs that may be influenced significantly by planned management programs.

The Ochoco National Forest Land and Resource Management Plan (Forest Plan) identified the pileated woodpecker; common flicker (northern flicker); primary cavity excavators (including, but not limited to woodpeckers and sapsuckers); golden eagle and prairie falcon; bald eagle; Rocky Mountain elk and mule deer as terrestrial management indicator species.

Table 83. Management indicator species and reason for selection.

MIS Species	Representing	Habitat Requirements	Habitat Present in Analysis Area
Pileated Woodpecker	Old growth dependent wildlife	Extensive areas of dense coniferous forests with tall closed canopy, high basal area and large diameter snags	Yes
Primary Cavity Excavators	Cavity dependent species that consume insects	Snag habitat	Yes
Common (Northern) Flicker	Old growth juniper	Any terrestrial habitat but most abundant in open forests and forest edges adjacent to open country	Yes
Golden Eagle & Prairie Falcon	Cliff, talus, or cave Habitats	Nesting habitat includes ledges along rims and cliffs	Golden Eagle – Yes Prairie Falcon – Yes
Bald Eagle	State or Federal Threatened or Endangered Species	Associated with large bodies of water and nests in forested areas near water	Yes
Rocky Mountain Elk & Mule Deer	Species that are commonly hunted	Forests, meadows, mountain valleys, and foothills	Yes

Pileated Woodpecker (*Dryocopus pileatus*)

The pileated woodpecker was selected to serve as an indicator for other species that require large snags, large amounts of down-dead wood, and large trees with defects. The pileated woodpecker represents the presence of favorable habitat for species that require mature and old growth habitat. It may also indicate the presence of favorable habitat for secondary cavity nesters, such as the northern flying squirrel, pygmy owl, saw whet owl, and flammulated owl (FEIS pp. 3-21).

Life History and Habitat

Pileated woodpeckers prefer late successional stages of coniferous or deciduous forest, but also use younger forests that have scattered, large, dead trees (Bull et al. 2007). In northeastern Oregon, pileated woodpeckers selected unlogged stands of old-growth grand fir with closed canopies (Bull & Holthausen 1993) and in some cases open stands with high densities of large snags and logs (Bull et al. 2007). These woodpeckers are rarely found in stands of pure ponderosa pine (Bull & Holthausen 1993).

Their association with late seral stages stems from their use of large-diameter snags or living trees with decay for nest and roost sites, large-diameter trees and logs for foraging on ants and other arthropods, and a dense canopy to provide cover from predators (Marshall et al. 2006). The resource concern for pileated woodpecker is the reduction of: large snags, down-dead wood, and large trees with defect.

Existing Condition

The Forest Plan allocated areas for old-growth management to provide habitat for wildlife species dependent on old growth averaging 300 acres in size. The Forest Plan also identified that additional “feeding” areas, averaging 300 acres, would be located adjacent to these old-growth management areas.

There are two old-growth management areas (OGMA) within the Wolf project area, OG-D2-05 (309 acres) and OG-D2-17 (286 acres). The quality of habitat within the allocated OGMAs is variable and in some cases is not providing suitable pileated woodpecker habitat (see Table 120). In general, pileated reproductive habitat within the project area is naturally fragmented by the scab stringer

nature of the landscape and further fragmented by past timber harvesting which has reduced the large tree component.

Consistent with Forest Plan direction, feeding areas or Pileated Woodpecker Feeding Habitats (PFHs) were identified adjacent to the OGMAs. A 317 acre feeding area was designated for OG-D2-05 and a 320 acre feeding area was designated for OG-D2-17. Field reviews of OG-D2-17 indicate the species composition is predominantly ponderosa pine with some juniper steppe habitat (see Table 120) and lacks attributes associated with pileated woodpecker foraging and reproductive habitat. The old growth management area also lacks suitable pileated foraging habitat in close proximity to the designated old growth management area. OG-D2-17 is primarily surrounded by other pine dominated habitats or juniper and sagebrush dominated scabs, therefore, a suitable feeding area does not exist for this old growth area. Nonetheless, a PFH was designated, and although it's not likely suitable for pileated woodpeckers, other old growth dependent species, such as the white-headed woodpecker, may benefit from its designation.

Suitable habitat outside of OGMAs exists within the project area. Queries of forest habitat databases, using the Viable Ecosystems definition of habitat (forest type and structure) identified 3,977 acres of suitable pileated woodpecker reproductive habitat within the project area, this acreage includes those acres identified within the OGMAs. This habitat is primarily located in the northern portion of the project area in the dry grand fir plant association (see Table 121). Lidar was used to provide a broad scale look at the live-tree component and this portion of the analysis does not provide information on stand specific snag or down log levels. A watershed scale snag analysis has been done for the watershed and is summarized in the Primary Cavity Excavator section of this section.

The forest fish and wildlife database includes about 200 recorded sightings of pileated woodpeckers, 4 of which occur within the project boundary. Currently there are 14,508 acres of primary nesting habitat for pileated woodpecker on the Ochoco National Forest.

Direct, Indirect, and Cumulative Effects

Alternative 1

The no action alternative would maintain the existing condition. This alternative would not treat within LOS stands, designated OGMAs, or PFHs, and no connectivity corridors would be designated under this alternative. This action would maintain the existing acres of fir-dominated understory and canopy closure.

Management activities would be limited to ongoing activities. Alternative 1 would not conduct any additional timber harvest or prescribed burning activities in pileated woodpecker habitat. In the short term, habitat would not change. In the long term, stands would slowly move towards old growth conditions, providing better movement and dispersal habitat for pileated woodpeckers and old growth associated species. In the long term, this habitat would be more at risk for insect, disease, and wildfire damage. Under the no action alternative, pileated woodpecker habitat would increase.

Overtime, high stand densities may lead to mortality due to insects and disease providing increased forage for the pileated woodpecker; however, it would also lead to increased risk and potential for high intensity fire which could ultimately render these areas less suitable. The effect of such disturbances on pileated woodpecker habitat in the long term is dependent on the type, severity and extent of the event(s). Extensive areas of high mortality that could potentially result from future large scale disturbance could limit the amount of suitable nesting habitat in affected areas, whereas events resulting in mosaics including moderate and low intensity disturbance may continue to provide high quality nesting habitat over time.

Implementation of this alternative would not do anything to address current open road densities. Areas would remain accessible to firewood cutting. Therefore, snags creating important habitat for pileated woodpeckers as well as other old growth dependent species would be at risk of being removed.

Conclusion

Alternative 1 would not affect the pileated woodpecker and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Effects Common to Alternatives 2, 3, & 4

Connectivity corridors were designated on 954 acres to connect LOS (2,355 acres) habitat and OGMAs (595 acres), both within and outside the watershed (see Silviculture report- Late and Old Structure, and Connective Corridor Treatments for more details). Long term connectivity between LOS would be maintained according to Amendment #2 standards. These corridors would continue to provide for the free movement of LOS associated species.

No commercial or noncommercial thinning or prescribed burning would occur within OGMA's. The only activity occurring within OGMAs is approximately 1 mile of road decommissioning occurring in OG-D2-05. Decommissioning this segment of road would reduce fragmentation and reconnect adjacent habitats, as well as reduce firewood harvest that reduces snag habitat.

Thinning would occur within connectivity corridors on varying acres depending on the alternative. Within those stands proposed for thinning, Amendment #2 standards would apply. Although understory stocking levels would be reduced, canopy closures would remain in the top one-third of site potential. In all units slash would be handpiled and burned.

Outside of harvest units, prescribed fire would be implemented within connectivity corridors. Prescribed fire would reduce the amount of down wood but has very little effect on larger trees or overstory. As a result, connectivity would be largely unchanged from the existing condition.

Roads bisecting connectivity could impede the movement, interaction, and the dispersal of wildlife species associated with late and old structural conditions. None of the action alternatives propose to alter open road densities within connectivity corridors. However, temporary roads, both existing (.4 miles) and new (.1 miles), are proposed within connectivity corridors and are the same for each action alternative. Temporary roads would be constructed on flat ground (slope less than 20%); excavation and construction of embankments would be negligible; they would be constructed in such a way as to minimize disturbance and impacts to adjacent resources (see section titled "Transportation" in Chapter 3 of this document). Following completion of Wolf project activities, all temporary roads would be rehabilitated. The impact of temporary road activities would be negligible to pileated woodpeckers and old growth dependent species.

Alternative 2

See table 121 for a comparison of pileated woodpecker habitat by alternative based on the Viable Ecosystems Model. The historic range of variability for pileated nesting habitat within the project area ranges from a high of 2,039 acres to a low of 964 acres. This alternative would reduce primary nesting habitat for this species by 1,273 acres. These acres represent 32% of existing primary nesting habitat in the project area. Primary nesting habitat would remain above the HRV, however, with 2,704 acres of primary nesting habitat remaining post treatment.

Table 84. Habitat designations for Old Growth Management Areas (OGMA), Pileated Woodpecker Feeding Habitat (PFH), and treatments, by alternative.

			Treatment Types					
Habitat Designations			**Commercial**		**Noncommercial**		**Prescribed Fire**	
	Total Acres	**Reproductive Habitat**	**Total Acres**	**Within Reproductive Habitat**	**Total Acres**	**Within Reproductive Habitat**	**Total Acres**	**Within Reproductive Habitat**
OG-D2-05	**309**	**268**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
PFH Alt. 1	317	299	0	0	0	0	0	0
PFH Alt. 2	317	299/97[1]	178	172	3	3	27	27
PFH Alt. 3	317	299/97[1]	178/85[2]	172/85[2]	3	3	27	27
PFH Alt. 4	317	299/102[1]	169	163	5	4	31	30
OG-D2-17	**286**	**0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
PFH Alt. 1	320	125	0	0	0	0	0	0
PFH Alt. 2	320	125/0[1]	68	38	3	3	212	84
PFH Alt. 3	320	125/0[1]	68/0[2]	38	3	3	212	84
PFH Alt. 4	320	125/0[1]	39	17	3	3	233	105

[1]Acres of suitable reproductive habitat remaining after treatment.
[2]Acres proposed for the harvest of ≥ 21" dbh trees.

Table 85. Pileated Woodpecker Primary Nesting Habitat using the Viable Ecosystems Model.

Alternative	HRV – Min Acres	HRV – Max Acres	Acres (Post Treatment)	HRV (Year 1)
Alternative 1	964	2,039	3,977	Above
Alternative 2	964	2,039	2,704	Above
Alternative 3	964	2,039	2,610	Above
Alternative 4	964	2,039	3,005	Above

The reduction of primary habitat would come as a result of commercial and noncommercial thinning and prescribed burning which could also have varying effects on habitat suitability as well. Commercial treatment would reduce the suitability of these stands for nesting and foraging immediately after treatment. With time, canopy closure is expected to recover to some extent, as the retained trees expand their crowns in diameter and depth in response to the release from competition that results from the thinning. Noncommercial thinning would help to promote the development of larger trees in the stand. Thus, this treatment could facilitate the development of higher quality foraging and nesting habitat in the long term. Noncommercial thinning proposed in grand fir and Douglas-fir PAGs is not expected to affect foraging or nesting habitat in the short term because trees less than 9" dbh are not commonly used for foraging or nesting. In the long term, foraging habitat may be slightly reduced because thinning would select against grand fir species which is a desirable forage species.

Prescribed burning may reduce habitat suitability by reducing down wood and canopy closure, and by altering the timing of mortality in grand fir and Douglas-fir. Fire is likely to result in an abundance of fire-killed fir trees soon after the treatment, providing a flush of foraging substrate, but as stand mortality declines, foraging opportunities would wane. The level of impact to suitability for pileated woodpeckers with this treatment is dependent on fuel loading and burn conditions initially, as well as the frequency of maintenance burning. It is anticipated that across the majority of prescribed burn units, forested stands are expected to retain sufficient tree density within these PAGs.

The following analysis focuses on the treatments associated with each PFH within the project area. See Table 120 on habitat designations (OGMAs and PFHs) and treatments within those designations. These acres have been discussed previously in relation to the HRV analysis. However, the intent of this analysis is to clarify what activities would be occurring within designated habitat areas (see Map 13).

OG-D2-05 PFH

Commercial thinning would occur on 178 acres within the PFH associated with OG-D2-05. Treatment would reduce the suitability of habitat for the pileated woodpecker within 172 acres of reproductive habitat as identified by using the Viable Ecosystems Model. In addition, noncommercial thinning (3 acres) and prescribed burning (27 acres) would occur within reproductive habitat and have similar effects as those described earlier.

OG-D2-17 PFH

Commercial thinning would occur on 68 acres within the PFH associated with OG-D2-17. Treatment would reduce the suitability of habitat for the pileated woodpecker within 38 acres of reproductive habitat as identified by using the Viable Ecosystems Model. In addition noncommercial thinning (3 acres) and prescribed burning (84 acres) would occur within reproductive habitat as well and have similar effects as those described earlier. Prescribed burning would occur on an additional 128 acres not currently reproductive habitat but within OG-D2-17 PFH.

Alternative 3

Alternative 3 would have similar effects to those identified in Alternative 2. However, units proposed for commercial harvest may remove fir species >21" dbh (see Table 120). Removal of these fir species >21" dbh, although not defined as old growth, would reduce future snag recruitment to a greater degree than Alternative 2. Alternative 3 would reduce current reproductive habitat by 1,367 acres. Upon completion of proposed activities, 2,610 acres of reproductive habitat would remain and would be above the maximum HRV value for this species (see Table 121).

OG-D2-05 PFH & OG-D2-17 PFH

The number of acres treated within PFHs remains the same, however, fir species >21" dbh would be removed in the PFH associated with OG-D2-05.

Alternative 4

Alternative 4 has similar results to Alternative 3; however, fewer acres are identified for commercial harvest. As a result, this alternative has the least impact to pileated woodpecker. Reproductive habitat would be reduced by 972 acres and still be above the maximum HRV value for pileated woodpecker habitat with 3,005 acres remaining.

OG-D2-05 PFH

The total acres of commercial harvest are less than those proposed in Alternative 2. However, the amount of acres of noncommercial thinning (5 acre) and prescribed burning (31 acres) increases, therefore the total acreage treated is similar to that of Alternatives 2 and 3. Total area treated in Alternatives 2 and 3 are 208 acres versus 205 acres in alternative 4.

OG-D2-17 PFH

The total acres of commercial harvest are less than those proposed in Alternative 2. However, the amount of acres of noncommercial thinning (3 acre) and prescribed burning (233 acres) increases; therefore, the total acreage treated is similar to that of Alternatives 2 and 3. Total area treated in Alternatives 2 and 3 are 283 acres versus 275 acres in Alternative 4.

Cumulative Effects for All Action Alternatives

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions. Harvest prior to 1995 focused primarily on the larger high value trees which would have otherwise provided high value pileated nesting and roost trees. These past activities and events affected the amount of habitat on the landscape and are reflected in the Viable and Wildhab analysis of the existing condition. The alternatives further affect the amount of primary nesting habitat on the landscape.

Removal of snags for firewood, for hazard abatement or under salvage sales would have reduced habitat for woodpeckers. However, at the same time that pileated woodpecker habitat was being reduced within timber harvest units, fire suppression activities were being implemented across all plant associations. As a result of this fire suppression, grand fir was allowed to develop in the understory of many stands that were previously dominated by ponderosa pine and larch. In these stands, pileated woodpecker habitat has increased compared to historic conditions.

Ongoing grazing (Southside EA, 2009), recreational use, riparian improvement and exclosure maintenance activities are not expected to result in effects to this species when combined with effects of this project. However, ongoing firewood cutting may combine with this project to further reduce habitat for pileated woodpeckers. When implemented within the rules established by the firewood synopsis, there should be no net cumulative effect. However, people continue to remove large snags illegally, accessing them cross country or on old timber harvest access routes. Though all skid trails and new roads are scheduled to be closed after project activities are completed, some people are likely to utilize these road beds and skid trails for a period of time before closures are implemented (some people may breach closures after they are implemented) in order to access firewood. This project may contribute to increased accessibility, and thus additional area vulnerable to illegal snag removal which would reduce potential nesting habitat for this species and other primary cavity excavators.

As shown in Table 121, pileated woodpecker habitat would remain above HRV after treatment under all alternatives in the short term and long term. Habitat for pileated woodpeckers would be concentrated on sites that are more likely to sustain such stand densities and species distributions, and would be reduced on some sites that are less likely to sustain it in the long term.

Conclusion

As shown in Table 121, pileated woodpecker habitat would remain above HRV after treatment under all alternatives in the short term and long term. Habitat for pileated woodpeckers would be concentrated on sites that are more likely to sustain such stand densities and species distributions, and would be reduced on some sites that are less likely to sustain it in the long term.

Because this project impacts less than 10% of suitable habitat across the Forest, the overall direct, indirect and cumulative effects would result in a small negative trend of habitat (increase in disturbance). The loss of habitat (increase in disturbance) would be insignificant at the scale of the Forest. The Wolf Project is consistent with the Forest Plan, and thus continued viability of the pileated woodpecker is expected on the Ochoco National Forest.

Primary Cavity Excavators

The primary cavity excavator group was selected as a MIS to represent the species that require snag habitat that is often reduced by forest management activities. The primary cavity excavator MIS group includes birds that feed primarily on dead wood insects and that excavate their own nest cavities. The PCEs serve as ecological indicators for a large number of species and for secondary cavity users, like swallows, blue birds and bats (FEIS pp 3-21).

The primary cavity excavator group includes several species including the pileated woodpecker and northern flicker (LRMP MIS), white-headed woodpecker and Lewis' woodpecker (TES and Focal species), and red-naped sapsucker (focal species) that are on other special status lists and that will be further discussed in this report.

Management Direction

Forest Plan standards and guidelines for snags specify that across the forest, snags must meet an average of 47% of biological potential. The Regional Forester's Forest Plan Amendment # 2 of the Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards (Amendment #2) requires managing snags at 100% maximum potential for primary cavity excavators, which is a minimum of 2.25 snags/acre (Thomas 1979), as determined using the best available science.

Currently, the Ochoco National Forest is managing snags according to the Viable Ecosystem Management Guide (VEMG) levels. VEMG levels are based on the historical range of variability. VEMG snag levels were agreed upon with the Regional Office to meet the standards and guidelines, however, snags would not be managed below the 100% maximum potential as required by the Regional Forester's Forest Plan Amendment #2. Table 87 is a summary of the weighted average snags/acre by plant association group, as described by the Viable Ecosystems Management Guide. Table 88 lists the log retention standards from the Amendment #2.

Table 86. Viable Ecosystem Management Guide Snag Levels

Plant Association Group	<20"dbh		>20"dbh	
	Low	High	Low	High
Moist Grand Fir	4.4/ac.	10.0/ac.	1.5/ac.	4.9/ac.
Dry Grand Fir	3.2/ac.	7.1/ac.	1.0/ac.	3.3/ac.
Douglas Fir*	1.3/ac.	3.1/ac.	.2/ac.	1.6/ac.
Moist Ponderosa Pine*	1.2/ac.	2.7/ac.	.2/ac.	1.6/a.
Dry Ponderosa Pine*	.0/ac.	.3/ac.	.1/ac	.5/ac.

***Although VEMG snag levels are less than 2.25 in these PAGs snag levels will not be managed below 2.25 per acre to be consistent with the Regional Forester's Forest Plan Amendment #2.**

Table 87. Viable Ecosystem Management Guide down Log Levels

Plant Community	Pieces Per Acre	Diameter (Small End)	Piece Length & Total Length
Ponderosa Pine	3-6	12"	>6 ft. 20-40 ft.
Mixed conifer	15-20	12"	>6ft. 100-140 ft.

The Decayed Wood Advisor (DecAID) has become available for use (Mellen-Mclean et al. 2009). This work is an advisory tool to help land managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags, down wood, and other wood decay elements. Until new information becomes accessible, the DecAID vegetation data provides the most current, empirical data available for dead wood evaluations. It is important to remember that there is a variable range of conditions across the forest from insects, disease and management practices. The results are varying densities of snags across the landscape. It must be noted that DecAID must be utilized at an appropriate scale. The general rule of thumb is that the analysis area be at least 20 square miles (12,800 acres), roughly the size of a fifth field hydrologic unit code watershed. The Wolf analysis area is comprised of 24,506 acres. The DecAID assessment process is based on the concept of HRV. It's assumed that by managing habitat within HRV, adequate habitat will be provided because species survived those levels of habitat in the past. Thus, if we manage current habitats within the range of HRV we will likely do an adequate job of ensuring population viability for those species that remain (Landres et al. 1999).

A snag analysis utilizing the best available data was completed for the Wolf project to analyze the existing amount of snag habitat. The snag analysis utilized information from the VEMG, the Landscape Ecology, Modeling, Mapping and Analysis team's Gradient Nearest Neighbor (GNN) Models, and DecAID. The VEMG stratifies the environment along a gradient of size, structure, species composition, and relative tree density. The 2004 satellite imagery layer was used to develop a map of PAGs with tree size and density, seral condition, and structural condition.

Data is mapped on a 25 meter pixel grid, meaning the map is divided up on a 25 meter grid and that every 25 meter square (pixel) is assigned a value that relates to a stratum of size, structure, tree species composition, and relative tree density. VEMG was utilized to estimate the HRVs for the habitat types within the planning area.

The GNN is an imputation modeling technique that produces maps where each pixel is associated with an inventory plot that has the most similar spectral and environmental characteristics (Ohmann and Gregory 2002). The GNN utilized field data from the Continuous Vegetation Survey (CVS) and Forest Inventory Analysis (FIA) to impute snag data into each Viable pixel to estimate existing snag levels at the landscape level.

DecAID presents information on wildlife use of dead wood, including snag diameter, snag density, down wood diameter, and down wood percent cover; and on the range of natural (unharvested) and current (all) conditions of snag density and down wood percent cover by diameter classes (Mellen-McLean et al. 2009).

For this analysis, the satellite imagery was from 2004 and the GNN data were from 2006. The satellite imagery and GNN data do not include fires or activities that have occurred since that time; this should not affect the snag analysis in the Wolf project area because there have been no timber harvest or large wild fires since that time. Non-commercial thinning and fuels projects have occurred, but these activities do not remove snags. Fuels projects in general tend to create slightly more snags than may be removed by the activity, therefore the existing snag numbers may be slightly underestimated. The 2006 GNN data was also not updated with snag fall down rates. There have been no epidemic levels of insects or diseases within the analysis area since the GNN snapshot. Although, there has been scattered mortality occurring in lodgepole pine, it is not likely represented by the GNN data; this mortality would not be represented in the analysis. Based on knowledge of the area's existing transportation system and ongoing fuel wood removal, snag numbers in portions of this watershed may be slightly overestimated.

To begin the snag analysis, the 5 structural stages of VEMG were combined to match the three structural stages in DecAID. A crosswalk was created from all VEMG to DecAID habitat types and structure codes. This was done using the VEMG guide and DecAID information, as well as input from the Forest Ecologist.

DecAID structural stages include: Open, Small and Large. In DecAID the Open structural stage is everything from grass/forbs to sapling and pole sized trees where tree stocking is less than 10% or where tree stocking is equal to or greater than 10% and quadratic mean diameter (QMD) is 1-9 inches. The small structural stage includes a range of conditions that consists of small trees with an open canopy to medium trees with a closed multi-storied canopy where tree stocking is equal to or greater than 10% and QMD is 10-19 inches. The Large structural stage includes the conditions that have stocking greater than or equal to 10% and trees with QMD greater than or equal to 20 inches and includes open and closed multistoried canopies.

Table 88. VEMG and DecAID Habitat Structure Crosswalk

VEMG STRUCTURE	DecAID STRUCTURE
• Grass/forb/shrub – trees may be present but not dominant	Open
• Seedling and sapling – trees ≤4.9" dbh	
• Pole – trees 5-8.9" dbh	
• Small – trees 9-20.9" dbh	Small
• Medium and Large – trees ≥21"dbh	Large

Next, the VEMG structure and plant association groups were converted to habitat types in DecAID. The HRV for snag densities for each DecAid habitat type and structure class was identified. DecAID data from unharvested stands provides a reference condition in the various habitat types for distribution of snag and down wood size and densities across a large landscape. DecAID analyzes snag habitats not only by habitat type and structure, but by snag size (>= 10" dbh and >= 20" dbh). In the VEMG, the historic range of variability is given by both structure and plant association group. The Viable structure and plant association groups were converted to habitat types in DecAID and a weighted average of HRVs across the habitat was computed. Juniper stands are not included within the DecAID framework for the snag analysis.

Table 89. VEMG Plant Association Group and DecAID Habitat Type Crosswalk

VEMG PLANT ASSOCIATION GROUPS AND SERAL STAGES	DecAID HABITAT TYPE
• Douglas Fir – Late seral structural stages	Eastside Mixed Conifer
• Dry Grand Fir – Mid and late seral structural stages	
• Moist Grand Fir – Early, mid, and late seral structural stages	
• Douglas Fir – Early and mid seral structural stages	Ponderosa Pine/Douglas Fir
• Dry Grand Fir – Early seral structural stages	
• Dry Ponderosa Pine – Mid and late seral structural categories	
• Moist Ponderosa Pine – all seral structural categories	

Primary Cavity Excavator Habitat Selection

The following tables identify the PCE's that occur by habitat type in the Wolf project area and the habitat characteristics preferred by each species; preferences by snag size and density class are indicated by tolerance level. DecAID identified three tolerance levels (30%, 50% and 80%) for dbh of snags and the density of snags used by PCEs. Thus, an 80% tolerance level indicates 80% of the individuals in the population have a value for the parameter of interest between 0 and the value for the 80% tolerance level. Or conversely, 20% of the individuals in the population have a value for the parameter of interest greater than the 80% level. For example, an 80% tolerance level of wildlife use of snag diameter (dbh) means that 80% of all individuals observed of some species (combined across one or more wildlife studies) uses snags less than or equal to some specific dbh, and 20% use snags greater than that dbh. With normally distributed data the 50% tolerance level is the mean (Mellen-McLean et al. 2009).

Eastside Mixed Conifer Habitat Type (EMC)

The Eastside Mixed Conifer DecAid habitat type contains a wide array of tree species and stand dominance patterns. Douglas-fir is the most common tree species in this habitat. It is almost always present and dominates or co-dominates most overstories. Lower elevations or drier sites may have ponderosa pine as a co-dominant with Douglas-fir in the overstory and often have other shade-tolerant tree species growing in the undergrowth. On moist sites, grand fir is dominant or co-dominant with Douglas-fir. Other conifers include western larch on mesic sites, Engelmann spruce, lodgepole pine, and subalpine fir on colder sites. Stand canopy structure is generally diverse.

Table 90. Snag Size, Decay Class, and Tree Species Preferred by MIS PCE's in the East-side Mixed Conifer Forest

Species/Group	Snag size (in) for 30%, 50%, 80% tolerance levels	Snag decay	Primary Snag Species
Black-backed woodpecker	Nesting: 8.8, 12.0, 16.7 Roosting: 6.7, 10.9, 16.8 Foraging: 10.9, 14.0, 18.9	Moderate to Hard	Douglas-fir, western larch, ponderosa pine, lodgepole pine
Hairy woodpecker	Nesting: 10.5, 16.3, 25.2 Foraging: 8.3, 11.7, 17.0	Moderate	Aspen, ponderosa pine, western larch
Northern flicker	Nesting: 17.7, 22.2, 30.6 Foraging: 18.2, 21.8, 27.2	Moderate	Western larch, ponderosa pine, Douglas-fir
Northern three-toed woodpecker	Nesting: 8.8, 10.8, 14.0 Roosting: 9.8, 11.7, 14.3 Foraging: 11.4, 14.7, 19.7	Soft to Moderate	Aspen, Douglas-fir, Lodgepole pine, western larch for nesting Lodgepole pine for foraging
Primary cavity nesters/ excavators/ woodpeckers	Foraging: 50% tl = 11.3 select > (12") 30 cm dbh[1]	Soft to Moderate	Aspen, western larch, ponderosa pine for nesting Ponderosa pine[1] and western larch for foraging
Pileated Woodpecker	Nesting: 25.2, 29.5, 36.0. Roosting: 25.8, 28.0, 31.2 Foraging: 12.9, 19.9, 30.4	Hard to Soft	Ponderosa Pine, western larch, grand fir
Pygmy nuthatch	Nesting: 14.7, 21.3, 30.8		Ponderosa pine
Red-breasted nuthatch	Nesting: 13.0, 20.0, 29.0	Moderate	Douglas-fir
Red-naped sapsucker	Nesting: 20.9, 26.3, 34.5		Western larch, lodgepole pine, Douglas-fir
White-breasted nuthatch	Nesting: 9.8, 21.2, 36.7		
White-headed woodpecker	Nesting: 20.8, 26.7, 35.9	Moderate	Ponderosa pine
Williamson's sapsucker	Nesting: 20.2, 26.2, 34.6	Moderate	Douglas-fir, ponderosa pine, western larch

[1]Lyons et al. 2008

Table WL-15. Snag Densities Surrounding Nest and or Roost Sites of PCE's in East-side Mixed Conifer

Species	Snag density/acre for 30%, 50%, 80% tolerance levels			
	Green Forests		Recent Post-fire	
	>10" dbh	>20" dbh	>10" dbh	>20" dbh
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	57.2, 82.4, 119.2	
Hairy woodpecker	No Data for green forests		42.9, 67.2, 104.1	
Lewis's woodpecker	No Data for green forests		24.2, 39.5, 62.8	0.0, 6.2, 16.1
Northern flicker	No Data for green forests		26.8, 49.6, 84.1	2.2, 17.4, 39.6
Pileated Woodpecker	14.9, 30.1, 49.3	3.5, 7.8, 18.4		
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.3, 1.9, 4.3	0.0, 1.5, 3.8	18.6, 52.0, 98.7	
Williamson's sapsucker	14.0, 28.4, 49.7	3.3, 8.6, 16.6		

Eastside Mixed Conifer Habitat (EMC)

There are 4,100 acres of EMC habitat type in the Wolf project area. To ensure that the analysis of EMC was done at the appropriate scale as suggested by DecAID, an additional 16,613 acres from an adjacent watershed were incorporated into the analysis. Historically, there was a substantial portion of the landscape in the EMC habitat type that did not have any snags and therefore did not provide nesting habitat for PCEs. It is estimated that 17-26% of the EMC habitat was devoid of snags greater than or equal to 10" dbh and 32-44% was devoid of snags greater than or equal to 20" dbh. Currently, the amount of the EMC without snags is below HRV, with 16% of the Wolf area devoid of snags greater than 10"dbh and 29% of the EMC devoid of snags greater than 20" dbh. Presently, 68% of the EMC in Wolf is within or exceeds the HRVs for snag density in snags greater than 10" dbh and 66% of the EMC exceeds or is within the HRVs for snag density where snags are greater than 20" dbh. The greatest abundance of snags is represented in the less than 6 snags per acre range. Forty-six percent of the EMC habitat has between 0-6 snags per acre that are ≥10" dbh and 82% of the EMC has between 0-6 snags per acre that are ≥20" dbh. Increased stocking levels resulting from fire suppression and ingrowth of trees has resulted in more of the EMC habitat with snags.

Stands with very high snag densities would have been more common historically than what is present today. The amount of very high density snag patches (36+ snags per acre in the greater than 10" dbh size class) is less than historic conditions. Although, high density snag patches (18+ snags per acre in greater than 20" dbh size class) are within historic conditions. Very high snag densities would have likely occurred following large fires or epidemic insect or disease outbreaks which have not occurred in the watershed. This condition was relatively rare historically, however. High density snag patches have been reduced in some areas due to past timber harvest practices in the last four to five decades. Ongoing firewood cutting and hazard tree removal along forest roads have also negatively affected snag numbers, especially the large diameter snags and high density snag patches. Areas of low road density within the planning area however are likely to contain higher snag levels than mixed conifer stands in more accessible areas. Presently, 3% of the EMC has very high snag density (>36+ snags per acre) in the greater than 10" dbh size class. About 1% of has very high density patches (>18+ snags per acre) in the large diameter >20" dbh size class. Primary cavity excavator species that select for high density snag patches in the EMC habitat type include the black-backed woodpecker, hairy woodpecker, pileated woodpecker, and Williamson's sapsucker. Reviewing the literature in DecAID, the EMC habitat in the Wolf area provides enough snag habitat to meet the 80% tolerance level for the black-backed woodpecker, pygmy nuthatch, and white-headed woodpecker and easily provides adequate snag densities and size for the 50% tolerance level for the pileated woodpecker and Williamson's sapsucker. Higher snag densities in the smaller diameter snag classes benefits all the primary cavity excavators by providing foraging habitat but is especially suited for the black-backed woodpecker, hairy woodpecker, and northern three-toed woodpecker. These species are generally associated with the small and medium sized snags between 10" and 20" dbh.

Table 91. HRVs by Snag Density Class, Existing Snag Abundance by Density Class, and PCE Habitat Use of Snags >=10"dbh and >=20" dbh by Density Class in the EMC Habitat Type.

Eastside Mixed Conifer Habitat Type													
	Snags > 10" dbh						Snags > 20" dbh						
Snags/Acre	0	0-6	6-12	12-24	24-36	36+	0	0-2	2-4	4-6	6-10	10-18	18+
HRV (%)	17-26	27-31	15-17	15-24	6-10	5-8	32-44	14-20	13-17	9-13	9-14	5-7	1-2
Ex. Cond. (%)	16%	46%	16%	12%	6%	3%	29%	23%	16%	14%	12%	4%	1%
Relationship	Below	Above	Within	Below	Within	Below	Below	Above	Within	Above	Within	Below	Within

Figure 14. Distribution of Snags Greater Than or Equal to 10" dbh for the Eastside Mixed Conifer Habitat Type included in the Wolf Project area.

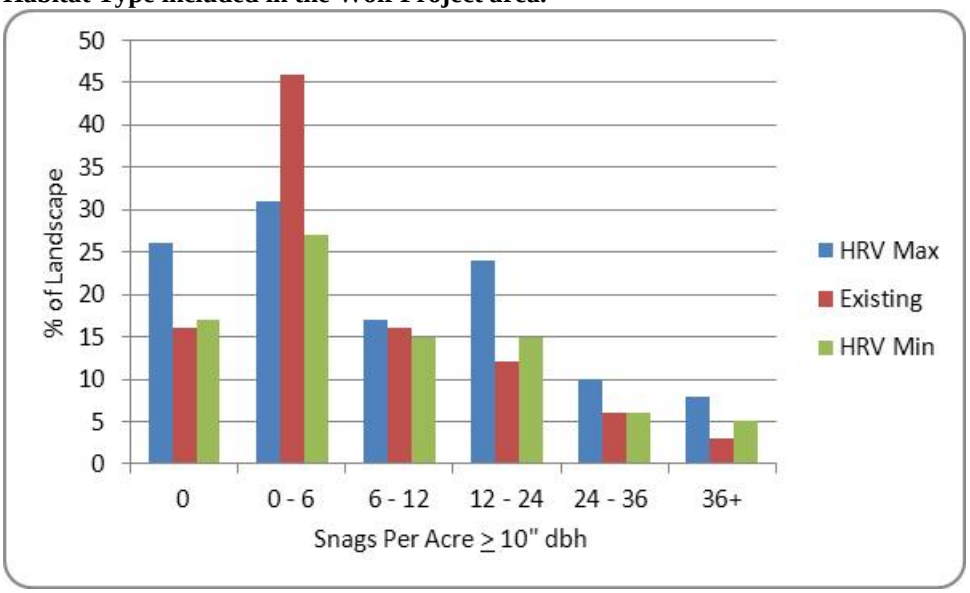


Table 92 and Figure 17 display the snag distribution, existing condition, and the HRV within the **Eastside Mixed Conifer** habitat type where snags are ≥ 10" dbh. In summary the Wolf project area is:

- Below HRV in the:
  - 0 snags per acre
  - 12-24 snags per acre
  - 36+ snags per acre
- Above HRV in the:
  - 0-6 snags per acre
- Within HRV in the:
  - 6-12 snags per acre
  - 24-36 snags per acre

Figure 15. Distribution of Snags Greater Than or Equal to 20" dbh for the Eastside Mixed Conifer Habitat Type included in the Wolf Project area.

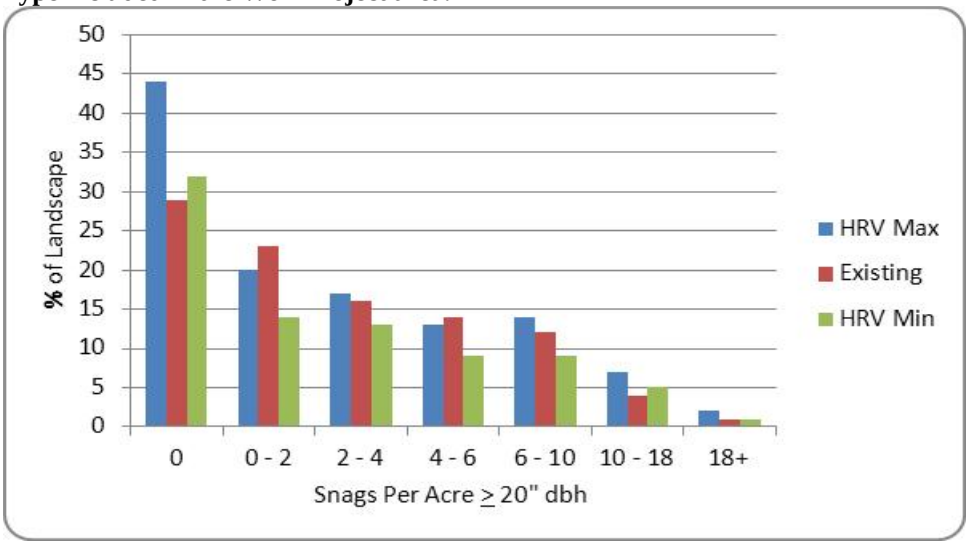


Table 92 and Figure 18 above also display the snag distribution, existing condition, and the HRV within the **Eastside Mixed Conifer** habitat type where snags are ≥ 20" dbh. In summary the Wolf project area is:

- Below HRV in the:
  - 0 snags per acre
  - 10-18 snags per acre
- Above HRV in the:
  - 0-2 snags per acre
  - 4-6 snags per acre
- Within HRV in the:
  - 2-4 snags per acre
  - 6-10 snags per acre
  - 18+ snags per acre

Ponderosa Pine/Douglas-fir Habitat Type (PPDF)

The Ponderosa pine/Douglas-fir (PPDF) Wildlife Habitat Type is composed of ponderosa pine and ponderosa pine-Douglas-fir forest and woodland alliances (Grossman 1998). Ponderosa pine and Douglas-fir are the most common trees in this habitat but western larch may be a co-dominant. On more productive sites grand fir may occur in the understory, producing a multi-layer structure.

Table 92. Snag Size, Decay Class, and Tree Species Preferred by MIS PCE's in the Ponderosa Pine/Douglas-fir Forest

Species/Group	Snag size (in) for 30%, 50%, 80% tolerance levels	Snag decay	Primary Snag Species
Black-backed woodpecker	Nesting: 8.1, 13.2, 20.5 Foraging: 8.0, 12.1, 18.2	Hard	Ponderosa pine, western larch, lodgepole pine, Douglas-fir
Hairy woodpecker	Nesting: 10.3, 16.4, 25.3 Foraging: 8.3, 11.7, 17.0	Moderate to hard	Ponderosa pine, Douglas-fir, Lodgepole pine
Lewis's woodpecker[1]	Nesting: 15.1, 19.8, 26.8		Ponderosa pine
Northern flicker	Nesting: 17.2, 21.8, 28.8 Foraging: 18.2, 21.8, 27.2	Soft to Moderate	Ponderosa pine, , Douglas-fir
Northern three-toed woodpecker	Nesting: 8.8, 10.8, 14.0 Foraging: 7.5, 9.4, 12.1		Lodgepole pine for foraging
Primary cavity nesters/ excavators/ woodpeckers	Foraging: select > (12") 30 cm dbh[2]	Moderate	Aspen, western larch, ponderosa pine, Lodgepole pine for nesting Ponderosa pine[2] and western larch for foraging
Pileated Woodpecker	Nesting: 25.5, 30.1, 36.8 Foraging: 12.9, 19.9, 30.4	Hard to Soft	Ponderosa pine, western larch, grand fir
Pygmy nuthatch	Nesting: 16.9, 22.8, 31.5		Ponderosa pine
Red-naped sapsucker	Nesting: 11.8, 2.03, 31.9		Western larch, lodgepole pine, Douglas-fir
White-headed woodpecker	Nesting: 20.6, 26.4, 35.5 Roosting: 19.9, 23.8, 29.6	Moderate	Ponderosa pine, aspen, grand fir
Williamson's sapsucker	Nesting: 20.0, 25.8, 34.5		Douglas-fir, ponderosa pine, western larch

- [1]Post-fire habitat only
- [2]Lyons et al. 2008

Table 93. Snag Densities Surrounding Nest and Roost Sites of PCE's in Ponderosa Pine/Douglas-fir

Species	Snag Density (snags/acre) for 30%, 50%, 80% Tolerance Levels			
	Green Forests		Recent Post-fire	
	>10" dbh	>20" dbh	>10" dbh	>20" dbh
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	44.4, 64.4, 94.3	
Hairy woodpecker	No Data for green forests		42.9, 67.2, 104.1	
Lewis's woodpecker	No Data for green forests		24.1, 39.2, 62.4	0.0, 6.2, 16.1
Northern flicker	No Data for green forests		26.8, 45.6, 84.1	2.2, 17.4, 39.6
Pileated Woodpecker	14.9, 30.1, 49.3	3.5, 7.8, 18.4		
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.5, 1.9, 4.0	0.5, 1.8, 3.8	18.6, 42.7, 98.7	
Williamson's sapsucker	14.0, 28.4, 49.7	3.0, 8.4, 16.3		

Ponderosa Pine/Douglas-fir Habitat (PPDF)

There are 11,889 acres of PPDF habitat type in the Wolf project area. Similar to the EMC habitat type, the number of snags in the PPDF habitat type is also greater than historic conditions. Historically, more than half (54-62%) of the landscape in the PPDF did not have any snags greater than or equal to 10" dbh and nearly three quarters (67-75%) of the landscape did not have snags greater than 20" dbh. The higher density categories (24-36 and 36+ snags per acre ≥ 10 and 10-18, and 18+ snags per acre ≥ 20"dbh) are within HRV, but at the low end. These higher snag density classes historically occupied less than 1% of the landscape in the PPDF habitat type, however. Currently, there is less area devoid of snags (47% vs 54-62% historically) and more area with snags. Densities are within or are above the HRV in all other density categories except for the 0-2 snags per acre category for snags ≥ 20" dbh which is below HRV. The 0-2 snags per acre density class historically would have occurred on 14-19% of the PPDF habitat type while it currently occurs on 7%. Over 80 years of fire suppression has increased dense stands, resulting in tree mortality from insects, and has resulted an excess of snags (above HRV) in the 12-24 snags per acre (≥ 10 dbh) and 2-4 snags per acre (≥ 20" dbh) in the PPDF habitat type. The abundance of snag habitat is within or above HRVs for all primary cavity excavators. Adequate habitat is available to meet the 80% tolerance level for all the primary cavity excavators associated with the PPDF habitat type.

Table 94. HRVs by Snag Density Class, Existing Snag Abundance by Density Class, and PCE Habitat Use of Snags >=10"dbh and >=20" dbh by Density Class in the PP/Df Habitat Type.

Ponderosa Pine/Douglas-fir Habitat Type													
	Snags > 10" dbh						Snags > 20" dbh						
Snags/Acre	0	0-4	4-12	12-24	24-36	36+	0	0-2	2-4	4-6	6-10	10-18	18+
HRV (%)	54-62	18-27	12-15	3-5	0-1	0-1	67-75	14-19	7-10	1-2	1-2	0-1	0-1
Ex. Cond. (%)	47%	27%	14%	8%	1%	1%	64%	7%	20%	2%	4%	0%	0%
Relationship	Below	Within	Within	Above	Within	Within	Below	Below	Above	Within	Above	Within	Within

Figure 16. Distribution of Snags Greater Than or Equal to 10" dbh for the Ponderosa Pine/Douglas-fir Habitat Type within the Wolf Project area.

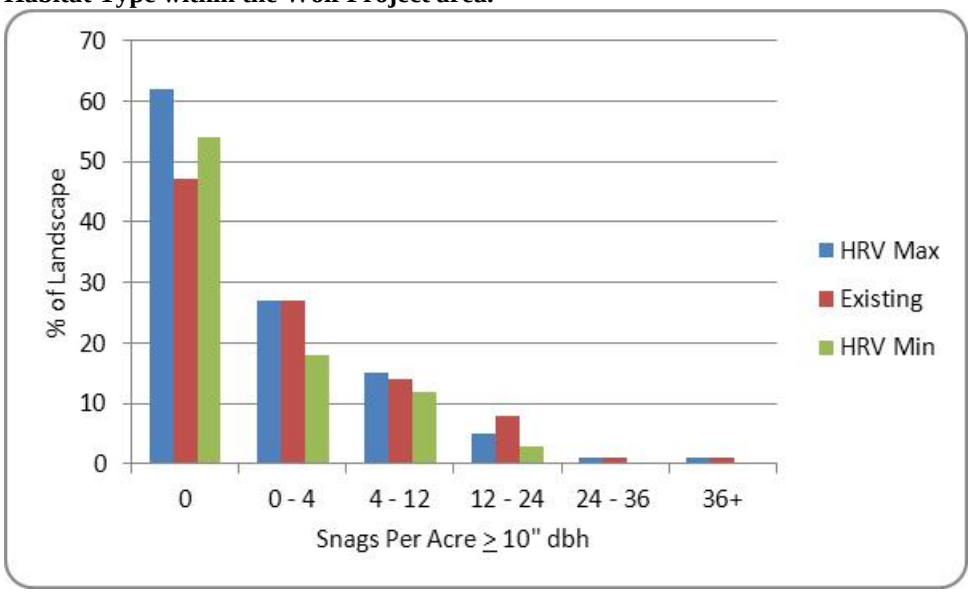


Table 95 and Figure 19 above also display the snag distribution, existing condition, and the HRV within the **Ponderosa Pine/Douglas-fir** habitat type where snags are ≥ 10" dbh. In summary the Wolf project area is:

- Below HRV in the:
  - 0 snags per acre
- Above HRV in the:
  - 12-24 snags per acre
- Within HRV in the:
  - 0-4 snags per acre
  - 4-12 snags per acres
  - 24-36 snags per acre
  - 36+ snags per acre

Figure 17. Distribution of Snags Greater Than or Equal to 20" dbh for the Ponderosa Pine/Douglas-fir Habitat Type within the Wolf Project area.

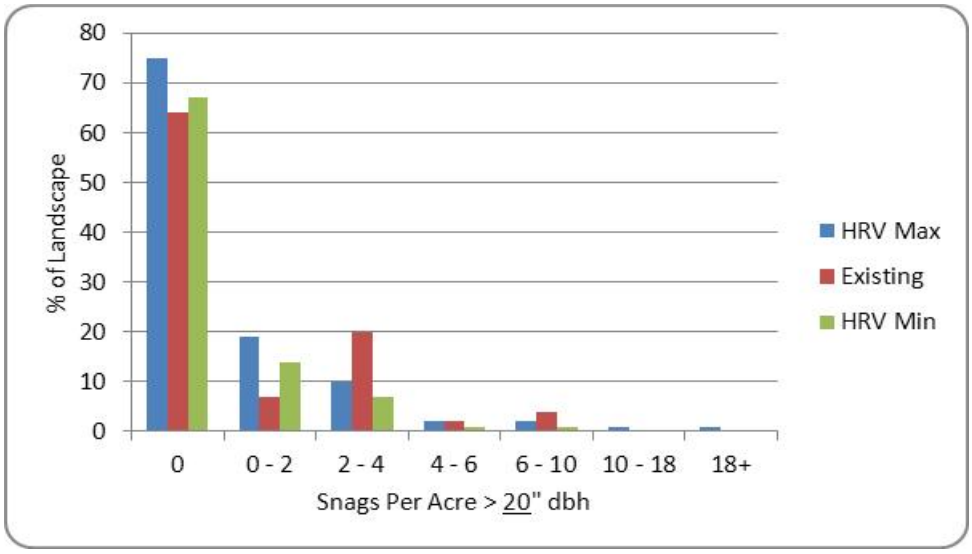


Table 95 and Figure 20 above also display the snag distribution, existing condition, and the HRV within the **Ponderosa Pine/Douglas-fir** habitat type where snags are ≥ 20" dbh. In summary the Wolf project area is:

- Below HRV in the:
  - 0 snags per acre
  - 0-2 snags per acre
- Above HRV in the:
  - 2-4 snags per acre
  - 6-10
- Within HRV in the:
  - 4-6 snags per acre
  - 10-18
  - 18+

Direct, Indirect, and Cumulative Effects

Alternative 1

Under the no action alternative, no management activities are proposed. In the short term, snag levels would change slowly over time. The assumption is that snag creation due to endemic levels of insects, disease and stress mortality generally equals the loss of snags through natural processes. Due to the increased number of dense stands in the planning area however, wildfire risk is also increased which could lead to increased snags in larger areas than with active management. Alternative 1 has the greatest potential for the development of high density snag patches.

Conclusion

Alternative 1 would not affect Primary Cavity Excavators and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Alternatives, 2, 3, & 4

The effects from Alternatives 2, 3, and 4 are similar; therefore the discussion will be combined. Under all action alternatives harvest units would not have snags marked for removal, except as required to meet OSHA requirements for safety. Harvest treatments would not directly alter the available snag habitat. Additionally, project design features incorporate strategies to retain snags. For example, variable density thinning prescriptions would be utilized in all units except those units in developed recreation sites. Typically, variable density prescriptions call for a mixture of individual trees, small clumps, and leave areas (skips) to be retained as well as the creation of small openings (gaps). Skips and gaps usually amount to about five to ten percent of each unit respectively. Skips often occur around unique habitat features such as seeps or rock outcrops, or to preserve areas with high levels of downed logs, snags, or dense cover.

Project Design Features (PDF) for the Wolf project allow snag densities to meet or exceed Forest Plan standards and moves toward managing snag habitat across the landscape at higher levels by retaining all existing snags within harvest units. This management strategy recognizes the need for high densities of snags for primary cavity excavators (Forest MIS). Although PDFs require all snags to be retained, there may be a slight loss of individual snags through necessary danger tree removal during harvest activities. The number of snags which would possibly be removed would be so small that it would not affect the overall densities. In the noncommercial units unlike the harvest units, generally all snags are retained as danger trees can easily be avoided by sawyers on foot.

For action Alternatives 2 and 4 all trees greater than or equal to 21 inches would be retained and only trees less than 21 inches would be thinned. Alternative 3 on the other hand proposes to remove trees greater than 21 inches. Grand fir and Douglas-fir larger than 21 inches could be removed on up to 384 acres. However, grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where the prescription is applied there would be an average of 1 to 2 large trees per acre removed. Removal of large diameter trees from the vicinity of old trees for approximately twice the canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al. 2013). For all action alternatives the intent is to retain trees exhibiting old tree characteristics regardless of size.

Thinning would reduce tree stocking, increase growth rates on residual trees, and accelerate the development of old forest structure. These changes could potentially affect species that rely on dense, multi-stratum conditions for nesting habitat. However, not all multi-strata stands would be thinned. Alternatives 2 and 3 would retain 956 acres of LOS and the Old Growth Management Areas (MA-F6) would retain stands for the development of dense multi-stratum stands on 595 acres as well. Where only thinning occurs, harvest methods may provide more control over tree mortality and snag creation. Although, it is likely there would be some reduction in snags as result of falling hazard trees.

Commercial and noncommercial thinning and prescribed burning would reduce tree densities. Thinning overstocked trees is expected to reduce tree mortality, and thus the rate of snag recruitment. Thinning also reduces the amount of trees left standing within treatment units and thus there are fewer trees available to eventually die and become future snags. In addition fuels treatments may alter snag availability (see table 96 for treatments in the Wolf project area).

Table 95. Wolf Vegetation Management Activities by Alternative.

Treatments	Alt. 2	Alt. 3		Alt. 4
Commercial Thinning (acres)	4,706	4,322 384*	Total: 4,706	3,394
Noncommercial Thinning (acres)	988	988		1,177
Juniper Cutting (acres)	481	481		481
Hardwood (acres)	75.5	90.2		92.3
Underburning only (acres)	5,000	5,000		5,853
Hand-piling (activity slash)	126	126		137
Total Treatment (Acres)	11,252	11,266		10,998

The alternatives set treated stands on different courses for rate of large snag development and overall snag recruitment. Indirect effects of the proposed harvest treatments would increase growth rates on residual live trees, which would accelerate increased growth of future large snags on those sites. Treatments would decrease the number of potential small snags in the short term but the amount of area with small snags >=10” but <= 20” are above or within HRVs, with the exception of the very high density category for both the EMC and PPDF habitat types. Treatments are designed so stands would be more open with increased distances between trees, therefore reducing stress and risk of mortality from insects and disease. Thinned stands should generally stay healthy longer, and thus would not provide snags as quickly as unhealthy stands. Also, as a result of the thinning there would be less trees left following treatment than there would be prior to treatment and thus there would be fewer trees available to become snags in the future. Trees that are removed from thinned stands would not contribute to future snag habitat. Compared to untreated stands, thinned stands are not likely to provide a large number of dead trees quickly. These treatments would also lessen the chances of large wildfires in the area. This could mean less snag pockets and possibly lower snag densities per acre in the short and long term especially in the mixed conifer habitat types.

The net result is that treated units would provide fewer, but larger snags in the future compared to untreated stands with similar initial stand density and tree size. Refer to the Silviculture Report for more details on predicted response of released trees to thinning.

Fire has more influence on snag densities than any of the other proposed activities. Fuels treatments that affect snag densities are activity fuels burning and natural fuels burning. Activity fuels underburning would reduce the forest debris (slash) from harvest and noncommercial thinning. Activity fuels projects provide the greatest chance of retaining the existing snags – especially in the larger categories. Flame lengths are generally low. Large trees can be lost however if the duff layer is too dense around the large trees or if the slash is too close to the retained trees. In an effort to retain large snags and down wood that are susceptible to loss from prescribed burning, lighting techniques would vary to retain snags and as stated in Amendment #2; fire prescription parameters would ensure that consumption would not exceed 3 inches total (1 ½" per side) of diameter in featured large logs. Amendment #2 standards for retaining logs include: Retain woody debris during thinning with these parameters: 1) ponderosa pine, 3-6 pieces/acre, 12 inch minimum diameter at small end, greater than 6 feet in length, for a total of 20-40 feet/acre. 2) Mixed conifer, 15-20 pieces/acre, 12 inch minimum diameter at small end, greater than 6 feet in length, for a total of 100-140 feet/acre. 3) Lodgepole pine, 15-20 pieces/acre, 8 inch minimum diameter at small end, greater than 8 feet in length, for a total of 120-160 feet/acre.

Natural fuels burns consist of utilizing prescribed fire in densely forested, dry mixed conifer stands, with heavy fuels on steep slopes and limited road access. Prescribed fire in these stands would be a multiple entry process over a period of several years, starting with one or two burns to reduce large fuel concentrations under moist conditions, to protect large old trees. Prescribed burning can alter or remove vertical and horizontal stand structure including snags and down wood. Studies by Hardy and Reinhardt (1998) document both the loss of existing snags during prescribed burning and recruitment of new snags through fire caused mortality. The level of loss and the replacement is dependent on fire intensity, time of year, local weather conditions, and fuel load. In prescribed burn only areas it is assumed there would be the largest number of snags recruited. This pulse of snags would provide foraging for numerous woodpecker species, however, snags likely would be too small to provide suitable nesting habitat. However, multiple entries with prescribed fire (repeated burning), which is often the only way to reduce fuels effectively without thinning, may reduce the structural complexity of the forest over time (Pilliod et al. 2006). In areas where both thinning and prescribed burning occur, it is assumed that snag loss would be highest and stand structure would be most similar.

During both activity fuels and natural fuels burns snags and down wood may be consumed by prescribed fire. This should be partially offset by the creation of snags and down wood due to fire-killed trees. The effect of fire on snag retention would likely result in a higher number of hard snags, with a concurrent reduction in soft and hollow snag habitat. Because of anticipated low fire intensity, it is also likely that while large existing snags may be consumed by fire, the snags created by fire would tend to be in smaller size classes and/or fire intolerant species (such as grand fir) due to the higher vulnerability to fire mortality of smaller and thin barked trees.

In the short to mid-term (1-25 years) treatments may affect old growth species dependent on high canopy cover and structure, such as the Williamson's sapsucker. Species preferring large trees in open habitat type's i.e. white-headed woodpecker, hairy woodpecker, Lewis' woodpecker, and northern flicker, would benefit immediately as a result of treatments. In the short term, species preferring riparian habitats and hardwoods would not likely see much benefit but in the long term they would benefit as a result of stream restoration, and aspen and hardwood treatments. In prescribed burn only areas it is anticipated a large pulse of small diameter snags would benefit black-backed woodpeckers. However, this benefit would diminish with each additional prescribed burn entry.

When comparing the existing condition and the HRV of snag densities in both the EMC and PPDF habitat types, with the exception of acres where snag densities = 0, in most instances the Wolf project area is within or above the ranges for the HRV. In the EMC habitat type, where snag densities are 36+ in the ≥ 10' dbh size class and the 10-18 snags per acre in ≥ 20" dbh size class, current snag densities are below the HRV. The Wolf project would have a negligible impact on the snag densities within those ranges for those size classes because of project design features; however, they are not likely to increase densities in those size classes either. To attain those high densities of snags the contributing factor would likely be fire. This projects goal is to reduce forest vegetation density and fuel loadings to reduce the risk that disturbance events such as insect, disease and wildfire would lead to a loss of desired forest conditions. As a result of treatments and continued fire suppression, species dependent on large high density stands of snags, such as the pileated woodpecker, could be negatively affected. However, tree species and stand structure would better mimic the HRV and as a result treatments are considered beneficial to old growth dependent species in the long term (25+ years). In the EMC habitat type, the action alternatives would continue to provide habitat for all primary cavity excavators at the 80% tolerance level. With the exception of the 0-2 snags per acre density class, Alternatives 2, 3, and 4 would maintain snags in both size and abundance within or above HRV in the PPDF habitat type. Adequate habitat would continue to be available to meet the 80% tolerance level for all primary cavity excavators associated with the PPDF habitat.

All action alternatives propose to reduce open road densities. The effective closing or decommissioning of roads would secure potential habitat from the risks of firewood cutting and hazard tree removal. However, during project implementation roads not normally open could receive higher than normal traffic making some areas that were off limits to firewood cutting open.

Cumulative Effects

The only project that could have affected snags since the data was collected in 2004 is the Upper Beaver Timber sale, which implemented 43 acres of timber harvest and 142 acres of noncommercial thinning. The Upper Beaver timber sales purpose and need was similar to the Wolf project and many of the project design features, including those for snag retention, are the same as Wolf. As a result, snag loss on those acres treated in Upper Beaver were likely negligible. Treatment of the thinned stands, while not as susceptible to insects and disease, now should in the long term grow larger trees and eventually provide for larger snags in those areas.

Current actions that continue to negatively affect snag numbers are hazard tree removal along major forest roads and public firewood collection. Although firewood regulations have restricted firewood cutting to within 600 feet of main roads, there is some illegal firewood cutting occurring on open and closed roads and snags other than lodgepole (which in some cases takes care of the hazard trees) are being harvested. The Travel Management EIS (2011), as well as the Rager Cooperative Travel Management Area, apply to the Wolf project area. Both preclude off-highway vehicles from travelling cross-country in the project area. As a result, habitat conditions for nesting PCE's could benefit by limiting the disturbance and destruction of nests as well as further reducing access to the illegal cutting of snags for firewood. Cumulatively, open road densities would decrease promoting the longevity of snags within the project area.

When the past, current and reasonably foreseeable actions are considered in combination with the action alternatives there is not expected to be a significant change in snag densities across the watershed. The high density snag category within the EMC habitat type is currently below HRV. The high density snag categories are typically created from wild fires and are not expected to occur from prescribed fire activities that are part of the proposed actions. Returning fire to the watershed has the potential to create small snag patches within the watershed but is not expected to move overall snag densities in the high density category towards HRV.

There would be open areas with fewer, but larger snags in the future (in treated areas), and there would be areas with numerous, but smaller average diameters of snags and down wood (in untreated areas). As a whole, this complex distribution of dead wood habitat should provide for the range of species listed above at the landscape scale, and proposed treatments should not move snag habitat away from HRV. Since only young trees are proposed for thinning, opportunities to provide snags in deficient areas, and sources for recruitment of future snags would be retained. For these reasons, this project is determined to be consistent with the LRMP as amended by the Regional Forester's Plan Amendment 2, and would not foreclose options to meet snag levels described in the VEMG in the long term.

Conclusion

Because this project provides habitat for PCE's at the 80% tolerance level and result in a small negative trend of habitat (due to the reduced rate of snag recruitment and the felling of hazard trees). The loss of habitat would be insignificant at the scale of the Forest and snag levels would likely remain within or above the HRV for most size classes. The Wolf Project is consistent with the Forest Plan, and thus continued viability of Primary Cavity Excavators is expected on the Ochoco National Forest.

Northern Flicker (Colaptes auratus)

The northern flicker was selected to represent species that utilize old growth juniper habitat (Forest Plan FEIS 3-21 and 4-96). The flicker is probably the only primary cavity excavator that is capable of creating cavities in juniper (Thomas 1979, FEIS pp 3-21).

Life History and Habitat

This species utilizes a wide variety of plant communities and successional stages. It prefers open habitats, and is commonly found foraging on the ground in open woodlands, meadows, fields and regeneration harvest areas (DeGraaf et al. 1991 and Csuti et al. 1997). Thomas et al. (1979) report this species using all forest successional stages for foraging, and young (40-79 years) and old-growth (160+ years) for reproduction. Limited reproductive use of earlier stages is due to the absence of snags that this species requires for nesting. Nesting occurs in open areas in snags with some decay.

Existing Condition

Northern flickers are observed in almost all forest types. Habitat for this species is well distributed throughout the project area. However, because this species is an MIS for old growth juniper habitat, only those activities occurring in juniper habitat will be analyzed in this project.

There are 508 acres of juniper woodland and 3,588 acres of juniper steppe PAGs scattered across the analysis area. Of the 4,096 acres of total juniper habitat, viable analysis indicates that there are no acres of LOS stands identified. The historic range of variability for LOS associated with the juniper PAGs ranges from a high of 492 acres to a low of 194 acres.

This is an under representation of the amount of juniper that occurs within the project area. Historically, juniper would have occurred on less acreage throughout the project area than what currently exists due to periodic fire that removed young juniper. Most of the expansion has been into the ponderosa pine habitats and the interface between non-forest PAGs with other forested PAGs. There is also a juniper component scattered within the 3,598 acres of non-forested lands that occur within the project area. A majority of the juniper associated with the non- forested lands are old growth juniper due to infrequent fires that would have historically occurred within this vegetation type.

Habitat for the northern flicker occurs throughout the Ochoco National Forest in minor amounts in the following plant associations; juniper steppe, juniper woodlands, lodgepole pine, ponderosa pine, Douglas-fir, and grand fir where the stands average tree size is 15" dbh or greater. Approximately 11,569 acres of habitat occurs on the Ochoco National Forest.

Direct, Indirect and Cumulative Effects

Alternative 1

Habitat for the northern flicker would not be treated and current trends in habitat condition would continue. Younger juniper would continue to occur at higher densities as a result of fire suppression. Juniper would continue to out-compete grasses, forbs, and shrubs. In the short term, there would be no change to LOS habitat. In the long term, stands would move towards LOS but stands would continue to be denser than what historically existed.

Alternative 1 would not affect the northern flicker and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Alternatives 2, 3, & 4

All action alternatives propose to remove post settlement juniper on 481acres. Younger junipers up to 20.9" dbh would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size, providing potential nesting structure for the northern flicker. Concentrations of felled juniper slash would be burned. Burning is expected to occur in patches; a continuous fuel bed of slash is not anticipated due to the low density of juniper. The vegetative objective of this treatment is to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation. Other past, present, and foreseeable activities identified in the cumulative effects table do not remove old growth juniper. There would be no cumulative effects associated with those activities.

Conclusion

Alternatives 2, 3, & 4 of the Wolf project would not contribute to a negative trend in viability on the Ochoco National Forest for the northern flicker because all old growth junipers would be retained.

Golden Eagle (*Aquila chrysaetos*) & Prairie Falcon (*Falco mexicanus*)

The golden eagle and prairie falcon were chosen as a terrestrial management indicator species (MIS) on the Ochoco National Forest (ONF) for cliff, talus or cave habitat (Forest Plan 4-245).

Life History and Habitat – Golden Eagle

Golden Eagles inhabit shrub-steppe, grassland, juniper, and open ponderosa pine and mixed conifer/deciduous habitats. It forages in a variety of habitat types and successional stages, preferring areas with an open shrub component that provides food and cover for prey. Suitable nesting and foraging habitat can be found in mountains, canyons, and rolling hills. Of 506 occupied nests in 1982, 35% were in mature trees and 65% on ledges along rims and cliffs (Isaacs & Opp 1991). Nest trees are typically large live ponderosa pine with sturdy open branching and a trunk dbh >30 in. Golden eagles have large breeding territories ranging from 10-41 square miles. Nest territories may contain several alternate nests. Golden eagles forage on a variety of species including: jackrabbit, cottontail, California and Belding's ground squirrels, marmots, woodrats, small mammals, fresh carrion, and a variety of bird species (Marshall et al. 2003).

Life History and Habitat – Prairie Falcon

Prairie falcons are most common in rimrock country, where they nest, but may travel great distances in search of prey (Marshall et al. 2003). A combination of rimrock or other outcrops and adjacent open country provides ideal breeding habitat. Cliffs need not be large.

Denton (1976) found 59% of nests occur on cliffs less than 100 ft, some as low as 15 ft high. The principal requirement is that the nest site be sheltered from above (Bent 1938, Webster 1976). This appears to reflect a need for shade and possibly protection from predators (Marshall et al. 2003). Grasslands are preferred habitat although they also occur in less-producitve areas dominated by sagebrush (Marshall et al. 2003). Prey most often consists of ground squirrels, but they will prey on birds as well (Marshall et al. 2003)

Existing Condition

On the Ochoco National Forest, including the Crooked River National Grassland, there are historic records for 147 golden eagle nest sites. The majority of the nests occur in the rimrock habitat present in Jefferson County. Only 12 nests occur in Crook County and none of them are within the project area. One historic territory is recorded at Big Summit Prairie, about 12 miles northwest of the project area.

Prairie falcons have been seen in the area and are likely utilizing the grassland and sagebrush habitat. No known nests occur in or adjacent to the project area.

Based on GIS and aerial photo analysis, nesting habitat in the form of rock features are absent in the project area. However, suitable foraging habitat for both the golden eagle and prairie falcon, as well as nesting habitat for golden eagle, in the form of mature ponderosa pine, does occur in the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Under all alternatives, the Forest Plan provides guidance for the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting individuals.

There are no known golden eagle or prairie falcon nests within the project area. Cliff faces and ledges suitable for prairie falcons or golden eagles do not occur within the project area. Thinning of overstocked stands and prescribed burning could improve foraging opportunities by making the habitat more open. Juniper thinning, riparian restoration and aspen stand enhancement could improve habitat for prey species associated with golden eagle and prairie falcons. However, the project area is likely to have a relatively minor influence on potential nesting and foraging habitat for golden eagles and prairie falcons due to a lack of rock cliff features within the project boundary.

Conclusion

For these reasons implementation of any alternative proposed in the Wolf project would not contribute to a negative trend in the viability of either the prairie falcon or golden eagle on the Ochoco National Forest.

Bald Eagle *(Haliaeetus leucocephalus)*

The bald eagle was analyzed in the Threatened, Endangered, Proposed, and Sensitive Species section of this document. That analysis determined that project activities may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH). In the long term, treatments would help retain and promote growth and longevity of large trees and would have a Beneficial Impact (BI) on Bald Eagles.

Therefore, implementation of any action alternative proposed in the Wolf project would not contribute to a negative trend in the viability of the bald eagle on the Ochoco National Forest.

Rocky Mountain Elk (*Cervus elaphus*) **& Mule Deer** (*Odocoileus hemionus*)

Mule deer and Rocky Mountain elk are species that are commonly hunted and were chosen as terrestrial management indicator species (MIS) for populations of big game and their habitat (Forest Plan 4-245). The desired condition is to provide foraging, thermal cover, and security habitats to maintain healthy populations of Rocky Mountain elk, mule deer, and pronghorn that are consistent with population management objectives established by the Oregon Department of Fish and Wildlife (ODFW) (Forest Plan 4-37).

The Ochoco National Forests objective is to manage elk and deer habitat to meet the population objectives of the ODFW to the extent practicable. Big game management on the Ochoco National Forest is a cooperative effort between the Forest Service and the ODFW where the Forest Service manages habitat while ODFW manages populations. The agencies cooperate by managing big game according to pre-established Management Objectives (MOs) for each big game management unit. The management objective (MO) is the number of elk and deer that ODFW manages for to prevent depletion of big game animals and to provide optimum recreational and aesthetic benefits for the public (quality hunting and wildlife viewing opportunities in the present and in the future). The project area is in the Ochoco Big Game Management Unit (GMU). Table 97 displays MOs for elk, deer, and antelope populations in the Ochoco GMU.

Table 96. Management Objectives for elk, deer, and pronghorn antelope in the Ochoco Big Game Management Unit.

ELK			
Year	**Population**	**Bulls per 100 cows**	**Calves per 100 cows**
Management Objectives	**4,600**	**20**	**N/A**
2012	3,033	12	19
2011	3,900	26	42
Deer			
Year	**Population**	**Bucks per 100 does**	**Fawns per 100 does**
Management Objectives	**20,500**	**15**	**N/A**
2012	15,000	20	44
2011	15,400	26	38
Pronghorn Antelope			
Year	**Population**	**Bucks per 100 does**	**Kids per 100 does**
Management Objectives	**N/A**	**N/A**	**N/A**
2012	N/A	35	46
2011	N/A	47	49

Life History and Habitat

Elk occur throughout Oregon and are most abundant in the Blue and Wallowa mountains and in the northern coast range (Verts & Carraway 1998). Elk require a mosaic of early forage-producing stages and later cover forming stages (Harper 1987). Deer occur throughout Oregon east of the Cascade Range, and in summer range into the Cascades (Verts & Carraway 1998). Mule deer occupy a wide range of habitat types but in general prefer more open and rugged areas (Verts & Carraway 1998).

Existing Condition

Thomas et al. (1988) developed the Habitat Effectiveness Index (HEI) model for estimating elk habitat effectiveness on the landscape. Overall, habitat effectiveness (HEcsrf) incorporates four variables or indices: cover quality (HEc), size and spacing of cover (HEs), density of roads traveled by vehicles (Her), and quality and quantity of forage (HEf). The Forest Plan establishes minimum habitat effectiveness standards for various Management Areas (see table 98). In addition, the Forest Plan identifies minimum standards for cover and open road density.

Quantity and quality of cover, and open road density are the main factors influencing the habitat effectiveness index (HEI). The Forest Plan page 4-258 states that, "It is expected that individual projects will be above and below these values, but that the overall objective (HEI) for the management areas will be met". The Forest Plan does not identify a model for deer habitat analysis.

Elk and mule deer use the project area throughout the year. The MO for the Ochoco WMU is 4,600 elk and 20,500 deer. Currently, elk and mule deer populations are below the management objectives in the Ochoco GMU (see table 98); it is unlikely that forage availability within the project area is limiting population size. Instead, the legal harvesting of animals, poaching, predation, and the quality of wintering habitat on private and BLM land are likely the primary factors limiting population size. The Forest Plan objective is 2,600 elk and 18,300 deer across the Ochoco National Forest (LMRP 4-37). In the third decade (current decade) of Forest Plan implementation it was expected that there would be 2,900 elk and 18,300 deer across the Forest. Mule deer populations have been generally declining across the Western States. This decline is evident in the Ochoco WMU as well. The elk population steadily increased from the 1970's through the early 2000's and has leveled off since. The current population numbers of both elk and mule deer are below the management objectives for the Ochoco GMU; however, they exceed the Forest Plan objectives.

The project area is broken into Winter Range (F20), General Forest Winter Range (F21), and General Forest (F22). Winter range is primarily at lower elevations, less than 5,200 feet, where forested areas are interwoven with non-forested grasslands and shrublands. The project area contains: 7,504 acres of Winter Range, 701 acres of General Forest Winter Range, and 13,002 acres of General Forest. Though the entire project area (24,506 acres) is occupied by big game throughout the summer, this analysis will only focus on those management areas identified in the Forest Plan that have standards associated with them. On the Ochoco National Forest there are 36,372 acres of Winter Range, 82,623 acres of General Forest Winter Range, and 356,888 acres of General Forest.

Calving and fawning can occur throughout the project area, but most consistently they occur in proximity to riparian areas; these habitats provide the highest quality forage and cover. Aspen stands and other riparian hardwoods such as willow are also likely to be attractive areas for calving and fawning. Pronghorn kidding may occur in more open and dry habitat where predator detection is better.

Elk and mule deer use the project area throughout the year. Seasonal movements are primarily influenced by snow depth. During winters with below average snow fall, both species can remain in the southern portion of the project area throughout the year. During winters with normal to above normal snow accumulations, the majority of animals move to lower elevations on the Forest, private or BLM managed lands.

Upland shrub species that provide forage for big game such as mountain mahogany, ceanothus, upland willow and bitterbrush do not occur in large numbers within the project area. Mountain mahogany was likely represented by higher populations and wider distribution historically because there were more open ponderosa pine stands and shrub steppe habitat that occurred at lower elevations. Bitterbrush did not cover large areas historically and remains limited within the watershed.

Open road densities were calculated using the district access travel management database. It is important to note that for the purpose of this analysis, only open roads were considered. The analysis did not account for ineffective road closures, limited enforcement, vegetation and relative flat topography that contribute to non-authorized use of Maintenance level 1, closed roads. . Table 98 displays open road densities by alternative. Because of the aforementioned reasons, the road densities do not give an accurate indication of the amount of vehicle use and the potential disturbance effects to big game habitat. Many of the three digit roads receive very light use until the beginning of archery

season, at which time road use increases. OHV use within the project area has also increased in the last 10 years, which is also primarily associated with the beginning of archery season and related hunting activities. Many studies have documented that elk avoid areas near open roads (Wisdom 1998, Ager et al 2003). Elk may be spending more time on private land in response to traffic on federal lands. This may also be a response to hunting pressure, forage quality and availability, and an increase in disturbance from motor vehicle use, or a combination of these factors.

Table 97. Existing Cover, Road Density, HEI Value and Goals (HEI values are average values for the watershed) based on values within HEI Tables – PIN #11 (September 13, 1990).

Management Area	Cover % of MA	Open Road Density (miles/mile^2)	HEI Value
General Forest			
Forest Plan Standards[1]	20%	3	7
Alternative 1	34%	1.86	89
Alternative 2	24%	1.82	38
Alternative 3	24%	1.73	38
Alternative 4	28%	1.73	77
Winter Range			
Forest Plan Standards[1]	19%	3 (1)*	7
Alternative 1	25%	1.28	24
Alternative 2	21%	1.15	25
Alternative 3	21%	0.97	25
Alternative 4	23%	0.97	26
General Forest Winter Range			
Forest Plan Standards[1]	18%	3 (1)*	7
Alternative 1	29%	2.84	43
Alternative 2	13%	2.84	9
Alternative 3	13%	1.99	11
Alternative 4	14%	1.99	11

[1]The goal for winter range road densities is 1 mile per square mile from Dec. 1 - May 1 and 3 miles per square mile for the remainder of the year.
[2]Forest Plan Standard and Pin #11 Objectives for the 3rd Decade

Direct, Indirect and Cumulative Effects

Alternative 1

No commercial thinning or noncommercial thinning would occur. With no activities proposed, cover percentages, quantity and quality of forage, and open road densities, which are all used to evaluate habitat effectiveness of elk, would remain in their current condition (see table 98). Elk habitat would remain the same; therefore, there would be no impact to elk populations.

In the mid to long term (with continued fire suppression), development of multi-strata stands would create additional marginal cover stands (stands with greater than 40% canopy cover) and potentially satisfactory stands (greater than 70% canopy cover) increasing both thermal and hiding cover. Long term changes could improve cover over time, although with improved cover or potentially larger homogeneous stands of cover, there would be less forage which could conceivably reduce HEI values.

The current quantity and quality of forage within the project area would be unchanged. However, forage habitats would be affected in the short to mid-term as a result of increased tree densities and canopy cover (increased development of marginal and satisfactory cover). In the mid to long term, forage would decrease as tree canopies close and increase shade along the ground.

Increased tree stocking may increase the chance of a high severity wildfire. A fire of moderate to intense magnitude and severity could convert multi-strata cover habitat to stand initiation forage habitat in the short and mid-term, thereby increasing available forage.

No prescribed fire would occur. With no activities proposed, cover percentages which are used to evaluate habitat effectiveness of elk, would remain in their current condition (see table 98). Possible benefits to forage quantity and quality would not occur.

Open road densities would be maintained at current levels as described in the existing condition section. Implementation of this alternative would construct no new temporary roads, but at the same time, it would do nothing to modify existing open road densities or road management. Relationships between the spatial distribution and disturbance associated with open roads and hiding cover habitat would also not change, as existing road densities and levels of use are expected to remain the same in the short, mid, and long term.

Aspen stands would remain in their current condition. Grazing and browsing of aspen stands would continue. Conifer encroachment into groves would remain and continue to increase. The overstories of each stand would remain even aged and be approaching the end of their life cycle. Aspen would continue to decline and stands could slowly disappear.

Conclusion

Alternative 1 would not affect habitat of the Rocky Mountain elk or mule deer and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Alternatives 2, 3, & 4

All of the action alternatives would reduce cover (see table 98). This analysis is based on the assumption that cover, in the all proposed harvest treatment units, would be reduced below the 40% canopy cover needed to classify as marginal cover. Additionally, it is assumed that noncommercial thinning and prescribed burning would not affect cover, in the short term, because the trees that provide canopy cover that are greater than 40 feet tall would not be cut during noncommercial thinning (PCT) or killed by prescribed burning.

The reduction of cover would decrease security and increase the potential for human disturbance for both deer and elk. Disturbance is primarily related to activities associated with hunting seasons and to a lesser extent other recreational activities. Increased disturbance due to decreases in cover could increase the movements of elk and deer onto adjacent BLM and private lands. Cover quality and quantity is expected to increase over time as the forest canopy recovers and the ingrowth of conifer seedlings occurs. Commercial thinning, noncommercial thinning, and prescribed burning, while reducing cover, would improve forage conditions throughout the project area. With the exception of General Forest Winter Range, cover standards within each MA would be met for each alternative. General Forest Winter Range would see a reduction from each action alternative below the prerequisite 18% to as low as 13% in both Alternatives 2 and 3.

Cover requirements may not always be compatible with the HRV. This conflict is readily apparent in the hot-dry and warm-dry biophysical environments dominated by ponderosa pine. Historical conditions and fire return intervals favored large blocks of single story, mature stands with canopy closure too low to support large blocks of satisfactory and marginal cover. Under historical conditions, cover percentages would be inherently low, probably below Forest Plan standards. Today, cover requirements are being met on many ponderosa pine sites; however, stands are overstocked and at high risk to bark beetle attack and uncharacteristically severe wildfires. Unfortunately, tree thinning, the treatment that most effectively reduces beetle and fires risk, also reduces the effectiveness of a stand as cover.

The noncommercial thinning of small trees would have the greatest impact on hiding cover in the short term. In the long term, noncommercial thinning is expected to increase growth on younger trees and increase the development of crowns in the long term. Those areas where thinning would occur would be expected to transition back to marginal cover in approximately 25-50 years depending on the residual stand density, species composition, site quality, etc., following treatment.

Prescribed fires are expected to burn relatively cool, move slowly, and burn in a mosaic of burned and unburned patches. Burning would primarily be conducted in dry forest vegetation types that were historically dominated by open-park like stands of large diameter trees. Prescribed burning can reduce hiding cover when allowed to burn at moderate to high intensity in thickets of young understory, but rarely reduce the stocking of understory trees at the upper level of management objectives. Burning would improve forage conditions by reducing forest litter (needles and limbs), opening canopies, and allowing more light to the forest floor. Most native grasses and forbs and many shrubs respond positively to increased light and fire.

Open road densities vary by alternative within each MA (see table 98). For all action alternatives, open road densities would decrease within the project area. Open road densities within General Forest are further reduced below Forest Plan standards for each alternative. Open road densities would be further reduced within Winter Range, although Forest Plan standards would only be met for Alternatives 3 and 4, not Alternative 2. Within General Forest Winter Range road densities are reduced, approaching Forest Plan standards; however, it is not likely that those standards would ever be met for the Wolf project area. General Forest Winter Range within the project area is a narrow strip and 3 main roads occur within that strip including: the 58 road (an operational maintenance level 5 road), the 42 road (an operational maintenance level 4 road), and the 3810 road (an operational maintenance level 2 road). Otherwise, both Alternatives 3 and 4 close all remaining roads within General Forest Winter Range within the Wolf project area.

Within the first 10 years new temporary road construction would decrease big game security. When timber sales are active, log haul activities would temporarily increase local traffic levels. Disturbances to big game would be expected to increase over the current condition. Disturbance to big game is a concern in both Winter Range and General Forest Winter Range and therefore, timber management activities would be restricted from December 1 to May 1 to minimize disturbance. Elk are likely to shift use areas as activities progress across the watershed (USDA 2006). As timber sales are completed, specified haul roads would be closed within the first 5 years, road closures to be completed with harvest activities would be about 50% complete. By year 10 all roads scheduled for closing would be 100% complete. As roads are physically closed, disturbances to deer and elk from vehicular traffic and mortality from hunting would be expected to decrease from current levels. The physical closure of roads would in part off-set losses in hiding cover that occur due to timber harvest and prescribed fire resulting in increased security.

Quaking aspen can be found sparsely scattered within the project area; the project area contains approximately 5 acres of mapped aspen habitat, though additional acreage is known to exist. They are primarily located along streams, at springs, rock outcrops, within meadows and scattered amongst upland forest stands. Aspen stands are relatively small in size with the largest one at less than 1.5 acres. Aspen stands within the project area are characterized as being heavily over-browsed and encroached upon by conifers, leading to declines in health and vigor. Besides improving forage, all action alternatives propose aspen treatments that could be beneficial to calving and fawning as well. Hardwoods treatments would enhance current hardwoods that exist, although the treatments occur on a small percentage of the entire project area. In the first 10 years many of these trees would be fenced and essentially off limits to elk, but as new regeneration becomes established and protective fences deteriorate or are removed, available browse should increase. Aspen groves would be larger and healthier and more likely to remain a viable component of the landscape. Project design features would ensure the implementation of wildlife friendly fences, negating any harmful affects to big game.

Repair of headcuts and stream restoration to stop channel down cutting and provide for stable water tables would occur at 5 sites and help ensure that hardwood release and planting projects would be successful. It is anticipated that there would be an increase of forage as a result of stream restoration activities, and a potential of increased hardwoods. These riparian areas would become more desirable for calving and fawning.

With the exception of Winter Range, action alternatives propose to reduce the habitat effectiveness for each management area. Within Winter Range there are slight increases of habitat effectiveness for each action alternative. Road closures and the amount of cover are likely contributing to the increased habitat effectiveness in winter range. The results of the HEI analysis for each action alternative show that the decreased HEI values likely would affect elk within the project area. However, HEI values exceed Forest Plan standards and overall stand treatments would more closely resemble the HRV.

Cumulative Effects

For the purposes of this analysis, the cumulative effects boundary includes the Wolf and North Wolf subwatersheds. Past and present management activities that have affected elk habitat within the project area include: harvest activities, road construction, fire suppression, and livestock grazing. Past harvest activities have led to the existing road densities, cover values, and HEI values referred to in the existing condition.

Past harvest activities reduced the quality and quantity of cover within the project area, but also improved the quality and quantity of forage. It should be noted that the project area has a natural low potential for producing cover, due in part to the scab stringer nature of the topography. There is approximately 15,613 acres within general forest within the project area. Of those acres, approximately 1,825 acres (12%) of General Forest is within vegetation types that either do not have the potential to produce cover or have a low potential for producing cover. Currently, 39% of the approximate 13,788 acres capable of producing cover are producing cover. Combined effects from timber projects would improve forage quality and quantity for big game, while reducing cover habitat and increasing big game vulnerability.

Present actions include the Upper Beaver Timber sale; the sale proposes to commercially harvest 43 acres within the General Forest Winter Range, further reducing total cover on 15 acres within this management area. However, the HEI value remains above standards even with this additional reduction in cover. Restoration of HRV in the dry forest types is expected to reduce the risk of disturbances such as uncharacteristically severe wildfire and insect epidemics that could result in an undesirable ratio of open and closed canopy habitats.

Road construction associated with past timber harvest has increased road-related disturbance on big game. Disturbance of elk by hunting along open roads and off road vehicle use has impacted big game populations. The Wolf project reduces open road densities further managing towards the Forest Plan standards; cumulatively, with the implementation of the Travel Management EIS (2011) and the Rager Cooperative Travel Management Area, elk security would be further increased. The Travel Management EIS's decision to preclude off-highway vehicles from traveling cross-country in the project area coincides with the goals of the Rager Cooperative Travel Management Area.

Current livestock grazing (Southside EA, 2009) affects the quality, condition and quantity of forage available to elk. As a result of historic grazing practices, combined with increased elk populations and effective fire suppression efforts, browse species including bitterbrush, willow, chokecherry, and mountain mahogany, have been reduced. As result, within the project area, riparian shrubs are deficient in the majority of riparian areas; riparian areas are important sources of high quality forage during calving periods. Both action alternatives propose riparian restoration and aspen treatments. The Southside EA (2009) includes adaptive and active management of livestock which should

increase cattle distribution and reduce pressure on riparian areas. As a result, it is anticipated that cumulatively, the benefits to riparian species and big game would be beneficial.

Invasive plants lead to habitat degradation by reducing the quantity and quality of forage. The Wolf project includes project design features to decrease the spread of noxious and invasive plants. In addition, the Deschutes and Ochoco Invasive Plants EIS (2012) allows for the treatment of invasive species, cumulatively resulting in fewer invasive plants and thus improving big game forage.

Foreseeable future actions include the Ochoco Summit Trail project; because of disturbance, this project may have localized impacts to big game. In addition, this project proposes the designation of varying miles of trail for off-highway vehicles. A portion of the designated trails fall within the project area and have the potential to reduce big game security. The Ochoco Summit Trail project would add up to 11.6 miles of open OHV trails including up to 5.75 miles of new trail construction all within General Forest. Additional miles of open trail would essentially increase the open road densities to a high of 2.29 miles per square mile, which would remain below Forest Plan standards. As a result of the open road density increasing, HEI could decrease to 33. Although road densities increase and HEI decreases the overall HEI value would continue to exceed Forest Plan standards.

Conclusion

The overall direct, indirect and cumulative effects would result in a small negative trend of habitat (decrease in cover and HEI, and increase in disturbance). The decrease of cover and reduced HEI, and increase in disturbance during harvest and post-sale activities would be insignificant at the scale of the Forest. The Wolf Project is consistent with the Forest Plan, and thus continued viability of Rocky Mountain elk and mule deer is expected on the Ochoco National Forest.

Other Species or Habitat Identified in the Forest Plan

The Forest Plan provides standards and guidelines for an additional suite of species identified as Other Species. This section analyzes the affects to the Other Species identified in the Forest Plan (see table 99) and may include species already analyzed as Threatened, Endangered, Proposed, Sensitive, or Management Indicator Species.

Table 98. Other Species Identified by the Forest Plan (Ochoco National Forest)

Other Wildlife Identified in the Forest Plan		
Species	**Management Direction**	**Habitat Present in the Analysis Area**
Antelope	Activities will be in accordance with ODFW population objectives.	Yes
Raptor Habitat	Protect nest sites and nesting habitat. Minimize disturbance during the nesting period.	Yes
Bald & Golden Eagles	Protect nesting and roosting sites and protect those sites from disturbance in accordance to the Bald and Golden Eagle Protection Act	Yes
Hawks and Owls	Protect nest sites and nesting habitat. Minimize disturbance during the nesting period	Yes
Prairie Falcon	Protect nest sites and nesting habitat. Minimize disturbance during the nesting period	Yes
Northern Goshawk	In 1995 the Regional Forester's Eastside Forest Plan Amendment #2 amended the Forest Plan. This amendment included interim management guidelines for northern goshawk in regards to timber sales	Yes, five documented goshawk territories.

Pronghorn Antelope (*Antilocapra americana*)

Life History and Habitat

Pronghorn antelope are established east of the Cascade Range in most of Oregon. They are usually associated with areas of open plains, but in Oregon their primary habitats are broad areas dominated by big sagebrush and intermittent lakes. They eat a variety of forbs, grasses and shrubs. Pronghorn diets consist mostly of woody sagebrush in fall and winter, with a mixture of forbs in spring and summer. Dietary overlap between cattle and pronghorn varied from 8% in winter to 25% in spring (McInnis & Vavra 1987).

Existing Condition

Pronghorn occur throughout the project area. The Forest Plan specifies that habitat for pronghorn is to be managed in accordance with ODFW Management Objectives. However, ODFW does not have Management objectives similar to elk and deer, instead population trends are monitored and hunting seasons vary according to those trends. Available information from ODFW is presented in table 98.

Direct, Indirect and Cumulative Effects

Alternative 1

Pronghorn habitat would not be treated and current trends in habitat condition would continue. Juniper expansion would continue to occur and change the proportion of trees, shrubs, grasses, and forbs. This change would decrease not only the availability of forage, but it would be less desirable because antelope prefer open areas with short vegetation to evade predators. This alternative would have no direct effects on pronghorn but could lead to habitat loss.

Alternatives 2, 3, & 4

The Wolf project proposes a variety of actions including commercial and noncommercial thinning, riparian restoration, juniper management, underburning and the closing of roads. It is anticipated that the effect to pronghorn ,as a result of all action alternatives, would be similar to those summarized for Rocky Mountain elk and mule deer (see table 98). However, prescribed burning and juniper management would likely benefit the species. All action alternatives propose prescribed fire and juniper management to meet project objectives. Prescribed burning would incorporate design features to minimize the invasion of noxious weeds and retain existing sage brush, bunch grasses, forbs, and shrubs (see Botany Specialist - report Project Design Features).

Juniper treatment would focus on post-settlement juniper. These treatments would reduce juniper densities within core habitat, benefitting bunch grasses, forbs, shrubs, and sage brush, thus increasing forage for antelope.

The effects of reducing road densities are similar to Rocky Mountain elk and mule deer as well and would increase security for antelope.

The chances of negative direct or indirect effects to the pronghorn as a result of implementing any action alternative are small. Most activities would benefit the species, but there is a slight chance of disturbance and an increase of noxious weeds as a result of implementation.

Conclusion

Effects to Antelope would be similar to Rocky Mountain elk and mule deer, although pronghorn antelope would likely benefit more as a result of juniper management.

Raptor Habitat

Raptors are birds of prey, of which numerous species occur or have been seen throughout the project area. The Forest Plan provides guidance for the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting or roosting individuals.

A variety of raptors are known to be within the area of influence of this project or have sightings within the project area including: red-tailed hawk, Cooper's hawk, bald eagle, golden eagle, goshawk, osprey, and prairie falcon. There are no known golden eagle, prairie falcon, or osprey nests within the project area. The project area does include nesting habitat for raptors. There are five goshawk territories, one Cooper's hawk nest, three red-tailed hawk nests, one bald eagle nest territory, and two bald eagle winter roost sites. The bald eagle (TES), golden eagle (MIS), Northern goshawk (Other Species), and prairie falcon (MIS) have been discussed in other sections of this report.

Existing Condition

Avian and vertebrate population densities may adjust in response to changes in vegetation structure and composition (Chambers 2002). Although some wildlife species are highly mobile and can move to more favorable habitat, many species are often restricted to small areas (Hall & Morrison 1997). In the project area, a combination of fire suppression, logging practices, insect infestations, livestock grazing, and other factors have led to a change in vegetative structure on the landscape likely leading to a change in prey species.

Direct, Indirect and Cumulative Effects

Alternative 1

This alternative would not treat forest stands and thus the current trends in forest development would continue. This alternative would maintain the existing acres of fir-dominated understories and the trend toward fir dominated habitats. This would tend to favor the forest dwelling accipiter's (Coopers hawk) and the small forest dwelling owls (pygmy owls, saw whet owls). These dense, fir-dominated understory conditions would result in a continued loss of herbaceous and shrubby vegetation in the understory. As a result, shrub and ground nesting bird populations (prey) would remain depressed, and the ability of open forest avian predators to effectively hunt ground dwelling small mammals would continue to be limited. There would be a continued decline in habitat for species which prefer open ponderosa pine habitats (flammulated owls) as ponderosa pine dominated habitats would increase in stand densities.

Conclusion

This alternative would maintain the suitability of all existing habitat for raptors in the short term and would not result in disturbance or displacement of raptors from existing occupied territories.

Alternatives 2, 3, & 4

These alternatives would commercial thin up to up to 4,706 acres, noncommercial thin up to 1,177 acres, and treat juniper on up to 481 acres on no more than 6,175 acres. Additionally, Alternative 3 proposes the removal of trees >21" dbh on 384 acres identified for commercial thinning. After thinning, up to 5,853 acres of natural fuels underburning would occur. Other activities include hardwood enhancement on up to 75.5 acres, 2.2 miles of stream restoration, and headcut repair at up to 6 locations. These are the maximum amount of acres proposed for treatment, though exact acres vary by alternative. In treated stands, thinning could reduce canopy closure below 60%. As a result of thinning, retained trees would expand their crowns in diameter and depth in response to the release from competition.

Riparian thinning and aspen treatments are intended to improve riparian shrubs and riparian hardwoods; this would improve vegetation diversity and habitat for a variety of raptor prey species. Thinning of mid-story trees would promote the development of large structure trees, large snags and down logs. Reducing competition from below is also likely to improve the longevity of existing large trees in the overstory. Thus, treatments may reduce suitability, in the short term, for the forest dwelling accipiters and the small forest dwelling owls. However, over time, the treatments may maintain overstory canopy by improving health and vigor of retained trees in the stands. The development of herbaceous and shrubby vegetation in the understory that results from reducing conifer density should also improve habitat for many species of shrub and ground nesting birds, and the ability of open forest avian predators to effectively hunt ground dwelling small mammals would also be improved. Large raptors that nest on large trees or snags in relatively open forests, such as red-tailed hawks and golden eagles, would benefit in the long term from treatments that promote the development of large trees and snags.

Cumulative Effects

Present actions within the cumulative effects boundary, defined as the Wolf project area, include cattle grazing (Southside EA, 2009). Cattle grazing activity can result in changes to herbaceous and sometimes shrubby vegetation. Grazing of grasses and forbs can alter the height of these plants and the amount of ground cover. This can impact the quality of nesting and brood rearing habitat for ground nesting birds and small mammals, which may serve as prey for raptors. However, removal of coarse vegetation by large ungulates can also improve the palatability and nutritional value of this forage for prey species that consume vegetation. By making these food resources more visible, foraging opportunities for species that feed on insects and other invertebrates may improve. Browsing of palatable species of shrubs can reduce their size, height and density. This can alter the quality of nesting habitat for shrub nesting birds that may serve as prey to raptor species. Raptors which forage on ground dwelling animals such as insects, amphibians, reptiles and small mammals often take advantage of open areas with reduced ground cover as foraging sites.

Invasive plants lead to habitat degradation by reducing native plant species. The Wolf project design features are intended to prevent the spread of noxious and invasive plants. In addition, the Deschutes and Ochoco Invasive Plants EIS (2012) allows for the treatment of invasive species, cumulatively resulting in fewer invasive plants and thus improving desirable grasses, and forbs important to raptor prey.

Alternative 1 would not add to the cumulative effects in this area. The implementation of alternatives 2, 3, and 4 would provide positive effects to past negative cumulative impacts in this area. These alternatives were developed to improve the forest/riparian/hardwood vegetative conditions in the project area faster than the no action alternative.

Conclusion

These alternatives would maintain the suitability of habitat for raptors that select for open forest environments within treated stands and for other species in untreated stands. This alternative has potential to disturb nesting raptors in occupied territories. Design features as identified in the Forest Plan are included in this project to minimize disturbance to nesting raptors.

Forest Plan Consistency

In accordance with standards and guidelines for hawk and owl nests contained in the Forest Plan, a primary buffer of five chains (330’) would be flagged around each nest site and a seasonal restriction (March 1 to August 1), within 10 chains (660’) of active hawk or owl nests, would be implemented under all action alternatives. Within the primary nest buffers, the management objective is to maintain the current habitat characteristics.

If risk of loss of overstory trees within these nest areas is imminent, then selective removal of competing understory conifers from the base of large trees and associated slash disposal may occur. However, commercial removal would not occur within primary nest buffers. The seasonal restrictions may be waived on a case-by-case basis, if appropriately timed monitoring indicates that the nest area is not reproductive during that nesting season. This assessment cannot be made until well into the nesting season. Waivers would only be valid for the year in which they are granted. For this reason, this project is expected to be consistent with the Forest Plan.

Northern Goshawk (*Accipiter gentilis*)

In 1995, the Regional Forester's Eastside Forest Plans Amendment 2 (Amendment #2) amended the Forest Plan. This amendment included interim management guidelines for northern goshawk in regards to timber sales. The northern goshawk is a raptor and the Forest Plan provides guidance for the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting individuals.

Life History and Habitat

The northern goshawk is highly adapted to forested landscapes and is found throughout the intermountain west (Hanauska et al. 2003). In the Pacific Northwest, goshawks prefer to nest in mature, unlogged, or lightly managed forested habitats. These areas include sites with closed canopies (greater than 60%), northerly exposures, gentle slopes, and close proximity to water (Reynolds et al. 1992). Canopy closure is an important factor in nest site selection and, in the desired percentages, provides security from avian predators as well as decreasing impacts from human disturbance. Nest trees are typically dominant trees in the canopy (10"- 58" dbh) and are usually in Douglas-fir, ponderosa pine, and western larch (McGrath et al. 2003).

Recent peer-reviewed research suggests that goshawks forage in a variety of forested and non-forested environments (Brewer et al. 2007). Small openings and forest edges in mixed conifer and ponderosa pine forests, in particular, appear to be important for foraging. These foraging habitats support higher plant diversities and, in turn, support a higher number of desirable prey species such as rabbits, squirrels, and grouse. Because it decreases availability of appropriate nesting habitat, timber harvest methods that create large areas of reduced canopy cover (< 35-40%) are considered a primary threat to breeding goshawks (Bright-Smith & Mannan 1994, Beier & Drennan 1997). In addition, increased human presence could also displace the northern goshawk during nesting.

Existing Condition

Amendment #2 established minimum standards for protection of the northern goshawk, stating that "until further information is known and management plans approved to ensure species viability, the following standards are to be met as a minimum." The minimum standards which are still in effect are:

- Protect every known active and historically used goshawk nest site from disturbance. "Historical" refers to known nesting activity occurring at the site in the last 5 years. Seasonal restrictions on activities near nest sites will be required for activities that may disturb or harass a pair while bonding and nesting.
- 30 acres of the most suitable nesting habitat surrounding all active and historical active nest tree(s) will be deferred from harvest.
- A 400-acre "post fledging area" will be established around every known active nest site. While harvest activities can occur within this area, retain late and old structure (LOS) stands and enhance younger stands toward LOS condition, as possible.

There are five known nesting territories with three known nest locations. 400-plus acre post- fledging areas (PFAs) have been mapped for all five known territories within the project area. Nest stands have been delineated for 2 of the 5 territories. Nests have not been located in 3 of the territories located in 2013 (see table 100). Territories lacking known nest sites would be surveyed prior to implementation of activities. For the purpose of this analysis all five territories are considered occupied.

Table 99. Goshawk Nest and Post Fledgling Status within the Analysis Area.

Territory	Last Year of Documented Activity	Size of Post Fledgling Area	Size of Nest Stand	Number of Documented Nest Cores
Clear Creek	2002	404 acres	30 acres	1
E.F. Wolf Creek	2013	403 acres	Unknown	Unknown
N.F. Widows Creek	2002	401 acres	62 acres total	2
Six Corners	2013	441 acres	Unknown	Unknown
Survey Spring	2013	431 acres	Unknown	Unknown

Additional habitat outside of PFAs exists within the project area. Queries of forest habitat databases, using the Viable Ecosystems definition of habitat (forest type and structure) identified 9,124 acres of suitable northern goshawk reproductive habitat within the project area. The 9,124 acre total includes those acres identified within the PFAs. Historically, between 1,456 acres and 3,385 acres of reproductive habitat would have been present within the project area (see table 101). The amount of suitable habitat is currently above the Historic Range of Variability.

Table 100. Northern Goshawk Reproductive Habitat using the Viable Ecosystems Model.

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	HRV (Year 1)
Alternative 1	1,456	3,385	9,124	Above
Alternative 2	1,456	3,385	6,026	Above
Alternative 3	1,456	3,385	5,642	Above
Alternative 4	1,456	3,385	6,711	Above

Direct, Indirect and Cumulative Effects

Alternative 1

This alternative would not treat forest stands within currently mapped PFAs, nesting areas, or suitable goshawk habitat outside of existing PFAs. The no action alternative would maintain the existing acres of suitable habitat within mixed conifer and ponderosa pine stands in the short term. The majority of the existing habitat consists of stands dominated by trees in the 9” to 20’ dbh range with scattered larger overstory trees exceeding 20” dbh. Lack of treatment of the mid story trees where a larger overstory exists would lead to the development of multiple canopy layers with increased canopy closure, a condition preferred by goshawks. Within the majority of habitat, the development of stands dominated by large tree structure with high canopy closures would be slow because of the high stocking levels that currently exist.

Over time, stand densities would continue to increase and the risk of mortality to the remaining overstory trees is expected to increase. Observations within the project area indicate that mortality is occurring within the larger diameter trees that are scattered across the project area. High stocking levels are likely responsible for the observed mortality. There is also an increased threat of high severity wildfires occurring as stand densities increase, ladder fuels increase and ground fuels accumulate. Dense understories, which exist in many of the PFA’s, as well as additional suitable nesting/foraging habitat outside of PFA’s, may lead to increased susceptibility of stand replacing fire and insect and disease outbreaks, which can result in the deterioration or loss of nesting habitat (Graham et al. 1999, cited in NatureServe 2010, Wisdom et al. 2000).

Under Alternative 1, open understory conditions that are preferred by foraging goshawks are expected to decrease over time as trees continue to develop in the understory.

This alternative would maintain the suitability of all existing habitat for goshawks within the PFAs. This alternative would result in short-term retention of the existing amount (9,124 acres) distribution of goshawk habitat at the landscape scale, 9,124 acres of primary nesting habitat within the analysis area. The suitability of the existing habitat would change over time, both positively and negatively. Some stands attain increased tree diameters over time, although, the diameter growth of retained trees would not be as rapid as that of retained trees in treated stands. This alternative would not result in displacement of goshawks from existing occupied territories.

Table 101. Habitat designations for Post Fledgling Areas and treatments within those areas.

			Treatment Types					
Post Fledgling Areas			Commercial		Noncommercial		Prescribed Fire	
	Total Acres	Reproductive Habitat Post Treatment	Total Acres	Within Reproductive Habitat	Total Acres	Within Reproductive Habitat	Total Acres	Within Reproductive Habitat
Clear Creek								
PFH Alt. 1	404	226	0	0	0	0	0	0
PFH Alt. 2	404	170	92	56	0	0	187	64
PFH Alt. 3	404	170	92	56/0[1]	0	0	187	64
PFH Alt. 4	404	182	78	44	0	0	193	68
E.F. Wolf Creek								
PFH Alt. 1	403	351	0	0	0	0	0	0
PFH Alt. 2	403	351	1	0.23	0	0	32	24
PFH Alt. 3	403	351	1	0.23/0[1]	0	0	32	24
PFH Alt. 4	403	351	0	0	0	0	32	24
N.F. Widows Creek								
PFH Alt. 1	401	308	0	0	0	0	0	0
PFH Alt. 2	401	282	31	26	31	29	0	0
PFH Alt. 3	401	282	31	26/0[1]	31	29	0	0
PFH Alt. 4	401	295	23	13	35	33	0	0
Six Corners								
PFH Alt. 1	441	225	0	0	0	0	0	0
PFH Alt. 2	441	85	182	140	39	33	204	48
PFH Alt. 3	441	85	182	140/0[1]	39	33	204	48
PFH Alt. 4	441	200	49	25	39	33	338	163
Survey Spring								
PFH Alt. 1	431	217	0	0	0	0	0	0
PFH Alt. 2	431	167	70	50	1	0	217	99
PFH Alt. 3	431	167	70	50/0[1]	1	0	217	99
PFH Alt. 4	431	176	61	41	1	0	226	109

Alternatives 2, 3, & 4

There are no commercial or noncommercial thinning proposed within identified nest stands under Alternatives 2, 3, and 4. However, there are a number of activities proposed within mapped PFAs. Refer to table 102 for the treatments types and acres affected. The effects are similar for all action alternatives because treatments are similar and just vary by acreage for each alternative. Prescriptions would selectively thin the existing stands from below with ponderosa pine and western larch being the tree species favored for retention. No trees > 21”dbh would be removed from PFAs although in Alternative 3, trees > 21”dbh are proposed for harvest on up to 335 acres within goshawk reproductive habitat. It is expected that commercially treated areas would express a reduction in habitat suitability at least in the short term due to a reduction in canopy closure.

Some treated stands would be structurally less complex following treatment and though still suitable, may have reduced habitat quality immediately following treatment. Commercial thinning would be followed by noncommercial thinning, prescribed burning and or hand piling.

Outside of commercial thinning units, noncommercial thinning would occur on up to 66 acres of reproductive habitat associated with the N.F. Widows Creek PFA (33 acres) and the Six Corners PFA (33 acres). Noncommercial thinning would be followed by prescribed burning and is expected to retain or improve habitat suitability for the northern goshawk. The thinning of small understory trees in stands with an existing overstory would reduce competition and improve the health of the overstory. Dense understories may obstruct flight corridors used by goshawks to hunt prey (Wisdom et al. 2000). In many cases, habitat may be improved through opening up of overly dense understory conditions and creating a patchy distribution of dense clumps and small openings in a matrix of intermediate burn conditions (a fire mosaic). Underburning is proposed on up to 789 acres of reproductive habitat within all 5 PFAs. Underburning would enhance goshawk foraging habitat by reducing seedling and saplings within the treatment areas which maintains open understory favored by goshawks. The effects to snag and downed wood habitat which can affect goshawk prey species can be variable. In most areas variability remains with the amount and distribution of downed wood following underburning activities. Canopy gaps created by prescribed burning activities can benefit some prey species. The noncommercial thinning and prescribed burning proposed under Alternatives 2, 3, and 4 are intended to decrease the risk of habitat loss through insect and disease outbreaks and stand replacing fires.

New temporary road construction would reduce habitat for goshawk prey species and have the potential to fragment existing mature stands within the Clear Creek PFA (.41 miles) and the Six Corners PFA. However, for Alternatives 2, 3, and 4 open road densities would decrease as a result of project implementation. It is expected that the overall decrease in road densities including .9 miles of decommissioning in the East Fork Wolf Creek PFA and the closure of .3 miles of road in the Survey Springs PFA would benefit goshawk by reducing fragmentation and potential for human disturbance.

Conclusion

Although treatments are proposed within reproductive habitat, PFAs, and nest stands (underburning only), goshawk reproductive habitat would remain above the HRV and exceed the maximum HRV value by 2,257 acres within the project area. Treatments occurring within designated PFA's for the territories where nests have not yet been located allow for a minimum of 85 acres of reproductive habitat (complex stand structure with high canopy cover) remaining after implementation of Alternatives 2 or 3. Considering that nest surveys would occur within unknown nest sites locations prior to project implementation in the PFA's, and project design features to protect nest stands exist, it is likely that those PFAs would remain suitable post implementation. However, some treated stands would be structurally less complex following treatment and, though still suitable, they may have reduced habitat quality immediately following treatment. Over time, stand complexity is expected to improve and may in the long run result in habitat that is higher in quality than what may develop in some untreated stands.

Cumulative Effects

Past timber sales have affected the quality and distribution of goshawk habitat within the project area. District records indicate the following harvest activities have occurred since 1986. Regeneration harvest activities have occurred on 1,298 acres within the project area. Treatments included: clearcut, clearcut with reserve trees or shelterwood. Overstory removal has occurred on 2,550 acres.

Most of the 2,550 acres of treatments would have removed most or all of the overstory trees and potential to provide suitable goshawk nesting habitat. Partial cutting has occurred on 1,011 acres within the project area. Portions of these acres could retain enough large or medium tree structure with high densities that would continue to provide suitable nesting habitat and likely provide suitable foraging habitat. The majority of acres that received commercial thinning or selective harvest prescriptions would have reduced large and medium tree structure and stand density and the quality of nesting habitat would have been reduced. These stands would have the potential of providing suitable nesting habitat in the future as the stands develop larger structure and densities over time. Additional harvest occurred in the project area beginning as early as 1950 and likely included the majority of the project area. The older harvest likely focused on individual tree selection, removing the high value trees at risk to insect mortality. Past management activities have altered the amount, quality and distribution of suitable goshawk habitat on the landscape. All PFAs and suitable goshawk habitat outside of PFAs are deficient in large tree structure either single or multi-storied stands with canopy closures exceeding 50%. The majority of the existing habitat is composed of small tree size (9”-20” dbh) with scattered large tree size (>21” dbh).

Fuels reduction projects occurring after 1995, including the Upper Beaver Timber Sale (2010), have likely had positive effects to goshawk habitat by reducing seedling and saplings within treatment areas which maintains open understory conditions favorable for goshawk foraging activities. Past fuels treatments have also reduced the potential for high intensity wild fires occurring within suitable habitat. The effects to snag and downed wood habitat which can affect goshawk prey species have been variable. In most areas, variability remains with the amount and distribution of downed wood following prescribed burning activities. Canopy gaps created by prescribed burning activities have benefited certain prey species. Snags have been increased and reduced across treatment areas with extremes in both directions.

Under the Southside EA (2009), grazing by livestock would continue to occur in the project area. This activity can result in changes to herbaceous and sometimes shrubby vegetation. Grazing of grasses and forbs can alter the height of these plants and the amount of ground cover. This can impact the quality of nesting and brood rearing habitat for ground nesting birds and small mammals, which may serve as prey to raptors. However, removal of coarse vegetation by large ungulates can also improve the palatability and nutritional value of this forage for prey species that consume vegetation, and can improve foraging opportunities for species that feed on insects and other invertebrates by making these food resources more visible. Browsing of palatable species of shrubs can reduce their size, height and density. This can alter the quality of nesting habitat for shrub nesting birds that may serve as prey to raptor species. Raptors which forage on ground dwelling animals such as insects, amphibians, reptiles and small mammals often take advantage of open areas with reduced ground cover as foraging sites.

Invasive plants lead to habitat degradation by reducing native plant species. The Wolf Creek includes project design features to prevent the spread of noxious and invasive plants. In addition, the Deschutes and Ochoco Invasive Plants EIS (2012) allows for the treatment of invasive species, cumulatively resulting in fewer invasive plants and thus improving desirable grasses, and forbs important to goshawk prey.

Forest Plan Consistency

Post-fledging areas (PFA) have been mapped for all known occupied goshawk territories in the project area. The 30 acre goshawk nest core areas would have no commercial or noncommercial treatments under any action alternative. Harvest activities within PFAs would not remove late and old structure trees or snags. Treatments within nest core areas and PFAs would be implemented with seasonal restrictions. Seasonal restrictions would be employed for disturbance activities within ½ mile of known nest sites, from March 1 to September 30 of each year.

These restrictions may be waived on a case-by-case basis, if appropriately timed monitoring indicates that the nest area is not reproductive during that nesting season. This assessment cannot be made until well into the nesting season. Waivers would only be valid for the year in which they are granted. All action alternatives considered in the Wolf Project are consistent with the Forest Plan, as amended by the Regional Forester's Plan Amendment 2.

Threatened, Endangered and Sensitive Species (TES)

Existing Condition and Affected Environment

The U.S. Department of Interior Fish and Wildlife Service (USDI FWS) provides a list of threatenened, endangered, proposed, and sensitive species that have the potential to occur in both Crook and Wheeler Counties for consideration in analysis (USDI FWS 2013a and USDI FWS 2013b). Currently, there are no threatened, endangered, proposed, or sensitive species that may occur within Crook or Wheeler County identified on the FWS list. However, the greater sage grouse is listed as a candidate species that may occur in both counties and there is a note about the status of gray wolves in the state of Oregon. In addition, there is no designated or proposed critical habitat for Threatened or Endangered species in the affected subwatersheds.

The Ochoco National Forest is also within the listing range for the Canada lynx (*Lynx canadensis*), but Canada lynx habitat was remapped in 2001. Due to insufficient quantities of primary habitat, Key Linkage Areas (KLA) and Lynx Analysis Units (LAU) are not currently mapped on the Ochoco National Forest. In addition, The Deschutes and Ochoco National Forests requested informal consultation (March 30, 2001) on continued implementation of their respective Forest Plans with LAUs mapped in accordance with the 2000 LCAS; the U. S. Fish and Wildlife Service (USFWS) gave concurrence that the mapping was consistent with the current mapping direction. Based upon the lack of habitat to support lynx residency and reproduction and the view that lynx are not a resident, reproductively active animal in Oregon, it has been concluded that implementing forest plans using the current mapping would result in "may affect, but not likely to adversely affect" (NLAA) conflict determinations (May 24, 2001 and June 22, 2001). The Regional Foresters Special Status Species list dated December 9, 2011 does not have the Canada Lynx as either suspected or documented on the Ochoco National Forest. Sensitive species that are not listed as documented or suspected on the Regional Foresters Sensitive Species list for the Ochoco National Forest are not analyzed for potential effects.

There are 16 species on the 2011 Regional Forester's Sensitive Species list that are known or suspected to occur on the Ochoco National Forest. However, only nine species have potential habitat in the proposed project area. The Columbia spotted frog is addressed in the Aquatics BE; therefore, it will not be discussed further in this section. Table 103 describes threatened, endangered, and sensitive species considered in the analysis of the Wolf project.

Table 102. Threatened, Endangered, Proposed and Sensitive Species: Status and Occurrence

Common Name	Scientific Name	Status	Occurrence
Gray Wolf (outside Northern Rocky Mountains)	*Canis lupus*	E	HD/N
California Wolverine	*Gulo gulo luscus*	S/C	HD/N
Pygmy Rabbit	*Brachylagus idahoensis*	S	HD/N
Townsends Big-Eared Bat	*Corynorhinus townsendii*	S	HN/N
Bald Eagle	*Haliaeetus leucocephalus*	S, DL	HD/D
American Peregrine Falcon	*Falco peregrinus anatum*	S, DL	HD/N
White-headed Woodpecker	*Picoides albolarvatus*	S	HD/D
Lewis's Woodpecker	*Melanerpes lewis*	S	HD/D
Greater Sage Grouse	*Centrocercus urophasianus*	S, C	HD/D
Bufflehead	*Bucephala albeola*	S	HN/N
Tricolored Blackbird	*Agelaius tricolor*	S	HN/N
Upland Sandpiper	*Bartramia longicauda*	S	HN/N
Silver-bordered Fritillary	*Boloria selene*	S	HN/N
Johnson's Hairstreak	*Callophrys johnsoni*	S	HD/N
Crater Lake Tightcoil	*Pristiloma arcticum crateris*	S	HN/N
Columbia Spotted Frog	*Rana luteiventris*	See Aquatics BE	

Status

E	Federally Endangered
DL	Federally Delisted
T	Federally Threatened
S	Sensitive species from 2011 Regional Forester's list
C	Candidate species under Endangered Species Act

Occurrence

HD	**Habitat Documented** or suspected within the project area or near enough to be impacted by project activities
HN	**Habitat Not** within the project area or affected by its activities
D	Species **Documented** in general vicinity of project activities
S	Species **Suspected** in general vicinity of project activities
N	Species **Not documented** and not suspected in general vicinity of project activities

Gray Wolf *(Canis lupus)*

In 2008, the Service published a final rule that established a distinct population segment (DPS) of the gray wolf in the northern Rocky Mountains (which includes a portion of Eastern Oregon, east of the centerline of Highway 395 and Highway 78 north of Burns Junction and that portion of Oregon east of the centerline of Highway 95 south of Burns Junction). Any wolves found west of this line in Oregon belong to the conterminous USA population [see 73 FR 10514]. On May 5, 2011, the Fish and Wildlife Service published a final rule – as directed by legislative language in the Fiscal Year 2011 appropriations bill – reinstating the Service's 2009 decision to delist biologically recovered gray wolf populations in the Northern Rocky Mountains (USDI FWS 2011). Gray wolves in Oregon are State-listed as endangered, regardless of location.

Life History and Habitat

Gray wolves are highly adaptable and use a variety of habitats, with a preference for remote areas. Remote, forested areas provide refuge from humans and support ungulate prey. Gray wolves feed extensively upon large ungulates, including Rocky Mountain elk, and mule deer. In unexploited populations, survival of young and population growth are dependent upon availability of food during the rearing season (Jordan et al. 1967, Verts & Carraway 1998). Currently, the major limiting factor to gray wolf populations throughout its range is human caused mortality and disturbance.

Distribution

Oregon: In July of 2008, a biologist confirmed the presence of Oregon's first reproducing pack of wolves on the Umatilla National Forest. Currently, Oregon Department of Fish and Wildlife (ODFW) confirms six wolf packs in Oregon with individuals dispersed throughout the state.

Ochoco National Forest: In 2011, a collared wolf from the Wallowa County Imnaha pack was confirmed travelling through the Ochoco National Forest. The wolf, known as OR-7, currently resides near the Oregon/California border.

Existing Condition

There are 613,844 acres of available habitat for the gray wolf on the district. Within the project area, 24,506 acres of suitable habitat exists and abundant prey (deer and elk) is available. High road densities and human presence may be factors that limit wolf presence within the Wolf project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

According to the US Fish and Wildlife Service, "occupied wolf range" is defined as follows: areas of confirmed presence of resident breeding packs of wolves or an area consistently used by $\geq$1 resident wolf or wolves over a period of at least one month. As a result, until an active pack is identified within the Ochoco National Forest, there would be no direct, indirect, or cumulative effects to wolves as a result of Alternatives 2, 3, or 4.

Determination

The determination for wolves is **No Effect (NE)** because no populations currently occupy the Ochoco National Forest.

California Wolverine *(Gulo gulo luteus)*

Life History and Habitat

Wolverines are strongly associated with remote mountainous wilderness habitats (Beauvais et. al 2004). Open areas are avoided and the most critical habitat component is the absence of human activity or development. Wolverines prefer higher elevation alpine and mature coniferous forest. The presence of avalanche chutes, boulder fields, and/or large piles of down logs are also important habitat features. In Oregon, the wolverines diet consists mainly of elk and deer carrion. Wolverines are extremely mobile travelling great distances within large home ranges. The major limiting factor to wolverine populations is human caused mortality and disturbance.

Distribution

Oregon: Suitable wolverine habitat in Oregon is considered to be the high-elevation forests of the Cascade Range, Blue Mountains, Wallowa Mountains, and Ochoco Mountains. There is potential for wolverines from the Rocky Mountain population to enter Oregon from Idaho, Wyoming, or Montana.

Ochoco National Forest: Since 1965 wolverine presence has not been confirmed on the forest, although museum specimens have been collected from Linn, Deschutes, and Wheeler Counties (Verts & Carraway 1998). Unconfirmed wolverine sightings or potential wolverine sign have been recorded on the forest between 1969 and 1996. Suitable habitat consists of areas with low human impacts, low human disturbance, and high deer and elk concentrations such as the Bridge Creek, Mill Creek, and Black Canyon Wilderness Areas.

Existing Condition

The project area lies within the historic range for wolverines. One potential wolverine track was found approximately 3 miles from the project area in 1992, near Tamarack Butte. There are no areas within the project's boundary with suitable foraging or reproductive habitat for wolverine. Wolverine presence in the project area would likely be a result of animals dispersing from suitable habitat areas to other suitable habitats, or in search of mates such as those identified on the Ochoco National Forest or other subpopulations

Direct, Indirect and Cumulative Effects

Alternative 1

The no action alternative does not directly alter cover or forage for species that would be likely food resources for wolverine. However, there may be a higher risk of future large scale disturbance associated with this alternative. Road densities have decreased within the project area in the past 10 years however; they remain at levels that are less desirable for species like wolverines because of their aversion to human activities. Under this alternative forage for many herbivorous species would continue to decline because of the continued development of closed forest canopies resulting in less available food resources for wolverine. At some point in the future, forage areas would likely develop due to insect or disease outbreaks or high intensity wildfire. Thus, availability of prey would vary over time depending on extent and intensity of future disturbance events. Ongoing uses in the project area would continue to occur.

Alternatives 2, 3, & 4

The Wolf project area may be used seasonally by wolverines when human access is impeded by snow or more likely used as dispersal habitat for animals traveling between suitable habitat areas in the unroaded areas listed in the existing condition. The greatest impacts on wolverines would be habitat fragmentation and increased human presence associated with activities during implementation. Wolverines do not tolerate land-use activities that permanently alter their habitat. However, travel corridors are expected to facilitate wolverine travel and dispersal and all action alternatives propose to close roads. Elk and deer distribution, an important food source, could be altered, but treatment is not expected to decrease big game populations.

Management activities and uses that have occurred in the past have influenced the availability and quality of habitat for wolverine. Removal of large down wood through timber harvest or prescribed burning has altered the availability of potential denning sites for wolverine. Road construction and development of recreation sites have altered the extensiveness and level of human activity throughout the project area, increasing the potential for disturbance to wildlife. There has also been increased forage production for big game in thinned or burned areas. Ongoing uses in the project area would continue to occur. Recreational use would continue to limit remote character in the project area. The net combined effects of implementing the alternatives in this project with the past, present and reasonably foreseeable actions in the area are the same as described under the direct and indirect effects section above.

Determination

Implementation of Alternatives 2, 3, and 4 **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)** because the project: does not alter rock or talus habitat, reduces open road densities, is not expected to decrease big game populations. However, the project would increase human presence associated with activities during implementation which has a low probability of disturbing wolverines travelling between source habitats.

Pygmy Rabbit *(Brachylagus idahoensis)*

Life History and Habitat

Habitat for this species consists of tall dense stands of big sagebrush (*Artemesia tridentata*) in deep loose soils. Pygmy rabbits live in burrows they construct themselves or in those modified from burrows dug by other mammals. Burrows are typically found in deep loamy soils with minimum depth of 20" in alluvial fans, swales in rolling hills, large flat valleys, or creek bottoms (Weiss and Verts 1984).

The single largest loss in cover types for pygmy rabbit within the Columbia Basin has been linked to the decline of big sagebrush habitat resulting from conversion of exotic forbs and annual grasses for agriculture, as well as mismanaged grazing practices and associated soil erosion (Hann et al. 1997, Wisdom et al. 2000).

Distribution

Oregon and the Ochoco National Forest: Weiss and Verts (1984) found only 51 occupied sites in Oregon, out of 211 potentially suitable sites, which include 1 site in Crook County. There are no records of pygmy rabbits on the Ochoco National Forest.

Existing condition

Suitable habitat for the pygmy rabbit occurs within the project area; however occupancy has not been determined.

Direct, Indirect and Cumulative Effects

Alternative 1

The no action alternative does not directly alter sagebrush habitat. In the short term, shrubs, grasses, and forbs would remain in their current state. However, in the long term, juniper may continue to out compete habitat associated species, reducing the suitability of habitat and potential for occupancy.

Alternatives, 2, 3, & 4

For all action alternatives the primary treatment proposed within potential pygmy rabbit habitat is juniper cutting. This treatment is primarily proposed within the juniper woodland/steppe Plant Association Group (PAG) to reduce juniper density. Younger junipers up to 20.9" dbh would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size. Concentrations of slash would be burned. Burning is expected to occur in patches as a continuous fuel bed of slash is not anticipated due to the low density of juniper. The vegetative objective of this treatment is to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation.

Management activities and uses that have occurred in the past have influenced the availability and quality of sage brush habitat for the pygmy rabbit. Roads associated with past timber sales have fragmented sagebrush steppe habitat and some removal of sagebrush from prescribed burning has occurred. However, most of the proposed projects occur outside of potential pygmy rabbit habitat

and are likely to have negligible effects to this species. The net combined effects of implementing the alternatives in this project with the past, present and reasonably foreseeable actions in the area are the negligible.

Determination

The determination for pygmy rabbit is **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH).** This determination is based on the low likelihood that potential habitat within the project area is occupied and proposed treatments are likely to benefit grass and shrub vegetation.

Townsend's Big-Eared Bat *(Corynorhinus townsendii)*

Life History and Habitat

The Townsend's big-eared bat occurs in a wide variety of habitat types ranging from sea level to 3,300 meters. Habitat associations include: coniferous forests, mixed meso-phytic forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitat types. Distribution is strongly correlated with the availability of caves and cave-like roosting habitat, including abandoned mines. The Townsend's big-eared bat is a moth specialist, foraging within wooded areas, along edge habitats and near streams. The primary threat to the Townsend's big-eared bat is related to disturbance and/or destruction of roost sites. Timber harvest and loss of riparian habitat further threatens the persistence of this bat (Western Bat Working Group 2005).

Distribution

Oregon: In Oregon, the Townsend's big-eared bat has been collected throughout most of the state except in parts of the Blue Mountain Province and in the western part of the Basin and Range Province (Verts and Carraway 1998).

Ochoco National Forest: Townsend's big-eared bats were detected at one mine site located on the Ochoco National Forest that is approximately 25 airline miles from the Wolf project area.

Existing Condition

There are no caves or mines that would provide suitable sites for maternity or hibernation colonies within the project area. There are no recorded locations for Townsend's big-eared bat within the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Suitable habitat for the Townsend's big-eared bat does not occur within the project area; lack of caves or mines limits this species presence. Because of the lack of habitat and the unlikely occurrence of the species in the project area no direct, indirect, or cumulative effects are expected.

Determination

The determination for Townsend's big-eared bat is **No Impact (NI)** due to lack of suitable habitat and species presence is the project area.

Bald Eagle (*Haliaeetus leucocephalus*)

Life History and Habitat

The bald eagle is heavily associated with aquatic habitats and a majority of their diet is fish and waterfowl. During winter, bald eagles are known to feed heavily upon carrion. Nests are typically located in large trees or snags in close proximity to water.

Habitat loss and human activities that adversely affect the suitablitliy of breeding, wintering, and forage areas continue to be the most significant long term threat to bald eagles (USDI 1986).

Distribution

Oregon: Bald eagles are most common around large lakes, marshes, along the coast and along the Columbia River (Csuti et al. 2001).

Ochoco National Forest: The bald eagle has been documented on the Forest and adjacent private lands. There are 3 known eagle nests on the forest. Most observations of bald eagles are seasonal occuring in the late fall, winter, and early spring. The Forest has identified 4 Eagle Roost Management Areas (F-12), and 7 Ochoco Eagle Management Areas.

Existing Condition

There are two Eagle Roost Management Areas (F-12) located within the project area as well as an occupied nest site; the Forest Plan designated109 acres for the Wolf Creek eagle roost, all of which occurs in the project area. The second eagle roost, Sugar Creek, has 152 acres of the designated 394 acres occurring within the Wolf project area. Management plans were written for both the Wolf Creek winter roost and the Sugar Creek winter roost areas in 1991. The management plans have specific recommendations for management of the winter roosts.

The occupied nest site was first located in 1997 and has subsequently moved to other trees, once in 2010, and then again in 2012. The original nest tree has since died and fallen and the 2010 nest tree has died and is believed to have weakened to the point it no longer can support an eagle nest.

In general, stand exams indicate that the majority of the stands within the Eagle Roost Areas (ERAs), as well as the nest site, are currently over-stocked, and as a result, larger diameter trees that provide suitable nesting are declining in health. Many of the larger diameter trees >30” dbh that were present have died and are either snags or dead and down woody debris. Suitable nest trees that are greater than 30” dbh with an open, large branch structure are limited in all areas. Historically stands were more open in nature than what occurs today.

Direct, Indirect and Cumulative Effects

Alternative 1

There would be no activities outside of the ongoing program of work that would affect bald eagles or their habitat within the project area. There could be increased risk of loss of habitat due to future wildfire intensity or extent due to retention of existing fuel loads and continuation of fuel development and accumulation over time. However, predicting the impact of future events on bald eagle nesting, roosting, or foraging areas in a quantitative manner is difficult because of uncertainties regarding the location and conditions under which such future events might occur. Over time, live trees currently supporting a nest, or with potential as future nest sites, may be weakened by stress competition, and succumb to insect infestation. Once the live overstory trees die they become less attractive as nest sites for bald eagles.

The potential cumulative effect of combining implementation of this alternative with the past, present, and reasonably foreseeable actions, is that the risk for high intensity wildfires threatening existing nesting habitat increases in this alternative. However, such a loss is not predictable. Large diameter trees would continue to be at risk for insect attacks and disease. The development of additional potential nest or roost trees would be slower under the no action alternative because of the current high stocking levels that exist. Winter roost stands would remain susceptible to insect infestations and disease.

Conclusion

Lack of action to increase the health and vigor of large diameter ponderosa pine used for nesting may result in loss of large ponderosa pine and reduce or eliminate the use of the area for nesting; this alternative would likely result in the eagle moving to another nest tree or possibly out of the area.

Alternatives 2, 3, & 4

Alternatives 2, 3, and 4 propose activities within the Wolf Creek ERA, the Sugar Creek ERA, and the Wolf Creek Nest Stand activities will be addressed by ERA (see table 104).

Table 103. Activities occurring in Bald Eagle Roost Management Areas (F-12)

Activity	Alternative 2	Alternative 3	Alternative 4
Wolf Eagle Roost Area			
Commercial Harvest (acres)	82	82	68
Juniper Understory Treatment (acres)	21	21	21
Noncommercial Thinning (acres)	0.7	0.7	0.7
Total Acres	***103.7***	***103.7***	***89.7***
Sugar Creek Eagle Roost Area			
Road Closures (miles)	0	0.11	0.11

Wolf Creek ERA

Commercial harvest would occur in within both the primary and secondary zones of the Wolf Creek ERA. Treatment follows direction as outlined in the Wolf Creek Bald Eagle Winter Roost Management Plan, the Forest Plan, and the Wolf Creek watershed analysis. In general, the roost stands would be managed to yield an uneven-aged stand containing five to eight trees 36-40” dbh in the overstory. The understory would be managed to provide 15-20 trees per acre, 12” to 20” dbh. Roost trees actively in use would be preserved, along with any potential replacement trees. Additional proposed treatments are designed to reduce tree density and improve growth and vigor of the residual trees and reduce susceptibility to insects and disease. The area would be free of potentially disturbing human activity from December 1 to May 1. Although Alternative 3 proposes to cut grand fir species over 21” on 384 acres within the project area, no trees over 21” would be harvested within the Wolf Creek ERA. The prescriptions would thin from below to promote the development of large live trees which are important as both nest trees and roost trees. Currently large trees are deficient.

Juniper understory treatment would occur on 21 acres within the designated ERA. This treatment would focus on removing juniper that established post settlement and would not cut old growth juniper. This treatment would not likely impact the ERA’s potential as a roost site or nesting area as juniper are not utilized as nest sites or roosting trees. These treatments would enhance vigor of residual ponderosa pine which, over time, may provide suitable nesting or roosting structure.

Noncommercial thinning would take place to reduce the currently heavy stocking levels in the understory to decrease the risk of insects and disease. In addition, thinning would be designed to maintain un-even aged classes. Noncommercial thinning would increase the health and vigor of

overstory ponderosa pine, and increase the longevity of large diameter ponderosa pine used for nesting and roosting.

Understory burning would reduce fuel loadings in the roost area and reduce the risk of loss of habitat from high severity wildfire; prescribed fire would be implemented to retain roost trees. The Wolf Creek Bald Eagle Winter Roost Management Plan identifies two measures that would be taken to safeguard the roost trees including: 1) pulling slash away from the trees and 2) handpiling slash near the roost trees.

Sugar Creek ERA

No vegetative treatment would occur in the Sugar Creek ERA. The only activity proposed within the ERA is .11 miles of road closure in both Alternatives 3 and 4.

Wolf Creek Nest Stand

Commercial thinning in Units 22 and 26 would be modified to improve bald eagle habitat in consultation with the wildlife biologist. These prescriptions would include "doughnut" thinning, or removing small diameter trees within the dripline, or dripline plus a specified distance around selected trees to provide future nest and/or roost trees.

Noncommercial thinning in unit 204 (24 acres) would be modified to enhance the development/retention of large ponderosa pines which can be available for future bald eagle nest trees. In this unit, up to 12 large ponderosa pines would be selected as potential nest trees and noncommercial thinning would include the removal of live trees up to 18" dbh that are within 40 feet of the select tree. The larger trees may be cut down or may be pushed or pulled over with low impact machinery (such as a walking excavator). The larger trees would be available for placement in the adjacent headcut repair/stream restoration in Wolf Creek (Unit 253).

Understory burning would reduce fuel loadings in the nest area and reduce the risk of loss of habitat from high severity wildfire. To safeguard the nest trees prescribed fire would be implemented to retain nest trees. The two measures identified in the Wolf Creek Bald Eagle Winter Roost Management Plan for retaining roost trees would also be used to retain nest trees which are: 1) pulling slash away from the trees and 2) handpiling slash near the nest trees.

Cumulative effects

There are no present or foreseeable future actions that would add cumulatively to what is being proposed in the Wolf project.

Determination

The determination for bald eagle is **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH).** In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on Bald Eagles.

Peregrine Falcon *(Falco perigrinus anatum)*

Life History and Habitat

Peregrine falcons nest on cliffs greater than 75 ft. tall and are typically found no farther than 1 mile away from water (Pagel 2003). Nest locations and prey species vary considerably and are difficult to characterize. However, nest sites usually overlook open habitat where waterbirds are plentiful as peregrines are not well suited for interior forests (Csuti et. al. 1997).

Distribution

Oregon: Peregrine falcons were once found throughout Oregon. Peregrines were extirpated from much of their range due to the use of DDT, which was banned in 1972 and are slowly increasing in numbers. During migration, peregrine falcons can be seen throughout Oregon (Csuti et. al. 1997).

Ochoco National Forest: There are no known peregrine falcon eyries on the Ochoco National Forest. However, some sightings have occurred on the forest and are likely associated with migration.

Existing Condition

Suitable foraging habitat exists, although peregrines typically do not select denser forested habitats or rolling topography that characterizes the project area. There is no suitable cliff habitat for nesting within the Wolf project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Due to the lack of suitable cliff habitats within the watershed, it is unlikely that peregrine falcons would be reproducing within the project area. There have been no sightings of peregrine falcons within the project area, although there have been peregrine sightings on neighboring private land. Other sightings have occurred on the Ochoco National Forest and are likely associated with migration. Peregrine falcons may forage in this watershed, especially during migration. Suitable foraging habitat exists, although peregrines typically do not select denser forested habitats or rolling topography that characterizes the project area.

Dispersing falcons that may pass through the project area are expected to avoid any human disturbance associated with Alternatives 1, 2, 3, and 4. Action alternatives 2, 3, and 4 could improve foraging habitat for this species by creating more open forest conditions which could make prey more accessible.

Past activities, ongoing projects and reasonably foreseeable activities are not expected to combine with effects from this project to result in cumulative effects. If a peregrine falcon nest site was located, protection measures described in the Forest Plan (1989) standards and guidelines would be implemented to protect active birds of prey nests from human disturbance until nesting, feeding, and fledgling are completed and provide protections of nest sites and nesting habitat for the species involved (USDA FS 1989).

Determination

A **No Impact (NI)** determination is reached for the alternatives proposed in the Wolf project. Suitable nesting habitat for this species is not present in the project area and any foraging falcons in the project area will likely Other Featured Species

White-headed Woodpecker *(Picoides alborarvatus)*

Life History and Habitat

White-headed woodpeckers are associated with Old Forest Single Stratum (OFSS) stands, i.e., open canopy stands of large mature and over mature ponderosa pine, and less frequently mixed ponderosa and Douglas-fir stands (Burleigh 1972, Ligon 1973, Cannings, 1995, Buchanan et al. 2003). The white-headed woodpecker differs from many of the other primary cavity excavators in its near exclusive selection of mature single stratum ponderosa pine dominated habitats. In the project area this species relies almost exclusively upon the seeds from large ponderosa pine cones for foraging and eats insects gleaned off ponderosa pine trees. White-headed woodpeckers prefer large ponderosa pine snags for nesting; however, species such as grand fir, Douglas-fir, and aspen are also utilized.

Because of its more limited need and use of snags for foraging, the species snag requirements are less than those required by other primary cavity excavators such as the pileated, downy, and hairy woodpeckers. Altman (2000) identified conservation issues within dry forests affecting white-headed woodpecker-they include:

- Extensive loss of large ponderosa pine trees to timber harvesting
- Fire suppression which has allowed understory encroachment and increased fuel loads which predisposes these areas to stand-replacement fires
- Lack of recruitment of young ponderosa pine due to factors such as fire suppression which has allowed the understory encroachment of firs and exotics, and intensive grazing which can suppress development of young pines
- Loss of snags and down logs (foraging) from timber harvest and fire wood cutting
- Fragmented habitat increases energy expenditure and risk of predation to secure resources

Distribution

Oregon: White headed woodpeckers are found in the Blue, Ochoco, and Wallowa mountains as well as the east side of the Cascades. Loss of mature ponderosa pine habitat has resulted in a severe decline of this species in the Blue Mountains of Oregon (Csuti et al. 2001)

Ochoco National Forest: As with the rest of Oregon, habitat abundance and distribution for white-headed woodpeckers has been reduced or eliminated in the warm dry and hot dry forest types. Past harvest activities have concentrated on removing the large overstory ponderosa pine, western larch and Douglas-fir trees and snags, setting many stands back to younger structural stages. Fire suppression has increased stocking of understory firs, shifting stand structure from old forest single structure to old forest multi structure. The Wolf Creek watershed analysis documents the level of old forest single strata as being well below the historical range of variability (HRV).

Existing Condition

Satellite imagery from 2004 was used to characterize vegetation, which was subsequently used to estimate white-headed woodpecker reproductive habitat within the watershed. The satellite imagery only provides a broad scale look at the live-tree component and does not provide information on stand specific snag or down log levels. A watershed scale snag analysis has been done for the watershed and is summarized in the Management Indicator Species section under Primary Cavity Excavators.

Predictive model (Viable) indicates that the HRV for white-headed woodpecker nesting habitat would have been between 6,716 and 12,651 acres in the project area (see table 105). Currently, white-headed woodpecker primary reproductive habitat includes approximately 5,163 acres which is below the HRV. In addition, a majority of the primary reproductive habitat may be dominated by mid-sized trees as the large tree component has been removed during past timber harvest within much of the ponderosa pine PAGs. Dense understories, consisting primarily of young trees, are likely limiting suitable white-headed woodpecker habitat within the project area.

Table 104. White-Headed Woodpecker Primary Nesting Habitat (in acres)

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	HRV (Year 1)
Alternative 1	6,716	12,651	5,163	Below
Alternative 2	6,716	12,651	8,232	Within
Alternative 3	6,716	12,651	9,185	Within
Alternative 4	6,716	12,651	7,906	Within

Table 105. Treatments in Potential White-headed Woodpecker Habitat (Ponderosa Pine PAGs)

Treatment	Commercial Thinning	Non-Commercial Thinning	Prescribed Burning Only
Alternative 1	0	0	0
Alternative 2	2,105	249	1,244
Alternative 3	2,105	249	1,244
Alternative 4	1,531	380	1,567

Direct, Indirect, and Cumulative Effects

Alternative 1

This alternative would not treat forest stands and thus the current trends in snag and large wood abundance would continue to occur. The amount of existing snags present within the project area would not be altered by implementation of this alternative, though continued competitive stress would likely result in mortality of trees and thus recruitment of snags and down wood. Concurrently, the build up of fuels and canopy conditions that favor crown fires which could result in a stand replacing disturbance event. Such events yield an abundance of snags in the short term, but may result in large areas devoid of snags in 50 to 100 years afterwards (after the majority of the initial pulse of snags has fallen down). Large snag recruitment would begin again after the new stand matures enough to provide such structure- this may take 150 years or more.

This alternative would remain below the HRV for white-headed woodpecker and its associates in the short term. This alternative would maintain the existing acres of fir-dominated understories and the trend toward fir dominated habitats. In the long term, there would be a continued decline in white-headed woodpecker habitat which prefers open pine dominated stands. Mortality of large ponderosa pine due to stand densities being above sustainable levels would likely result in a loss of foraging habitat for white-headed woodpeckers (live pine) as the overstory pine trees succumb to stress from competition in overstocked stands. Open road density would remain the same, thus fuel wood cutting (snag removal) is not likely to change.

Over time, stand conditions area expected to decline on sites that cannot sustain high densities of conifers. As trees on such sites succumb to insect invasion they would stop producing seeds, sap and invertebrates associated with foliage. These are listed as important food resources for this species (Marshall et. al. 2003). If the mortality becomes extensive and live canopy closure is lost in large areas of severe insect infestations or fire intensity, then affected areas would become less suitable for this species. If the mortality remains moderate and patchy, then the affected areas may become more suitable for this species which prefers relatively open forest conditions.

Under Alternative 1, habitat for the white headed woodpecker would not be treated and current trends in habitat condition would continue. Habitat for the white-headed woodpecker would remain below the HRV. Trends in risk of habitat loss to insect, disease, and wildfire would not be altered.

Conclusion

This alternative would have no direct effects on the white-headed woodpecker. Indirectly, it could ultimately lead to an elevated level of risk of habitat loss in some areas. Lack of treatment in ponderosa pine habitats to reduce stand density and create single stratum habitats would maintain the current projection of reduced habitat suitability for the white-headed woodpecker.

Alternative 2

This alternative would reduce the understory fir component on acres dominated by ponderosa pine and western larch and increase the abundance of more open stand structure with ponderosa pine contributing a relatively larger percentage of the species composition. This would help restore white-headed woodpecker habitat within most of the commercial harvest area. This alternative would improve white-headed woodpecker habitat on 4,706 acres within the project area. Of the 4,706 acres of commercial thinning harvest, 2,105 acres of treatment would occur in ponderosa pine PAGs which would be priority sites for white-headed woodpecker habitat (see table 106). The remainder of the commercial thinning would occur within Douglas-fir and dry grand fir plant associations that are dominated by early seral species, primarily ponderosa pine and western larch on 2,601 acres. Due to the variation in species composition and size within the Douglas-fir and dry grand fir plant associations, the quality of habitat for white headed woodpeckers would be variable within these acres. A portion of these acres are expected to retain higher concentrations of fir species in the understory, which may reduce the suitability.

Where noncommercial thinning occurs in two-storied stands with a component of large live ponderosa pine and suitable snags for nesting, this treatment would restore white-headed woodpecker habitat. Noncommercial thinning in young stands promotes the development of large pine in the future, and thus habitat for white-headed woodpecker. Prescribed underburning would occur on 1,244 acres outside of thinning units in ponderosa pine PAGs.

Implementation of Alternative 2 would result in an additional 3,069 acres of primary reproductive habitat for white-headed woodpeckers compared to the no action as shown in table 106. This alternative would restore white-headed woodpecker habitat and increase the total reproductive habitat to 8,232 acres; habitat, post treatment, would be within the HRV.

Post treatment stand conditions are expected to provide conditions in which white-headed woodpeckers would be expected to nest for up to 15 years on mesic sites (grand fir and Douglas-fir PAGS), or up to 30 years on more xeric sites (ponderosa pine PAGs) depending on the level of maintenance burning that occurs.

Determination

This alternative could improve habitat for this species by enhancing the development of large trees and snags in stands where they are currently limited, and by creating more open forest conditions. Prescribed fire has the potential to modify the abundance of large snags and their condition class in treated areas. This could lead to a reduction in nesting structure for this species. Protective measures incorporated in the project design should reduce the loss of large snags, but some would still be consumed during prescribed burning. This alternative results in a net increase in habitat for this species at the landscape scale, based on structural/seral stages. The determination of effect of this alternative on white-headed woodpecker is **may impact individuals or habitat, but not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**. In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on white-headed woodpecker.

Alternative 3

Alternative 3 would have similar effects to those described for Alternative 2 (see table 106), but with the addition of harvesting trees > 20.9” dbh on 384 acres. Trees >20.9” dbh proposed for harvest would be done to meet the purpose and need of the project. Species targeted for removal are grand fir and Douglas-fir within ponderosa pine PAGs. This alternative would increase reproductive habitat from the existing condition (5,163 acres) by 4,022 acres, thus reaching a level within the HRV.

Determination

This alternative results in a net increase in habitat for this species at the landscape scale, based on structural/seral stages. The determination of effect of this alternative on white-headed woodpecker is **may impact individuals or habitat, but not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**. In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on white-headed woodpecker.

Alternative 4

Alternative 4 would have effects similar to those described above for Alternatives 2 and 3. However, this alternative proposes to increase white-headed woodpecker reproductive habitat by 2,743 acres, also reaching a level of habitat within the HRV.

Determination

This alternative results in a net increase in habitat for this species at the landscape scale, based on structural/seral stages. The determination of effect of this alternative on white-headed woodpecker is **may impact individuals or habitat, but not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**. In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on white-headed woodpecker.

Cumulative Effects

All of the present and foreseeable future activities within the cumulative effects boundary have been considered for their cumulative effects on the white-headed woodpecker (see Cumulative Effects, table 189. The following discussion focuses on present and foreseeable future actions that may contribute positive or negative effects. Past activities such as timber harvest, road construction associated with timber harvest, wildfire, fire suppression, mining, and firewood cutting have impacted the quantity, quality, and distribution of habitat. The bounds of analysis for cumulative effects on white-headed woodpecker are the project area.

Present and foreseeable future projects within the cumulative effects boundary that would affect the white-headed woodpecker include the implementation of the Upper Beaver Timber Sale (2010). Upon full implementation, 43 acres of commercial harvest activities and additional 142 acres of noncommercial thinning are planned within the Wolf project boundary. However, the purpose and need of the Upper Beaver Timber Sale is similar to that of the Wolf project and has similar direct and indirect effects. The goal of reintroducing fire on the landscape is to maintain stands with high proportions of fire tolerant species and restore dry forest types. The exclusion of fire has increased stand densities, which has reduced white-headed woodpecker habitat by creating heavily stocked stands with higher canopy cover than what existed historically. Overtime, reducing stand densities should increase foraging habitat for the white-headed woodpecker.

Cattle may have caused shifts in plant species composition and abundance through selection of more palatable forage species; however, it does not alter snag densities or the number of mature pine so there are not anticipated effects as a result of implementation of any action alternatives. Therefore, there would no cumulative effects on white-headed woodpecker as a result of the adaptive management activities associated with Southside EA (2009).

The extensive road network in the analysis area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. The Ochoco National Forest personal use firewood cutting guidelines prohibit the cutting of standing snags, however, violations of these rules occur and standing snags are often felled.

The Travel Management EIS (2012), Rager Road Closure, and Upper Beaver Timber Sale (2010) establish vehicular road and trail system use, potentially minimizing the impacts of firewood cutting to white-headed woodpecker by reducing open road densities; however illegal access of closed roads continue. Effective road closures would help minimize the loss of snag habitat for white-headed woodpecker.

Invasive weed treatments in the project area, although beneficial to the persistence of native desirable vegetation would have very little beneficial impact to the white-headed woodpecker. Cumulative effects when combined with invasive weed treatments proposed in the Deschutes and Ochoco Invasive Plant EIS (2012) would be negligible.

The implementation of Alternatives 2, 3, & 4 would provide positive effects to foraging habitat; this may diminish some past negative cumulative impacts to foraging habitat within the cumulative effects boundary. These alternatives were developed to improve the forest/riparian vegetative conditions faster than Alternative 1.

Lewis' Woodpecker *(Melanerpes lewis)*

Life History and Habitat

Unlike most other woodpecker species in Oregon, Lewis' woodpecker primarily inhabits open forests and woodlands since its principal foraging strategy is fly catching. Nesting habitat consists of two distinct types in eastern Oregon: riparian areas with large cottonwoods, and fire maintained or burned old-growth ponderosa pine forests (NatureServe 2012). This species seldom excavates its own nest cavity; instead it uses cavities created by other woodpeckers (Bock 1970). In burned areas, ponderosa pine snags greater than 16”dbh are chosen for nesting. Similar diameter cottonwood snags in riparian areas are also selected (Galen 1989).

Distribution

Oregon and Ochoco National Forest: Currently, the Lewis ‘woodpecker is common year round only in the white oak-ponderosa pine belt east of Mt. Hood. However, it breeds in eastern Oregon river and stream valleys such as the John Day, Grande Ronde, Lower Deschutes, Wallowa, Imnaha, Burnt, Klamath, Squaw, Murderers, and Pike Creek (Marshall et al. 2006).

There has been an approximate 70-75% decline in source habitat for this woodpecker compared to historic estimates in the Blue Mountains (Wisdom et al. 2000). This decline is possibly due to loss of habitat including both nest and food storage trees, and from increased competition for nest trees by introduced European starlings. In addition, Altman (2000) identifies numerous conservation issues specific to Lewis’ woodpecker including: fire suppression, salvage logging, the alteration of single stratum old forest to younger structural stages, high grading individual old ponderosa pine trees before decay and snag formation, fuel wood cutting, increased roads accessing fuelwood, limited insect productivity due to grazing and brush control, insect control, and pesticides.

There have been limited sightings on the Ochoco National Forest, although nesting is known to occur along streams in the Blue Mountains (Marshall et al. 2006).

Existing Condition

The Paulina Ranger District has had numerous stand replacing fires that provide suitable foraging habitat for Lewis’ woodpecker, although no post fire habitat exists in the project area. Potentially, some cottonwoods in the riparian zones exist; however, in numerous locations, the declining water table is limiting the regeneration of such hardwoods.

Reproductive habitat for Lewis' woodpecker is composed of 5,199 acres within the project area which is below the HRV (see table 107). The reproductive habitat estimate is a broad scale look at the live tree component and does not provide information on stand specific snag or down wood log levels. A watershed scale snag analysis has been done for the project area and is summarized in the Management Indicator Species section under Primary Cavity Excavators.

According to district records and GIS data layers, there are a few records of the woodpecker within ½ mile of the project area. However, there have been limited sightings on the Ochoco National Forest.

The Partners In Flight - Northern Rocky Mountains Bird Conservation Plan identifies Lewis's woodpecker as a representative focal species for Dry Forest - Burned Forest habitats and Riparian Woodland and Shrub habitats.

Direct, Indirect and Cumulative Effects

Alternative 1

Habitat for Lewis's woodpecker would not be treated and current trends in habitat condition would continue. Habitat would remain below the HRV, and Lewis' woodpecker habitat would be expected to decline with the ingrowth of understory trees and subsequently a reduction in the amount of open habitats. Trends in risk of habitat loss to insect, disease and wildfire would not be altered. Refer the Silviculture and Fuels sections for detailed discussion of risk of loss to these disturbance agents.

Conclusion

This alternative would have no direct effects on the Lewis's woodpecker, but indirectly could lead to an elevated level of risk of high intensity wildfire which could provide an increase of habitat for the Lewis' woodpecker.

All Action Alternatives 2, 3 & 4

The action alternatives improve habitat for this species by promoting riparian hardwood vegetation, enhancing the development of large trees and snags in stands where they are currently limited, and by creating more area with open forest canopy. Prescribed fire has the potential to modify the size, abundance and condition class of snags in treated areas, which could yield both positive and negative results to habitat for this species. The extent of project activities and expected outcomes should provide for a net increase of reproductive habitat acres for each action alternative (see table 107). However, the amount of reproductive habitat would only be within the HRV as a result of implementing Alternative 3. Although implementation of Alternatives 2 and 4 would increase reproductive habitat, the amount would remain below the HRV.

Past activities that impacted Lewis' woodpecker habitat include salvage and green timber harvest through the removal of large trees and snags that would have provided nesting habitat. Management practices, including clearcutting, overstory removal, salvage, and shelterwood harvest of ponderosa pine have converted many stands previously dominated by open, large diameter pine to stands now characterized as young even-aged plantations.

Ponderosa pine stands have also experienced reductions in snag and down wood habitat due to firewood cutting. Personal use firewood gathering would continue to occur, and may remove some potential perch sites and nest structures.

The exclusion of fire has increased stand densities, which has reduced Lewis' woodpecker habitat by creating heavily stocked stands with higher canopy cover than what existed historically. An increased canopy cover limits shrub production, decreasing foraging habitat for Lewis' woodpecker.

Cumulative Effects

Present and foreseeable future projects within the cumulative effects boundary, as defined by the Wolf project boundary, that would affect the Lewis' woodpecker include the implementation of the Upper Beaver Timber Sale (2010). Upon full implementation, 43 acres of commercial harvest activities and additional 142 acres of noncommercial thinning are planned within the Wolf project boundary. However, the purpose and need of the Upper Beaver Timber Sale is similar to that of the Wolf project and has similar direct and indirect effects. The goal of reintroducing fire on the landscape is to maintain stands with high proportions of fire tolerant species and restore dry forest types. Overtime, reducing stand densities should increase shrub densities and foraging habitat for the Lewis's woodpecker. Cumulatively, the effects of the Upper Beaver sale and the Wolf project would benefit the Lewis' woodpecker.

Current livestock grazing, as managed under the Southside EA (2009), in the uplands and along streams is affecting nesting and foraging habitat for Lewis' woodpecker. Cattle may shift plant species composition and abundance through selection of more palatable forage species. Cattle reduce ground cover through trampling or consuming vegetation, decreasing insect availability. Past grazing in stream corridors has also reduced riparian shrub habitat. The conditions of some riparian areas and aspen habitats has been improved by new management practices and restoration activities in more recent years, but some areas are still not fully restored to conditions that are most suitable for Lewis's woodpecker. However, the adaptive management approach being implanted under the Southside EA (2009), along with the riparian restoration efforts being proposed in the Wolf project, should cumulatively enhance and expand habitat and connectivity of riparian habitats. Expanding and enhancing riparian habitats would benefit the Lewis' woodpecker.

The extensive road network in the analysis area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. The Travel Management EIS (201201) and the Rager Road Closure restrict vehicular road and trail system use on many roads, potentially minimizing the impacts of firewood cutting and the effect to Lewis' woodpecker nesting habitat. This, combined with the road closures and decommissioning proposed in the Wolf project, should cumulatively benefit the woodpecker.

Within the cumulative effects boundary, invasive weed treatments, as being currently implemented through the Deschutes and Ochoco Invasive Plant EIS (2012), are beneficial to the persistence of native vegetation, but have little to no impacts to the Lewis' woodpecker or its habitat. Cumulative effects when combined with invasive weed treatments would be negligible

Determination

The determination of effect of the action alternatives on the Lewis' woodpecker is **"May impact individuals or habitat, but not likely to result in a trend toward federal listing or loss of viability of the species or populations (MIIH).** In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on Lewis' woodpecker.

Table 106. Lewis's Woodpecker Primary Nesting Habitat (in acres)

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	HRV (Year 1)
Alternative 1	8,382	16,319	5,199	Below
Alternative 2	8,382	16,319	8,232	Below
Alternative 3	8,382	16,319	8,873	Within
Alternative 4	8,382	16,319	7,906	Below

Greater Sage Grouse *(Centrocercus urophasianus)*

Life History and Habitat

Sage grouse are sagebrush obligates, relying on the plant for food and cover throughout the year (Marshal et al. 2003).

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 containing palatable sagebrush probably is the most limited seasonal habitat in some areas (NatureServe 2008). This species aggregates on breeding sites (leks) in the spring which are open sites with sparse cover. After breeding, the females nest in stands of tall sagebrush with spreading (umbrella shaped) crowns and abundant bunchgrass cover. After hatching the females lead their chicks to riparian areas and other sites where succulent forbs and invertebrate food resources are abundant. These birds eat sagebrush leaves during the winter and they tend to select the more palatable species such as Wyoming and mountain big sagebrush, though they may also be found in basin big sagebrush among other species. Although human disturbance, fire, juniper encroachment and other conversions have had an impact of sage grouse populations, juniper and juniper sage are the two greatest risks to sagebrush in the Prineville Implementation Area as identified by the *Sage-Grouse Conservation Assessment and Strategy for Oregon* (2011).

Distribution

Oregon: Sage grouse were once widespread in sagebrush-dominated areas east of the Cascades (Aldrich 1963). Currently, they are most common in the southeastern desert regions (Crawford & Lutz 1985, Marshall et al. 2003).

Ochoco National Forest: On the Ochoco National Forest there are19, 550 acres of sage grouse habitat, of which 16,933 acres is identified as core habitat and 2,617 acres is identified as low density habitat. Core areas represent a proactive attempt to identify a set of conservation targets to maintain a viable and connected set of populations before the species experiences continued decline (Doherty et al. 2011, Hagen et al. 2011). The core area approach provides guidance to land use planners, land managers, and the public (Hagen et al. 2011). Low density areas are low productivity sites that provide for occasional breeding, summer, and migratory habitats. (Hagen et al. 2011).

Existing Condition

3,717 acres of sage grouse habitat occur in the project area in the form of core habitat. Juniper encroachment and the presence of annual grasses and exotic weeds are impacting habitat quality within the project area. The nearest lek occurs off forest and is approximately 1.5 miles away while 6 leks are within 7 miles of the project boundary. Fire suppression effects are associated with the changes in plant community composition because of the absence of fire as a disturbance agent. As a result of fire suppression, juniper habitat within sagebrush communities is expanding and becoming increasingly dense. Increasing juniper densities can have an effect on the understory shrub component and moisture availability for understory grasses and forbs. Currently, many of the mountain big sagebrush and low sagebrush cover types in the early phase of woodland encroachment, which still support populations of sage grouse, will be lost as trees gain dominance on these sites and shrubs are lost (Bates et al. 2000). Increasing juniper densities also provide additional perch sites for raptors that prey on sage grouse. To a lesser degree, conifer encroachment into meadow and riparian habitats through the exclusion of fire has reduced the availability of those habitats to sage-grouse. A limiting factor in the presence of sage-grouse is the availability of mesic meadow and riparian habitats for use in brood rearing. The loss of these habitats to conifer encroachment can be significant to sage-grouse presence and habitat use.

Direct and Indirect Effects

Alternative 1

Habitat for sage grouse would not be treated and current trends in habitat condition would continue. Juniper expansion would continue to occur and change the proportion of trees, shrubs, grasses, and forbs likely decreasing the availability of forage and nesting cover for sage grouse. This alternative would have no direct effects on sage grouse but could, overtime, lead to habitat loss.

Alternatives 2, 3, & 4

Within mapped sage grouse core habitat, the Wolf project proposes a variety of actions including; commercial and noncommercial thinning, riparian restoration, juniper management, underburning and the closing of roads (see table 108). Of these activities, prescribed burning and juniper management would directly affect sage grouse habitat. All action alternatives propose prescribed fire and juniper management to meet project objectives. Prescribed burning within core habitat would incorporate design criteria to minimize the invasion of noxious weeds and retain existing sage brush, bunch grasses, forbs, and shrubs (see Botany Specialist section and PDF).

Table 107. Treatments in Greater Sage Grouse Core Habitat.

Treatment	Commercial Thinning	Non-Commercial Thinning	Prescribed Burning Only	Juniper Management	Total Treatment
Alternative 1	0	0	0	0	0
Alternative 2	666	194	153	467	1480
Alternative 3	666	194	153	467	1480
Alternative 4	454	194	210	467	1325

Juniper treatment would focus on post-settlement juniper. These treatments would reduce juniper densities within core habitat, benefitting bunch grasses, forbs, shrubs, and sage brush, thus benefitting sage grouse. Additionally, the reduction of juniper would reduce perch sites for raptors which would decrease predation and sage grouse mortality.

The chances of negative direct or indirect effects to the greater sage grouse as a result of implementing any action alternative are small. Most activities would benefit the sage grouse, but there is a slight chance of disturbance and an increase of noxious weeds as a result of implementation.

Cumulative Effects

The bounds of analysis for cumulative effects on sage grouse are sage grouse core habitat on the forest. Based upon the Sage-Grouse Conservation Assessment and Strategy, the major historic actions that have affected sage-grouse populations were habitat loss and degradation, changes in predator control methods, and increases in human disturbance (Hagen et al. 2010). The alternatives do not propose to add to any of these identified adverse cumulative effects on sage-grouse.

Historic grazing, particularly the documented over-grazing of sheep and cattle near the turn of the century has affected some plant community types. Shallow soils, low precipitation, and low overall productivity make shrub-steppe habitats particularly vulnerable to over grazing. Overgrazing can result in unfavorable changes to species composition and thereby cause an increase in invasive or noxious plant species. In general, such changes are detrimental to sage grouse (Connelly et al. 2004).

The implementation of the Southside EA (2009) has improved grazing management though adaptive management, better livestock distribution and reduced grazing pressure; this should allow for more favorable habitat conditions for sage grouse. Implementation of the juniper thinning proposed in the Wolf project should cumulatively benefit sage grouse core habitat.

Connelly et al. recognized the significant adverse effects invasive species have on sage-grouse habitat quality (2004). Cheat grass is perhaps the most well-known invasive species that has permanently altered sage-grouse habitat, but others are also having an effect (Connelly et al. 2004, Connelly et al. 2000). The effects of invasive species are further compounded by the other actions described above, in both taking advantage of disturbances created by actions such as livestock grazing, prescribed burning, road building, and recreational use of habitats, and simultaneous use those actions as distribution vectors to spread out across the landscape. Invasive species issues in relation to cheat grass are relatively small in the project area. *Ventanata* is another annual that occurs in the project are. The extent of occupancy within the project area has not been determined. Implementation of the Deschutes and Ochoco Invasive Plant EIS (2012) should decrease the spread of noxious weeds with in the project area and, along with the management activities proposed in the Wolf project, should cumulatively benefit core sager grouse habitat.

Determination

These alternatives result in a benefit to habitat for this species. The determination of effect of this alternative on greater sage grouse is **may impact individuals or habitat, but not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)** due to the potential disturbance associated with increased activities adjacent to sage grouse habitat. In the long term, treatments would benefit sagebrush-steppe habitats and have a **Beneficial Impact (BI)** to greater sage grouse.

Bufflehead *(Bucephala albeola)*

Life History and Habitat

The bufflehead nests near high mountain lakes surrounded by open woodlands. Buffleheads are the smallest diving ducks which allowing them to nest in small cavities excavated by northern flickers. After breeding season, buffleheads can be seen on major rivers, lakes, and along estuaries. Buffleheads eat crustaceans and aquatic insects during the nesting season and seeds of pondweeds and bulrushes (Csuti et al. 1997). The bufflehead is a game species in Oregon.

Distribution

Oregon: Nesting primarily occurs in the central and southern Cascade Mountains. The bufflehead is widely distributed throughout the state frequenting open waters on major rivers and lakes. As of 1997 Csuti et al. documented only several hundred breeding pairs in the state.

Ochoco National Forest**:** On the Ochoco National Forest buffleheads are not commonly seen. However, the occasional bufflehead is spotted during migration on small ponds and reservoirs. There are few mountain lakes or reservoirs suitable for nesting on the forest.

Existing Condition

There have been no sightings of bufflehead within the project area. There are no lakes and no stock ponds or reservoirs of sufficient size to provide suitable nesting, brooding, or foraging habitat for a pair of buffleheads and their young.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

No habitat for bufflehead exists within the project boundary, therefore would be no direct, indirect or cumulative effects associated with the Wolf project.

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable breeding habitat for this species is not present in the project area. Any use that may occur would be incidental. The alternatives would have no environmental effects on habitat, individuals, or the population.

Tricolored Blackbird *(Agelaius tricolor)*

Life History and Habitat

The Tricolored blackbird is a highly gregarious colonial breeder largely endemic to California. Tricolored blackbirds nest in large lowland marshes with an abundance of tall emergent or shrubby vegetation. Nesting occurs in fresh-water marshes of cattails, tules, bulrushes and sedge, or in thickets of willows or other shrubs. Tricolored blackbirds are vulnerable to nesting failures that affect entire colonies (Beedy & Hamilton 1999, Marshall et al. 2003).

Distribution

Oregon: Breeding colonies are scattered and intermittent in Oregon. The Oregon population was estimated to have declined by 22 percent in the 1980s, but the Oregon population represents only one percent of the total tricolored blackbird population (Beedy et al. 1999).

Ochoco National Forest: While the tricolored blackbird has been documented to occur between Prineville and Madras, (Marshall et al. 2003) and are occasionally observed near Powell Butte by local birders and posted on the Central Oregon Birders On-Line internet site, there are no known breeding locations of either species on the Forest. Habitat for tricolored blackbird has likely always been limited in this watershed by the absence of extensive marsh habitat with an abundance of cattails or bulrush.

Existing Condition

The project area does not contain any marshes with expansive thickets of cattail, bulrush, willow, nettles or blackberries that could potentially provide adequate nesting habitat for this colonial nesting species. This species has not been observed in the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Suitable habitat does not exist in the project area; therefore, there would be direct, indirect or cumulative effects to the tri-colored blackbird.

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable habitat does not exist in the project area. There are no documented occurrences of this species in the project Species associated with various plant communities and successional stages

Upland Sandpiper *(Bartramia longicauda)*

Life History and Habitat

The upland sandpiper breeds in partly flooded meadows, grasslands and prairies, usually with a fringe of trees, and often in the middle of higher elevation sagebrush communities (Csuti et al., 1997). Meadows favored by this sandpiper are little grazed and are comprised of grasses, sedges, and herbaceous plants (Marshall et al., 1992). Marshall et al. (2003) identified possible reasons for the western population decline which may include the encroachment of pine into meadows, use of herbicides to control or eliminate forbs in nesting meadows, overgrazing in meadows especially during incubation and brood rearing, downcutting of streams which impact water table and meadow systems.

Distribution

Oregon: According to Marshall et al. 2003, Oregon's upland sandpiper population, probably the largest west of the Rocky Mountains is close to extirpation, and that remnant breeding populations are limited to Bear and Logan Valleys in Grant County. However, some field guides show isolated or rare occurrences in South Central Oregon and northern California (Kaufman 2000, Sibley 2000). Breeding by this species at Big Summit Prairie was reported in 1919 and a single bird was observed in that area in 1987. Big Summit Prairie is located approximately 14 airline miles west of the project area. Though populations east of the Rocky Mountains are stable or increasing, populations west of the Rockies are declining and its continued existence in the Northwest is precarious (Marshall et al. 2003).

Ochoco National Forest: The Forest contains potentially suitable breeding habitat for upland sandpipers within Little Summit Prairie. The edges of the prairie are under Forest Service ownership and may be suitable for nesting sandpipers. The majority of this prairie is privately owned and is grazed each year by livestock which would likely reduce the quality for nesting.

Existing Condition

There are no known sightings of sandpipers on the Paulina Ranger District or within the planning area. However, historically breeding populations of sandpipers occurred in Big Summit Prairie northwest of the Wolf Creek subatershed.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Suitable habitat does not exist in the project area; therefore, there would be direct, indirect or cumulative effects to upland sandpiper.

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable habitat does not exist in the project area. There are no documented occurrences of this species in the project area or on the district. Because of lack of habitat and species presence, there would not be any direct, indirect, or cumulative effects to this species.

Silver-bordered Fritillary *(Boloria selene)*

Life History and Habitat

Habitat for silver-bordered fritillaries consists of open, boggy, wet meadows that contain marsh and bog violets, the host species for caterpillars. Adults feed on plants including black-eyed Susan' and goldenrod. Loss of open meadows or bogs due to encroaching woody-stemmed plants, de-watering of marsh habitat, and livestock grazing practices have degraded habitat for this species (Miller and Hammond 2007).

Distribution

Oregon and the Ochoco National Forest: Only two primary colonies are found in Oregon. One colony is found at Big Summit Prairie in the Ochoco Mountains and one in the Strawberry Mountains of the Malheur National Forest (Miller and Hammond 2007).

Existing Condition

Historically, moist meadow and riparian habitats were more abundant than what currently exist today. A variety of activities have influenced the existing conditions, including historic and current livestock grazing, timber harvesting, road construction, and the loss of beaver. Many stream channels within the project area have down cut, resulting in a lowering of the water table and a loss of riparian vegetation, including cottonwood, aspen, dogwood, birch and willow species. The down cutting also caused a reduction in moist meadow habitats within the project area.

On the Ochoco National Forest, 307 acres of potential habitat have been identified. Within the project area potential habitat is limited. Potential habitat is in association with meadow systems that occur within the watershed. There is no current inventory of marsh and fen type habitats that may be associated with the meadow systems. To date, all recorded locations of the silver bordered fritillary occur outside the watershed.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Alternatives 1, 2, 3, and 4 would not alter habitat for this species. Suitable habitat does not exist and there are no documented occurrences of this species in the project area. Because of lack of habitat and presence, there would not be any direct, indirect or cumulative effects to this species.

Determination

The determination for the action alternatives is **No Impact (NI)** to silver-bordered fritillary. There are expected to be no cumulative effects associated with activities under Alternatives 2, 3, and 4.

Johnson's Hairstreak *(Callophrys johnsoni)*

Life History and Habitat

Johnson's hairstreak habitat is almost entirely restricted to cool, moist, old-growth conifer forests of the Pacific Northwest (Miller and Hammond 2007). Caterpillars feed on dwarf mistletoes that grow on various conifers while adults feed on nectar from various flowering plants (Miller and Hammond 2007). Loss of mature to old-growth forests have contributed to this species decline.

Distribution

Oregon: This species is found in conifer forests throughout the Pacific Northwest west of the Cascade Mountains and in the Sierra Nevada Mountains in California. However, there is a disjunctive population of Johnson's hairstreak in the Hell's Canyon region of northeast Oregon and adjacent Idaho (Miller and Hammond 2007).

Ochoco National Forest: In 2010, the Interagency Special Status/Sensitive Species Program (ISSSSP) conducted field surveys in Oregon and Washington to document presence of Johnson's hairstreak butterfly where species presence is currently unknown but likely to occur based on habitat modeling (Davis and Weaver 2011). Survey efforts focused on high probability of occurrence areas, none of which occur on the Ochoco National Forest. The Johnson's hairstreak is not known to occur on the forest.

Existing Condition

The project area contains 40 acres of cool moist plant association groups. To date there have not been surveys for Johnson's hairstreak on the Ochoco National Forest and it is unknown whether or not they occupy the 40 acres within the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Suitable breeding habitat for this species may occur within 39 acres of the cool moist grand-fir PAG. Action alternative propose to treat 33 of the 39 acres present in the watershed. However, the Johnson's hairstreak is not known to occur on the forest. In addition, habitat modeling (Davis and Weaver 2011) indicated that there are no high probability areas of occurrence areas on the Ochoco National Forest and therefore effects would be negligible.

Determination

A **No Impact (NI)** determination is reached for all action alternatives because there are no activities proposed within potential habitat of the Johnson's hairstreak. The Johnson's hairstreak is not known to occur on the forest. Habitat modeling (Davis and Weaver 2011) indicated that there are no high probability areas of occurrence areas on the Ochoco National Forest.

Landbirds including Migratory Birds

Migratory birds breed in the U.S. and winter south of the border in central and South America. Continental and local declines in population trends for migratory and resident landbirds have developed into an international concern and led to the creation of the North American Bird Conservation Initiative (NABCI). Under this initiative, plans have been developed for the conservation of waterbirds, shorebirds, seabirds and landbirds. The landbird initiative known as Partners-In-Flight (PIF) has developed a series of bird conservation plans for every state.

The Oregon and Washington Chapter of PIF was formed in the fall of 1992 and has since developed a series of publications aimed at assisting private, state, tribal and federal agencies in managing for landbird populations. In 2000, the Oregon-Washington Partners in Flight published the *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington* (Altman 2000). This strategy is used to address the requirements contained in Executive Order 13186 (Federal Register 3853, 2001) and FS/FWS MOU #08-MU-1113-2400-264, "To Promote the Conservation of Migratory Birds", (12/08)], responsibilities of federal agencies to protect migratory birds. Many of the birds identified in this plan are also addressed in the U.S. FWS *Birds of Conservation Concern* (USFWS 2008).

The overall goal of PIF Bird Conservation Planning is to ensure long-term maintenance of healthy populations of native landbirds. Conservation strategies are intended to facilitate that goal by identifying conditions and habitat attributes important to the landbird community, describing the desired landscape based on habitat relationships of a select group of species, provide interim management targets (i.e., biological objectives) to achieve desired conditions, and recommend management actions (i.e., conservation options). The strategy for achieving functioning ecosystems for landbirds is described through the habitat requirements of "**focal species**".

By managing for a group of species representative of important components in a functioning coniferous forest ecosystem, many other species and elements of biodiversity also will be conserved.

The project area falls within the Blue Mountains Landbird Conservation Planning Region and contains the following priority habitat types; dry forest, mesic mixed conifer, riparian woodland and shrub habitats, and unique habitats such as montane meadows, aspen and steppe shrublands. There are no alpine or subalpine habitats that occur within the project area.

Methods Used to Measure Effects

To determine the effects to migratory birds and resident landbirds, priority habitat types were identified using criteria described by Altman (2000). Within the project area, stand information that correlated with these priority habitat types were identified by using GIS layers, aerial photographs, and ground reconnaissance. The existing amount of priority habitat was compared to the desired range of habitat identified as the Historic Range of Variability (HRV). This allows a comparison between what exists today as opposed to the balance of conditions that may have existed historically. Species that require specialized habitats such as riparian vegetation, meadows, shrublands, aspen or alpine cannot be modeled this way. Focal species associated with each priority habitat type are addressed and affects to each species are analyzed.

Dry Forest

Existing Condition

The dry forest habitat type incorporates the hot dry and warm dry biophysical environments which refer to the dry ponderosa pine dominated habitats and the dry mixed conifer habitats, i.e., conifer stands of ponderosa pine, Douglas-fir, and/or grand fir. The project area contains approximately 13,100 acres of dry forest habitat. However, only a certain portion of this habitat was identified as suitable for each of the dry forest focal species. The focal species listed for the dry forest habitats are white-headed woodpecker, Lewis's woodpecker, flammulated owl, and the chipping sparrow. The Conservation Strategy (Altman 2000) identifies four habitat components of the dry forest types that are important to landbirds: Old Forest Single Stratum (OFSS), OFSS with patches of regenerating pines, OFSS with grassy openings and dense thickets of small trees, and burned habitats. There are currently 2,354 acres of late and old structure (LOS) within the dry grand fir, Douglas-fir, and ponderosa pine PAGs, the majority (2,330 acres) of which are in a multi strata condition. Historically, the overall amount of LOS would have ranged from between 5,770 and 11,280 acres, with the bulk of it in OFSS condition due to frequent low-intensity fires which were the dominant disturbance regime in the area. Key habitat components and existing condition of Dry Forest associated species can be found in table 109.

Table 108. Dry Forest Habitat type. Key habitat components, and existing condition of Focal Species found in the Wolf project area

Dry Forest Habitats - 13,100 acres			
Focal Species- Key Habitat Components	**HRV - Min**	**HRV - Max**	**Existing HRV**
White-headed woodpecker (*Picoides albolarvatus*)	6,716	12,651	5,163 (Below)
☐Large patches of old forest with large trees and snags.	*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.*		
☐Large high-cut stumps.			
☐Ponderosa pine.			
Flammulated owl *(Otus flammeolus)*	7,869	15,070	3,998 (Below)
☐ Old forest with grassy openings and dense thickets			
☐ Thick patches for roosting and grassy opening for foraging			
☐ Ponderosa pine and Douglas-fir			
Chipping sparrow (*Spizella passerine*)	10,407	16,319	5,458 (Below)
☐Open coniferous forests or stands of trees interspaced with grassy openings.			
☐Ponderosa pine, Douglas-fir, and grand fir.			
Lewis's woodpecker (*Melanerpes lewis*)	8,382	16,319	5,199 (Below)
☐Patches of burned old forest.	*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.*		
☐Soft snags for excavation.			
☐Ponderosa pine.			

Migratory birds and resident land birds could be vulnerable to the types of proposed activities in this project- they include commercial and non-commercial timber harvest, riparian restoration activities, aspen enhancement and protection, and prescribed burning.

Project related conservation issues of concern identified by Altman (2000) by priority habitat type include:

Dry forest and late successional mesic mixed conifer

- Invasion of exotic plants contributing to alteration of understory conditions and increase in fuel loads.
- Restoration issues such as techniques (mowing, thinning, burning) and timing (spring/summer versus fall) of understory removal or prescribed burning which is especially detrimental to single-clutch species
- High risk of loss of remaining ponderosa pine, other Dry Forest overstories, and Mesic Mixed Conifer overstories from stand-replacing fires due to high fuel loads in densely stocked understories
- Habitat degradation from fire suppression/exclusion, particularly declines in characteristic herbaceous and shrub understories from increased density of small shade-tolerant trees
- Loss of old forest stages and large diameter trees and snags from timber harvesting
- Fragmentation of remaining tracts negatively impacts species with large area requirements

Dry Forest Habitats and Focal Species

Direct and Indirect Effects

Alternatives 1, 2, 3, & 4

Direct and indirect effects to dry forest associated species can be found in table 110.

Table 109. Effects by alternative for Dry Forest Habitat Focal Species.

Dry Forest Habitats			
White - Headed Woodpecker			
HRV	**Min**	**Max**	**Effects**
	6,716	12,651	
Alt. 1	5,163 (Below)		*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.*
Alt. 2	8,232 (Within)		
Alt. 3	9,185 (Within)		
Alt. 4	7,906 (Within)		
Flammulated Owl			
HRV	**Min**	**Max**	**Effects**
	7,869	15,070	
Alt. 1	3,998 (Below)		*Continued decline of open forest and early seral species*
Alt. 2	6,658 (Below)		**All action alternatives:** *Increase in grassy openings from commercial thinning and prescribed burning, but likely reduction of dense thickets from non-commercial thinning. Reduced open road densities would reduce firewood harvest and retain snags (nesting habitat). Although suitable habitat remains below HRV, there is an increase for all action alternatives.*
Alt. 3	7,218 (Below)		
Alt. 4	6,375 (Below)		
Chipping Sparrow			
HRV	**Min**	**Max**	**Effects**
	10,407	16,319	
Alt. 1	5,458 (Below)		*Continued decline of open forest and early seral species.*
Alt. 2	8,519 (Below)		**All action alternatives:** *Increase in grassy openings from thinning and prescribed burning. Although suitable habitat remains below HRV, there is an increase for all action alternatives.*
Alt. 3	9,217 (Below)		
Alt. 4	8,245 (Below)		
Lewis' Woodpecker			
HRV	**Min**	**Max**	**Effects**
	8,382	16,319	
Alt. 1	5,199 (Below)		*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.*
Alt. 2	8,232 (Below)		
Alt. 3	8,873 (Within)		
Alt. 4	7,906 (Below)		

Cumulative Effects

Present and foreseeable future projects (see Cumulative Effects table 189) with potential cumulative effects boundary, as defined by the project area, for dry forest focal species include timber harvest, noncommercial thinning, and prescribed fire being implemented in the Upper Beaver EIS (2010); continued invasive plant and weeds treatments from the Deschutes and Ochoco Invasive Plants EIS (2012); grazing management under the Eastside EA (2009), and increased road closures and decommissions by the Deschutes and Ochoco Travel Management EIS (2011) and Rager Cooperative Travel Management Area. In addition, the Ochoco Summit Trail System project is awaiting a planning decision and implementation could begin in 2014.

The Upper Beaver timber sale consists of approximately 43 acres of commercial activities and an additional 142 acres of non-commercial thinning within the project area- all of which are in dry forest habitat. The benefits to dry forest focal species from the Upper Beaver timber sale are expected to be similar to those in the Wolf project because the purpose and need of each project is to manage vegetation towards the HRV. Cumulatively, the combined effects would be beneficial to dry forest focal species.

The Travel Management EIS, as well as the Rager Cooperative Travel Management Area, occur within the Wolf project area. Both preclude off-highway vehicles from travelling cross-country in the project area. As a result, habitat conditions for nesting birds could benefit by limiting the disturbance and destruction of nests as well as further reducing access to the illegal cutting of snags for firewood. Cumulatively, the Wolf project and Travel Management EIS would decrease open road densities and decrease illegal firewood cutting across the project area, benefitting dry forest focal species.

Cattle may have caused shifts in plant species composition and abundance through selection of more palatable forage species; however, it grazing does not alter snag densities or the number of mature pine so there are no anticipated effects as a result of implementation of any action alternatives. Therefore, there would not be any cumulative effects on dry forest associated focal species as a result of the adaptive management activities associated with Southside Grazing EA (2009).

Invasive weed treatments in the project area are beneficial to the persistence of native desirable vegetation and will have a beneficial impact to the dry forest associated species. Therefore, there would be no negative cumulative effects when combined with the Deschutes and Ochoco Invasive Plants EIS (2012).

The Ochoco Summit Trail System proposes to create up to 5.75 miles of new trail to be utilized by Off Highway Vehicles (OHVs) within the Wolf project area. The project is anticipated to have little direct effect on existing or potential nesting habitat to any landbirds because of the small scale of impact to the vegetation and supporting landbase compared to what is available at the landscape scale. However, dry forest habitat would be reduced, existing tracts of land could be fragmented, and there could be an increase to disturbance of dry forest focal species as a result of the project. Because the Wolf project anticipates benefitting dry forest habitats and focal species, there would be no negative cumulative impacts as a result of implementation.

The implementation of Alternatives 2, 3, & 4 would provide positive effects to foraging habitat; this may diminish some past negative cumulative impacts to foraging habitat within the cumulative effects boundary. These alternatives were developed to improve the dry forest vegetative conditions faster than Alternative 1.

Mesic Mixed Conifer

Existing Condition

The mesic mixed conifer habitats refer to the cooler, moister mixed conifer habitats that occur at higher elevations, wetter sites, northerly aspects, and in areas where soils are mesic and well developed. These forests are generally dominated by the true fir species (grand and white fir), with Douglas fir, western larch, and occasionally ponderosa pine scattered within these stands. Stand structure is generally a multi-strata habitat condition. Suppression of fire and timber harvest has generally resulted in the expansion of this habitat condition into much of the dry forest types described earlier, however this habitat type is limited in the Wolf project area with there being only 39 acres of this habitat type.

The mesic mixed conifer focal species primarily utilize the moist grand-fir habitat type for reproduction. However, within the Blue Mountains, these species are also known to utilize other habitats, such as dry grand-fir, as viable reproductive areas. These focal species were chosen for the mesic mixed conifer habitat type because they are associated with specific habitat features which were identified as a conservation focus for this habitat. Though there is a small amount of mesic mixed conifer habitat present within the project area, these species have suitable reproductive habitat available outside of the mesic mixed conifer habitat which is reflected in the existing acreage of HRV (table 111).

Table 110. Mesic Mixed Conifer Habitat type. Key habitat components, and existing condition of Focal Species found in the Wolf project area.

Mesic Mixed Conifer Habitats - 39 Acres			
Focal Species- Key Habitat Components	**HRV - Min**	**HRV - Max**	**Existing**
Vaux's swift (*Chaetura vauxi*)	964	2,039	3,977 (Above)
Large snags			
☐Recruitment snags (live trees) with signs of defects, and within close proximity to riparian areas.			
Varied thrush (*Ixoreus naevius*)	964	2,740	3,979 (Above)
• Structurally diverse and multi-layered canopies			
• Area sensitive, avoids edges, needs dense leaf litter for foraging.			
• Douglas-fir and grand fir			
Townsend's warbler (Dendroica townsendi)	505	1,090	677 (Within)
• Overstory canopy closure			
• Grand fir and Douglas-fir			
McGillivray's warbler (*Oporornis tolmiei*)	1,521	3,978	2,626 (Within)
• Dense shrub layer in forest openings			
• Dense willow thickets around springs and streams.			
• Douglas-fir			
Olive-sided flycatcher (*Contopus cooperi*)	1,521	3,978	2,626 (Within)
• Edges and opening created by fire			
• Patches of mixed live and dead trees			
• Grand-fir and ponderosa pine			

Many of the project related conservation issues of concern identified by Altman (2000) by priority habitat type are the same as those identified for dry forest habitat types and can be found in the Dry Forest section of this analysis.

Mesic Mixed Conifer Habitats and Focal Species

Direct and Indirect Effects

Alternatives 1, 2, 3, & 4

Direct effects to mesic mixed conifer species can be found in table 112.

Table 111. Effects by alternative for Mesic Mixed Conifer Habitat Focal Species.

Mesic Mixed Conifer Habitats			
Vaux's Swift			
HRV	**Min**	**Max**	**Effects**
	964	2,039	
Alt. 1	3,977 (Above)		*Continued overstocking of stands maintaining vegetation above HRV.*
Alt. 2	2,704 (Above)		**All action alternatives:** *Restoration of ponderosa pine forests towards historic levels would reduce suitable closed canopy, dense understory habitat in what was historically ponderosa pine forest. Project design features and reduced open road densities would help retain snag habitat. Suitable habitat would remain above HRV.*
Alt. 3	2,610 (Above)		
Alt. 4	3,005 (Above)		
Varied Thrush			
HRV	**Min**	**Max**	**Effects**
	964	2,740	
Alt. 1	3,979 (Above)		*Continued overstocking of stands maintaining vegetation above HRV.*
Alt. 2	2,706 (Within)		**All action alternatives:** *Decrease in structurally diverse and multi-layered canopies as a result of restoring large open ponderosa pine stands. Treatments would focus on removing grand fir and Douglas-fir. Suitable habitat would be reduced but remain within or above HRV post implementation.*
Alt. 3	2,610 (Within)		
Alt. 4	3,005 (Above)		
Townsend's Warbler			
HRV	**Min**	**Max**	**Effects**
	505	1,090	
Alt. 1	677 (Within)		*Increase of Douglas-fir and grand fir understory providing more nest sites and prey.*
Alt. 2	476 (Below)		
Alt. 3	474 (Below)		**All action alternatives:** *Decrease of understory fir species, decreasing foraging and nesting habitat as a result of restoring ponderosa pine forests towards historic levels. Suitable habitat would be reduced to below historic levels in Alternatives 2 and 3 and remain within historic levels under Alternative 4.*
Alt. 4	539 (Within)		
McGillivray's Warbler			
HRV	**Min**	**Max**	**Effects**
	1,521	3,978	
Alt. 1	2,626 (Within)		*Increase of dense understory shrub layers providing foraging and nesting habitat.*
Alt. 2	2,305 (Within)		
Alt. 3	2,402 (Within)		**All action alternatives:** *Reduction of shrub habitat as a result of restoring relatively open understory dry forests. Willow and other*
Alt. 4	2,385 (Within)		

			shrub habitats around riparian areas may increase as a result of stream restoration and aspen treatments. Suitable habitat would be reduced but remain within historic levels.
Olive-sided Flycatcher			
HRV	**Min**	**Max**	**Effects**
	9,647	16,319	
Alt. 1	5,395 (Below)		*Continued overstocking of stands and reduction of edge habitat.*
Alt. 2	8,547 (Below)		**All action alternatives:** *Increase in edges and openings (foraging habitat) as a result of thinning and burning in a mosaic. Benefit from reducing open road densities promoting snag retention. Increase in suitable habitat although habitat remains below the historical levels post implementation.*
Alt. 3	9,212 (Below)		
Alt. 4	8,239 (Below)		

Cumulative Effects

The cumulative effects boundary is defined by the Wolf project boundary. The Upper Beaver timber sale consists of approximately 43 acres of commercial activities and an additional 142 acres of non-commercial thinning within the project area. All activities propose to restore ponderosa pine PAGs towards historic levels. Although these impacts occur within dry forest habitat types, the impacts to mesic mixed conifer forest focal species from the Upper Beaver timber sale are expected to be similar to the direct effects identified in Wolf. These effects occur because the purpose and need of each project is to manage vegetation towards the HRV, which manages for open ponderosa pine forests by removing fir species within the Dry Forest habitat types. Cumulatively, the effects of the Upper Beaver and Wolf projects would be amplified.

The Travel Management EIS, as well as the Rager Cooperative Travel Management Area, occur within the Wolf project area. Both preclude off-highway vehicles from travelling cross-country in the project area. As a result, habitat conditions for nesting birds could benefit by limiting the disturbance and destruction of nests as well as further reducing access to the illegal cutting of snags for firewood. Cumulatively, open road densities will decrease promoting the longevity of snags within the project area.

In regards to grazing management being implemented by the Southside EA (2009), cattle can reduce ground cover through trampling or consuming vegetation, decreasing insect availability. However, mature Douglas-fir and grand fir as well as large snags are not impacted by grazing. Impacts to mesic mixed conifer focal species are likely negligible.

Invasive weed treatments in the project area are beneficial to the persistence of native desirable vegetation and will have a beneficial impact to the mesic mixed conifer associated species. Therefore, there would be no negative cumulative effects when combined with the Deschutes and Ochoco Invasive Plants EIS (2012).

The Ochoco Summit Trail System proposes to create up to 5.75 miles of new trail to be utilized by Off Highway Vehicles (OHVs) within the Wolf project area. The project is anticipated to have little direct effect on existing or potential nesting habitat to any landbirds because of the small scale of impact to the vegetation and supporting landbase compared to what is available at the landscape scale. However, mesic mixed conifer habitat would be reduced, existing tracts of land could be fragmented, and there could be an increase to disturbance of mesic mixed conifer focal species as a result of the project. Because the Wolf project anticipates a reduction of suitable habitat for some mesic mixed conifer focal species there could be cumulative impacts as a result of implementation.

Riparian Woodland and Shrub Habitats

Existing Condition

The project area contains approximately 4,160 acres of potential riparian woodland and shrub habitats that are in areas identified as Riparian Habitat Conservation Areas (RHCAs). For over 100 years, lands within the watershed have been subjected to a variety of land-use practices. Practices have included fire suppression, timber harvest, road construction, and livestock grazing. These activities have contributed to the decline of riparian woodland and shrub habitats and impacts are observable today.

HRV analysis was not done for each focal species, because PAG information does not identify riparian and shrub habitats.

Project related conservation issues of concern identified by Altman (2000) for riparian woodland and shrub habitats:

- Habitat loss due to numerous factors such as inundation from impoundments, riverine recreational developments, and cutting and spraying for eased access to watercourses.
- Habitat degradation from conversion of native riparian vegetation to invasive exotics.
- Fragmentation and loss of large tracts necessary for area-sensitive species

Riparian Woodland and Shrub Habitats and Focal Species

Direct, Indirect & Cumulative Effects

Alternatives 1, 2, 3, & 4

Direct effects to riparian woodland and shrub associated species can be found in table 113.

Table 112. Riparian Woodland and Shrub Habitat type. Key habitat components, and effects by alternative for Focal Species found in the Wolf project area.

Riparian Woodland and Shrub Habitats - 4,160 Acres of RHCAs	
Focal Species- Key Habitat Components	**Effects By Alternative**
Lewis' woodpecker (*Melanerpes lewis*)	
• Woodlands with large snags • Dependent on insect food supply • Cottonwood and aspen	*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis*
Red-eyed Vireo (*Vireo olivaceus*)	
• Woodlands with canopy and foliage • Cottonwood, aspen, Oregon Ash, red alder, and various willow species	**No action alternative:** Continued decline of hardwoods and shrubs as a result of conifer encroachment.
	All action alternatives: Hardwood treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance hardwood regeneration.
Veery (*Catharus fuscescens*)	
• Woodland with and understory shrub layer • Cottonwood and aspen	**No action alternative:** Continued decline of hardwoods and shrubs as a result of conifer encroachment.
	All action alternatives:

		Hardwood treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance hardwood regeneration.
Willow flycatcher (*Empidonax traillii*)		
• Shrubs with willow and alder patches	**No action alternative:**	
• Willow and alder	Continued decline of hardwoods and shrubs as a result of conifer encroachment.	
	All action alternatives:	
		Hardwood treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance hardwood regeneration.

Cumulative Effects

The cumulative effects boundary is defined by the Wolf project area. The Southside EA (2009) reauthorizes grazing and is expected to improve cattle distribution and further improve riparian conditions in localized areas within the Wolf project area. As a result, when combined with the anticipated beneficial effects of the Wolf Vegetation project activities, there are cumulative benefits to riparian woodland and shrub habitats and associated focal species.

The Ochoco Summit Trail System proposes to create up to 5.75 miles of new trail to be utilized by OHVs within the Wolf project area. New trail construction occurs within riparian areas reducing riparian woodland and shrub habitat. Disturbance from OHV's could impact riparian woodland and shrub habitat focal species. However, the Wolf project anticipates benefiting riparian areas as a result of stream restoration, hardwood planting and aspen treatments. As a result, no negative cumulative impacts are expected as a result of implementing the Wolf project.

Unique Habitats - Montane Meadows

Existing Condition

The project area contains 29 acres of montane meadow habitat. This habitat type includes wet and dry meadows dominated by herbaceous vegetation and grass at moderate and high elevations. These meadows are generally associated with streams and springs. Fire suppression as well as other legacy activities have altered the productivity of meadow habitats within the project area. Key habitat components and Focal species associated with montane meadows can be found in table 114.

Project related conservation issues of concern identified by Altman (2000) for montane meadows include:

- Conifer invasion at edge of meadows, possibly due to lowered water table from grazing (Marshall et al. 1996).

Unique Habitats - Steppe Shrublands

Existing Condition

The project area contains 8,605 acres of steppe shrubland habitat type. This habitat type includes mesic shrub, scabland shrub, and juniper steppe habitat. Steppe shrublands in the project area have been historically overgrazed. The selection of palatable forage species by cattle has caused shifts on plant composition and abundance. Key habitat components and Focal species associated with steppe shrublands can be found in table 114.

Altman does not identify conservation issues of concern for steppe shrubland habitat associated with project activities.

Unique Habitats - Aspen

Existing Condition

Aspen stands occupy moist, nutrient-rich sites, and with the exception of wetland areas, are considered the most biologically diverse ecosystem in the Intermountain West (White et al. 1998). As a species, aspen is in severe decline both in the Blue Mountains and the rest of the western U.S. (Wall et al. 1999). For over 100 years, lands within the two subwatersheds have been subjected to a variety of land-use practices. Practices have included fire suppression leading to increased conifer densities in aspen stands, road construction, and livestock grazing. These activities have contributed to the decline of aspen within the analysis area. Key habitat components and Focal species associated with aspen can be found in table 114.The project area contains approximately 5 acres of mapped aspen habitat, although additional stands are known to exist. Aspen stands within the project area are relatively small in size with the largest one at less than 1.5 acres.

Unique Habitat Types and Focal Species

Direct and Indirect Effects

Alternatives 1, 2, 3, & 4

Direct effects to Unique Habitat associated species can be found in table 114.

Table 113. Key habitat components, and effects by alternative for unique habitat Focal Species found in the Wolf project area.

Unique Habitats	
Focal Species - Key Habitat Components	**Effects By Alternative**
Montane Meadows - 29 Acres	
Upland sandpiper (*Bartramia longicauda*)	*See Threatened, Endangered, Proposed, and Sensitive Species section for analysis*
• Moist habitat generally surrounded by lodgepole and sometimes ponderosa pine forests.	
Steppe Shrubland - 8,605 acres	
Vesper sparrow (*Pooecetes gramineus*)	**No action alternative:**
• Wide variety of habitats including grassland, sagebrush, fields, meadows, juniper steppe, and croplands.	*Juniper would continue to out-compete desirable bunch grass and shrub species.*
	All action alternatives:
• Grass dominated understory for foraging and nesting.	*Juniper thinning would increase the availability of grasses and forbs improving nesting and foraging habitat.*
Unique Habitats Cont.	
Aspen - 5 acres	
Red-naped sapsucker (*Sphyrapicus nuchalis*)	**No action alternative:**
• Riparian habitats, especially aspen stands, as well as cottonwoods, alders and pine forests.	*Conifer competition would continue to inhibit aspen suckering. Stands in need of protection would continue to be over browsed by ungulates.*
	All action alternatives:
	Removes conifers from aspen stands allowing for suckering to occur. Repair of headcuts and stream restoration would provide stable water tables increasing potential of aspen regeneration.

Cumulative Effects

The cumulative effects boundary is defined by the Wolf project boundary. The Upper Beaver timber sale (2010) consists of approximately 43 acres of commercial activities and an additional 142 acres of non-commercial thinning within the analysis area. All activities propose to restore ponderosa pine PAGs towards historic levels and do not occur in unique habitat types within the Wolf project area and therefore would not contribute to cumulative effects.

The Travel Management EIS (2011), as well as the Rager Cooperative Travel Management Area, exist within the cumulative effects boundary of the Wolf project. Both preclude off-highway vehicles from travelling cross-country in the project area. As a result habitat conditions for nesting birds could benefit by limiting the disturbance and destruction of nests. Cumulatively, considering the road closures and decommissioning proposed in the Wolf project, open road densities would decrease thereby reducing disturbance and the potential for resource damage in unique habitats.

Rangeland monitoring studies, stream surveys, weed monitoring, aspen and cottonwood inventories, and the Upper Beaver watershed assessment conducted prior to initiating the Southside EA (2009) found the riparian and upland vegetation, riparian and upland soils, water quality, and noxious weed occurrence or risk of occurrence in need of improvement. As a result the Southside EA (2009) reauthorized grazing using the adaptive management strategy and is expected to improve cattle distribution and further improve conditions in localized areas within the Wolf project area. Combined with the riparian restoration efforts proposed in Wolf, cumulatively, aspen would benefit.

Invasive weed treatments being implemented in the project area by the Deschutes and Ochoco Invasive Weed EIS (2012) are beneficial to the persistence of native desirable vegetation. When combined with the riparian restoration activities proposed in the Wolf project, unique habitats and their associated focal species would benefit.

The Ochoco Summit Trail System proposes to create up to 5.75 miles of new trail to be utilized by OHVs within the Wolf project area. New trail construction occurring in Wolf project area is proposed within steppe shrubland habitats, reducing habitat for focal species associated with those priority habitat types. In addition, disturbance to focal species could result from OHV traffic. Because the Wolf project anticipates benefiting steppe shrubland habitats, and focal species associated with those habitat types, there would be no negative cumulative impacts as a result of implementation of the Wolf project.

Birds of Conservation Concern

The Birds of Conservation Concern (BCC) species list was reviewed to determine which species may occur in the Wolf project area. Those species and habitats that are within the project area are incorporated and effects disclosed in this analysis. Table 115 displays the list of BCC species found within Bird Conservation Region (BCR) 10 which includes the Northern Rocky Mountains exclusively within the United States. This list identifies species, subspecies, and populations of migratory and resident birds not already designated as federally threatened or endangered that represent the highest conservation priorities and are in need of additional conservation actions.

Table 114. Priority species for conservation action as identified by the U.S. Fish and Wildlife Service within Bird Conservation Region (BCR) 10 Northern Rockies U.S. portion only.

Bird Species	Preferred Habitat	Effects by Alternative (1,2,3, &4)
Bald Eagle *(b)*	Associated with large bodies of water, forested areas near the ocean, along rivers, and at estuaries, lakes and reservoirs.	• See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.
Swainson's Hawk	Found in open country with no need for numerous trees prefer prairies and irrigated farmland with high prey densities.	• Swainson's hawk is a raptor. Effects to raptors are addressed in the Raptor Habitat section.
Ferruginous Hawk	Occupy habitats with low tree densities and topographic relief in sagebrush plains of the high desert and bunchgrass prairies in the Blue Mtns.	• Ferruginous hawk is a raptor. Effects to raptors are addressed in the Raptor Habitat section.
Peregrine Falcon *(b)*	Wide range of habitats, nests on cliff ledges, bridges, quarries.	• See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.
Upland Sandpiper	OR only, in montane meadows from 1,000-3,000 ac at 3,400 – 5,060 ft. surrounded by lodgepole and sometimes ponderosa pine forests.	• See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.
Long-billed Curlew	Open grassland areas E of the Cascades. Found in small numbers in estuaries along the coast.	• Open grassland habitat was considered in the Steppe Shrubland priority habitat section for analysis.
Yellow-billed Cuckoo (w. U.S. DPS) *(a)*	No known breeding population in OR. Found in large expanses of riparian forest, particularly black cottonwood, Oregon ash and willow	• Riparian forest habitat was considered in the Riparian Woodland and Shrub priority habitat section for analysis.
Flammulated Owl	Associated with ponderosa pine forests and mixed conifer stands with a mean 67% canopy closure, open understory with dense patches of saplings or shrubs.	• See Dry Forest priority habitat section for analysis.
Black Swift	Nests on ledges or shallow caves in steep rock faces and canyons, usually near or behind waterfalls and sea caves. Forage over forests and open areas in montane habitats.	• This species is closely associated with waterfalls. There are no waterfalls in the project area therefore neither preferred habitat or species will be affected.
Calliope Hummingbird	Predominantly a montane species found in open shrub sapling seral stages (8-15 years) at higher elevations and riparian areas.	• No action alternative - *No change in habitats.* • All action alternatives - *Prescribed fire may reduce shrub saplings however riparian areas will benefit as a result of stream restoration, aspen treatments, and hardwood planting.*
Lewis's Woodpecker	Ponderosa Pine, Cottonwood riparian or Oak habitats with an open canopy, brushy understory, dead and down material, available perches and abundant insects.	• See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.
Williamson's	E. Cascades, mid to high elevation, mature	• See Management Indicator Species -

Bird Species	Preferred Habitat	Effects by Alternative (1,2,3, &4)
Sapsucker	open and mixed coniferous - deciduous forests. Snags are a critical component.	Primary Cavity Excavators section for analysis.
White-headed Woodpecker	Mixed conifer forests (< 40 % canopy cover) dominated by old growth Ponderosa Pine and open habitats where standing snags and scattered tall trees remain	• See Threatened, Endangered, Proposed, and Sensitive Species section for analysis.
Olive-sided Flycatcher	Open conifer forests (< 40 % canopy cover) and edge habitats where standing snags and scattered tall trees remain after a disturbance.	• See Mesic Mixed Conifer priority habitat section for analysis.
Willow Flycatcher (c)	Associated with riparian shrub dominated habitats, especially brushy/willow thickets. In SE WA also found in xeric brushy uplands.	• See Riparian Woodland and Shrub priority habitat section for analysis.
Loggerhead Shrike	Inhabits grasslands, pastures with fence rows, agriculture fields, sagebrush with scattered juniper and open woodlands. Requires elevated perches throughout for hunting and nesting.	• Grassland habitat was considered in the Steppe Shrublands priority habitat section for analysis.
Sage Thrasher	A sagebrush obligate dependent on large patches and expanses of sagebrush steppe and bitterbrush with shrub heights in the 30 - 60 cm height. Prefers bare ground over grassy understories.	• Sagebrush habitat was considered in the Steppe Shrublands priority habitat section for analysis.
Brewer's Sparrow	Sagebrush obligate found in shrublands of contiguous big sagebrush, greasewood, rabbit brush, and shadescale habitats.	• Sagebrush habitat was considered in the Steppe Shrublands priority habitat section for analysis.
Sage Sparrow	Found in se. and c. OR associated with semi-open evenly spaced shrubs 1-2 m high in big sage up to 6,800 ft.	• Shrub habitat was considered in the Steppe Shrublands priority habitat section for analysis.
McCown's Longspur	Rare in OR & WA, A bird of the plains prefers dry sparse prairies	• Potential habitat was considered in the Steppe Shrublands priority habitat section for analysis.
Black Rosy-Finch	Rare in OR found above timberline among bare rock outcroppings, cirques, cliffs, and hanging snowfields.	• Priority habitats as identified by Altman (2000), (subalpine and alpine) are not present within the project area.
Cassin's Finch	Open, mature coniferous forests of lodgepole and ponderosa pine, aspen, alpine fir, grand fir and juniper steppe woodlands	• Open mature coniferous forest was considered in the Dry Forest priority habitat section for analysis.
(*a*) ESA Candidate, (*b*) ESA delisted, (*c*) non-listed subspecies or population of Threatened or Endangered species		

Botany

This section describes expected effects of the proposed action and alternatives upon botanical resources as part of the Wolf Fuels and Vegetation Management project (Wolf project). Included is the Biological Evaluation (BE) for proposed, endangered, threatened, and sensitive plant species within the Wolf project area. Also addressed are non-native invasive plants (noxious weeds).

This section summarizes the Botany specialist's report; the entire report and appendices can be found in the Wolf project file, Prineville, Oregon.

Effects are analyzed for the short-term (<10 years). Determining effects beyond 10 years would be speculative due to many variables that are difficult to predict, such as wildfire, future funding for control of non-native invasive plants (noxious weeds), and other factors.

Threatened, Endangered and Sensitive Plants

Biological Evaluation for Proposed, Endangered, Threatened, and Sensitive Plant Species (PETS)

The purpose of this biological evaluation (BE) is to determine the effects of the proposed action and alternatives on plant species : 1) listed or proposed for listing by the US Fish and Wildlife Service as Endangered or Threatened (USFWS 2009); and 2) designated by the Pacific Northwest Regional Forester as Sensitive (USDA 2011). This BE is consistent with the requirements of the Endangered Species Act of 1973, Forest Service Manual 2630.3(FSM, USDA 1995a), FSM 2670 and R-6 Supplement 2600-95-3 (1995) and the Ochoco National Forest Land and Resource Management Plan (USDA 1989). The intent of these requirements is to ensure that management activities will not likely jeopardize the continued existence of proposed, endangered, or threatened species, or adversely modify critical habitat, and for sensitive species, determine if the alternatives would result in a trend toward Federal listing.

This BE primarily discusses the more immediate, short-term (<10 years) effects of the proposed action and alternatives. Long-term (>10 years) effects are included where trends and other information are available and discussion is not speculative.

Desired Future Condition

The desired future condition for rare botanical species is to ensure that current populations remain viable and to promote more suitable habitat for many of these species in the future.

Pre-field Review

Each area to be affected by management actions is investigated for sensitive plant habitat in the pre-field review. The following sources were consulted to determine whether potential habitat exists: USFWS list of Proposed, Endangered and Threatened Plant Species (USFWS 2009), Regional Forester's (R-6) Sensitive Plant Species List (USDA 2008), Oregon Natural Heritage Information Center Rare, Threatened and Endangered Species List (updated by the Regional Forester Dec 2011), Species fact sheets provided by the Interagency special status sensitive species program website (http://www.fs.fed.us/r6/sfpnw/issssp), USFS personnel and District botanical survey records, USGS topographical maps, current literature, and knowledge provided by individuals familiar with the area. Effects of actions on sensitive plant populations are analyzed and the Ochoco NF Plan is consulted to determine whether actions are consistent with direction.

There are no known occurrences of federally listed endangered or threatened plants within The Wolf project area. The Ochoco National Forest has no habitat recognized as essential for the listed or proposed plant species recovery under the Endangered Species Act. There are currently 39 sensitive species on the Regional Forester's Sensitive Species List that are known to occur or have habitat on the Ochoco National Forest (table 116). Each sensitive species listed in the table below was ranked with a probability of occurrence as HIGH, MODERATE, or LOW.

Table 115. Summary of Pre-field Review for sensitive plants in the Wolf project area.

Species	Habitat	Probability of Occurrence	Rationale
Achnatherum hendersonii **Henderson's needlegrass**	**Sagebrush scablands**	**HIGH**	**Habitat present**
Achnatherum wallowaensis **Wallowa needlegrass**	**Sagebrush scablands**	**MODERATE**	**Habitat present**
Astragalus peckii Peck's milkvetch	Sage/juniper/lodgepole pumice/coarse soils	LOW	Outside Doc. range
Astragalus tegetarioides **Bastard milkvetch**	**Sage steppe/ponderosa pine forest**	**HIGH**	**Documented in project area**
Botrychium ascendens **Ascending moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Botrychium crenulatum **Crenulate moonwort**	**Wet meadows, springs, seeps**	**HIGH**	**Documented in project area**
Botrychium minganense **Mingan's moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Documented in Project Area**
Botrychium montanum **Mountain moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Documented in project area**
Botrychium paradoxum **twin-spike moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Calochortus longebarbatus* var. *peckii **Peck's mariposa lily**	**Vernally moist mdws,streambanks**	**HIGH**	**Documented in project area**
Camissonia pygmaea Dwarf suncup	Low elev plains/washes w/ coarse soil or gravel	LOW	No Habitat present
Carex diandra **Lesser panicled sedge**	**Sphagnum bog, lakeshores**	**MODERATE**	**Habitat present**
Carex lasiocarpa* var. *americana **Slender sedge**	**Very wet sedge mdws, along lakes/streams**	**MODERATE**	**Habitat present**
Carex retrorsa **Retrorse sedge**	**Swamps, marsh, mdws, along lakes, streams**	**MODERATE**	**Habitat present**
Cheilanthes feei **Fee's lip fern**	**Basalt cliffs but occasionally limestone**	**MODERATE**	**Habitat present**
Cyperus lupulinus ssp. *lupulinus* Great Plains flatsedge	Riparian edge but dry hackberry, wheatgrass	LOW	No habitat
Elatine brachysperma Short-seeded waterwort	Muddy shores, shallow pools	LOW	No habitat
Eleocharis bolanderi **Bolander's spikerush**	**Seasonally wet; low sage/sandberg in basalt**	**MODERATE**	**Habitat present**
Eriogonum cusickii **Cusick's buckwheat**	**Juniper/big sage and low sage scabland**	**MODERATE**	**Habitat present**
Heliotropium curassavicum Salt heliotrope	Moist to dry, saline soils	LOW	No habitat
Lipocarpha aristulata Aristulate liptocarpa	Low elev, silty below high water along banks	LOW	No habitat
Lomatium ochocense **Ochoco lomatium**	**Sagebrush scablands**	**MODERATE**	**Habitat present**
Mimulus evanescens Disappearing monkeyflower	Sage/juniper vernally moist streambanks	LOW	No habitat

Muhlenbergia minutissima **Annual dropseed**	**Weathered lava soils in riparian**	**MODERATE**	**Habitat present**
Penstemon peckii Peck's penstemon	Stream banks Disturbed areas	LOW	Outside Doc. range
Potamogeton diversifolius **Water thread pondweed**	**Lakes, ponds, including created habitat**	**MODERATE**	**Habitat present**
Rorippa columbiae Columbia yellowcress	Wet meadows, moist plains, streams	LOW	No habitat
Rotala ramosior Lowland toothcup	Sand and silt below high water, Low Elev	LOW	No habitat
Salix wolfii **Bebb Wolf's willow**	**Riparian**	**MODERATE**	**Habitat present**
Talinum spinescens (*Phemeranthus spinescens*) Spiny fameflower	Sagebrush scablands	LOW	No habitat
Thelypodium eucosmum Arrow leaf thelypody	Dry slopes in vernal drainages	LOW	Outside Doc. range
Utricularia minor **Lesser bladderwort**	**Lowland and montane fens, sedge meadows**	**MODERATE**	**Habitat present**
Bryophytes and lichens			
Encalypta brevipes	In soil on ledges and cliffs	LOW	No habitat
Entosthodon fascicularis Banded cord moss	Seasonally wet seeps, along intermittent streams	LOW	No habitat
Helodium blandowii **Blandow's bogmoss**	**Montane fens**	**MODERATE**	**Habitat present**
Schistidium cinclidodonteum **Schistidium moss**	**Wet/dry rocks or soil along intermittent streams**	**MODERATE**	**Habitat present**
Tomentypnum nitens **Tomentypnum moss**	**Montane fens**	**MODERATE**	**Habitat present**
Tortula mucronifolia **Mucronleaf tortula moss**	**Riparian *Populus* montane *Abies***	**MODERATE**	**Habitat present**
Texosporium sancti-jacobi Woven spore lichen	Often old root clumps of Sandberg or scat	LOW	No habitat

Species were ranked with a high probability of occurrence if: 1) there was a documented population within the project area, 2) there is high quality habitat present, and 3) the species is known to occur within a few miles of the analysis area. Species determined to have a moderate probability of occurrence are those for which some habitat is present but there are no documented occurrences near the project area. Species determined to have a moderate probability of occurrence are those for which habitat is present and the species may occur on the Ochoco National Forest, but there are no documented occurrences in the analysis area. Species determined to have a low probability are those for which habitat is not present within the analysis area or are not suspected to occur in the area because the project is outside of the potential distribution and geographic range of the species. Of the 39 species, 24 occur or have suitable habitat within the Wolf project area (they are bolded in the table). The other 15 species have a LOW probability of occurrence in the project area. These species would not be affected by the proposed project and will not be discussed further in the analysis.

Field Review and Surveys

The purpose of field reconnaissance is to conduct sensitive and rare plant surveys within the affected area, and determine the extent and condition of any TES species that are encountered. Areas identified in the pre-field analysis as having potential TES habitat were the primary focus of the

surveys; these generally included riparian areas, meadows, seeps, springs, fens, scablands, rock outcrops and forested areas. Extensive surveys for vascular sensitive plants were conducted between 1993 and 2005 within the Wolf Creek project area. Additional surveys were completed in the summer of 2012 and the spring of 2013. Surveys were conducted according to standardized procedures with varying degrees of survey intensity: complete, general, intuitive control, incidental. Surveys for sensitive nonvascular plants occurred in 2005 by bryophyte expert Rick Dewey, focusing primarily on fen species.

Surveys documented the following sensitive plant species within the analysis area: *Astragalus tegeteroides, Botrychium crenulatum, Botrychium minganense, Botrychium montanu, and Calochortus longebarbatus* var. *peckii*

Table 116. Summary of Proposed Activities by action alternative and affected rare plant habitat.

	Alt. 2	**Alt. 2**	**Alt. 3**	**Alt. 3**	**Alt. 4**	**Alt. 4**
Activity	**Treatment (acres)**	**Rare Plant (acres)**	**Treatment (acres)**	**Rare Plant (acres)**	**Treatment (acres)**	**Rare Plant (acres)**
Commercial thinning	4,706	30.6	384 of 21" units	30.6	3,394	0.2
Non-commercial thinning	988	12.8	988	12.8	1,177	21.4
Hardwood acres	75	0	90.2	5.2	92.3	5.2
Juniper removal	481	3.8	481	3.8	481	3.8
RHCA Treatments						
Commercial thinning	589	35.8	589	35.8	0	0
Non-commercial thinning	253	16.6	113	16.6	347	25.3
Fuels Reduction						
Activity fuels treatment	6,250	47.2	6,250	47.2	5,145	30.5
Natural fuels treatment	5,000	30.2	5,000	30.2	5,853	51
Hand piling	126	0	126	0	137	0
Stream restoration						
Stream restoration	1 site	0	2 sites	0	2 sites	0
Headcut repair	5 sites	0	6 sites	5.2	6 sites	5.2
Transportation System	**Miles of road**	**Rare Plant (miles)**	**Miles of road**	**Rare Plant (miles)**	**Miles of road**	**Rare Plant (miles)**
Temporary roads on existing disturbance	17.6	0.040	17.6	0.040	14.1	.040
New temporary roads	1.8	0.034	1.8	0.034	1.6	.034
TOTALS		**77.4 acres**		**82.6 acres**		**81.5 acres**

Riparian Habitats

Existing Condition

Riparian habitat in the Wolf project area is characterized by hardwood stream vegetation composed primarily of mountain alder (*Alnus incana*) with remnant patches of black cottonwood (*Populus trichocarpa*), quaking aspen (*Populus tremuloides*), and willow species (*Salix spp*.) with sedges (*Carex spp*), rushes (*Juncus spp*), and grass communities forming riparian meadows scattered across the project area. Deciduous riparian habitats provide important ecological functions on the landscape. Riparian communities made up of these species are extremely diverse in plant and wildlife.

Hydrologically, these deciduous plant communities provide excellent stability to stream banks and soil surfaces. Their deep spreading root systems can resist flooding and slow water velocity while providing shade to stream channels which assists in keeping water temperatures low.

The extent of these riparian communities has been greatly reduced within the last 200 years. By the 1900s, many of these stream systems were severely damaged or eliminated because of improper livestock use (Elmore1992). Estimates are that the riparian vegetation and in-stream habitats of 85% of the streams and rivers of the arid west are significantly degraded (Heilman 1996). The current pattern of distribution of aspen and willow suggests that in the past the majority of streams in these watersheds were connected aspen, alder, cottonwood and willow communities. Today, aspen and willow establishment in the Wolf project area is highly limited and fragmented. This suggests that the riparian habitat is also reduced and fragmented affecting associated sensitive plant species. There are 23 acres of alder/willow habitat mapped in the Wolf project area and 5 acres of mapped aspen habitat. Riparian meadow habitat accounts for approximately 21 acres in the project area GIS database.

Non-native invasive weeds are established in the Wolf project area; the majority of the weed sites are located along major travel routes. There are major roads along these riparian areas, and most weeds occur along these road shoulders; however, some are beginning to invade the surrounding native habitat. These creeks contain major populations of sensitive plants, notably Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*) and sensitive Botrychium species. Canada thistle is of particular concern because it readily establishes in riparian zones and has the ability to form large patches of rhizomatous growth. There is no effective manual or chemical control of this species to date because of its rhizomatous growth form and proximity to water.

Road construction, grazing, timber harvest and other management activities have resulted in hydrological changes, especially stream down cutting that has lowered water tables and in many places within the Wolf project area has resulted in loss of riparian habitat. Shifts in species composition resulting from the introduction of non-native plants, including both introduced perennial grasses and non-native invasive plants (noxious weeds), has also degraded riparian habitat for rare plants (USDA 2004b, DiTomaso 2000).

Riparian habitat (associated sensitive plant species)

Botrychium ascendens

Botrychium crenulatum

Botrychium minganense

Botrychium montanum

Botrychium paradoxum

Botrychium pinnatum

Calochortus longebarbatus var. peckii

Carex diandra

Carex lasiocarpa var. Americana

Carex retrorsa

Eleocharis bolanderi

Muhlenbergia minutissima

Potamogeton diversifolius

Salix wolfii

Utricularia minor

Helodium blandowii

Schistidium cinclidodonteum

Tomentypnum nitens

Tortula mucronifolia

Moonwort's *(Botrychium spp.)*

There are six species of Botrychium, also known as moonworts or grapeferns, on the Regional Forester's Sensitive Species List (USDA 2011). All of them occur or have potential habitat in Wolf project area. *Botrychium ascendens* , *Botrychium crenulatum, Botrychium paradoxum* are on the ORBIC List 1 (2010), meaning these species are considered to be threatened with extinction throughout their range. *Botrychium montanum* is on the ORNHIC List 2, meaning this species is of conservation concern but is not currently listed by the State of Oregon as threatened or endangered. *Botrychium minganense* has been determined to be less at risk, and is currently on the ORNHIC List 4, meaning this species is of conservation concern but is not currently listed by the State of Oregon as threatened or endangered.

Moonworts are found in a variety of habitats in Oregon, from old growth Western red cedar forests to xeric open meadows, seeps, and springs. On the Ochoco National Forest, moonwort species occupy primarily moist meadow sedge/forb communities associated with seeps, drainages, and the edges of wet meadows, to lightly shaded forested riparian areas. The habitat requirements of moonwort species on the Ochoco National Forest are similar, with several species often growing together; therefore, they will be considered as one group for this analysis.

The Wolf project area contains three species of *Botrychium*. Two populations of *Botrychium crenulatum* are known along Wolf Creek, two populations of *Botrychium montanum* occur-one along Wolf Creek and the other along East Wolf Creek, and two population of *Botrychium minganense occur* along East Wolf Creek. These populations were documented from 1993 through 1996 and occupy a total of 4 acres in the Wolf project area. Field surveys from 2012 and 2013 determined that habitat conditions for these documented populations are severely degraded as a result of continual overgrazing (stubble height was well below standard (1-2 inches), post holing in seeps and springs, and streambank erosion by cattle trailing. New surveys were conducted in the Wolf project area during the summer of 2012/13 and no new populations were found. However, these plants are small in stature, may be dormant underground for several years, and are therefore easily overlooked. While populations are difficult to locate, their habitat is readily identifiable and their presence will be assumed in high probability habitat.

Peck's Mariposa Lily *(Calochortus longebarbatus var. peckii)*

Calochortus longebarbatus var. *peckii*, Peck's mariposa lily, is a local endemic to Central Oregon occurring mostly on the Ochoco National Forest (2,965 acres), with a few populations on the Malheur NF (290 acres) and Prineville BLM (150 acres). It is currently on the Oregon Biodiversity Information Center (ORBIC 2013) List 1, meaning it is considered to be threatened with extinction throughout its range. Peck's mariposa lily is a sterile triploid, which reproduces exclusively through the asexual production of bulblets that form at the base of the plant and are presumably dispersed downstream (Fredricks 1986). Peck's mariposa lily is found in habitats ranging from riparian bands along seasonal streams and meadows within open ponderosa and lodgepole pine forests to open meadows, but is restricted to seasonally moist areas with patches of open, exposed, moderately deep to shallow soil. Very wet meadows and wetter portions of meadows tend not to support Peck's

mariposa lily; however, the drier margins of these meadows and meadows that are seasonally dry or moist overall tend to support the largest populations of the lily.

The Conservation for *Calochortus longebarbatus* var. *peckii* (Dewey 2011) suggest that this species may benefit from changes to riparian areas that result in increased amounts of transitional habitat. It also suggests that in some areas of the Ochoco National Forest, habitat for this species has been eliminated due to human influences. Road construction, grazing, timber harvest and other management activities has resulted in hydrological changes; especially stream down cutting that has lowered water tables and in some areas, has resulted in loss of riparian habitat for *Calochortus longebarbatus* var. *peckii* (USDA 2004b).

The Wolf project area contains many known populations and substantial habitat, most of which are located along tributaries to North Fork Wolf Creek, Widow Creek and Miles Creek. There are 11 existing entries for *Calochortus longebarbatus* var. *peckii* in the rare plant database (NRIS-TESP) occupying 120 acres within the Wolf project area. All known populations will be managed with the goal of maintaining or increasing the overall population of Peck's mariposa lily. If the management recommendations in the Conservation Strategy (Dewey 2011) are followed, viability of the species would not be compromised.

Sensitive Sedge Species (*Carex spp.*)

There are three sedge species listed as sensitive on the Regional Foresters list and are suspected of occurring on the Ochoco National Forest. Lesser-panicled sedge (*C. diandra*), slender sedge (*C. lasiocarpa* var. *americana) and* retrorse sedge (*C. retrorsa*) are on the ORNHIC (2007) List 2. These listed sedge species occupy moist to very wet habitats and are found over a wide geographic range in Oregon and across N. America.

Other Riparian Species

Eleocharis bolanderi, or Bolander's spikerush, is on ORNHIC List 2. It is a densely tufted, grass-like perennial that grows in seasonally moist meadows and channel edges in grass steppe-scablands, from foothills to moderate elevations in the mountains. *Eleocharis bolanderi* was known in Oregon only from historical records (1940's) until it was located in Lake and Wallowa counties in 2002-2004. It also occurs in other eastern Oregon counties as well as other western states.

Muhlenbergia minutissima, or annual dropseed, is on the ORNHIC List 2. This annual grass is associated with sandy gravelly drainages, rocky slopes, flats, road cuts and open sites at moderate to high elevations. In Oregon, it has been documented at only one site in Malheur County. It has also been documented in other western states.

Potamogeton diversifoliius, or Rafinesque's pondweed, is on the ORNHIC List 2. This aquatic perennial forb is found in shallow ponds, marshes, and reservoirs in sage grassland or pine woodlands. It is found in most states.

Salix wolfii, or Wolf's willow, is on the ORNHIC List 2. It is primarily a high elevation species associated with sites that collect cold air (Brunsfeld and Johnson 1985). In Oregon, it has been documented in Wallowa and Harney Counties. It has been documented in Idaho, Nevada, and the Rocky Mountain States.

Utricularia minor, or lesser bladderwort, is on ORNHIC List 2. Its habitat is low nutrient lakes and peatbog pools in lowlands and montane zones up to 4,000 feet. In Oregon, it has been documented in several counties on both sides of the Cascades. It also occurs in most western states and across the northern half of the US to the east coast.

Helodium blandowii, or Blandow's bogmoss, is on the ORNHIC List 2. This moss forms mats and small hummocks in medium to rich montane fens or along streamlets in fens. Elevations range from 5,000 to 6,000 feet. In Oregon, it has been documented in several counties, on both sides of the

Cascade Mountains and in the Blue Mountains, including the Ochoco National Forest. No management guide is available, but the species fact sheet suggests managing habitats to maintain hydrology and other processes needed for fen species.

Schistidium cinclidodonteum is on the ORNHIC List 2. It occurs in large loose mates on wet or dry rocks or on soil in rock crevices along intermittent streams. It is suspected on the Ochoco National Forest but has not yet been documented.

Tomentypnum nitens, or tomentypnum moss, is on ORNHIC List 2. It forms loose or dense sods or intermixes with other bryophytes in medium to rich montane fens, where it favors slightly elevated microsites sites such as logs, stumps, or hummocks. Potential habitat occurs in, but not limited to, areas with calcareous bedrock. Elevations range from 5,000 to 6,000 feet. It has been documented in several counties in Oregon, including both sides of the Cascade Mountains and the Blue Mountains, including the Ochoco National Forest. It is widely distributed across the Northern Hemisphere. No management guide exists yet, but the species fact sheet suggests managing habitats to maintain hydrology and other processes needed for fen species.

Tortula mucronifolia, or mucronleaf tortula moss, is on the ORNHIC List 2. It has been documented in Southwest Oregon and in two sites in eastern Oregon. It distributed widely across North America and also in New Zealand. No management guide exists yet, but the species fact sheet suggests managing known sites and surveying for more sites until more is known about this species.

Direct and Indirect Effects

Riparian Habitats

While effects such as damage by falling trees, logging equipment, and road construction can directly impact sensitive plants and their habitats, one particular indirect effect is the lowering of the water table in riparian zones, and associated sensitive plant habitat, due to stream down cutting. This can be caused by road construction, logging, wildfire, and livestock grazing that removes vegetation and exposes stream banks, increasing runoff effects and the potential for channel erosion (USDA 2004b). Therefore, analysis of effects to rare plant populations in riparian habitats is intricately tied to hydrological changes in their habitat (Seymour 2009).

Alternative 1

This alternative would have no disturbance through road construction, timber harvest, burning, or other activities that could directly or indirectly affect the viability of sensitive plant species. Habitat would be maintained as is, at least in the short term (<10 years). Therefore, for species associated with riparian habitats, no direct impact is expected. However, no beneficial indirect effects through improvements to habitat would be made through a decrease in competition from surrounding plants or from stand density reduction as a result of timber harvest, noncommercial thinning, or prescribed natural fire. Natural wildfires prevent these early successional species from being outcompeted by plant species, including encroaching conifers. With wildfire suppression, overstocked stands, and lack of prescribed burning, a long-term decline of early successional species such as *Calochortus longebarbatus* var. *peckii*, and several species of *Botrychium*, may continue to decline if competition is not set back (Kagan 1996, Halvorson 2003, Farrar 2006). However, livestock grazing may offset the risk of being outcompeted by lack of fire. Grazing will be discussed further in the cumulative effects section.

Alternative 2

Soil disturbance from heavy machinery can directly impact individual rare plants. Soil compaction or erosion caused by logging activities can impact future recruitment by changing hydrological patterns in riparian habitat.

Heavy slash resulting from both commercial and noncommercial thinning activities can bury plants, and burning this slash, particularly grapple piles, can scorch soils, damaging plants and their habitat.

The Conservation Strategy for Peck's mariposa lily (Dewey 2011) provides conservation strategies to protect the viability of the species. These management strategies would be followed for all action alternatives and are described in the design elements section of this document. Similarly, the Conservation Assessment for 13 species of Moonworts (Ahlenslager & Potash 2007) is used to design protection measures for *Botrychium* populations and its habitat in the Wolf project area.

Table 117. Proposed activities for Alternative 2 with sensitive plant populations

Unit number	Rx1	Rx2	Fuels treatment	Rare plant	acres
16	Commercial harvest	PCT	underburn	Peck's mariposa lily	5.2
18	Commercial harvest	PCT	underburn	Peck's mariposa lily	3.3
20	Commercial harvest	PCT	underburn	Peck's mariposa lily	0.53
21	Commercial harvest	PCT	underburn	Peck's mariposa lily	5.4
22	Commercial harvest	PCT	underburn	Peck's mariposa lily	15.1
173	Commercial harvest	PCT	underburn	Peck's mariposa lily	1.0
174	Commercial harvest	PCT	underburn	Peck's mariposa lily	0.01
208		Juniper thin	underburn	Peck's mariposa lily	0.63
210		Juniper thin	underburn	Peck's mariposa lily	2.0
220		Juniper thin	underburn	Peck's mariposa lily	1.1
209		PCT	underburn	Peck's mariposa lily	3.0
230		PCT	underburn	Peck's mariposa lily	8.7
52		PCT	underburn	Peck's mariposa lily	1.2
338			underburn	Peck's mariposa lily	16.8
342			underburn	Mountain moonwort	0.3
343			underburn	Peck's mariposa lily	12.9

Calochortus longebarbatus var. peckii

Commercial timber harvest

Direct effects

Seven proposed timber sale harvest units are adjacent to or encompass Peck's mariposa lily populations (See table 119). In this alternative, 30.6 acres of the 120 total acres of *Calochortus longebarbatus* var. *peckii* occurring in the Wolf project area would be affected by commercial timber harvest, all of which are in designated RHCA's. Design elements based on recommendations in the Species Management Guide for Peck's mariposa lily would minimize direct effects to these populations. No slash piling or ground based equipment would be used within 50 feet of Peck's mariposa lily populations or habitat. No new road construction would occur within 100 feet Peck's mariposa lily habitat.

The harvest prescription for these RHCA units has been designed to meet Riparian Management Objectives. The harvest would be light, with the majority of the trees removed being from 7 to 14" diameter range. Large populations of Peck's mariposa lily have been observed under previously harvested, partially opened canopies. While complete opening of the canopy through clearcut or shelterwood harvests appears to have detrimental effects to this species, a partially open canopy appears to be beneficial (Kagan 1996). This harvest, which would reduce competition and shade from smaller trees, would be expected to maintain or benefit the population.

Indirect effects

Short-term indirect effects are possible within all the populations in or adjacent to RHCA harvest units. A short term, localized increase in sedimentation is expected. This may affect Peck's mariposa lily by changing microsite conditions as stream pools expand or contract.

Table 118. Commercial timber units in Alternatives 2&3 with Peck's mariposa lily populations

Unit	Comments	TES #	mitigation
16	Entire Eastern half	107	50 feet buffer
18	SW portion	107	50 feet buffer
20	Small portion of east edge	102	50 feet buffer
21	Along eastern border	102	50 feet buffer
22	Through center	102	50 feet buffer
173	NE edge	106	50 feet buffer
174	SE edge	106	50 feet buffer

Road construction and decommission

There would be 1.8 miles of new temporary roads proposed for logging activity and 17.6 miles of temporary road construction on existing disturbance. There is 0.034 miles (182 feet) of new temporary road construction proposed within Peck's mariposa lily habitat to access unit 22, and 0.040 miles (211 feet) of temporary road construction on existing disturbance in Peck's mariposa lily habitat.

Direct effects

There could be a direct negative effect to approximately 182 feet of Peck's mariposa lily habitat. As stated in the conservation strategy, there should be no new road construction within 100 feet of Peck's mariposa lily habitat. The impacts to habitat affected by temporary road construction on existing disturbance (211 feet) should not increase beyond what has already occurred if activities are confined to the existing road bed. Because of project design features, there would be no new temporary road construction within 100 feet of Peck's mariposa lily habitat and therefore there should be no direct effect on the population. There are no proposed road closures or decommissioning in Calochortus habitat therefore no negative direct effects are expected.

Indirect effects

Road construction could have a negative indirect effect on Pecks Mariposa lily by interrupting surface hydrology and re-routing the subsurface and surface flow of water (Dewey 2011). Road closures and decommissions would have a long-term positive effect on pecks mariposa by re-establishing hydrological function important to this species

Noncommercial thinning

There is a proposed 988 acres of noncommercial thinning (PCT) in addition to the PCT proposed after commercial harvest (4,706 acres); 47.2 acres are in sensitive riparian plant habitat. Noncommercial thinning is split out for juniper removal, noncommercial hardwood, and post commercial thinning. This report will group these categories as PCT for this analysis.

Direct effects

Direct negative effects could result from noncommercial thinning as slash from these activities may bury sensitive plants. Design criteria for Peck's mariposa lily specifically state 1) noncommercial thinning should be done after the growing season (July-August); 2) noncommercial thinning would be done by hand without ground disturbing equipment, 3) No slash from noncommercial thinning would be piled in lily habitat. These design criteria would reduce the potential for burying sensitive plants and therefore no direct impacts are anticipated.

Indirect effects

Short-term indirect effects are expected to be negligible, with indirect long-term effects benefiting the lily populations. Units that have sensitive riparian plants are listed in table 118 with the activity. All PCT units that have rare plant species within them would be protected by the project design criteria listed above.

Fuels treatment

There are 6,250 acres of activity fuels treatments and an additional 5,000 acres of natural fuels treatments proposed in this alternative. Of the acres, 47.2 acres of activity fuels treatment and 29.8 acres of natural fuels treatment are in Peck's mariposa lily habitat. Fuels treatments have the potential to directly impact these populations if there are heavy fuel loads in the area, and the fire intensity is high. Historically, riparian habitats, in which this species occupies, was subject to low intensity, low frequency, late summer fires that removed competing vegetation and prevented fuel build up. Currently, fuels have accumulated as a result of decades of fire suppression, and therefore, may sustain fires of greater intensity than under the historical fire regime, possibly sterilizing soil and damaging bulbs.

There are design elements specified to address these concerns. Broadcast burning would occur in these sensitive plant areas, but no activity slash would be piled within sensitive plant populations, thereby reducing unnatural fuel loading. Timing of fuels treatment is also important to maintaining viable Peck's mariposa lily populations. Spring burning can have a negative effect on plants by damaging the newly emerged vegetative material. *Calochortus* individuals are adversely affected by the removal or damage of leaves, which depletes carbohydrate reserves (Fredricks, 1986). Prescribed fire would take place in the fall after the plants are dormant, to avoid leaf damage. Implementation of design criteria should minimize adverse direct effects to Peck's mariposa lily populations.

In a study of the effects of fire and grazing on Peck's mariposa lily on the Ochoco National Forest, Kagan (1996) observed that cool burns appeared to reduce competition to the lily, and did not affect the moisture gradient in the meadows. This burn was conducted in a high moisture year and the burn did not carry well through the majority of the study plots. Thus, there were no data on the effects of hot burns on the population. On the Winema National Forest, a wildfire burned a population of *Calochortus longebarbatus* var. *longebarbatus,* a close relative of Pecks mariposa lily. Flowering individuals greatly increased in the year following the fire (Kagan 1996). Long-term indirect effects should be beneficial for the species by returning to a more historical fire regime.

There is a total of 126 acres of hand piling of slash proposed under this alternative, but none proposed in Pecks mariposa lily habitat. Because there is no proposed piling of fuels in lily habitat there would be no negative impact to this species or its habitat.

Stream restoration and Headcut repair

There is one location on Wolf Creek that has proposed stream restoration activities. There are 5 proposed head cut repairs for Alternative 2.

Direct and indirect effects

There are no known populations of Pecks mariposa lily within proposed stream restoration or headcut repair activities, therefore no negative direct effects are expected for Alternative 2. Indirect effects would be beneficial to Peck's mariposa lily habitat because proposed stream restoration activities would improve the proper hydrological conditions that this species is adapted to (Dewey 2011, Kagan 1996, Goldenburg 1995).

Conclusion

Overall, this alternative has a potential for direct and indirect impacts to Peck's mariposa lily habitat. Peck's mariposa lily is influenced by changes in hydrology and stream bank condition, and vegetation changes (Kagen 1995). Heavy equipment and temporary road construction and reconstruction would compact soils and disrupt and reroute the subsurface and surface flow of water negatively affecting Peck's mariposa lily habitat. Noncommercial thinning and prescribed burning along the forest/meadow interface with habitat for Peck's mariposa lily, could have positive long- term effects (>10 years), by removing shade and reducing competition from neighboring plants. Stream restoration activities may have a short-term negative impact but a long-term positive effect of population viability by improving habitat conditions overall.

Botrychium species

Three species of Botrychium (moonworts) are documented in the Wolf project area, *Botrychium crenulatum, Botrychium minganense* and *Botrychium montanum.* These species occupy the same major habitat type, wet meadows, seeps and springs and partially shaded riparian forests, and will be analyzed together.

Commercial timber harvest

There are no known Botrychium species within proposed commercial timber harvest units under Alternative 2. The majority of the sensitive Botrychium populations in the Wolf project area occur in designated Old Growth allocations and there are no proposed commercial harvest activities in these areas. However, it is likely that there are sensitive Botrychium populations in the project area that have not been documented because these plants are small in stature, may be dormant underground for several years, and are therefore easily overlooked. While populations are difficult to locate, their habitat is readily identifiable and their presence will be assumed in high probability habitat.

Direct and indirect effects

There is a potential for both direct and indirect effects to Botrychium habitat as a result of commercial harvest because they are very sensitive to changes in soil moisture, soil temperature, mycorrhizae associations, and canopy cover (Ahlenslager and Potash 2007). Logging equipment could directly affect undocumented populations by mechanically damaging plants and their mycorrhizae associations. Conventional ground based logging equipment increases soil compaction and runoff, causing indirect negative effects to the adjacent wet habitat.

Noncommercial thinning

Direct and indirect effects

Direct negative effects of noncommercial thinning on Botrychium species could result from the piling the slash on the tops of individual plants. If this were to occur, because these plants are tiny, it is likely that buried plants would be unable to reproduce. Moonworts can be found on small hummocks under lodgepole pine, and other conifers within wet meadows. There is typically partial shading in these habitats, which is thought to be beneficial to the species, but when partial shaded sites succeed to closed canopy sites, Botrychium populations may disappear (Zika, 2002).

There is one noncommercial thinning unit (#201) that is adjacent to documented Botrychium populations. Design criteria would be followed to minimize any potential negative direct on Botrychium populations and their habitat: 1) noncommercial thinning would be done after the growing season (August), 2) noncommercial thinning would be done by hand without ground disturbing equipment, and 3) no slash from noncommercial thinning would be piled in Botrychium habitat. These design criteria would reduce the potential for burying sensitive plants and therefore no direct impacts are anticipated. These design criteria would protect unknown moonwort populations from any negative direct effects. Indirect effects are expected to be negligible as well, with indirect long-term effects of maintaining early successional habitat for recruitment of new individuals would benefit Botrychium populations.

Road construction and decommission

Direct and indirect effects

There are no new or temporary road construction proposed near Botrychium populations; therefore, no direct or indirect effects are anticipated. There is a proposed road decommission along East Wolf Creek that is adjacent to several Botrychium populations. Proposed road closures and decommissioning would only benefit sensitive plant habitat by reducing sedimentation, improving surface hydrology, increasing infiltration rates and reducing further compaction as well as reducing the potential for spreading non-native invasive weeds along roads travelled by vehicles which are well known vectors of invasive species.

Fuels treatment

There are 0.32 acres of natural fuels treatments proposed in Botrychium habitat (see table 118). Much of this habitat is considered too wet to carry fire and therefore is naturally buffered from any adverse direct effects. For populations that may be susceptible to fire, careful monitoring during burning operations is necessary to avoid harmful direct or indirect effects of hot burns. Hot burns could result in the complete consumption of duff which would increase sediment loading. Johnson-Groh and Farrar (1996a) conducted studies to show the effects of fire on moonwort populations and concluded that normal fires that were not excessively hot or dry pose no serious threat to moonworts. However, they noted that exceptionally hot burns or ones that occur when soil is desiccated can kill moonworts directly or indirectly by killing the mycorrhizae that they depend on for increased water and mineral absorption. Indirect effects of fire, desiccation and sedimentation negatively affect moonworts (Ahlenslager and Potash 2007). The district botanist would review burn plans and make recommendations for unit 342 that has one Botrychium population within it and is adjacent to several others. This would minimize any direct or indirect effects to Botrychium populations.

Other sensitive riparian species

The riparian habitat for these species is similar to Peck's mariposa lily and Botrychium species and would be protected from heavy equipment. Moist habitat associated with riparian areas is unlikely to burn during prescribed burning, though the fringes of this habitat may burn, direct or indirect effects on these species if they are present should be minimal. In addition, other activities including road maintenance, reconstruction, noncommercial thinning, and fuels treatments that would occur within the RHCA's may damage some individual *Calochortus longebarbatus* var. *peckii*, *Botrychium spp*., sensitive *Carex spp*. or other sensitive plant species associated with riparian areas. However , these activities are expected to 1) only affect the periphery of such habitat (thinning along a meadow edge); 2) are not expected to burn with high intensity; 3) would affect areas already heavily disturbed (road reconstruction, decommissioning); or 4) would otherwise occur in marginal habitat or areas unlikely to affect viability of populations. Therefore, for sensitive plant species associated with riparian habitats (including seasonally-moist habitats, wet meadows, seeps, springs, and aquatic habitats),

anticipated short-term effects (< 10 years) would be that some individuals or habitat may be affected, but would not be likely to contribute to a trend towards federal listing or loss of viability.

Alternative 3

Alternative 3 proposes the same activities as Alternative 2, with the addition of the commercial harvest of selected trees over 21" from specific commercial units in alternative 2 (384 acres in total), 14.7 additional acres harvested in hardwood units, an additional stream restoration activity in North Wolf Creek, and 5.8 additional miles of road closures.

Sensitive Riparian Species

Commercial timber harvest

There would be no difference in direct or indirect effects to riparian plant populations or habitat compared with Alternative 2. All proposed commercial harvest units with sensitive riparian plant species are listed in Tables 118.

Noncommercial thinning

Alternative 3 proposes the same noncommercial thinning activities as Alternative 2 with the addition of 14.7 acres of thinning in hardwood (aspen) stands. Design criteria would be followed for these additional treatments.

Direct and indirect effects

In addition to the units proposed for noncommercial thinning activities in Alternative 2, there is one proposed unit for aspen improvement (#350) that would pose a direct impact to 5.2 acres of Peck's mariposa lily habitat. Project design criteria would be implemented to minimize any direct negative effects to the lily population.

Fuels treatment

Natural and activity fuels treatments in Alternative 3 are the same for Alternative 2 (see table 118).

Stream restoration

There is one additional stream restoration site and one additional headcut repair proposed in Alternative 3. None of these proposed activities are within documented sensitive plant populations and therefore no direct effects are anticipated. There would be a beneficial indirect effect of these proposed activities by improving and potentially expanding sensitive riparian plant habitat.

Alternative 4

This action alternative addresses concerns with commercial harvest within riparian habitat conservation areas. There are no proposed commercial harvest units within designated RHCA's and a total of 3,394 acres of commercial harvest (1,312 acres less than Alternatives 2 and 3). There are additional noncommercial thinning units in Alternative 4, for a total of 1,177 acres (189 acres more than Alternatives 2 and 3). There are approximately 870 additional fuels treatment acres, but a reduction in proposed temporary road construction compared with Alternatives 2 and 3. The proposed stream restoration, headcut repair, road closures and decommissions are the same as the other action alternative therefore the effects analysis is the same as for Alternative 3.

Table 119. Proposed activities in sensitive plant habitat under Alternative 4.

Unit number	Rx1	Rx2	Fuels treatment	Rare plant	acres
21	Commercial harvest	PCT	underburn	Peck's mariposa lily	0.09
22	Commercial harvest	PCT	underburn	Peck's mariposa lily	0.1
355	Commercial harvest	PCT	underburn	Peck's mariposa lily	0.001
350	Aspen thin	Headcut		Peck's mariposa lily	5.2
208		Juniper thin	underburn	Peck's mariposa lily	0.63
210		Juniper thin	underburn	Peck's mariposa lily	2.0
220		Juniper thin	underburn	Peck's mariposa lily	1.1
16		PCT	underburn	Peck's mariposa lily	5.2
18		PCT	underburn	Peck's mariposa lily	3.3
209		PCT	underburn	Peck's mariposa lily	3.0
230		PCT	underburn	Peck's mariposa lily	8.7
52		PCT	underburn	Peck's mariposa lily	1.2
338			underburn	Peck's mariposa lily	37.7
342			underburn	Mountain moonwort	0.3
343			underburn	Peck's mariposa lily	12.9

Sensitive Riparian Species

Commercial timber harvest

Direct and indirect effects

Although there is a reduction in the number of acres of rare plant habitat within proposed commercial harvest in Alternative 4, compared with the other action alternatives, there are three proposed commercial harvest units in Alternative 4 with documented *Calochortus longebarbatus* var. *peckii* populations. There could be a direct effect to 0.2 acres of Peck's mariposa lily habitat in Alternative 4 as a result of commercial harvest activities within a known population with no rare plant habitat affected within RHCA's (see table 120 for units). Design elements would be followed for these units with a 50 feet no heavy equipment buffer to protect this population against adverse effects.

Table 120. Commercial harvest units in Alt 4

Unit	Comments	TES #	Mitigation
21	Entire Eastern half	102	50 feet buffer
22	SW portion	102	50 feet buffer
355	Western portion	102	50 feet buffer

Noncommercial thinning

There could be a direct effect for 25.3 acres of Peck's mariposa lily habitat as a result of proposed noncommercial thinning in Alternative 4, mostly within RHCA's (see Table 120). This is an increase in the number of acres of habitat affected from Alternatives 2 and 3. Project design features would minimize the negative impacts to these populations and are the same as discussed for Alternatives 2 and 3.

Fuels reduction activities

There are a proposed 30.5 acres of underburning for activity fuels and 51 acres of natural fuels reduction in sensitive riparian plant habitat. Effects would be the same as discussed for Alternatives 2 and 3. Project design features would minimize the negative effects of fuels treatments on the rare plant populations, and are the same as discussed for the other action alternatives.

Upland Forest Habitat

Existing Condition

The most common upland forest plant associations include ponderosa pine (*Pinus ponderosa*)/Idaho fescue (*Festuca idahoensis*), Douglas-fir (*Psuedotsuga mensiesii)/*pinegrass (*Calamagrostis rubescens*) and grand-fir (*Abies grandis*)/pinegrass (*Calamagrostis rubescens*).

The current vegetation is the result of natural processes occurring over the last few thousand years, including such influences as the ice age and volcanic eruptions. However, the vegetation has also been influenced by human activities and associated changes within the last one hundred and fifty years. Most notable changes include an increased density of fire intolerant conifers and reduced density of understory vegetation due to fire exclusion and grazing (Miller and Rose 1999, USDA 2004b, 1999, Arno 2000, Agee 1993).

Altered species composition has resulted from the introduction of non-native plants, including both introduced perennial grasses and non-native invasive plants (noxious weeds), and a decline in overall landscape health such as soil compaction and erosion.

Upland forested habitat (associated sensitive plant species)

Deschutes milk-vetch *(Astragalus tegetarioides)*

Astragalus tegetarioides, Deschutes milk-vetch, is currently on the ORNHIC List 1. This species occurs in openings, swales, and canyon bottoms in ponderosa pine forests and open stands of low and big sagebrush. Specific ecological requirements are not well known for this species, but there is one documented population in the Wolf project area and it is growing on an old skid road below ponderosa pine and occupies approximately 14.2 acres. It is the northernmost documented population in its range which is primarily in the John Day drainage and therefore is important for species viability.

Direct and Indirect Effects

Alternative 1

Alternative 1 would have no direct effects on Deschutes milk-vetch. However, no beneficial indirect effects to Deschutes milk-vetch through habitat improvement would be made through prescribed fire, stand density reduction through timber harvest, or through noncommercial thinning.

Alternative 2

No commercial harvest, noncommercial thinning, fuels reduction or road construction is proposed within known Deschutes milk-vetch populations or high probability habitat; therefore, no direct or indirect effects from these activities would occur. Deschutes milkvetch is usually found on volcanic soils in openings of shrublands and dry ponderosa pine forests. The most common associated plants are *Artemesia arbuscula*, *Poa sandbergii*, *Festuca occidentalis* and *Phlox hoodii*. The single population of Deschutes milkvetch in the Wolf project area is growing on a closed road and has over 1,000 individuals. Despite the assumption that Deschutes milk-vetch is an early successional, fire tolerant species like its congeners, the effects of prescribed burning on the plants' biology and habitat is unknown. Current fuel loadings due to fire suppression are greater than these species may have evolved with. Therefore, the same localized populations could be negatively impacted in the short term by prescribed burning. Long-term effects of burning may be beneficial by reducing dense stands of brush and understory ponderosa pine, creating more milk-vetch habitat. This population will continue to be monitored to ensure its population viability

Alternative 3

No harvest or road building is proposed within known Deschutes milk-vetch populations or high probability habitat; therefore, no direct or indirect effects from these activities would occur. This alternative only includes the commercial harvest of selected trees over 21 inches for 384 acres, additional road closures, and stream restoration activities, none of which would have a direct or indirect effect on Deschutes milkvetch.

Alternative 4

No commercial harvest, noncommercial thinning, fuels reduction or road construction is proposed within known Deschutes milk-vetch populations or high probability habitat; therefore, no direct or indirect effects from these activities would occur.

Non-Forested Habitat -Scablands

Existing Condition

Scablands are characterized by rocky clay soils that are very dry, shallow, gravelly lithosols with cryptogenic soils, characterized by frost heaves in the winter. There is a general lack of vegetation with much of the gravelly soils being bare. Plants that do colonize these scablands include *Artemesia rigida*, *Poa sandbergii* and *Danthonia unispicata.* There is approximately 3,602 acres of scabland habitat in the Wolf project area.

Scabland habitat (associated sensitive plant species)

Achnatherum hendorsonii

Achnatherum wallowaensis

Eriogonum cusickii

Lomatium ochochense

Two needlegrass species, *Achnatherum hendersonii* and *Achnatherum wallowensis*, were split from one former species *Orysopsis hendersonii*. Both species are on the ORNHIC list 1. *Achnatherum hendersonii* and *Achnatherum wallowensis* are regional endemic species that occur sporadically in central and northeastern Oregon. They are found on exclusively on scablands in Central and North Central Oregon.

There are forty-seven *Achnatherum hendersonii* sites and nine *Achnatherum wallowensis* sites documented on the Ochoco National Forest in the NRIS-TES database. None of these sites occur within the Wolf project area, but significant habitat is present.

Eriogonum cusickii (Cusick's buckwheat)

Eriogonum cusickii, or Cusicks's buckwheat is on ORNHIC List 1. Its habitat is sage scablands (lithosol soils), sandy volcanic flats, and mixed grasslands. In Oregon, it has been documented in Harney and Lake Counties. It has also been documented in Crook and Deschutes counties, but these occurrences may have been misidentified, no new occurrences have been found. There are no known populations in the project area.

Lomatium ochocense *(Ochoco lomatium)*

Lomatium ochocense , or Ochoco lomatium, is a local endemic species discovered in 1994, on the Ochoco National Forest. It is found on basaltic scablands on shallow lithosoic soils

Direct and Indirect Effects

Alternative 1

There are approximately 3,602 acres of high probability habitat for *Achnatherum hendersonii, Achnatherum wallowensis,* and *Lomatium ochocense* habitat in the Wolf project area. This alternative would have no direct or indirect effects on these species or their habitat.

There is no difference between the three action Alternatives for activities in scabland habitats and they will be analyzed together.

Alternative 2, 3, and 4

No harvest activities would take place on non-forested scablands in any alternative. No direct effects from logging would occur to sensitive scabland plant species or habitat. Indirect effects to habitat may occur from increased runoff, incidental tree falling, and slash accumulation outside of harvest unit boundaries.

No new system road construction is proposed within scabland habitat for any alternative. Proposed roads for re-use within scabs were surveyed and no sensitive species were found. There are 1.02 miles of proposed temporary road reconstruction on existing disturbance and 0.40 miles of proposed new temporary roads in scabland habitat. No rare scabland plant species were found in areas with proposed temporary roads. There should be no direct effects to high probability needlegrass habitat for the 1.02 miles of temporary road construction on existing disturbance, because there is already a pre-existing road bed that is considered to be a permanent disturbance due to the nature of road impacts on scabs. However, implementation of action alternatives would adversely impact sensitive *Achnatherum spp.* and *Lomatium ochocense* populations if present on the 0.40 miles of proposed new temporary road construction. There are four small sections of proposed new temporary road construction through scabland habitat to access commercial harvest unit 14. The Ochoco National Forest LRMP prohibits temporary road building on scabs unless there is no feasible alternative (Chap 4 pp 4-227). There is approximately 1.44 miles of temporary roads proposed on scabland with high probability needlegrass habitat. Design elements were developed to address some of these issues. Scabs would be avoided for road building if possible, if not they would not be constructed in a temporary fashion, they would be rocked, and have erosion control features.

There are approximately 390 acres of prescribed fuels treatment in scabland habitat. Natural and activity fuels burning are not designed to burn across scablands. However, no control lines would be constructed to keep fire out of these habitats; therefore, they are included in the total acres of prescribed fire. No lighting would occur within the scabs. It is unlikely that high probability needlegrass or *Lomatium* habitat would carry a fire; by nature it is rocky and bare with no fuel accumulation. *Achnatherum hendersonii* and *A. wallowensis* probably evolved in an infrequent, light intensity fire regime; however prescribed fire effects on these species are unknown. Natural or activity fuels treatments are not expected to have direct or indirect effects on rare scabland plant species.

There is no significant difference in activities for scabland habitat between the action alternatives. Direct and indirect effects of Alternative 3 and 4 on scabland species would be the same as discussed for Alternative 2.

Cumulative Effects

Cumulative effects are those that are expected from the effects of proposed project alternatives when added to other past, present, and reasonably foreseeable actions. The cumulative effects boundary includes only the Wolf project area.

Present actions include the Southside EA (2009) which reauthorizes cattle grazing on three allotments, one of which has acreage within the project area; 98% of the project areas is comprised of the Wolf Creek allotment. The continued influence of cattle grazing within the project area contributes to negative effects on sensitive plants and their habitat. Repeated and lengthy grazing by livestock in riparian areas can dramatically alter the plant community, compact the soil, change soil surface hydrology, microclimate, create down cutting of streams by removing vegetation that would otherwise stabilize stream banks and function to trap and deposit sediment creating wet meadows and floodplains (Elmore 1992). Grazing also causes trampling of actual Peck's mariposa lilies and consumption of their basal leaves reduces photosynthate available for bulb renewal (Fiedler 1987). Heavy grazing in riparian areas, along with the potential negative direct and indirect effects of implementing the Wolf project, could have negative cumulative impacts on sensitive plants and their habitat.

Botrychium populations in the Wolf project area occur within or close to seeps and springs and transition corridors between the wet edge of the stream and the drier upland. The majority of these populations have declined or been extirpated since 1994, and their habitat continues to degrade as a result of cattle grazing in these sensitive areas. Cattle trail right through these sensitive Botrychium populations, and the seeps and springs which create the habitat these species depend on are typically post holed, dewatered and overgrazed well below the standard stubble height requirements. It is apparent from habitat surveys that the adaptive management process is ineffective at protecting these sensitive areas from damage by cattle. When native vegetation is overgrazed, and bareground is exposed, it greatly increases the invasibility of the site by non-native invasive species which is evident in the Wolf project area. Non-native invasive species further degrades sensitive plant habitat, and outcompetes sensitive plant species such as small statured botrychiums. Commercial harvest, noncommercial thinning and fuels treatments would open up riparian habitat, create more bareground and could exacerbate the negative effects of cattle grazing in sensitive riparian plant habitat.

Another present action includes the Deschutes and Ochoco Invasive Plant EIS (2012). The decision authorized treatment of invasive plants using chemical, manual, and cultural methods, as well as "early detection/rapid response (EDRR)" treatments of new weed populations.

Non-native invasive weeds are established in the Wolf project area. The majority of the weed sites are located along Wolf Creek and its upper tributaries, and East Wolf Creek. There are major roads along these riparian areas, including the 3810 and the 4290, with most weeds occur along the road shoulders, although some are beginning to invade the surrounding native habitat. Canada thistle is of particular concern because it readily establishes in riparian zones, and has the ability for form large patches of rhizomatous growth. There is no effective manual or chemical control of this species to date because of its rhizomatous growth form, and proximity to water. Biological control is being tried with limited success. Non-native invasive weeds in sensitive plant habitat have a significant negative impact on rare plant populations. Non-native invasive weeds can out-compete sensitive plants by growing faster, larger and taking up limited resources, particularly nitrogen and water, more efficiently than rare native species. Noxious weeds particularly spotted knapweed can chemically inhibit the germination of rare plants and can invade disturbed sites as well as relatively undisturbed perennial plant communities (DiTomaso 2000). The majority of noxious weeds in Wolf and the surrounding areas readily establish after ground disturbing activities such as timber harvest, road construction, stream restoration activities and fuels treatments. Surrounding private and forest service lands are infested with Hound'stongue which is readily spread by cattle into the Wolf watershed.

Until recently we were unable to chemically treat newly discovered weed infestations on the Ochoco National Forest. With the newly signed Deschutes and Ochoco Invasive Plant Treatment EIS (May 2012), we are now able to chemically treat any new infestations under the early detection rapid response process which will greatly help reduce the rate of spread into newly disturbed ground as a result of the proposed activities in the Wolf planning area. However, project design features of the new weed EIS prohibit chemical treatment near perennial streams to protect aquatic species and water quality (USDA 2012). Therefore, invasive species such as Canada thistle will continue to spread and degrade sensitive riparian plant habitat.

The Deschutes and Ochoco Travel Management EIS (2011) has implanted numerous road closures on the Ochoco National Forest including several miles of roads in the Wolf planning area. Road closures have a positive cumulative effect on sensitive plant habitat by reducing erosion, sedimentation, and eliminating the spread of non-native invasive plants by vehicles traveling along these roads. With the road closures and decommissioning proposed in the Wolf project, cumulatively, these actions will have a beneficial effect on sensitive plant populations.

The Ochoco Summit Trail System project, which would designate varying miles of trails for off-highway vehicles (OHV), is a foreseeable future action that overlaps with the Wolf project cumulative effects boundary; OHV use could increase in the Wolf project area if the new trail system is implemented. OHV's could have a lasting negative effect on rare plants and their habitat by acting as a vector for non-native invasive plants which are known to attach to OHV vehicles and spread to new locations. African wire grass, or ventenata is common in the Wolf project area and is easily spread by OHV's when their seeds stick to mud and debris in their tires and chassis. The spread of this and other non-native annual grasses into new habitat, particularly scablands, would have a detrimental effect on sensitive plant species that occupy these sites. Similarly, noxious weeds in the Asteraceae family such as Canada thistle and knapweeds could easily spread along OHV trails and roads to riparian habitat and have negative effects on sensitive riparian plant species. Therefore, the implementation of the Ochoco Summit Trail System project, along with the potential negative direct and indirect impacts of implementing the Wolf project, could have negative cumulative impacts on sensitive plants.

Summary of Biological Evaluation for Sensitive Plants:

Table 122 contains the expected effects to sensitive plants for each of the proposed alternatives in the Wolf project. The Wolf project area has several large populations of *Calochortus longebarbatus* var. *peckii*. The Species Management Guide (Dewey 2011) has specific management recommendations that have been incorporated into the design criteria, while the Wolf project may impact some individuals and habitat, it is unlikely to adversely affect the viability if the species or cause a trend toward listing.

The analysis shows that for other sensitive plant species with populations or habitat within the analysis area, the Wolf project may impact some individuals or habitat, but it would not contribute to a trend toward listing.

Table 121. Expected Effects to Sensitive Plant Populations and Habitat for Wolf Alternatives

Species	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Achnatherum hendersonii	NI	MIIH	MIIH	MIIH
Achnatherum wallowaensis	NI	MIIH	MIIH	MIIH
Astragalus diaphanus var. diurnus	N/A	N/A	N/A	N/A
Astragalus peckii	N/A	N/A	N/A	N/A
Astragalus tegetarioides	NI	MIIH	MIIH	MIIH
Botrychium ascendens	NI	MIIH	MIIH	MIIH

Botrychium crenulatum	NI	MIIH	MIIH	MIIH
Botrychium minganense	NI	MIIH	MIIH	MIIH
Botrychium montanum	NI	MIIH	MIIH	MIIH
Botrychium paradoxum	NI	MIIH	MIIH	MIIH
Calochortus longebarbatus var. *peckii*	NI	MIIH	MIIH	MIIH
Camissonia pygmaea	N/A	N/A	N/A	N/A
Carex diandra	NI	MIIH	MIIH	MIIH
Carex lasiocarpa var. americana	NI	MIIH	MIIH	MIIH
Carex retrorsa	NI	MIIH	MIIH	MIIH
Cheilanthes feei	NI	MIIH	MIIH	MIIH
Cyperus lupulinus ssp. Lupulinus	N/A	N/A	N/A	N/A
Elatine brachysperma	N/A	N/A	N/A	N/A
Eleocharis bolanderi	NI	MIIH	MIIH	MIIH
Eriogonum cusickii	NI	MIIH	MIIH	MIIH
Heliotropium curvassavicum	N/A	N/A	N/A	N/A
Lipocarpha aristulata	N/A	N/A	N/A	N/A
Lomatium ochocense	NI	MIIH	MIIH	MIIH
Mimulus evanescens	N/A	N/A	N/A	N/A
Muhlenbergia minutissima	NI	MIIH	MIIH	MIIH
Penstemon peckii	N/A	N/A	N/A	N/A
Potamogeton diversifolius	NI	MIIH	MIIH	MIIH
Rorippa columbiae	N/A	N/A	N/A	N/A
Rotala ramosior	N/A	N/A	N/A	N/A
Salix wolfii	NI	MIIH	MIIH	MIIH
Talinum spinescens	N/A	N/A	N/A	N/A
Thelypodium eucosmum	N/A	N/A	N/A	N/A
Utricularia minor	NI	MIIH	MIIH	MIIH
Bryophytes and lichens				
Encalypta brevipes	N/A	N/A	N/A	N/A
Entosthodon fascicularis	N/A	N/A	N/A	N/A
Helodium blandowii	NI	MIIH	MIIH	MIIH
Schistidium cinclidodonteum	NI	MIIH	MIIH	MIIH
Tomentypnum nitens	NI	MIIH	MIIH	MIIH
Tortula mucronifolia	NI	MIIH	MIIH	MIIH
Texasporium santi-jacobi	N/A	N/A	N/A	N/A

NI No impact
MIIH May impact individuals or habitat, but will not likely contribute to a trend towards federal listing or a loss of viability to the population or species.
WIFV* Will impact individuals or habitat with a consequence that the action may contribute to a trend toward federal listing or cause a loss of viability to the population or species
BI Beneficial impact
N/A No Habitat or species present
*Trigger for a significant action as defined in NEPA

Non-Native Invasive Plants (Noxious Weeds) and Risk Assessment

Introduction

An invasive plant is defined as "a non-native plant whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order 13122). Noxious weeds are a subset of invasive plants and are designated as "noxious" by the Secretary of Agriculture or state agencies (USDA 2000, ODA 2001). An estimated 420,000 acres of Forest Service lands in Region 6 are infested with invasive plants (USDA 2005). Invasive non-native plants, including noxious weeds, are a threat to native plant communities, biological diversity, and proper ecosystem functioning on National Forest Land as well as other land ownerships. Invasive plants lead to many negative environmental impacts including: displacement of native plants; reduction in habitat and forage for wildlife and livestock; loss of threatened, endangered, and sensitive species; increased soil erosion and reduced soil productivity; and changes in the intensity and frequency of fires (Sheley and Larson 1994, Scott and Pratini 1995, Sheley et al. 1997, Di Tomaso 2000, USDA 2005).

These invasive plant species thrive in a new environment because they arrive without the complement of predators, disease, and other natural control agents found in their native region of the world. Most of these species take advantage of disturbances such as logged units and associated skid trails and landings, roads, rock quarries, burned areas, and heavily impacted areas caused by overgrazing and trails. Weed seeds and other propagules can be introduced by vehicles, wind, water, animals, humans and hay brought in for livestock. Once established, weed populations serve as a seed source for further dispersal, generally along roads and trail corridors.

Forest Service policy is to prevent and manage noxious weeds (FSM 2080). However, although this direction includes avoiding activities that increase the potential for spreading noxious weeds, the Forest Service is also directed to sell timber, implement thinning and fuels treatments, issue grazing permits, and maintain a road system for administrative use and recreationists. Because these ongoing activities can increase the risk of spreading invasive weeds, the Forest Service is directed to implement prevention measures to reduce the risk of introduction and spread of noxious weeds (USDA 2005, 2006).

Ground disturbing activities such as those proposed for the Wolf project, including timber harvest, temporary road construction, stream restoration and prescribed fire require a noxious weed assessment and analysis of prevention measures that reduce the risk of introduction and spread of noxious weeds. This report discusses and compares potential risks and effects of noxious weeds for the Wolf project proposed action and alternatives. Site specific weed concerns (high risk activities) are discussed in the effects analysis. Project design elements include prevention measures and recommendations that reduce the risk of introduction and spread of noxious weeds.

Desired Future Condition

The desired future condition is prevention of new invader establishments and cessation of established weed spread with a corresponding reduction in established weed presence. Allowing for the return of disturbed areas to a more natural condition and promoting establishment of the native plant community can impede noxious weeds from dominating these areas. This condition can be advanced through implementation of good management practices, minimizing human caused disturbance where possible, and executing mitigation measures such as invasive weed removal and native species re-vegetation.

Affected Environment

During the past half century, many non-native plant species have expanded their range in the western United States. Existing conditions favor the establishment and spread of noxious weeds, and weeds are likely to continue to be introduced and spread to new areas within the Ochoco National Forest. Introduced annual grasses such as cheat grass (*Bromus tectorum*) and ventenata (*Ventenata dubia*) are widespread throughout the Ochoco National Forest and have displaced native perennial bunchgrasses such as *Festuca idahoensis, Poa secunda ,Psuedoroegneria spicata, Elymus elemoides, and Achnatherum occidentalis* in some areas (Billings 1994, pers com. Mafera). Grazing, road construction, and logging has increased the potential for introduction and spread by removing native vegetation and exposing mineral soils which many invasive plants need for establishment. Wildfires, wildfire suppression activity and prescribed burning can also increase the risk of spread of noxious weeds (Asher et al 2001). Vehicular traffic and other ongoing recreation uses are expected to continue to introduce weeds to the area.

Weed infestations within the Wolf project area are considered moderate to low, occupying less than one percent of the project area, however the potential risk of rapid spread as a result of ground disturbing activities is high. Currently, there are approximately 57 sites of weed infestations totaling approximately 47.7 acres. These weed sites range from a couple individuals to many acres of scattered plants. Table 123 lists the weed status within the Wolf project area.

The majority of the weed sites are located along Wolf Creek and its upper tributaries, and East Wolf Creek. There are major roads along these riparian areas, including the 42, 3810 and the 4290 where most weeds occur along the road shoulders, although some are beginning to invade the surrounding native habitat.

These creeks contain major populations of sensitive plants, notably Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*). Canada thistle is of particular concern because it readily establishes in riparian zones, and has the ability to form large patches of rhizomatous growth. There is no effective manual or chemical control of this species to date because of its rhizomatous growth form, and proximity to water. Biological control is being tried with limited success. Houndstongue (*Cyanoglossum officinale*) is the most abundant noxious weed in the Wolf project area and several new infestations were found during surveys in the summer of 2013. Hound's tongue is an aggressive invader and has dramatically increased its population over the last several years on the Ochoco National Forest (personal observation). It is spreading into the Wolf project area from adjacent infestations where its population is abundant along Dry Paulina Creek, Roba Creek, Indian creek, and Dipping Vat Creek, where its seed is primarily spread by animal vectors, particularly cattle. Other common noxious weeds, particularly knapweeds (*Centaurea spp.*), occupy seven acres in the Wolf project area along roadsides and have spread into adjacent meadows and other open sites. In addition to invading disturbed sites with annual grasses, knapweeds can also invade relatively undisturbed perennial native plant communities (DiTomasi 2000).

Site Analysis

Surveys for invasive species, including noxious weeds, were conducted in the Wolf project area in the summer of 2012/2013, and in previous years. Previously known sites have been mapped in a GIS layer and tracked in databases. The risk assessment is calculated based on the amount of ground disturbance and/or creation of mineral soil caused by the project activity and the proximity to noxious weed infestations. Factors including the species of noxious weed, size of infestation, life history characteristics, as well as the dispersal mechanism are also incorporated into the risk assessment. The results from current and previous surveys, and the factors mentioned above form the rationale for analyzing effects.

Table 122. Non-native invasive weeds within the Wolf Analysis area

Scientific Name	Common Name	Acres in Analysis Area
Cardaria draba	White top	4.2
Centaurea diffusa	Diffuse knapweed	5.2
Centaurea stoebe	Spotted knapweed	2.2
Cirsium arvense	Canada thistle	10.6
Cynoglossum officinale	Common Hound's-tongue	14.2
Hypericum perforatum	St. John's wort	1.0
Leucanthemum vulgare	Oxeye daisy	0.2
Linaria dalmatica	Dalmation toadflax	0.1
Potentilla recta	Sulfur cinquefoil	3.5
Salvia aethiopis	Mediterranean sage	4.6
Verbascum thapsis	Common mullein	1.9

Prevention Measures

The Forest Service is directed to manage noxious weeds and implement prevention standards (US Congress 1994, USDA 1989, 2005, 2006). Design elements for preventing the introduction and spread of noxious weeds are outlined in Table 124. Specific prevention measures described in Chapter two of the EIS are designed to reduce the risk of spread of noxious weeds and to meet the standards outlined in the FEIS record of decision (USDA 2005).

As previously stated, the Forest Service is directed to manage noxious weeds and implement prevention measures (U.S. Congress 1974; Executive Order 13122; USDA 1989, 2005, 2006). Controls will continue under the existing weed management plan. Design elements for preventing introduction and spread have been incorporated in alternatives and are listed in the introduction portion of this document. These measures are designed to limit the expansion of current populations and to reduce risk of new infestations. The design elements to minimize weed risk have been reviewed by the interdisciplinary team, and are considered feasible.

It is feasible to undertake the management actions (design elements) described above, as these procedures have been a forest-wide standard for the past few years. Cost of prevention associated with cleaning equipment and other measures is estimated at $3,000 over the duration of project activities. Design elements such as training of field personnel to identify noxious weeds are also included in alternatives, and have been implemented in similar project areas. Post-treatment monitoring is occurring in similar project areas and survey for undiscovered weed populations is ongoing.

Table 123. Design elements for reducing the risk of introduction and spread of noxious weeds.

Action measure	Rationale
Retain shade and do not burn within 100 ft of infestations	Will reduce risk of weed introduction and spread
Avoid re-use of log landings that have or had infestations	Will reduce risk of weed introduction and spread
Avoid or minimize disturbance within existing infestations	Will buffer high risk areas by 100 feet to prevent disturbing seed bank, and reduce weed spread
Mineral material will come from weed free areas	Weed free material sources have been identified and will prevent the introduction of new infestations
Straw bales used for soil retention or mulching will be certified weed-free	Will reduce the risk of weed introduction
Equipment used for timber harvest as well as hauling material sources are required to be certified free of weed seed and plant parts	Will reduce risk of introduction of weeds from off forest sites
Revegetate decommissioned roads, landings and skid trails using native seed as soon as possible	Reduces establishment sites for noxious weeds

Document and buffer weed infestations discovered during implementation	Early detection and rapid response to new infestations will limit spread
Include a noxious weed locator map in projected	This will identify all known infestations so marking crews and fire crews can avoid infested areas
Pre-treat existing weed infestations along major haul routes before sale activity begins	Will reduce spread of existing weeds along road corridors. Requires sale administrator to notify botanist BEFORE sale activity begins.
Water for fire control, road construction and maintenance or other activity would come from weed-free sites or use other measures to reduce risk	Reduces introduction of new infestations; need to involve botanist in reviewing watering sites
Minimize soil disturbance to the extent practical	Forest Plan Guidelines require detrimental soil disturbance be limited to less than 20% of treatment unit area.

Contract Provisions

To meet required prevention measures to reduce the potential for transport or spread of noxious weeds by temporary road construction or logging equipment, the timber sale contract would include BT 6.35 provision. This provision requires: 1) certification that equipment be clean of all plant or soil material that may result in the establishment or spread of noxious weeds; and 2) Notification of location where equipment was most recently used. There is also a provision in timber sale contracts for purchase of native seed for landings and skid trails to reduce likelihood of colonization by invasives.

To reduce the potential for weed spread through rock used on roads, Ochoco NF rock sources would be inspected to ensure materials are weed-free. Additionally, the sale contract would include provisions requiring any material used from other sources is weed-free.

Noxious Weed Risk Assessment

Forest Service Manual (FSM) direction requires that noxious weed risk assessments be prepared for all projects involving ground-disturbing activities. The Forest Service is required to determine factors that would increase the risk for introduction and spread of noxious weeds, and design projects to reduce these risks, especially for ground disturbing and site altering activities (FSM 2081.03, 2081.2, 1995). Proposed logging activities would remove vegetation and disturb the soil organic layer, increasing the potential of introduction and spread of noxious weeds. Prescribed burning is normally low-intensity, however burning slash piles or intense burning that results in scorched soils can exacerbate risk by increasing time for establishment of vegetation and the soil organic layer. Factors that influence the risk of weed introduction and spread are outlined below. These factors are discussed in the effects analysis and incorporated in a risk assessment for each alternative in the Wolf analysis area.

<u>Factors related to weed risk</u>

- Most non-native invasive plants are pioneer species that are shade intolerant, and therefore have a greater potential to invade forested sites that have been disturbed. Existing conditions favor establishment and spread of noxious weeds. Many areas have had road construction and timber harvest. Proposed activities would create an ideal seedbed for noxious weeds (Borman et al 1991, Alexanian 2000).
- Temporary road construction would create new disturbed areas and pathways into weed-free areas. Roads act as corridors for dispersal and provide suitable habitat for invasive weeds. (Perendes & Jones 2000). Weed seed can be introduced from weed-infested areas through soils attached to vehicles and road maintenance or other equipment. A corridor of habitat

along a closed road system can allow for expansion of weeds into a weed-free area even if future vehicle traffic is eliminated (Perendes & Jones 2000).

- Non-native plants are often difficult to replace with native species. On many sites, especially where roads or log landings have been constructed, soil disturbance, notably loss of the soil A-horizon, has resulted in sites not capable of returning to native plant communities for many years, or even decades. Weeds and non-native grasses often out-compete native species on altered sites (DiTomasi 2000).
- The potential for introduction of noxious weeds due to logging activity is much greater than other activities because of the soil disturbance and removal of vegetation by log skidding, road and landing construction activity. Logging equipment (skidders, cats, feller-bunchers, etc.) can bring noxious weed seed or plant material from one site to the next with soil and weed propagules attached.
- Project activities would reduce tree density and result in more ground vegetation, potentially resulting in greater distribution of livestock that can serve as vectors for weed introduction and spread.
- Burning natural and activity fuels (from logging and thinning slash) would increase susceptibility to invasion of non-natives. In general, prescribed burns occur in the spring and fall, with low intensity, so vegetation recovers quickly, and the majority of the soil organic layer is retained (an estimated 5% of area burned results in mineral soil exposure (Scholtz per comm.) . Conversely, burning dozer, or hand piles creates fuel levels that result in soil scorching that removes the soil organic layer and increases susceptibility to noxious weed establishment.
- Maintaining native vegetation and the soil organic layer results in less susceptibility to noxious weeds introduction and spread.
- Present and foreseeable livestock grazing can delay recovery of native vegetation, resulting in increased potential for introduction and spread of noxious weeds by selective grazing of more palatable natives and desirable non-natives and spreading weed seeds from existing populations to new sites (Callihan and Evans 1991, Olson 1999, Belsky 2000).
- Present and foreseeable vehicle use, road maintenance, recreation, would all contribute to weed risk.

Alternative 1 includes no disturbance that would increase risk for introduction and spread of noxious weeds. Alternatives 2, 3, and 4 involve high risk of spread where ground disturbance from logging, temporary road construction and fuels treatment is proposed near existing infestations. The increase in weed risk is reflected in the soil disturbance analysis portion of the noxious weed risk assessment discussed below.

Two types of analyses are included in the risk assessment. The first compares the amount of exposed soils that the proposed activities would create, increasing susceptibility to noxious weed introduction and spread. The other uses a combination of risk factors, such as commercial timber harvest activities, fuels treatments, or temporary road construction near known weed infestations, type of weed, life history, rate and method of spread etc., and incorporates those factors into the exposed soil risk. Table 125 outlines a risk factor assessment as the inherent risk for each alternative if no prevention measures are followed.

Table 124. Risk factor assessment and soil disturbance, by alternative

Activity	Alt 1	Bare soil acres	Alt 2	Bare soil acres	Alt 3	Bare soil acres	Alt 4	Bare soil acres
Acres of Commercial Harvest**	0	0	3	235.3	3	235.3	3	169.7
Construction of new temporary roads*	0	0	3	17	3	17	3	17
Temporary road construction on existing disturbance*	0	0	3	25.5	3	25.5	3	25.5
Activity fuels treatment***	0	0	3	247	3	247	3	202
Natural fuels treatment***	0	0	2	200	2	200	2	234
Hand Piling****	0	0	3	6.3	3	6.3	3	6.8
Stream restoration*****	0	0	3	1.25	3	2.6	3	2.6
Head cut repair*****	0	0	3	2.3	3	6.0	3	6.0
TOTAL		**0**		**735**		**740**		**664**

Assigned risk values of 0=no risk, 1=small risk, 2=moderate risk, 3=high risk. Derived from relative risk of invasive weed introduction and establishment by alternative based on the level of weed promoting activities within each alternative. Acres of exposed soil was calculated:*estimated total soil exposure is 1.7 ac/mile.**Est. 20% exposure of total area.*** Est. 5% exposure for 80% of area burned.****Est 100% exposure for 5% of area. *****10% exposure for area treated.

Discussion of Risk Assessment

Direct and Indirect Effects of the Alternatives

The degree of environmental impact due to noxious weeds is relative to the species and density of the weed infestation. Of the 57 known weed infestations occurring within the Wolf project area, 16 infestations occur in or immediately adjacent to proposed commercial timber harvest units (Table 126). Due to ongoing weed management, these infestations are typically small, less than 0.10 acres, and collectively occupy 0.22 % of the analysis area. Although a relatively small percentage of the analysis area is occupied by non-native invasive weeds, they continue to expand and spread.

The potential for non-native invasive plants to expand in the Wolf project area is directly related to the amount of ground disturbing activities proposed, and the risk of spread will be evaluated for each alternative.

Alternative 1-No action

This alternative would create no new ground disturbance from logging or road construction and there would be no fuels treatments or other activities. Because no ground disturbance would occur, risk for introduction and spread of noxious weeds would not increase as a result of proposed activities.

Weed introduction and spread could potentially continue through vehicular traffic along roads, off-road vehicular use, recreational users (particularly horseback riders that camp and bring weed infested hay), or other vectors such as cattle, wildlife, wind, and water dispersal.

Alternatives 2 and 3

Commercial timber harvest

Commercial timber harvest presents the greatest threat for spreading noxious weeds of all the proposed activities. There are 4,706 acres of proposed commercial timber harvest in Alternatives 2 and 3. The proposed commercial harvest units and acres are the same for Alternatives 2 and 3, the only difference is proposed harvest of trees over 21” for 384 of those acres for Alternative 3. Effects for noxious weed spread would be generally the same for both alternatives. Heavy equipment, the amount of disturbed area (up to 20% of treatment area), landing sites taken down to mineral soil, road construction, reconstruction, and increased traffic due to log hauling and administration, have

the potential to introduce new weed infestation and spread existing infestations. Seeded landings, skid trails and other disturbed areas with native seed would help establish natives in these highly susceptible areas and help prevent the subsequent colonization of noxious weeds. Timber sale contract provisions would ensure that these highly disturbed areas are seeded when ground disturbing activities are completed.

There is less than 1 acre of noxious weeds in commercial timber harvest units for both Alternative 2 and Alternative 3 (Table 126). There would be a risk of spreading these weeds throughout these units along connecting road corridors, as well as increasing the current infestation size. There would be a direct negative impact on the native plant community if ground disturbance occurs in or adjacent to weed infestations because native plants would have to compete with the non-native invasive plants to re-establish themselves. Broad-leaf invasive weeds such as Houndstongue and Canada thistle often germinate sooner, grow more quickly and are larger than many native plant species and effectively outcompete them on disturbed sites. Noxious weeds such as knapweeds have the ability to prevent the establishment of native plants by chemically inhibiting seed germination (DiTomasi 2000).

These non-native invasive weeds are likely to alter the composition of the surrounding native plant communities by pre-empting establishment sites, changing site conditions, or displacing native plants. This can reduce habitat, cover and forage for wildlife, and cause reductions in abundance and diversity of wildlife (USDA/USDI 2000, DiTomasi 2000).

Table 125. Commercial timber harvest units in Alt 2, 3 with noxious weed infestations.

species	infestation ID	unit #	acres in unit	risk factor
Canada thistle	437	12	0.03	3 High
Canada thistle	**490**	**27**	**0.22**	**3 High**
Canada thistle	**024**	**28**	**0.025**	**3 High**
Canada thistle	**490**	**28**	**0.21**	**3 High**
Canada thistle	**024**	**29**	**0.02**	**3 High**
Canada thistle	514	172	0.1	3 High
Sulphur cinquefoil	**003**	**26**	**0.02**	**2 Moderate**
Whitetop	**482**	**27**	**0.03**	**2 Moderate**
Spotted knapweed	**018**	**26**	**0.06**	**3 High**
Spotted knapweed	**002**	**26**	**0.01**	**3 High**
Spotted knapweed	**002**	**29**	**0.002**	**3 High**
Diffuse knapweed	**259**	**60**	**0.03**	**3 High**
Dalmation toadflax	**450**	**27**	**0.04**	**2 moderate**
Dalmation toadflax	**450**	**29**	**0.01**	**2 moderate**
Bolded units are also proposed for Alternative 4				

Canada thistle infestations in units 12, 27, 28 and 29 are likely to expand through underground rhizomes, and also by its wind dispersed seeds landing on adjacent exposed soil. However, if this infestation is not disturbed and adjacent ground disturbance is minimized, the risk of spread would be reduced. Preventative measures outlined in the design criteria buffer weed infestations from ground disturbing activity by 100 feet. This measure would prevent disturbing the seed bank as well as reduce the risk of dispersing weed seeds via logging equipment into other areas of the unit or along haul routes. However, thistle seed can still disperse by wind and other vectors such as birds and other wildlife into adjacent areas of disturbed soil. Although design criteria would reduce the risk of

spreading these noxious weed infestations within the 100 foot buffer, all proposed action alternatives would increase the amount of bare ground and therefore increase the risk of spreading these invasive species into surrounding disturbed areas.

Proposed units 26, 29, and 60 have knapweed infestations in or adjacent to the unit boundary. Spotted knapweed is also growing along the 42 road, the 4290 and the 3810. It is highly likely that these noxious weed infestations would be further dispersed along road corridors and would continue to spread and colonize disturbed ground in adjacent units. Design criteria would prevent disturbing the seed bank in proposed units, but the risk of dispersing seeds from populations established along roadsides would remain very high.

Temporary Road Construction

There is no proposed temporary road construction or new temporary road construction activities proposed through existing noxious weed infestations for any of the action alternatives; therefore, no direct risk of spreading known noxious weed infestations is expected to occur as a result of road construction activities proposed in the Wolf project.

There are several existing noxious weed infestations along designated haul routes that could spread as a result of timber hauling. The 4290 road, which runs along the west tributary to Wolf Creek, has houndstongue and Canada thistle infestations along its shoulder. This road would be a major haul route for both action alternatives. The 3810 road has small infestations of spotted knapweed, diffuse knapweed, houndstongue, white top and sulfur cinquefoil. The risk of spreading these weeds further along the road corridor and into commercial timber harvest units as a result of the proposed activities is moderate because these populations are well established but have been treated regularly for many years, and would be treated before ground disturbing activities begin. In the Six Corners area, knapweed infestations are common along the road 42 corridor and are also treated regularly. The 4290-040 has the largest houndstongue infestation in the project area and is expanding in a plantation on both sides of West Wolf Creek tributary, and also occurs along the 4260-700. Houndstongue is expanding across the 42 road just west of the project area, from large infestations along dry Paulina Creek, dipping vat, Indian creek, and all along the southern portion of the 4280. New infestations are discovered and treated every field season, but the risk of spreading seeds into the Wolf project area as result of increased haul traffic, cattle movement along road and riparian corridors, as well as increased traffic from forest service personnel implementing proposed activities is considered high for this species.

Noncommercial thinning/hardwood thinning

There is a total of 6.5 acres of non-commercial activities proposed for Alternatives 2 and 3 with existing noxious weed infestations. Noncommercial thinning would cause no direct risk of spread of noxious weeds because there is no associated ground disturbance. There is an indirect effect of spread of existing infestations as a result of opening the canopy to allow more light which could potentially increase growth and reproduction of noxious weeds. The greatest impact to the spread and introduction of noxious weeds through noncommercial thinning is the treatment of the slash and foot or vehicular traffic dispersing seeds. Design criteria prevent ground disturbance or vehicular traffic (including ATV's) within 100 feet of an infestation, which would minimize the risk of spreading existing infestations. Hardwood thinning followed by ground disturbing activities such as headcut repair, stream restoration or hand piling slash would have a higher risk of spreading weeds (Table 127).

Table 126. Non-commercial activities for all action alternatives

species	unit	activity	acres in unit	**Risk** factor
houndstongue	242	Hardwood thin	0.09	high
houndstongue	241	Hardwood thin	0.06	high
spotted knapweed	241	Hardwood thin	0.02	moderate
Canada thistle	217	Hardwood thin	0.32	high
Canada thistle	253	Hardwood thin/headcut repair	1.08	high
houndstongue	253	Hardwood thin/headcut repair	0.44	high
spotted knapweed	253	Hardwood thin/headcut repair	0.96	moderate
houndstongue	242	Hardwood thin	1.62	high
Canada thistle	242	Hardwood thin	1.62	high
houndstongue	279	PCT	0.00	high
spotted knapweed	271	PCT	0.10	moderate
spotted knapweed	202	PCT	0.15	moderate

Stream restoration

There is one unit (#253) proposed in all action alternatives for head cut repair with documented noxious weed infestations (Table 127). This proposed activity poses the highest risk for spreading existing noxious weed infestations because of the potential ground disturbance created by heavy machinery used to place large wood and boulders in the stream bed. Project design criteria prevents the use of heavy equipment within 100 feet of existing noxious weed infestations and therefor would lower the direct risk of spreading these infestations to new areas within the unit. However, Canada thistle has seed that is windblown for long distances and has a high risk of spreading seed to disturbed ground created by spyders or other heavy equipment used for headcut repair. Houndstongue is spread by attaching its Velcro like seeds to the fur of wildlife or cattle and also has a very high risk of being spread from its existing location to newly disturbed areas within the unit.

Fuels treatment

Fuels treatments in all action alternatives would have a direct effect of increasing the risk of introduction and spread of noxious weeds when burning occurs in or near weed infestations and exposes soil. Units with proposed prescribed fuels treatments for action alternatives are listed in table 128. There is a total of 6.5 acres of weed infestations in proposed fuels treatment units in Alternatives 2 and 3. Units with invasive weeds are listed in table 128. The risk factor ranks each weed population by the risk of spread based on the weed species, size of infestation, method of dispersal, and amount of bare ground created by the various fuels treatments. There are 126 acres of proposed hand piles for Alternatives 2 and 3, with 0.7 acres of existing weed infestations within these proposed hand pile treatment units. Hand pile treatments pose a higher risk of invasion than under burning because they create patches of bare ground after they are burned and are often sterilized and highly susceptible to colonization by noxious weed seeds that are blown in or by rhizomes that grow in to these areas from adjacent infestations.

Prevention measures outlined in the design criteria state that there would be no burning within 100 feet of weed infestations. As a result, the amount of bare ground created in or directly adjacent to the infestation would be minimized, reducing the risk of disturbing the seed bank. However, there is still a risk of spreading these high risk weed populations to other areas of disturbed ground caused by fuel treatment activities via seed dispersal from wildlife, livestock, wind, and human traffic.

Windblown seeds such as those of Canada thistle and knapweeds would spread beyond the 100 no disturbance buffer and are therefore ranked high (risk of spread) for commercial harvest activities or fuels treatments with hand piles where the greatest area of bare ground is created. Sulfur cinquefoil has a lower risk of spread, and although it can spread by seed and roots picked up by equipment, the no ground disturbance buffer would limit this species ability to colonize bare ground created by management activities.

Houndstongue populations in Table 128 are considered high risk due to the high competitive ability, toxicity, and rate of spread of this species. Units 279, 319, 329, and 343, are included in both alternatives and have common houndstongue populations within the unit boundary. Houndstongue has Velcro like seeds which attach to clothing, boots, machinery, and can be carried long distances before landing on exposed soil which they readily colonize. Further disturbance from noncommercial harvest activity, followed by fuels treatment, and any kind of traffic (foot, ATV, cattle, wildlife) through these infestations would expand current populations by exposing the seed bank and introducing new infestations in disturbed sites up to miles away. Preventative measures included in the design criteria would buffer these populations from ground disturbing activity by 100 feet. This would prevent the seed bank from becoming exposed and activated, as well as reduce the amount of seed dispersal from equipment. However, because houndstongue is readily dispersed by wildlife and livestock, there would still be a high risk of spreading this invasive species to areas of disturbed ground caused by fuels treatments well beyond the buffer.

Table 127. Prescribed fuels treatments units with noxious weed infestations Alternatives 2 &3

Species	Unit #	fuel type	Fuel treatment	Acres in unit	Risk factor
Canada thistle	12	activity fuels	underburn	0.003	high
Spotted knapweed	26	activity fuels	handpile	0.065	high
sulfur cinquefoil	26	activity fuels	handpile	0.002	high
Canada thistle	27	activity fuels	handpile	0.224	high
Dalmation toadflax	27	activity fuels	handpile	0.045	high
white top	27	activity fuels	handpile	0.031	high
Canada thistle	28	activity fuels	underburn	0.235	high
Canada thistle	29	activity fuels	underburn	0.014	high
Dalmation toadflax	29	activity fuels	underburn	0.011	high
Spotted knapweed	29	activity fuels	underburn	0.002	high
Diffuse knapweed	60	activity fuels	underburn	0.029	high
Canada thistle	172	activity fuels	underburn	0.098	high
Spotted knapweed	202	activity fuels	underburn	0.145	high
Canada thistle	217	activity fuels	handpile	0.315	high
Spotted knapweed	271	activity fuels	underburn	0.098	moderate
Houndstongue	279	activity fuels	underburn	0.036	high
Canada thistle	300	natural fuels	underburn	0.098	moderate
Houndstongue	316	natural fuels	underburn	0.017	high
Canada thistle	319	natural fuels	underburn	0.030	moderate
Houndstongue	319	natural fuels	underburn	0.566	high
Canada thistle	329	natural fuels	underburn	0.282	moderate
Diffuse knapweed	329	natural fuels	underburn	2.591	moderate
Houndstongue	329	natural fuels	underburn	1.304	high

Sulfur cinquefoil	329	natural fuels	underburn	0.108	moderate
whitetop	329	natural fuels	underburn	0.097	moderate
Houndstongue	343	natural fuels	underburn	0.084	high

Alternative 4

Commercial harvest

The highest risk activity for spreading noxious weeds proposed in the Wolf project area is commercial harvest, and because there are 1,312 fewer acres of proposed commercial timber harvest, there is less risk of spreading existing noxious weed infestation and less risk of new invasions. There are 0.22 acres of noxious weed infestations in proposed commercial harvest units under Alternative 4 (see table 129). The units with documented weed infestations and the associated risk factor are bolded in Table 129. Less commercial harvest acres means less disturbed ground, and a lower risk of noxious weed seeds blowing into or otherwise colonizing new sites. This is particularly important for noxious weed species like Canada thistle that readily colonize riparian areas after commercial harvest activities.

Noncommercial thinning/hardwood thinning

There are approximately 6.7 acres of existing noxious weed infestation within noncommercial activity units for Alternative 4. This is slightly more acres of weeds for noncommercial activity units (+0.2 acres) than is proposed for Alternatives 2 and 3 (table 129). The list of hardwood thinning units and noncommercial units are the same as listed in table 129 with the additional PCT units: 12, and 357. Both of these units have small populations of Canada thistle and have a High risk factor of spreading if disturbed.

Fuels treatment

Activity fuels treatments have a higher risk of spreading noxious weeds than natural fuels treatments because of the greater area of disturbed ground created by the activity. There are 1,105 fewer acres of activity fuels treatments proposed in Alternative 4 compared with Alternatives 2 and 3. This corresponds to a lower risk of spread for Alternative 4 compared with the other action alternatives. There is approximately 1 acre of noxious weed infestations existing within proposed activity fuels treatment units for Alternative 4 compared to 1.35 acres of existing infestations in activity fuels treatment units proposed for the other action alternatives (table 129). Hand piling of fuels poses a higher risk of invasion by noxious weeds than under burning, and although there are slightly more acres of proposed hand piles in Alternative 4 (137 acres), compared to Alternatives 2 and 3 (126 acres), there are actually fewer acres of existing weed infestations in proposed hand pile units (0.6 acres) for Alternative 4 compared to Alternatives 2 and 3 (0.7 acres).

Natural fuels treatment acres proposed in Alternative 4 is greater (5,853 acres) than for the other action alternatives (5,000 acres). The number if infestations that currently exist in proposed natural fuels units are also higher for Alternative 4 (5.5 acres) compared with the other action alternatives (5.2 acres). This is because several of the units that had proposed activities in Alternative 2 and 3 were dropped in Alternative 4 and are being proposed as natural fuels units. Natural fuels treatment poses a lower risk than activity fuels treatment because there is little to no ground disturbance created before fuels are treated. Therefore, although there is a greater number of natural fuels acres proposed in Alternative 4, they pose a lower risk than those same acres in alternatives 2 and 3.

Stream restoration

The proposed stream restoration and head cut repair is the same as for Alternative 3 and risk these activities have on the spread for noxious weeds is the same as discussed for Alternatives 2 and 3.

Table 128. Comparison table of acres of noxious weeds for proposed activity by alternative

Proposed activity	Alt 1	Alt 2	Alt 3	Alt 4
Commercial Harvest	0	0.8	0.8	0.22
Noncommercial harvest	0	6.5	6.5	6.7
Road Construction	0	0	0	0
Activity fuels treatment	0	1.35	1.35	1
Natural fuels treatment	0	5.2	5.2	5.5
Hand Piling	0	0.7	0.7	0.6
Stream restoration	0	2.5	2.5	2.5
Head cut repair	0	2.5	2.5	2.5

Cumulative Effects

The area analyzed for cumulative effects for the Noxious weed risk assessment is the Wolf project area, adjacent private and public land as well as the road system accessing the analysis area. Ground-disturbing activities such as ground-based yarding systems used during timber harvest, temporary road construction and reconstruction, fuels treatment, vehicular traffic including OHV's, cattle grazing, and recreation use contribute to the incremental increase in invasive weeds. Analysis included reviewing all proposed harvest units, non-commercial activities, fuels treatments, and proposed roads in the field to determine existing weed infestations. The pattern of known invasive weed sites was then reviewed along with the mechanisms for introduction, establishment, and expansion of invasive weeds and comparing this with present, and future foreseeable actions to determine potential impacts.

General effects

The risk of the introduction and spread of non-native invasive weeds is cumulative. The more disturbance and activity any given area is subject to, the higher the risk of noxious weed introduction and establishment, and/or expansion. Current conditions resulting from past management activities in the Wolf analysis area have resulted in considerable ground disturbance and have provided vectors for the introduction, establishment and spread of noxious weeds. Non-native invasive weeds are likely to continue to be introduced and spread to new areas within the Wolf project area as a result of past, present and future activities.

Non-native invasives and noxious weeds can have major negative impacts by 1) reducing plant diversity 2) threatening rare plant species, 3) reducing quality wildlife habitat and forage by replacing structurally diverse plant communities with large monocultures of unpalatable noxious weeds, 4) altering fire frequency through the introduction of non-native exotic winter annual grasses that produce fine fuels increasing fire intervals from more than 60 years to less than 5 years, 5) increasing erosion by displacing native plant communities with varying root depth and growth forms that hold the soil in place better than non-natives and 6) depleting soil moisture and nutrient levels compared with diverse native plant communities (DiTomasi 2000).

Cumulative Effects

The cumulative effects boundary is defined as the Wolf project area

Deschutes and Ochoco Invasive Plant Treatment EIS (2012)

Non-native invasive weeds are already established in the Wolf project area and new infestations are found every year. Until recently, we were unable to chemically treat newly discovered weed infestations on the Ochoco National Forest. With the newly signed Deschutes and Ochoco Invasive Plant treatment EIS (May 2012), we are now able to chemically treat any new infestations under the early detection rapid response process which will greatly help reduce the rate of spread into newly disturbed ground as a result of the proposed activities in the Wolf planning area. However, project design features of the new weed EIS prohibit most chemical treatment near perennial streams to protect aquatic species and water quality (USDA 2012).

The majority of the weed sites are located along Wolf Creek, its upper tributaries, and East Wolf Creek. There are major roads along these riparian areas, including the 3810 and the 4290, with most weeds occurring along the road shoulders, although some are beginning to invade the surrounding native habitat. Canada thistle is of particular concern because it readily establishes in riparian zones, and has the ability to form large patches of rhizomatous growth. There is no effective manual or chemical control of this species to date because of its rhizomatous growth form, and proximity to water. Biological control is being tried with limited success. Noxious weeds particularly spotted knapweed can chemically inhibit the germination of native plants and can invade disturbed sites as well as relatively undisturbed perennial plant communities (DiTomaso 2000). The majority of noxious weeds in Wolf and the surrounding areas readily establish after ground disturbing activities such as timber harvest, road construction, stream restoration activities and fuels treatments. Surrounding private, BLM and Forest Service lands are infested with houndstongue which is readily spread by cattle and big game into the Wolf watershed. All known existing infestations in the Wolf project area would be prescribed for treatment under the Ochoco and Deschutes Invasive Plant treatment EIS (2012) before implementation of proposed activities begins.

Southside EA (2009)

Current grazing activity will likely spread weeds to new areas. Cattle graze on native vegetation and often avoid eating noxious weeds such as common houndstongue and knapweed, as well non-palatable annual grasses such as cheat grass and ventenata (Callihan and Evans 1991, DeLoach 1991). Perennial bunchgrasses do not have good seedling vigor or readily recover from grazing and are replaced by non-native exotic annual grasses and noxious weeds (Young and Longland 1996, DiTomaso 2000). Introduced annual grasses such as cheat grass (*Bromus tectorum*) and ventenata (*Ventenata dubia*) are widespread throughout the Ochoco National Forest and have displaced native perennial bunchgrasses such as *Festuca idahoensis, Poa secunda ,Psuedoroegneria spicata, Elymus elemoides, and Achnatherum occidentalis* in some areas (Billings 1994, pers. observation). Medusa head has even higher potential to displace native grasses and can even outcompete cheatgrass (Miller et al. 1991). It spreads by animals including livestock, elk and deer, vehicles and foot traffic.

Much of the land base in the Wolf project area is composed of “scab stringer” which is scabland habitat characterized by shallow soils, more or less flat (0-8% slope), sparsely vegetated, with rigid and low sagebrush (*Artemisia rigida*, and *Artemisia arbuscula)*, sandburg’s bluegrass (*Poa secunda*), and a variety of other forbs, intersected by drainages “stringers” with deeper soils and streams of varying size classes at the bottom. Cattle are typically dispersed on the mid to high slopes and scablands earlier in the season. Cattle grazing on scablands have had detrimental effects to the native scabland community by compacting fragile soils, trampling biocrust (mosses and lichens that cover fragile soils, increase soil moisture and nitrogen, and prevent noxious weeds particularly winter annual grasses such as ventenata, cheatgrass and medusa head from colonizing), and spreading

noxious weeds into these sensitive habitats. Later in the season cattle graze heavily in the stringers, or riparian drainages, seeking water, shade and forage. Many sites across the Wolf project area have had native plant communities overgrazed in the late summer, particularly in riparian communities along Wolf creek, which has several populations of Canada thistle, houndstongue and spotted knapweed. There are very large infestations of houndstongue west and south of the Wolf project area and cattle as well as wild game are bringing seeds from those infested areas into the Wolf watershed. There is a high risk of new houndstongue infestations in the Wolf analysis area under current grazing practices. When native vegetation is overgrazed and bareground is exposed it greatly increases the risk of invasion by non-native invasive species. Proposed commercial timber harvest, noncommercial thinning, activity and natural fuels treatments would open up riparian habitat create more bareground and could further exacerbate the negative effects of cattle grazing in these areas.

Ochoco Summit OHV trail project

The Ochoco Summit Trail System project, which would designate varying miles of trails for off-highway vehicles (OHV), is a foreseeable future action that overlaps with the Wolf project cumulative effects boundary; OHV use could increase in the Wolf project area if the new trail system is implemented. OHV's could act as a vector for non-native invasive plants which are known to attach to OHV vehicles and spread to new locations. African wiregrass, or ventenata is common in the Wolf project area and is easily spread by OHV's when their seeds stick to mud and debris in their tires and chassis. The spread of this and other non-native annual grasses into new habitat, particularly scablands would have a detrimental effect on native plant communities in those areas. Similarly, noxious weeds in the Asteraceae family such as Canada thistle and knapweeds could easily spread along OHV trails and roads to riparian habitat and have negative effects on riparian ecosystem function. Therefore, the implementation of the Ochoco Summit Trail System project, along with the potential negative direct and indirect impacts of implementing the Wolf project, could greatly increase the risk of spreading noxious weeds in the Wolf Project area.

Deschutes and Ochoco Travel Management EIS (2011)

The Deschutes and Ochoco Travel Management EIS has implemented numerous road closures on the Ochoco National Forest including several miles of roads in the Wolf planning area. These road closures, along with those proposed in the Wolf project, would have a positive cumulative effect by reducing erosion, sedimentation, and lowering the risk of spreading noxious weeds by vehicles traveling along these roads.

Summary of effects

The on-going weed management program as well as site specific design criteria described in Chapter 2 of the Wolf EIS would help reduce direct, indirect and cumulative effects related to weed risk. However, the remaining risk of spreading invasive weed species is still high for several infestations in all action alternatives because of the area of ground disturbing activities proposed and the high probability of weed seed dispersal to these disturbed sites. In addition to the typical preventative measures outlined in the design criteria, we would treat all non-native weed populations ranked as High risk in Table 126 prior to ground disturbing activity and treat any remaining infestations 5 years post activity. These additional measures would help to meet the required standards described in the FEIS Record of Decision (USDA 2005).

Summary of noxious weed risk by alternative

Alternative 1

Alternative 1 creates no additional ground disturbance, and is the baseline for comparison. This alternative would have the lowest potential for increasing the risk for introduction and spread of noxious weeds from proposed management activities. However, new infestations are still likely to establish within the analysis area as a result of past, present and reasonably foreseeable activities, such as recreational vehicle use, public recreation, wildfire and suppression activities, and livestock grazing. 0

Risk Factor= 2 (Moderate).

Alternative 2, 3, & 4

These alternatives include; commercial and non-commercial thinning activities, fuels treatments, new temporary road construction, and stream restoration activities that increase the risk of noxious weed introduction and spread. There are 76 fewer acres of ground disturbing activities proposed in Alternative 4, and 5 fewer acres in Alternative 2 compared to those in Alternative 3. However, all action alternatives have high risk factors due to ground disturbing activities proposed adjacent to infestations. Design criteria described in Chapter 2 would lower the direct risk of spread of noxious weeds as a result of proposed activities, however livestock grazing activities would continue near infestations within the Wolf project area creating a high risk of seed dispersal to newly disturbed areas. Vehicle use and other activities will continue in the Wolf project area regardless of the alternative chosen. There is the inherent risk of new infestations from sources outside the Wolf project area (cattle moving from infested areas to newly disturbed ground in Wolf) as well as seed dispersal from wildlife, air and water and vehicles in all alternatives.

Risk Factor=3 (High)

Recommendations for Removing, Avoiding, or Compensating Adverse Effects

In addition to the design criteria outlined in Chapter 2, we would treat all non-native invasive weed infestations within or adjacent to proposed units with a high risk factor ranking and monitor and treat any remaining High risk populations for 5 years post-ground disturbing activity implementation. Treating weed infestations for two consecutive years would ensure that the majority of individual weeds would be removed the first year and that flowering stocks on biennials or individuals missed the first year would be removed before seeds were produced the second year. This treatment strategy would greatly reduce the number of weed seeds dispersing from these high risk infestations to newly disturbed ground as a result of the proposed activities. Five years of post-activity monitoring would ensure that these high risk infestations and new infestations would continue to be treated if persistent in the Wolf project area. Five years of post-activity weed monitoring and treatment would give the native vegetation enough time to recolonize the disturbed areas. Heavily disturbed areas such as landings and skid roads would be seeded with native grasses to facilitate native plant establishment.

Preventative measures and design criteria outlined in Chapter 2 would reduce the risk of spreading noxious weeds as a result of the proposed action alternatives and would meet the standards for noxious weed prevention and management.

Monitoring

As part of the Ochoco National Forest Integrated Weed Management Plan, activity areas would be monitored for noxious weeds. Because the FS 2700 and FS 3300 road corridors are among the more weed-infested areas on the Ochoco National Forest, weed monitoring along these corridors is regarded as a priority for post-project funding.

Climate Change and Invasive Species

Global climate change is predicted to alter precipitation and seasonal temperature patterns, as a result of increased levels of atmospheric carbon dioxide (CO_2) and other factors (Mote 2004). Most recent studies on the interaction between climate change and invasive plants conclude that climate change is likely to favor invasive plant species to the detriment of native plant species for individual ecosystems (Chornesky et al. 2005, Climate Change Science Program 2008, Dukes and Mooney 1999, Hellamann et al. 2008, Pyke et al. 2008).

Many invasive plants are species that can thrive in the presence of disturbance and other environmental stressors, have broad climatic tolerances, large geographic ranges, and possess other characteristics that facilitate rapid range shifts. The predicted changes in climate are thought to contribute additional stressors on ecosystems, including those on National Forests, making them more susceptible to invasion and establishment of invasive plant species (Joyce et al. 2008).

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

Predicting how climate change will affect invasive plants and invasive plant management at the local or even regional scale is more difficult to deduce than are these general indications. Anticipated changes in the climate for the Pacific Northwest (e.g. more rain, less snow, warmer temperatures [Mote 2004, Mote et al. 1999, National Assessment Synthesis Team 2000]) or elevated $C0_2$ may not be realized at a local area, particularly within the time frame of this analysis. Growth of invasive plants under elevated CO_2 conditions will also be influenced by environmental conditions such as soil moisture, nutrient availability, and the plant community in which the invasive species occurs (Cipollini et al. 1993; Dukes and Mooney 1999; Johnson et al. 1993; Taylor and Potvin 1997). The complex interaction of multiple and uncertain variables make site-specific predictions speculative.

Some scientists believe that in the Pacific Northwest, the wildfire season is likely to expand, leading to increased frequency of wildfire events (McKenzie et. al. 2004). However, current science is insufficient to precisely determine a cause and effect relationship between climate change and this project. A general conclusion, based on the preponderance of current literature, suggests that “most of the important elements of global change are likely to increase the prevalence of biological invaders” (Dukes and Mooney 1999). The National Forest landscape will become more vulnerable to the establishment of invasive plant infestations, actual acreage affected by invasive plants could increase, and control strategies may become more difficult.

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

Range

This section contains the range resource analysis in its entirety.

Introduction

This report discusses the affected environment and environmental consequences of the proposed alternatives on upland and riparian vegetation for the Wolf project area with respect to livestock grazing. One grazing allotment is primarily addressed within this report, although very small portions of four other grazing allotments are within the project area.

The Wolf Creek allotment contains 98.5 percent of the project area (24,776 acres), while Bearskull/Cottonwood (a closed allotment), Little Summit, Roba, and Rock Creek (a vacant allotment) comprise the other 1.5 percent (378 acres).

The discussion of range resources and potential effects uses existing information including the Ochoco National Forest Land and Resource Management Plan (USFS 1991), Southside Allotments Environmental Analysis (USFS 2010), project-specific resource reports, agency and scientific studies, as well as site-specific professional experience and judgment. It contains a discussion of short and long-term, direct, indirect, and cumulative effects associated with the implementation of each of the four alternatives as they relate to livestock grazing.

Existing Condition

Livestock Management

Past Livestock Management

Records indicate that intense, unregulated sheep grazing occurred within the Wolf project area from 1880-1907. Grazing pressure during that time period denuded native vegetation, contributing to increased amounts of bare soil, loss of topsoil, soil compaction, stream bank degradation and channel erosion. The inception of the Forest Service in the Paulina area in 1907 began the regulation of grazing use, with changes occurring slowly as fences were built, livestock numbers were limited, seasons of grazing use were shortened, and land ownership adjacent to the public land changed.

Management of the grazing infrastructure in the 1940s quickly increased the amount of fence and number of water developments that were constructed by permittees and CCC crews. Across the Paulina Ranger District from the late 1950s through the early 1960s, upland range conditions were monitored through Condition and Trend studies which were then used to develop allotment management plans. These plans often further reduced the livestock numbers, shortened or changed season of use, and identified projects to improve livestock distribution. In the early 1960s many of the allotments were converted from sheep to cattle. From 1907 to 1960 the amount of grazing use, measured in AUMs (animal unit months), was reduced from approximately 689,000 AUMs to 81,600 AUMs (Hall, 1967). This reduction was associated with Forest Service management, monitoring, and a change in grazing suitability when converting from sheep to cattle.

Current Livestock Management

Currently, part of five grazing allotments are within the project area, one of which is vacant (Rock Creek) and another has been administratively closed (Bearskull/Cottonwood). The three active grazing allotments include; very small portions of Little Summit and Roba allotments with the majority of the project area within the Wolf Creek allotment (see Table 131 for acreages for each allotment). Livestock control and distribution is primarily dependent on forage quality, location and availability, fences (and other obstacles to livestock travel), herding practices, water developments, salting, and pasture rotation.

Available forage for domestic livestock use is expressed in terms of Animal Units (AUs) or Animal Unit Months (AUMs). An animal unit is a 1,000 pound mature cow, or its equivalent based on an average daily forage consumption of 26 pounds of dry matter per day, while an AUM is the amount of forage required by an animal unit for one month (USDA 1991). A cow/calf pair is currently equivalent to 1.32 animal units. Table 132 describes the permitted use within the grazing allotments. The Wolf Creek allotment is split between two grazing permittees. One permittee's livestock graze in the Bull, Miles, and Widow pastures and the other permittee's livestock graze in the Nichol, Riparian, Riparian Holding, and Sugar (which is not included in the project area) pastures. The Wolf Creek Exclosure is not currently grazed

Table 129. Allotment and Pasture Acres within the Project Area.

Allotment and Pasture	Acres within the Project Area	Percent of Project Area
Bearskull/Cottonwood	**26**	**0.1%**
Little Summit	**42**	**0.2%**
Roba	**85**	**0.3%**
Dipping Vat	*85*	*0.3%*
Rock Creek	**225**	**0.9%**
Bear	*25*	*0.1%*
Podo Creek	*200*	*0.8%*
Wolf Creek	**24,776**	**98.5%**
Bull	*5,901*	*23.4%*
Miles	*2,769*	*11.0%*
Nichol	*4,979*	*19.8%*
Riparian	*1,563*	*6.2%*
Riparian Holding	*39*	*0.2%*
Widow	*8,090*	*32.2%*
Wolf Creek Exclosure	*1,435*	*5.7%*

Table 130. Allotment Permitted Use within the Project Area

Allotment	Permitted Numbers (Cow/Calf Pair)	Season of Use	AUMs
Bearskull/Cottonwood	*Closed to Grazing*		
Little Summit	200	06/21 – 09/30	898
Roba	236	06/16 – 10/15	1,256
Rock Creek	*Vacant Allotment*		
Wolf Creek (Bull, Miles, and Widow)	240	06/16 – 10/15	1,288
Wolf Creek (Nichol, Riparian, Riparian Holding and Sugar)	541	06/16 – 10/15	2,880

Grazing Management Standards

The grazing standards implemented under the Southside Environmental Analysis (EA), which includes the Wolf Creek allotment and Westside EA, includes Little Summit and Roba allotments, were assigned on a “pasture by pasture” basis. The standards are different depending on the compilation of various resource assessments, which were then categorized by pasture to indicate the priority for limiting livestock impacts. Analyses were conducted for several resources of concern and a determination was made to classify each pasture as properly functioning, functioning-at-risk, or non-functioning. Monitoring data for riparian and upland vegetation, soil and streambank condition, noxious weeds, and stream survey information were collectively used to determine these ratings (see table 133). The Bearskull/Cottonwood and Rock Creek allotments have no grazing standards as they are not actively grazed.

Grazing management standards were assigned to each rating with the goal of maintaining or improving resources that are impacted by livestock grazing (see table 134). These standards were not intended to be used as resource objectives, but rather to be used as triggers to guide livestock management to achieve the overall objectives of acceptable resource trends and conditions as required by the LRMP and subsequent amendments. Individual standards or practices would be more restrictive in a pasture that was rated as functioning-at-risk or non-functioning than in area pasture that was rated as functioning properly.

Grazing management standards were assigned for utilization levels for riparian and upland herbaceous and woody vegetation, stubble height along the greenline in riparian systems, stream bank alteration, and soil disturbance. Permittees are directed to use the standards as triggers for

determining when and how to manage livestock use. Some strategies that may be used by a permittee when standards are close to being met include: moving livestock to another pasture or off the allotment after the last pasture is used, sending riders to herd livestock away from areas where standards are being approached, or using temporary fences to exclude livestock from areas receiving higher impacts. Individual management standards are further described below.

An adaptive management strategy was also implemented as a result of the Southside and Westside Allotment EA decisions. This strategy integrates flexibility in the development of the Annual Operating Instructions (AOI) and the management standards set for each allotment, based upon active feedback through implementation and effectiveness monitoring and annual review of the allotment. The purpose is to move various resources on the allotments to a desirable class and condition in a more active and responsive way.

Table 131. Pasture ratings for all pastures within the project area.

Allotment	Pasture	Rating
Bearskull/Cottonwood	No grazing / Closed Allotment	
Little Summit		Functioning-At-Risk
Roba	Dipping Vat	Non-Functioning
Rock Creek	Bear	No Grazing / Vacant Allotment
	Podo Creek	
Wolf Creek	Bull	Functioning-At-Risk
	Miles	Satisfactory
	Nichol	Functioning-At-Risk
	Riparian	Functioning-At-Risk
	Riparian Holding	Satisfactory
	Widow	Functioning-At-Risk
	Wolf Creek Exclosure	No Grazing

Table 132. Management Standards for the pastures within the project area.

Resource Indicators		Management Standards		
		Satisfactory	At Risk	Unsatisfactory
UTILIZATION	Riparian and Upland Herbaceous Species Utilization (%)	≤ 40%	20-39%	<20%
	Riparian Woody Species Utilization	Cattle are moved when there is a change from herbaceous vegetation to woody vegetation consumption		
	Upland Woody Species Utilization (% of annual growth)	≤ 20%	10-15%	<10%
STREAMBANK ALTERATION	PACFISH/INFISH Streambank Alteration Standard (%)	≤ 10%	≤ 10%	0-5%
STUBBLE HEIGHT	Stubble Height (inches):Grass End of growing season	4”	5”	6”
	Stubble Height (inches):Grass-like End of grazing season	6”		

Bearskull/Cottonwood Allotment

This allotment is located in the northeastern portion with only 0.1% of the project area falling within this allotment. This allotment has been closed to grazing since February of 2008, but grazing has not been permitted on the allotment since January 2003. The last grazing permit authorized grazing by 50 cow/calf pairs and 900 ewe/lamb pairs from July 1 to September 30.

The 26 acres of the Bearskull/Cottonwood allotment that is within the project area consists of Dry and Moist Grand Fir plant associations with some Non-Forested, Stiff sage/Sandberg's bluegrass sites.

Little Summit Allotment

This allotment is located in the north western portion and covers only 0.2% of the project area. This allotment is comprised of a single pasture, of which 42 acres are within the project area. These 42 acres consist of Dry Grand Fir, Douglas-fir, and Dry Pine plant associations.

Sheep grazed on the allotment from1885 until 1962 when the allotment was converted from sheep to cattle. The permitted season of use is from June 21 to September 30 with permitted stocking of 200 cow/calf pairs. The permittee moves the cattle from the east to west side of the allotment throughout the grazing season. The Little Summit Allotment (by grazing permittee responsibility) has 1.2 miles of allotment fences within the project area.

The current permittee owns the majority of the private part of Little Summit Prairie which allows more livestock management flexibility with the use of NFS land. The permittee can quickly put cattle on the private land when they are approaching meeting grazing standards.

Roba Allotment

This allotment is located in the western portion with only 0.3% of the project area falling within this allotment. This allotment is comprised of three pastures. Eighty-five acres of the project area fall within one of these pastures. These 85 acres are almost equal parts of Juniper Steppe, Dry Pine, Mesic Pine, and Non-Forested, Stiff sage/Sandburg's bluegrass plant associations.

This allotment was established in 1957, and prior to its creation it was a portion of the western section of the old Beaver Creek Allotment. During the early 1900s, before the construction of the boundary fences, this range was freely grazed by livestock from early spring to late fall with virtually no control as to numbers or season of use. As a result, it developed into the poorest condition of any range on the Paulina District. Currently, the Roba Allotment has a permitted season of use from June 16 to October 15 with permitted stocking of 236 cow/calf pairs.

Rock Creek Allotment

This allotment is located in the northern portion with only 0.9% of the project area falling within this allotment. This allotment has been vacant (no permitted livestock grazing) since September of 1995. The last grazing permit authorized grazing by 80 cow/calf pairs from June 21 to September 30. The 225 acres of the project area that are within the Rock Creek allotment is split between two of the three allotment pastures, Bear (25 acres) and Podo Creek (200 acres). These 225 acres mainly consists of Dry Grand Fir and Dry Pine plant associations with some Douglas-fir and Juniper Steppe associations as well. There is approximately 0.1 miles of Rock Creek Allotment fence within the project area, which is currently Forest Service responsibility.

Historically, this allotment was created in 1951, by combining parts of the Squaw Meadow, Spanish Peak, Toggle Meadow and Derr Meadow grazing units. The area had been grazed by sheep since the late 1800's and was originally permitted in 1951 for 1,100 ewe/lamb pairs from July 1 to September 30. In 1972, the allotment boundary was changed to eliminate Rock Creek and Spanish Peak from the allotment acreage. In 1970, the allotment was changed to cattle (100 cow/calf pairs from June 21 to

September 30). In 1975, the allotment was divided into the three current pasture configuration with a rest rotation schedule.

Wolf Creek Allotment

The great majority (98.5%) of the project area falls within the Wolf Creek allotment. Six of the seven allotment pastures are within the project area, comprising 24,776 acres. The elevation varies from approximately 4,000 feet in Wolf Creek canyon to 6,100 feet at Bear Mountain. The topography is mostly gently sloping lava-scablands broken with moderate to steep-sided canyons with some rock outcrops. Generally, the allotment has a south aspect with drainages running north to south.

This allotment was established in 1957, and before that it was a portion of the old Beaver Creek allotment. Initially the Wolf Creek allotment was divided into three pastures, adding pastures up until the current time, with the Widow Pasture division fence scheduled to be completed before the 2014 grazing season. In 1957, the allotment had a season of use from June 16 to October 15 with a permitted stocking of 732 cow/calf pairs. Since 1957, permitted stocking has fluctuated very little and has been consistent at 781 cow/calf pairs since the 1971 Range Management Plan for the allotment. Currently the use of forage within the Wolf Creek Allotment is now authorized under two separate term grazing permits but still allows 781 cow/calf pairs between June 16 and October 15.

During the analysis of the Southside EA, five Condition and Trend study plots were examined and measured as well as nine paced transects to measure upland vegetative composition. All of the pastures were rated as Satisfactory, except for the Miles pasture which was rated At-Risk due to the apparent increase of “weedy” forbs. Riparian vegetation was evaluated using eight Proper Functioning Condition reach assessments, nine Riparian Area Greenline surveys, and five Area 4 Riparian Plots. The Sugar Holding pasture was rated as Satisfactory; Bull, Riparian, Widow, and Wolf Creek Exclosure pastures were rated as At-Risk; and Nichol and Sugar pastures were rated as Unsatisfactory. The poor ratings were mostly because of the lack of riparian obligate species, mostly woody species, and the presence of cut banks. No riparian data was collected for the Miles pasture.

The most recent Allotment Management Plan (AMP) was signed in 2012. Each grazing permittee uses a three pasture rotation, where the Riparian Holding pasture is used to gather livestock before moving them to adjoining private lands. An adaptive management strategy was set forth in the AMP to allow for changes if Standards or if Desired Conditions were not being met. The Wolf Creek Allotment contains nearly 30 miles of fence and 21 water developments, which are the maintenance responsibility of the two permittees.

Vegetation

Upland Vegetation

The most abundant plant association group (PAG) within the Wolf Creek project area is the dry grand fir PAG (approximately 30% of the watershed). The majority of the dry grand fir PAG is comprised of the grand fir (*Abies Grandis*)/pinegrass (*Calamagrostis rubescens*) plant association. Pinegrass is a preferred forage species for wildlife and livestock and is generally utilized later in the season as other grass species mature. Elk sedge (*Carex geyeri*), the usual subordinate and also a desirable forage species, is utilized earlier in the growing season by ungulates and in grand fir/elk sedge PAG can be a decreaser under heavy grazing pressure (Hall, 1989). As the disturbance regime in these PAGs has been altered through fire suppression and other human caused activities, the canopy cover in much of the project area has or is becoming closed enough to suppress grass and shrub growth (Hall, 1980 & 1987). Ongoing and future vegetation management activities within these PAGs, such as harvest, thinning, and prescribed fire could be used to promote understory species growth and diversity and benefit wildlife and livestock (Hall, 1976). Future vegetation management projects could also reduce the amount of lodgepole pine (*Pinus contorta*) encroachment in the riparian and meadow systems across the upper watershed.

The "scab stringer" landscape (approximately 31% of the watershed – Juniper Steppe and Non-forested PAGs) is topography driven, the "scab" portion, generally occurring on the ridge tops, presents a management challenge because it produces a droughty tolerant shrub and grass plant association group. The scab shrub/grass association produces very little forage and is extremely slow to show changes in vegetation trend due to the very shallow, rocky soils it occupies that dry very early into the growing season. Livestock prefer to utilize the grass species of the drier scabs earlier in the season while the forage is green. Once the forage has matured, the use on the scabs is very limited as they are generally drier, hotter sites that are furthest from available water.

Moist, or mesic pine PAGs (approximately 14% of the watershed) are moderately productive sites dominated by ponderosa pine (*Pinus ponderosa*), grasses such as pinegrass and elk sedge, antelope bitterbrush (*Purshia tridentata*) and a very small portion of mountain mahogany (*Cercocarpus ledifolius*) in the lower-mid elevations. These associations occupy transition zones between very shallow soiled scablands and the ponderosa pine/bunchgrass associations on deeper soils. Bitterbrush and mountain mahogany are important winter range species for big game and are utilized by livestock when desirable grass species are limited or have fully cured. Bitterbrush is an extremely deep-rooted species that grows on a variety of soil types. Overuse by ungulates can reduce bitterbrush seedling establishment and recruitment especially if bitterbrush is the limiting source of forage (Johnson and Clausnitzer, 1991).

The more productive big sagebrush (*Artemisia tridentata*), Idaho fescue (*Festuca idahoensis*), and bluebunch wheatgrass (*Pseudoregenaria spicata*) plant association on the fringe between the driest scab sites and the forested PAGs on the deeper soils is utilized more readily by ungulates. This PAG is included in this discussion because it is intertwined with the grass, shrubland, and pine associations throughout the project area and represents an important percentage of the overall watershed acreage. It is also the most likely plant association group to respond to management actions. The big sagebrush – Idaho fescue – bluebunch wheatgrass plant association has evolved with periodic disturbance by fire. Grazing by livestock in this plant association can in some ways "mimic" fire and stimulate grasses through the removal of above ground biomass. Late summer/fall burns may cause high mortality in Idaho fescue as well as sagebrush. However, lower intensity prescribed burning may decrease sagebrush and increase bluebunch wheatgrass and forbs which can benefit wildlife.

A notable threat to these more productive plant associations is encroachment by western juniper because these sites are productive enough to support juniper, yet under current management do not have frequent enough fire or mechanical disturbance to limit juniper expansion and establishment. Juniper encroachment is currently occurring across the project area and is occurring at higher elevations and in PAGs that receive more annual precipitation.

Riparian Meadow and Hardwood Communities Vegetation

Across the project area, several areas, meadows and springs/streams alike have, been fenced in order to enhance the vegetation by excluding livestock and, in a few cases wildlife. Historical use (grazing, road construction and timber harvest) of these systems contributed to entrenchment, lower water tables, and conifer encroachment. Many of the areas with riparian vegetation have shifted from more mesic riparian hardwood / sedge communities to drier community types dominated by upland grasses and forbs.

The extent of riparian hardwood communities has been greatly reduced over the last 200 years. The physical conditions that promote regeneration and vitality of hardwood species are currently lacking in many of the riparian areas. This is due to a number of factors including; extirpation of beaver, fire suppression, conifer competition, over browsing of young plants by deer, elk and cattle, lower water tables resulting from historic logging practices and shifts in vegetation from grazing pressure, and road building.

Forested riparian areas are dominated by coniferous tree species in their overstories. Vegetative structure is dominated by the small tree category (9-20.9" dbh). Riparian shrubs such as willow and alder are present, however their distribution is widely scattered and localized. Other shrub species, such as snowberry, currant and serviceberry can be found. With the advent of effective organized fire suppression, natural fire return intervals have been greatly increased resulting in higher tree densities. Riparian areas exhibit high tree stocking densities (above historic levels) within the watershed.

Mountain alder communities are the most common riparian hardwood communities in the watershed at the lower elevations in more open reaches of streams. They generally have understories dominated by sedges, with Kentucky bluegrass and other non-native grass species dominated terraces (timothy and mountain brome are examples) especially along the main roadways. Kentucky bluegrass is preferred as forage by livestock in many of the riparian areas across the project area; it is a competitive species capable of handling considerable grazing pressure. Shrubs in much of the project area show signs of heavy browse from both wild and domestic grazing animals. Aspen are scattered throughout the watershed in small isolated pockets or single mature trees. Seedling recruitment is limited by browsing pressure. Meadow systems are dominated by grasses and forbs, with most areas seeing a relatively recent increase (last 30 years) in sedges and rushes along their wetted edge. Drainages with north aspects have denser vegetation and a higher moisture regime than southern aspects.

Direct and Indirect Effects

Alternative 1

Fire was historically the primary controlling factor for the vegetation within this project area. Fire suppression efforts have been effective across the project area since the turn of the 20th century. With infrequent fire return intervals, plant communities tend to burn more severely and are replaced by vegetation different in composition, structure, and age. Fire has been mimicked or put back into much of the landscape within the project area between harvest, thinning, and burning activities that took place in the 1980's and 1990's. Where fire has not occurred in the last 50 years the risk is higher for severe fires and substantial loss of forage species in a wildfire situation. With increased fire frequency (reduced fire return intervals) vegetation tends to become dominated by grasses, forbs, and shrubby vegetation rather than by tree species. Plant vigor and plant community diversity is improved by fire, but forage production and palatability for ungulates are often improved as well (Adams, 1989).

Some sources maintain that livestock grazing has had definitive impacts on forest health, leading to dense stands of fire prone small trees (Belsky and Blumenthal are often cited). Currently, prescribed intensities of livestock grazing are expected to result in negligible local reductions in fine fuels and, therefore, are not expected to contribute to the forest health issue of tree overcrowding. In addition, many sources indicate that, although reduced competition due to livestock grazing may result in greater individual tree growth rates, tree survival associated with grazing has either not been appreciably affected (Skoulin, Harris, Strickler, Garrison 1976)(Karl 1991), or has been reduced (Currie, Edminster, Knot 1978)(McLean and Clark 1980)(Eissenstat, Mitchell, Pope 1982)(Krueger 1983)(Karl 1991)(Kingery and Graham 1991)(Allen and Bartolome 1989).

No additional vegetation treatments would be implemented under this alternative. Vegetation would continue to evolve towards a later seral plant community dominated by forested types and juniper woodlands. In the plant communities found in the scab areas, juniper would continue to increase resulting in a decrease in the shrub, grass, and forb system components. Understory grass and shrub production (pounds per acre) in the stringer areas would also decrease with the increase in tree density and canopy cover (Hall, 1976). Riparian species vigor and recruitment in portions of the project area would be decreased with the increase in shade and competition.

Overall the forage available to livestock would decrease over time. As forage in the uplands decreases, grazing pressure on meadows and riparian areas would be expected to increase because of forage availability and palatability in these areas. Conifer expansion and increased stand densities would result in increased fuel loading, fire susceptibility and potential fire severity.

Livestock Management

Under this alternative grazing would continue to take place within the project area. With a decrease in understory grass production over time, the forage available to livestock would decrease. A decrease in forage would require an adjustment in stocking rates (in either duration of the grazing season or number of permitted head) to meet Forest Plan Standards and Guidelines. Grazing standards in the riparian areas would also be more difficult to meet with a decrease in riparian species vigor and recruitment.

Range Improvements

Under this alternative no activities would take place which could potentially impact or influence existing range improvements. Range improvements would continue to age and require maintenance and reconstruction as the improvements reach and exceed their functional lifespans.

Vegetation

The no action alternative would allow for forested/wooded vegetation types to occupy the landscape and would continually reduce the herbaceous and shrubby components in the scab and riparian areas. The annual production (in pounds per acre) available as forage for livestock and wildlife would steadily decline over time without activities to reduce tree density and canopy cover. Eventually wildfire would be expected to occur. Fire dependent ponderosa pine/ pinegrass sites can produce 500 to 600 pounds of forage per acre in pinegrass and elk sedge under 50% canopy cover (Hall, 1990). As crown cower of ponderosa pine increases or is replaced by fir, forage production decreases. Fewer than 100% crown cover grass production is only 50 to 100 pounds per acre (Hall, 1990).

Changing understory vegetation due to tree cover poses a problem in evaluating grazing impacts by livestock; adjustment in livestock management will not alter a downward trend in forage condition caused by increasing tree cover (Hall, 1990). Conversely thinning trees can result in an upward trend without change in animal management (Hall1990, Weaver 1967). Without harvest, thinning, or underburning to improve upland forage, livestock and wildlife pressure on riparian areas would continue to be a major grazing management challenge. The vigor and recruitment of riparian hardwoods would be expected to decline as it is shaded by a conifer overstory and would be less likely to recover quickly from any wildlife or livestock browsing.

Under the no action alternative, the fuel load would accumulate and would be more susceptible to severe wildfire. A severe wildfire would be expected to reduce forage short term (two to three years depending on resource condition) and would be expected to make a site vulnerable to invasive species. This short term loss of forage on a large scale (pasture or allotment), and the required rest period would be expected to cause a large financial hardship on grazing permittees.

Alternatives 2, 3, and 4

Introduction

The “effect” of an activity may be described in terms of magnitude, intensity, direction and duration as described in the context of a given location (site specificity). Magnitude describes the area on which the activity occurs or the extent of the footprint of the activity. Intensity describes the severity or level of the activities disturbance. Direction describes the direction an activity moves the environmental attribute being effected, generally described as “improving” or “degrading”, “increasing” or “decreasing”, etc..

Duration describes the period of time estimated to reach a described "end point" or condition of an environmental attribute (i.e. three to five years until vegetative cover reaches or exceeds 60 percent).

As the three action alternatives under discussion include the implementation of the same types of activities but differ in the magnitude (area) and location of those activities, the discussion (Table 135) below will describe the intensity, direction and duration of the effects of each type of activity, while the alternatives portion of this effects analysis will describe the magnitude (area) and location (as described by allotment, pasture and mapped display) of the impact.

Table 133. Direct and indirect effects of management activities on rangeland resources under Alternatives 2, 3, and 4.

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
Commercial Harvest	Range Improvements	Damage to fence from felling, skidding, access	High	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Cutting line trees out of the fence	Moderate	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Damage to water development from felling, skidding, access	High	negative	Short-term up to the length of operation for a given sale (days to a couple of months).
		Increased water yield from tree removal.	Moderate	positive	Mid -term until replacement tree density utilizes subsurface moisture at pre-activity levels (5-15 years).
	Livestock Management	Operations within an active unit and along haul routes influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Disturbance associated with heavy equipment operation favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		within the system.			
		Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Disturbance associated with heavy equipment operation provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
Noncommercial Thinning	Range Improvements	Damage to fence from felling small trees	Light to Moderate	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Increased water yield from tree removal.	Moderate	positive	Short-term until tree growth utilizes subsurface moisture at pre-activity levels (3-5 years).

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Livestock Management	Operations within thinning units influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Increase barriers to livestock travel by placing thinning materials on the ground.	Light to High	negative	Short to long-term (15-30+ years), until thinning material is treated (fuels) or decompose2.
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
Thinning in Hardwoods	Range Improvements	Damage to fence from felling small trees	Light to Moderate	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Increased water yield from tree removal.	Moderate	positive	Short-term until tree growth utilizes subsurface moisture at pre-activity levels (3-5 years).

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Livestock Management	Operations within thinning units influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Increase barriers to livestock travel by placing thinning materials on the ground.	Light to High	negative	Short to long-term (15-30+ years), until thinning material is treated (fuels) or decompose2.
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
Fuels treatments (underburning)	Range Improvements	Damage to fence from burning wooden posts and heating wires.	Light to Moderate	negative	Mid-term shortens effective life of improvement until the fence is reconstructed (5-10 years).
		Burning line trees out of the fence	Light	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Livestock Management	Operations within burning units influence livestock travel and distribution typically when livestock are coming off of the Forest	Light to Moderate	net positive (although there are some negative influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Light to Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Disturbance associated with burning favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Light to Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Disturbance associated with burning provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Slight to Light	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic	High	positive	Mid through long-term until replacement tree density utilizes resources at pre-activity levels (5-30 years).

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		successional processes system resilience is increased and vegetative condition is improved.			
	Livestock Management	Operations within piling units influence livestock travel and distribution.	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Disturbance associated with grapple operation favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
	Riparian Vegetation	None			
Hand piling	Range Improvements	None			
	Livestock Management	Operations within piling units influence livestock travel and distribution.	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	None			
	Riparian Vegetation	None			
Pile burning	Range Improvements	Killing line trees in the fence from heat.	Light	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).
	Livestock Management	None			

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Upland Vegetation	Patches of heat sterilized soil provide seed beds for invasive, opportunistic plant species when propagules present or introduced. This may result in alteration of the historic successional functional processes within the system depending upon the resilience of surrounding plant communities.	Moderate to High	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
	Riparian Vegetation	Patches of heat sterilized soil provide seed beds for invasive, opportunistic plant species when propagules present or introduced. This may result in alteration of the historic successional functional processes within the system depending upon the resilience of surrounding plant communities.	Light to Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
Exclosure fence construction and caging	Range Improvements	Increases infrastructure which must be maintained.	Light to Moderate	negative	Short through long-term (3-30+ years) until exclosure is abandoned.
	Livestock Management	Prevents livestock from entering more intensely utilized areas when properly maintained.	High	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).
		Traps livestock and intensifies livestock use when maintenance is not conducted.	High	negative	Mid through long-term until fencing material is removed (5-30+ years)
	Upland Vegetation	None			
	Riparian Vegetation	Where livestock and big game are excluded hardwood establishment and growth is expected	High	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).
		Where only livestock use is excluded response of hardwoods is expected to be variable.	Slight to Light	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).
		Where maintenance is not conducted browse pressure on hardwoods is expected to exceed	Moderate	negative	Mid through long-term until fencing material is removed (5-30+ years)

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		pressure outside of the exclosure			
Temporary Road Construction	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	Removal of vegetation	Light to Moderate	negative	Short to mid-term until after scarified or otherwise de-compacted to facilitate their return to proper hydrologic function and vegetative productivity.
	Riparian Vegetation	Removal of vegetation	Light to Moderate	negative	Short to mid-term until after scarified or otherwise de-compacted to facilitate their return to proper hydrologic function and vegetative productivity.
Stream Restoration / Headcut Repair	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	None			
	Riparian Vegetation	Increase site potential to support riparian vegetation	Light to Moderate	positive	Mid through long-term as riparian vegetation establishes (5-30+ years)
Material Source Expansion	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	Removal of three acres from grazing	Light	negative	Short to long-term (0-30+ years), until site is reclaimed
		Increase exposure of disturbance area to invasive species	Light	negative	Short to long-term (0-30+ years), until site is reclaimed
	Riparian Vegetation	None			
Road Decommission	Range Improvements	None			
	Livestock Management	Inability to access areas with vehicles to check livestock	Light	negative	Short to long-term (0-30+ years) until road is reestablished
	Upland Vegetation	None			

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Riparian Vegetation	None			
Juniper treatments	Range Improvements	Damage to fence from felling juniper trees.	Light to Moderate	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Increased water yield from tree removal.	Moderate	positive	Short-term until tree growth utilizes subsurface moisture at pre-activity levels (3-5 years).
	Livestock Management	Operations within thinning units influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Increase barriers to livestock travel by placing thinning materials on the ground.	Slight to Moderate	negative	Short to long-term (15-30+ years), until thinning material is treated (fuels) or decomposes.
		Removal of barriers to livestock travel.	Slight to Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid to long-term until replacement tree density utilizes resources at pre-activity levels (15-30 years).
	Riparian Vegetation	Increased availability of space light and nutrients will increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is	Moderate to High	positive	Mid to long term until replacement tree density utilizes resources at pre-activity levels (10-30 years).

ACTIVITIES	ATTRIBUTE EFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		improved.			

Alternative 2 – Proposed Action

Table 136 described the type, intensity, direction and duration of the effects of each of the prescribed activities under both action alternatives. The Tables 149-152 elate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; for example, one timber stand unit may be commercially and noncommercially thinned. Effects of the actions of this alternative to fences are expressed by allotment only as pastures fences are shared.

Under this alternative there would also be one site (1 mile) of stream restoration on Wolf Creek in the Riparian pasture of Wolf Creek allotment. These restoration activities would occur from the Forest Service boundary north to FS Road 42. The material source site expansion (three acres) is also in the Wolf Creek allotment in the Bull pasture.

Table 134. Acres of non-hardwood treatments by allotment and pasture for Alternative 2

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Juniper Cutting
Bearskull/Cottonwood	**21**	**21**	**23**	**0**
Little Summit	**7**	**26**	**26**	**0**
Roba	**23**	**23**	**23**	**0**
Dipping Vat	*23*	*23*	*23*	*0*
Rock Creek	**86**	**86**	**132**	**0**
Bear	*4*	*4*	*0*	*0*
Podo Creek	*82*	*82*	*132*	*0*
Wolf Creek	**4,567**	**5,537**	**10,774**	**482**
Bull	*1,075*	*1,279*	*2,586*	*0*
Miles	*804*	*918*	*1,822*	*349*
Nichol	*702*	*821*	*1,594*	*0*
Riparian	*470*	*605*	*1,094*	*0*
Riparian Holding	*0*	*0*	*0*	*0*
Widow	*1,400*	*1,722*	*3,377*	*133*
Wolf Creek Exclosure	*116*	*192*	*301*	*0*
Totals	***4,704***	***5,693***	***10,978***	***482***

Table 135. Acres of hardwood treatments by allotment and pasture for Alternative 2 – Proposed Action.

Allotment and Pasture	Hardwood Thinning	Hardwood Thinning / Planting	Hardwood Thinning / Planting / Headcut Repair	Hardwood Thinning / Headcut Repair	Hand Pile burning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**	**0**
Roba	**0**	**0**	**0**	**0**	**0**
Dipping Vat	*0*	*0*	*0*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*	*0*
Wolf Creek	**12**	**20**	**34**	**10**	**126**
Bull	*0*	*5*	*7*	*6*	*6*
Miles	*3*	*0*	*0*	*0*	*3*
Nichol	*0*	*10*	*0*	*0*	*28*
Riparian	*2*	*0*	*27*	*0*	*79*
Riparian Holding	*0*	*0*	*0*	*0*	*0*
Widow	*3*	*2*	*0*	*4*	*6*
Wolf Creek Exclosure	*4*	*3*	*0*	*0*	*4*
Totals	***12***	***20***	***34***	***10***	***126***

Table 136. Miles of road activities by allotment and pasture for Alternative 2 – Proposed Action.

Allotment and Pasture	Existing Temporary Roads	New Temporary Roads	Road Closures	Road Decommissioning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**
Roba	**0**	**0.1**	**0**	**0**
Dipping Vat	*0*	*0.1*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*
Wolf Creek	**18.1**	**1.7**	**2**	**2.7**
Bull	*2.9*	*<0.1*	*0.2*	*0.3*
Miles	*4.9*	*0.6*	*0*	*0*
Nichol	*2.8*	*0.5*	*0.1*	*2.3*
Riparian	*1.5*	*<0.1*	*0*	*0*
Riparian Holding	*0*	*0*	*0*	*0*
Widow	*5.4*	*0.6*	*1.0*	*0.1*
Wolf Creek Exclosure	*0.6*	*0*	*0.7*	*<0.1*
Totals	***18.1***	***1.8***	***2***	***2.7***

Table 137. Miles of fencing by allotment, number of water developments that may be effected, and approximate acreage of exclosures by allotment and pasture for Alternative 2 – Proposed Action.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acreage of Exclosures
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0.2**	**0.2**	**0**	**0**	**0**
Roba	**0.3**	**0.3**	**0**	**0**	**0**
Dipping Vat			*0*	*0*	*0*
Rock Creek	**<0.1**	**<0.1**	**0**	**0**	**0**
Bear			*0*	*0*	*0*
Podo Creek			*0*	*0*	*0*
Wolf Creek	**14.5**	**17.8**	**9**	**12**	**7**
Bull			*1*	*2*	*2*
Miles			*2*	*3*	*1*
Nichol			*0*	*0*	*0*
Riparian			*0*	*0*	*1*
Riparian Holding			*0*	*0*	*0*
Widow			*6*	*6*	*3*
Wolf Creek Exclosure			*0*	*1*	*0*
Totals	***15.0***	***18.3***	***9***	***12***	***7***

Alternative 3

Table 140 described the type, intensity, direction and duration of the effects of each of the prescribed activities under both action alternatives. The tables 141 through 143 will relate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; for example, one timber stand unit may be commercially and noncommercially thinned. Effects of the actions of this alternative to fences are expressed by allotment only as pastures fences are shared.

Under this alternative there would also be two sites (2.2 miles) of stream restoration on Wolf Creek (1 mile) in the Riparian pasture, and on North Wolf Creek (1.2 miles) of the Wolf Creek allotment. These restoration activities would occur from the Forest Service boundary north to FS Road 42(Wolf Creek), and the Forest Service boundary to FS Road 4260 (North Wolf Creek). The material source site expansion (three acres) is also in the Wolf Creek allotment in the Bull pasture.

Table 138. Acres of non-hardwood treatments by allotment and pasture for Alternative 3.

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Juniper Cutting
Bearskull/Cottonwood	**21**	**21**	**23**	**0**
Little Summit	**7**	**26**	**26**	**0**
Roba	**23**	**23**	**23**	**0**
Dipping Vat	*23*	*23*	*23*	*0*
Rock Creek	**86**	**86**	**132**	**0**
Bear	*4*	*4*	*0*	*0*
Podo Creek	*82*	*82*	*132*	*0*
Wolf Creek	**4,567**	**5,537**	**10,774**	**482**
Bull	*1,075*	*1,279*	*2,586*	*0*
Miles	*804*	*918*	*1,822*	*349*
Nichol	*702*	*821*	*1,594*	*0*
Riparian	*470*	*605*	*1,094*	*0*
Riparian Holding	*0*	*0*	*0*	*0*
Widow	*1,400*	*1,722*	*3,377*	*133*

Wolf Creek Exclosure	*116*	*192*	*301*	*0*
Totals	***4,704***	***5,693***	***10,978***	***482***

Table 139. Acres of hardwood treatments by allotment and pasture for Alternative 3.

Allotment and Pasture	Hardwood Thinning	Hardwood Thinning / Planting	Hardwood Thinning / Planting / Headcut Repair	Hardwood Thinning / Headcut Repair	Hand Pile burning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**	**0**
Roba	**0**	**0**	**0**	**0**	**0**
Dipping Vat	*0*	*0*	*0*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*	*0*
Wolf Creek	**12**	**20**	**48**	**10**	**127**
Bull	*0*	*5*	*6*	*6*	*6*
Miles	*3*	*0*	*0*	*0*	*3*
Nichol	*0*	*10*	*0*	*0*	*28*
Riparian	*2*	*0*	*27*	*0*	*79*
Riparian Holding	*0*	*0*	*0*	*0*	*0*
Widow	*3*	*2*	*15*	*4*	*7*
Wolf Creek Exclosure	*4*	*3*	*0*	*0*	*4*
Totals	***12***	***20***	***48***	***10***	***127***

Table 140. Miles of road activities by allotment and pasture for Alternative 3.

Allotment and Pasture	Existing Temporary Roads	New Temporary Roads	Road Closures	Road Decommissioning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**
Roba	**0**	**0.1**	**0**	**0**
Dipping Vat	*0*	*0.1*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*
Wolf Creek	**18.1**	**1.7**	**7.8**	**2.7**
Bull	*2.9*	*<0.1*	*4.3*	*0.3*
Miles	*4.9*	*0.6*	*0.5*	*0*
Nichol	*2.8*	*0.5*	*0.1*	*2.3*
Riparian	*1.5*	*<0.1*	*1.2*	*0*
Riparian Holding	*0*	*0*	*0*	*0*
Widow	*5.4*	*0.6*	*1.0*	*0.1*
Wolf Creek Exclosure	*0.6*	*0*	*0.7*	*<0.1*
Totals	***18.1***	***1.8***	***7.8***	***2.7***

Table 141. Miles of fencing by allotment, number of water developments that may be effected, and approximate acreage of exclosures by allotment and pasture Alternative 3.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acreage of Exclosures
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0.2**	**0.2**	**0**	**0**	**0**
Roba	**0.3**	**0.3**	**0**	**0**	**0**
Dipping Vat			*0*	*0*	*0*
Rock Creek	**<0.1**	**<0.1**	**0**	**0**	**0**
Bear			*0*	*0*	*0*
Podo Creek			*0*	*0*	*0*
Wolf Creek	**14.5**	**17.8**	**9**	**12**	**12**
Bull			*1*	*2*	*2*
Miles			*2*	*3*	*1*
Nichol			*0*	*0*	*0*
Riparian			*0*	*0*	*1*
Riparian Holding			*0*	*0*	*0*
Widow			*6*	*6*	*5*
Wolf Creek Exclosure			*0*	*1*	*0*
Totals	***15.0***	***18.3***	***9***	***12***	***12***

Alternative 4

Table 144 described the type, intensity, direction and duration of the effects of each of the prescribed activities under both action alternatives. The Tables 145 through 147 will relate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; for example, one timber stand unit may be commercially and noncommercially thinned. Effects of the actions of this alternative to fences are expressed by allotment only as pastures fences are shared.

Under this alternative there would also be two sites (2.2 miles) of stream restoration on Wolf Creek (1 mile) in the Riparian pasture, and on North Wolf Creek (1.2 miles) of the Wolf Creek allotment. These restoration activities would occur from the Forest Service boundary north to FS Road 42(Wolf Creek), and the Forest Service boundary to FS Road 4260 (North Wolf Creek). The material source site expansion (three acres) is also in the Wolf Creek allotment in the Bull pasture.

Table 142. Acres of non-hardwood treatments by allotment and pasture for Alternative 4.

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Juniper Cutting
Bearskull/Cottonwood	**21**	**21**	**23**	**0**
Little Summit	**7**	**26**	**26**	**0**
Roba	**23**	**23**	**23**	**0**
Dipping Vat	*23*	*23*	*23*	*0*
Rock Creek	**86**	**86**	**136**	**0**
Bear	*4*	*4*	*4*	*0*
Podo Creek	*82*	*82*	*132*	*0*
Wolf Creek	**3,255**	**4,414**	**10,498**	**482**
Bull	*838*	*1,066*	*2,512*	*0*
Miles	*553*	*696*	*1,757*	*349*
Nichol	*502*	*622*	*1,512*	*0*
Riparian	*407*	*562*	*1,101*	*0*
Riparian Holding	*0*	*0*	*0*	*0*

Widow	*859*	*1,279*	*3,315*	*133*
Wolf Creek Exclosure	*96*	*189*	*301*	*0*
Totals	***3,392***	***4,570***	***10,706***	***482***

Table 143. Acres of hardwood treatments by allotment and pasture for Alternative 4.

Allotment and Pasture	Hardwood Thinning	Hardwood Thinning / Planting	Hardwood Thinning / Planting / Headcut Repair	Hardwood Thinning / Headcut Repair	Hand Pile burning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**	**0**
Roba	**0**	**0**	**0**	**0**	**0**
Dipping Vat	*0*	*0*	*0*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*	*0*
Wolf Creek	**12**	**20**	**49**	**12**	**137**
Bull	*0*	*5*	*7*	*8*	*8*
Miles	*3*	*0*	*0*	*0*	*19*
Nichol	*0*	*10*	*0*	*0*	*28*
Riparian	*2*	*0*	*27*	*0*	*71*
Riparian Holding	*0*	*0*	*0*	*0*	*0*
Widow	*3*	*2*	*15*	*4*	*7*
Wolf Creek Exclosure	*4*	*3*	*0*	*0*	*4*
Totals	***12***	***20***	***49***	***12***	***137***

Table 144. Miles of road activities by allotment and pasture for Alternative 4.

Allotment and Pasture	Existing Temporary Roads	New Temporary Roads	Road Closures	Road Decommissioning
Bearskull/Cottonwood	**0**	**0**	**0**	**0**
Little Summit	**0**	**0**	**0**	**0**
Roba	**0**	**0.1**	**0**	**0**
Dipping Vat	*0*	*0.1*	*0*	*0*
Rock Creek	**0**	**0**	**0**	**0**
Bear	*0*	*0*	*0*	*0*
Podo Creek	*0*	*0*	*0*	*0*
Wolf Creek	**14.5**	**1.4**	**7.8**	**2.7**
Bull	*2.6*	*0*	*4.3*	*0.3*
Miles	*2.5*	*0.5*	*0.5*	*0*
Nichol	*2.3*	*0.5*	*0.1*	*2.3*
Riparian	*1.5*	*<0.1*	*1.2*	*0*
Riparian Holding	*0*	*0*	*0*	*0*
Widow	*5.0*	*0.4*	*1.0*	*0.1*
Wolf Creek Exclosure	*0.6*	*0*	*0.7*	*<0.1*
Totals	***14.5***	***1.5***	***7.8***	***2.7***

Table 145. Miles of fencing by allotment, number of water developments that may be effected, and approximate acreage of exclosures by allotment and pasture Alternative 4.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acreage of Exclosures
Bearskull/Cottonwood	**0**	**0**	**0**	**0**	**0**
Little Summit	**0.2**	**0.2**	**0**	**0**	**0**
Roba	**0.3**	**0.3**	**0**	**0**	**0**
Dipping Vat			*0*	*0*	*0*
Rock Creek	**<0.1**	**<0.1**	**0**	**0**	**0**
Bear			*0*	*0*	*0*
Podo Creek			*0*	*0*	*0*
Wolf Creek	**14.5**	**17.8**	**3**	**9**	**12**
Bull			*1*	*2*	*2*
Miles			*0*	*3*	*1*
Nichol			*0*	*0*	*0*
Riparian			*0*	*0*	*1*
Riparian Holding			*0*	*0*	*0*
Widow			*2*	*3*	*5*
Wolf Creek Exclosure			*0*	*1*	*0*
Totals	***15.0***	***18.3***	***3***	***9***	***12***

Action Alternatives: Summarized Direct and Indirect Effects

Commercial and noncommercial thinning would open up dense tree stands and allow understory production to increase. Increased availability of space, light and nutrients would increase forage quantity and may increase forage quality. There would be an increase in species such as: pinegrass, elk sedge and bunchgrasses. Treatments that open up the tree canopy would create more transitory range for domestic livestock (see Table 148). Grazing management practices would be expected to improve with the increase of accessibility for herding cattle.

Table 146. Increase of transitory range due to thinning activities by alterative.

	No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Acres of increased access and forage	0	6,251	6,265	5,144

It is assumed that all harvest would result in a mosaic pattern on the landscape. Noncommercial treatments (noncommercial thinning, juniper thinning, and hardwood treatments) would be completed over a span of ten years. Loss of forage would be short-term, minimal, and would not be expected to affect livestock stocking rates.

Prescribed burning would most likely reduce available forage for the first year or two, post burn, but after recovery, forage would increase (see table 149). Burns would take place in a mosaic pattern, and over a span of ten to twenty years; loss of forage would be short-term, minimal, and would not be expected to affect livestock stocking rates. Forage species would no longer have to compete with small trees and shrubs. It is possible that permittees would be impacted economically if a rest period is required after burning large areas at the same time. Burned areas would be evaluated to determine if rest is needed; the necessity of rest depends on plant composition, accessibility for livestock, the degree of heat impact upon species, and how many acres are burned within each pasture.

Table 147. Increase of access and forage due to fuels treatments by alterative.

	No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Acres of increased access and forage	0	11,104	11,104	10,843

During management activities it is possible that domestic livestock would be temporarily displaced. Displacement would be minimal due to the fact that all harvest and burning activities would take place in a mosaic pattern and over a span of several years. This would be a short-term effect. Long-term benefits would include increased access and availability of forage.

Management activities may reduce the effectiveness of fences and water developments. Both are used to disperse domestic livestock throughout the allotment. Design elements have been included into the action alternatives to avoid or reduce the likelihood of damage to improvements.

Cumulative Effects

Current and reasonably foreseeable actions occurring within the project area have and will change resource conditions; there are many diverse activities as the following list indicates:

- Livestock grazing; Late May to mid-October (annually).
- Noxious weed treatments (annually).
- Fuelwood cutting (annually; limited opportunity due to permit restrictions).
- Maintenance of roads and culverts (annually).
- Recreation: hunting, camping, ATV/OHV use, snowmobile use, use of trail to wilderness (annually).
- Full-size vehicle use on open roads and ATV use on open and closed roads (annually).
- Ochoco Summit Trail System project may reduce unauthorized motorized travel within the project area.
- Reconstruction of range fence.
- Reconstruction and/or development range water developments.
- New construction of a pasture division fence in the Widow pasture (one time).
- Ongoing Powell timber sale (43 acres in southeast portion of the project area) commercial thinning.

Past activities and occurrences have shaped both the existing resource conditions and the current livestock use patterns within the analysis area. Cumulatively under Alternatives 2, 3, and 4 it is expected that the entire project area:

- Would be much more open over the short through mid-term (5-20 years) providing the best access for livestock as well as the most and highest quality forage.
- Provides potential conflicts associated with livestock management including the greatest overlap between mechanized equipment use, fuels treatments and rangeland improvements.
- Presents the potential for much more resilient plant communities than does the no action alternative.

Aquatic Species

This section summarizes the Aquatic Species specialists' report; information has been included almost verbatim, but some appendices were not included. The entire report and appendices are located in the Wolf project file, Prineville, Oregon.

Management Direction and Regulatory Framework

PACFISH

PACFISH (1994) provides interim direction to protect habitat and populations of anadromous fish habitat in eastern Oregon, eastern Washington, Idaho, western Montana, and portions of Nevada. There are no anadromous fish species or habitat in the Wolf project area. No further evaluation will occur as PACFISH does not apply to the Wolf project area.

INFISH

INFISH (USDA 1995) provides direction to protect habitat and populations of resident native fish outside of anadromous fish habitat and is applicable to the Wolf project area. The INFISH delineated Riparian Habitat Conservation Areas (RHCAs) where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. These RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems. These areas will be managed to maintain or restore water quality, stream channel integrity, channel processes, sediment regimes, in stream flows, diversity and productivity of plant communities in riparian zones, and riparian and aquatic habitats to foster unique genetic fish stocks that evolved within the specific region. RHCAs run through and are overlaid on other allocations. For the Wolf project area, INFISH provides protection for redband trout. A Forest Plan Amendment is being proposed for this project that addresses vegetation in RHCAs.

Riparian Management Objectives (RMO)

INFISH established landscape-scale interim Riparian Management Objectives (INFISH p. A-7) that would be applied to watersheds with inland native fish. Riparian Management Objectives (RMOs) were developed to describe desired conditions for fish habitat. RMOs have been refined to better reflect conditions that are attainable in the Wolf project area (see table 149). To meet RMOs, implementation of projects is designed to not "retard" the rate of recovery of habitat (INFISH p. A-6). INFISH recognized that in many cases interim RMOs would not be met instantaneously, but would be achieved over time (INFISH A-2). There are no RMOs that specifically address riparian vegetation; however, riparian vegetation can influence water temperature, large woody debris (LWD), pool frequency, width-to-depth ratios (W/D), and bank stability. All habitat features described in the interim RMO are inter-related.

Table 148. Riparian Management Objectives applicable to the Wolf Project (INFISH 1995).

Habitat Feature	Interim Objective
water temperature	No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period)
large woody debris (forested systems)	Natural amounts of large, woody material in the Blue Mountains
pool frequency (all systems)	Spacing between pools by channel type

bank stability (non-forest systems)	>80 percent stable banks (*Wolf planning area is primarily a forested system)*
lower bank angle (non-forested systems)	>75 percent of banks with >90 degree angle (i.e., undercut) (*Wolf planning area is primarily a forested system)*
width/depth ratio (all systems)	<10, mean wetted width divided by mean depth Width/depth ratio by channel type
Riparian Vegetation	*Maintain and restore the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency*

Under INFISH, timber harvest is prohibited within RHCAs except to acquire desired vegetation characteristics where needed to attain RMOs (TM1b - INFISH, A-7). The treatments described in table 14 were designed to protect RHCAs while carefully managing to attain RMOs. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs; site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be protected.

Need for a Forest Plan Amendment and the Change Being Proposed

The Forest Plan amendment to develop a new RMO is being proposed because none of the RMOs described in INFISH apply directly to vegetation management within RHCAs. Timber harvest within RHCAs is prohibited under INFISH standard TM-1 unless silvicultural practices can be applied to attain RMOs and adverse effects to inland native fish can be avoided.

During the completion of the Wolf watershed analysis, it was recognized that vegetation within RHCAs in the project area was not in a desired condition due to past timber harvest, fire exclusion, and other factors. RHCAs lack natural vegetative complexity, species compositions, and resiliency. Vegetative conditions exist which are not as resistant to disturbance as they were historically and there is an elevated risk of unwanted loss from stand replacement wildfire and/or insects and disease. Hardwoods have decreased in abundance or are completely lacking from areas where they occurred historically.

The majority of the RHCAs, outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition that was often dominated by large trees of fire tolerant species. Today, large trees are less abundant, stands are denser, within stands, spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. In many areas hardwoods have declined due to competition from conifers, big game and livestock grazing, and stream down-cutting.

Various silvicultural activities are proposed within RHCAs to meet the RMO of *maintaining and restoring the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency.* Specific objectives of these treatments are to:

- Retain and increase the abundance of large trees by reducing competition and increasing tree vigor.
- Restore fire tolerant species compositions.
- Reduce risk to high severity wildfire.
- Increase the abundance and vigor of hardwoods.

- Restore meadow habitats that have become stocked with encroaching conifer species.

To meet these objectives, site specific prescriptions have been developed on a unit by unit basis (see tables 14-17) based on slope, aspect, stream condition, soil conditions, and existing vegetation. These include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMOs already identified in INFISH as well as provide for no increase in the potential for sediment delivery.

Ochoco National Forest Land and Resource Management Plan

Direction for managing lands on the Ochoco National Forest to protect and enhance water quality and quantity, fisheries, aquatic habitat, and riparian areas is provided in the Ochoco National Forest Land and Resource Management Plan (Forest Plan) in the form of Forest-wide and Management Area Standards and Guidelines (USDA 1991). The project was developed in accordance with those standards and guidelines.

Additional regulatory orders and acts which are applicable to this project

Fish and Wildlife Act of 1956 (16 U.S.C. 742a-d, and e-j)

Fish and Wildlife Coordination Act (16 U.S.C. 661-666c)

National Environmental Policy Act of 1969

Clean Water Act of 1972. The Act was amended in 1977 and 1987 (Public Law 100-4) to protect and improve the quality of water resources and maintain their beneficial uses. Several streams in the project area are listed on Oregon Department of Environmental Quality's (DEQ) 303(d) list for water quality limited streams, due to high summer water temperatures (see affected environment section below).

Endangered Species Act of 1972

Executive Order 11990. This 1977 executive order requires the Forest Service to take action to minimize destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 11988. This 1977 executive order requires the Forest Service to take action to:

- Minimize adverse impacts associated with the occupancy and modification of flood plains and reduce risks of flood loss.
- Minimize impacts of floods on human safety, health, and welfare.
- Restore and preserve the natural and beneficial values of wetlands.

Executive Order 12962 – Recreational Fisheries, of 1995. This EO orders Federal agencies, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, improve the quantity, function, sustainable productivity and distribution of U.S. aquatic resources for increased recreational fishing opportunities.

Aquatic Species

Management Indicator Species

Forest Plan- Brook and rainbow trout

Fish species identified in the Forest Plan as management indicator species are rainbow trout (Oncorhynchus mykiss) and brook trout (Salvelinus fontinalis). In the past, these fish have been stocked on the Forest by the Oregon Department of Fish and Wildlife. Brook trout are not believed to

be present in the project area. ODFW no longer stocks rainbow trout in project area streams. Rainbow trout naturally reproduce in project areas streams (Classes I and II). For purposes of this analysis, effects to redband trout are described in the Threatened, Endangered, and Sensitive Species section and will act as a surrogate for MIS fish species effects analysis.

The Ochoco National Forest Management Indicator Species analysis is located in a separate document, *Aquatic Management Indicator Species Analysis in the Wolf Project*, located in the Wolf project file on the Paulina Ranger District.

Essential Fish Habitat

Magnuson-Stevens Fishery Conservation and Management Act Public Law 94-265

The Pacific Fishery Management Council designated EFH (Essential Fish Habitat) for chinook salmon on September 27, 2000. This designation included current and some historic habitat in the Deschutes Basin. Historical habitat above Pelton Round Butte complex and Bowman Dam (fish barrier) was included. No EFH was located within the Ochoco National Forest but downstream on the mainstem Crooked River. However, in 2013, the Pacific Fisheries Management Council's amendment 16 removed Middle Columbia River spring-run Chinook from their Fisheries Management Plan. No further evaluation of EFH will be discussed.

Threatened, Endangered and Sensitive Species (TES)

Endangered Species Act 1973

This Biological Evaluation (BE) documents possible effects of proposed activities on threatened and endangered species in the project area. There are no endangered species known or suspected to occur on the Ochoco National Forest. Threatened aquatic species that are known or suspected to occur on the Ochoco National Forest include bull trout and mid-Columbia River steelhead trout. Potential effects to these species were analyzed and the analysis is summarized in this Biological Evaluation. There would be no effect to bull trout or mid-Columbia River steelhead trout. Consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service is not required for the Wolf project area.

Endangered Species

There are no endangered aquatic species or habitat on the Ochoco National Forest. No further evaluation will be discussed.

Threatened Species

Two aquatic species are federally listed threatened and known to occur on the Ochoco National Forest and Crooked River National Grassland. These species are: bull trout, Salvelinus confluentus, and Mid-Columbia River steelhead trout, Oncorhynchus mykiss ssp.

Stocks of summer steelhead may have occurred in the Wolf project area before dams were built on the Deschutes River and Crooked River. Dams that block fish passage include: Opal Springs - constructed in 1921, Reregulating Dam in 1950, Pelton Dam in 1957, Round Butte Dam in 1964, and Bowman Dam. Anadromous fish currently are not present in the planning area due to downstream blockages at dams that do not provide fish passage facilities (Bowman). Consultation with National Oceanic and Atmospheric Administration (NOAA) is not required.

Bull trout are known to occur in Whychus (formerly called Squaw) Creek on the Crooked River National Grassland. There are no bull trout or habitat in the Wolf Project Area. Consultation with the U.S. Fish and Wildlife Service (USFWS) is not required.

Mid-Columbia River steelhead trout and bull trout are not discussed further.

USDA Aquatic and Terrestrial Programmatic Biological Assessment (2010-2013*)

Project Design Criteria (PDCs) for Columbia spotted frogs

PDC are designed to protect and maintain ponds, lakes, sloughs, wet meadows, and other wetlands, high channel complexity and stability, abundance and diversity of side channel habitats, water quality, low levels of fine sediment, in-stream wood, and wood recruitment. The criteria are also designed to protect and maintain hydraulic regimes and temperatures that are consistent with unaltered basins, and maintain, restore, and open connective corridors to spotted frog suitable habitat.

Columbia spotted frogs are considered a Candidate species and sensitive species by R6 PNW Region. They are not listed threatened or endangered at this time. Because the spotted frog is considered a Candidate species, it is listed in the Programmatic BA. The PDC in the BA pertain to Columbia spotted frogs for the Wolf planning area. The PDC are referenced in Appendix F of the EIS. If the Columbia spotted frogs become proposed for listing after the decision for this project is signed, conferencing with the U.S. Fish and Wildlife Service would be initiated. If the spotted frogs become listed threatened or endangered after the decision for this project is signed, formal consultation would be initiated with the U.S. Fish and Wildlife Service. If the PDCs for this Programmatic BA are followed, future conferencing or consultation would be on a short timeline. If the PDCs are not followed, and the frog becomes proposed for listing or listed, the project would not move forward until consultation is completed. Consultation would require a longer period of time.

*Letter from USFWS extended the Programmatic Consultation through April 2014 (see Wolf project record).

R6 Sensitive and Strategic Listed Species (2011)

Species Considered in this Assessment:

Table 149. Aquatic species, their status and occurrence within the project area.

Species	Scientific Name	Status	Occurrence
Bull trout	*Salvelinus confluentus*	T	HN/N
Mid-Columbia steelhead trout	*Oncorhynchus mykiss ssp*	T	HN/D
Columbia spotted frog	***Rana luteiventris***	**S/C**	**HD/S**
Redband Trout	***Oncorhynchus mykiss ssp.***	**S**	**HD/D**
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	S	HN/N
Shortface lanx (Gastropoda)	*Fisherola nuttalli* (suspected)	S	HN/N
Pristine springsnail (suspected)	*Pristinicola hemphilli*	St	HN/N
Caddisfly	*Namamyia plutonis* (suspected)	St	HN/N
Western ridged mussel	*Gonidea angulata*	St	HN/S
Indian Ford juga	*Juga hemphilli s. nov.*	St	HN/N
Harney basin dusky snail (suspected)	*Colligyrus depressus*	St	HN/S

Status

E	Federally Endangered
DL	Federally Delisted
T	Federally Threatened
S or St	Sensitive or Strategic species from 2011 Regional Forester's ISSSP list
C	Candidate species under Endangered Species Act

P	Proposed species published in the Federal Register to list as endangered or threatened

Occurrence

HD	Habitat Documented or suspected within the project area or near enough to be impacted by project activities
HN	Habitat Not within the project area or affected by its activities
D	Species Documented in general vicinity of project activities
S	Species Suspected in general vicinity of project activities
N	Species Not documented and not suspected in general vicinity of project activities

Analysis Methods

The following four analysis measures, comprised of parameters selected in part from stream data, represent the condition of aquatic habitat and water quality. The following is a discussion on redband trout, Columbia spotted frog (CSF) and their habitat. The mechanisms influencing fish populations and habitat features for redband and CSF that could be affected by the proposed treatments are outlined in table 151 below. This section identifies and describes analysis measures, provides context through description of affected environment and documents existing conditions.

Table 150. Analysis Measures and Parameters

Analysis Measure	Parameter
Direct Impacts to fish and frogs	Physical Disturbance
Water Quantity and Quality	Water Yield
	Sediment & % Fine Sediment in stream bed materials
	Stream Shade
	Temperature/TMDL
Sensitive Species Habitat	LWD
	Pools
	Streambank Condition (% stream bank stability, channel width to depth ratio by Rosgen Stream Class)
Riparian Vegetation	Upland RHCA vegetation (outer zone)
	Riparian vegetation including hardwoods (inner zone)

Measure 1: Direct impacts to fish and frogs

This measure addresses direct effects to fish and frogs from implementation of project activities including: vegetation management, stream crossings, roads, road closure and decommissioning, stream restoration and headcut repair within RHCAs.

Measure 2: Water Quantity and Quality

Water Quantity*:* This measure addresses effects to fish and frogs from implementation of project activities on water yield. Water yield is one of the primary drivers of aquatic species and their habitats. Changes in water yield can have effects on fish and frog populations.

Water Quality:

Fine Sediment: This measure addresses the effects to fish and frogs from sediment delivery via proposed activities. Specific actions that have the potential to deliver sediment to stream systems include a combination of commercial harvest, prescribed fire, roads and stream crossings including activities in RHCAs associated with the project. Sediment delivered to stream systems can translate to increased suspended sediment and turbidity that can affect aquatic life. Fine sediments in streams can also degrade channel form; these potential effects are addressed in Measure 4 – Aquatic Habitat.

Water Temperature and Stream Shade: This measure addresses the effects to fish and frogs from changes to stream shading and riparian vegetation. Specific actions that have the potential to affect temperature and shade include commercial harvest, PCT, prescribed fire, roads and stream crossings, and riparian restoration activities. Changes in stream shading can translate to increased temperature and affect aquatic life.

Measure 3: Riparian Vegetation

This measure addresses how the project effects the historic distribution, diversity, and complexity of vegetation within RHCAs. Specific actions that have the potential to affect riparian vegetation include: commercial harvest, PCT and prescribed fire in RHCAs, roads and stream crossings and riparian restoration activities. Changes in riparian vegetation can affect aquatic habitats and ultimately influence fish and frog populations.

Measure 4: Aquatic Species Habitat

This measure addresses the potential effects to fish and frogs from changes to stream habitats including: rates of large woody debris recruitment, pools and streambank condition (% stream bank stability, channel width to depth ratio). Specific actions that have the potential to affect these aquatic habitat parameters include commercial harvest, PCT and prescribed fire in RHCAs, roads and stream crossings and riparian restoration activities. Changes in aquatic habitats can affect fish and frog populations.

Affected Environment

Watersheds

The Lower Beaver Creek 5th-Field watershed drains 81,362 acres of land including parts of four 6th-field subwatersheds. Subwatersheds include North Wolf Creek, Wolf Creek, Alkali Creek, and Drift Canyon-Beaver Creek. The Lower Beaver Creek watershed drains to the south and east into Beaver Creek, which eventually flows into the Crooked River. These systems are all within the Beaver-South Fork Sub-Basin, and the larger Deschutes River Basin. Additional information on stream flow, base flow, water yield, peak flow, water rights, springs and reservoirs are included in the hydrologist report.

Streams

There are approximately 102 miles of mapped streams within the planning area. Based on inventory and map information on Forest Service lands, there are 5.6 miles of Class I streams; miles of stream by class are included below.

Table 151. Miles of Stream (by class) in the Project Area (2.87 miles are on private in-hold lands).

	Class I	Class II	Class III	Class IV	Totals
North Wolf Creek Subwatershed					**40.34**
North Wolf Creek		4.06		.02	4.08
Widow Creek			2.36		2.36
Unnamed Creek(s)		9.0	3.52	21.37	33.89
Wolf Creek Subwatershed					**64.91**
East Wolf Creek		2.76			2.76
Miles Creek			1.95		1.95
Wolf Creek	5.58	2.32			7.90
Unnamed Creek(s)		24.43	3.15	24.73	52.31

Riparian Habitat Conservation Areas

In accordance with the Ochoco National Forest LRMP and the Inland Native Fish Strategy (INFISH), all streams, wetlands and other water features in the project area have designated Riparian Habitat Conservation Areas (RHCA's). INFISH provides direction to protect habitat and populations of resident native fish outside of anadromous fish habitat and is applicable to the project area. For the Wolf project area, INFISH provides protection for redband trout.

The area of land to be managed as RHCA's is 3,837 acres, or 15.7% of the project area. The width of each RHCA depends upon factors listed below. Table 153 provides detail for each RHCA type within the project area. For purposes of these calculations, Drift Canyon-Beaver Creek subwatershed acres were not included. Table 153 provides RHCA and stream class information by subwatershed.

Table 152. RHCA and Stream Class in Wolf project area.

	North Wolf Creek Subwatershed		Wolf Creek Subwatershed		Total	
	8829.6	analysis acres	15659.3	analysis acres	24488.9	analysis
RHCA Class	(RHCA acres)	(% of subwatershed analysis area)	(RHCA acres)	(% of subwatershed analysis area)	(RHCA acres)	(% of analysis area)
Stream Class I	0	0%	422.16	2.70%	422.16	1.72%
Stream Clas II	951.3	10.77%	1121.74	7.16%	2073.04	8.47%
Stream Clas III	226.92	2.57%	372.18	2.38%	599.1	2.45%
Stream Clas IV	322.18	4%	363.1	2.32%	685.28	2.80%
Water Points	0.9	0.01%	1.4	0.38%	2.3	0.01%
Wetlands	6.4	0.07%	49.3	13.25%	55.7	0.23%
Total RHCA	**1507.70**	**17.08%**	**2329.9**	**14.88%**	**3837.6**	**15.67%**

Category I streams are fish bearing, perennially flowing streams (Class I and II streams) with RHCAs extending 300 feet slope distance from the stream channel (600 feet wide), including both sides of the stream channel. There are approximately 48.2 miles of Category I stream in the Wolf project area. The RHCAs for the Category I streams encompass 2,495 acres.

Category II streams are non-fish bearing, perennially flowing streams (Class III streams) with RHCAs extending 150 feet slope distance from the stream channel (300 feet wide), including both sides of the stream channel. There are approximately 11 miles of Category II streams in the Wolf project area. The RHCAs for the Category II streams encompass 599 acres.

Category III RHCAs are located along ponds, lakes, reservoirs, and wetlands greater than one acre (possibly fish-bearing) with RHCA buffer area extending 150 feet slope distance from the water. Category III RHCAs are 300 feet wide including both sides of the stream channel. The RHCAs for the waterbodies encompass 58 acres.

Category IV streams are seasonally flowing or intermittent streams (Class IV streams) and wetlands less than one acre and have RHCAs extending 50 feet slope distance for the water. Category IV RHCAs are 100 feet wide including both sides of the channel. There are approximately 46.2 miles of Category IV streams that encompass approximately 685 acres of RHCA in the Wolf project area.

Existing Condition

Stream and riparian conditions for the Wolf project area are described in the 2012 Wolf Watershed Analysis (USDA Forest Service 2012); this information has been summarized for the purposes of this analysis.

Existing Condition of Streams

Historically, the Wolf project area provided higher quality aquatic habitat than it does today. Over-time, channel alterations have occurred resulting in a loss of quality pools, spawning gravel, cold-water refugia, back-water rearing areas and hydrologic function. Riparian vegetation has been altered on most streams through direct impacts or indirectly through the loss of soil moisture retention characteristics. Thus, the current types of densities of riparian vegetation lack the same capacity as historic vegetation to control bank stability, maintain channel stability, supply woody debris to streams and provide shade. Historically, streams in this area were once populated with aspen, willow, black cottonwood and dogwood.

Today, forested riparian areas are dominated by coniferous tree species in their overstories and vegetative structure is dominated by the small tree category (9-20.9" dbh). Riparian shrubs such as willow and alder are present; however, their distribution is widely scattered and localized. Other shrub species, such as snowberry, mock orange, hawthorn and serviceberry can be found; most shrubs show signs of heavy pressure from browsing animals.

With the advent of organized fire suppression, natural fire return intervals have been greatly increased, resulting in higher vegetation densities. Riparian areas exhibit high stocking densities above historic levels within the watershed. During the summer months, warmer temperatures reduce fuel moistures and increase the chance of large scale stand replacement fire. Drainages with north aspects have denser vegetation and a higher moisture regime than southern aspects. Forested riparian connectivity can be naturally broken due to the scabland stringer environment created by the geomorphic terrains within the watershed. However, riparian areas that have been associated with past management activities are dominated by smaller tree structure. Riparian areas that have been unroaded and unmanaged within the watershed consist of older seral structures. Factors contributing to changes in riparian vegetation communities with the Wolf project area include timber harvest, road building, fire suppression, reduction in beaver activity, and livestock grazing. In 2010, the Southside Allotment Management Plan (AMP) was implemented and it is anticipated that many of the riparian and stream channel conditions will improve (USDA Forest Service 2009).

Channel morphology and condition data for streams in the watershed are presented in table 155. Limited data of stream channel conditions makes it difficult to establish trends for most habitat parameters. Still, the Ochoco National Forest has conducted Bottom Line Surveys (BLS), Level II Surveys, and other stream inventories or surveys in the major drainages on Forest Service lands. Survey data provides comparative information on parameters such as width/depth ratios, entrenchment, shade, cut banks, woody debris and pools by channel type. Channel typing was based on the Rosgen stream classification system and is widely used for this purpose because it permits easy communication of channel characteristics and provides a method for interpretation of channel development and stability (Rosgen, 1996). In general terms, A-type channels are relatively steep, straight, and narrow (e.g. mountain stream), B-type channels are transitional between the A and C-type channels, and C-type channels are relatively low-gradient, with wide meanders in larger floodplain areas. E-type channels tend to be relatively narrow and deep while meandering even more than C-type channels. F and G-type channels are generally degraded channel forms that can roughly be described as troughs and gullies, respectively.

Water Quantity and Quality

Information on stream flows, peak flows, water yield are discussed in the Hydrologist Report and 2012 Wolf Watershed Analysis (Wolf WA).

Water Quantity

Flows are highly variable within the project area. Primary runoff typically occurs between late-March and mid-May. Ground water resources (base flow) remain available in several project area streams throughout the year though the upper reaches may become dry. The lower reaches of the larger tributaries maintain flow on Forest Service lands during most years, while Wolf Creek and North Wolf Creek provides year-round habitat. Perennial springs along several named and unnamed streams provide isolated habitat for fish of various age classes or supply thermal refugia to stream that are otherwise temperature impaired for spawning or rearing.

Too little flow can pose a reduction in habitat amount, quality, and connectivity, and too much can scour or sweep organisms downstream. Decreases in low flows have the direct impact of reducing the volume of pools and habitat, but also reduces water surface area and therefore the delivery of food from upstream sources (Harvey and others 2006). Decreases in low flows could also cause some

sections of stream to become dry as to become impassible to migrating fish (Rieman and McIntyre 1996), which would compound the effects of water withdrawals.

Higher flood flows and debris flow-related flood events have complex effects as well, depending on timing and frequency. High stream flows scour redds (Montgomery and others 1996; Tonina and others 2008) or sweep fry downstream (Fausch and others 2001) when they occur at the right time of year. The speed at which affected reaches are recolonized will depend on the proximity of unaffected populations and habitat connectivity. Occupied streams within the project area are primary spawning and rearing habitat, that is, should these resources become unavailable, there is little to no downstream habitat capable of making.

Water Quality

(Fine) Sediment: Potential sediment delivery for the existing condition has been modeled in the Hydrologist Report. Increased sediment delivery and turbidity in streams have been documented following vegetation manipulation and associated activities. Sediment effects from anthropogenic disturbance are primarily due to changes in the quantities and patterns of overland flow, and the increased mobility of soils due to ground disturbing activities. Some streams in the watershed are inherently high in sediment due to local soil types and geology, but documented streambank instability, high embededness, and the occurrence of ground disturbing activities that have the potential to produce and deliver sediment, indicate that sediment levels are likely above historic values. Occurrence of more than 20% of unstable banks can be an indication of degraded aquatic habitat resulting in changes in substrate composition, and reduced ability of woody and riparian plants to increase and expand (USDA 1995[a] [b]). Unstable banks can result from management or acute natural disturbance event. Increases in fine sediment in streams due to erosion from unstable banks, and corresponding reduction in spawning and rearing success are indirectly tied to the amount of unstable banks within stream drainages. Percent cutbanks are exceeded in Wolf Creek, North Wolf Creek, Tributary 16 to Wolf Creek, and East Wolf Creek. Many of these streams currently have active headcuts that are migrating upstream; contributing sediment, eliminating pools, and simplifying stream habitat.

Substrate is important in the breeding and incubating of fish, but is also important in over wintering inland fish seeking thermal protection. Unstable banks can lead to changes in substrate, which in turn can reduce the frequency and quality of pools, as infilling of pools occurs and interstitial spaces between gravel and cobble fills. Changes in substrate that decrease the percentage of gravel and cobble or that armor the stream bed are associated with reduced survival of eggs and alevins, reduced primary and secondary productivity, interference with feedings, behavioral avoidance and breakdown of social organization, and pool filling (USDA 2012 GTR-300).

Where data exist, some streams (Wolf, East Fork Wolf, North Wolf and Widow Creeks) within the project area contain greater proportions of fine sands than what one would expect from the overall morphological classification of individual streams and reaches (district files). This occurrence is linked with the strong occurrence of unstable stream banks within those areas (see table 154 & Measure 4 - Streambank Condition). Given the number of streams with reaches not meeting RMO for unstable banks, it is reasonable to conclude that substrate is also impaired. Cobble embeddedness is a filling of the interstitial spaces of stream bed materials with fine sediment. As exhibited by surveys, fine sediment varies tremendously across the watershed and even within streams. Lows of 4% fine sediment and highs of 56% show that variability.

Fine sediment (embeddedness) is not identified as an RMOs for INFISH but is an important habitat feature for fish and is defined as an Ochoco National Forest Plan Monitoring Action (ONFLRMP section 5-3). For purposes of this analysis, average % fines <2mm, is being used as a surrogate for % embeddedness. The National Marine Fisheries Service (NFMS) defines a range of sediment relative to functional categories (Properly Functioning, Functional at risk and Non Functional) for use in

analysis of effects to salmon and steelhead trout; however, it is important to point out that NMFS uses a 0.85mm to define fine sediment. Though the project area does not contain T&E species (salmon or steelhead trout), these 'thresholds' provide a useful surrogate for effects to redband trout. When comparing the most recent (2011) survey data (Wolman pebble count) referenced above on some of the major tributaries in the project area, East Wolf Creek (23.2%) and North Wolf Creek (20.2%) would rate as Not Properly Functioning.

Table 153. Matrix of Pathways and Indicators (for Sediment)

Properly Functioning	At Risk	Not Properly Functioning
< 12% fines (<0.85mm) in gravel3, turbidity low	12-20% (east-side)2, turbidity moderate	>20% (east side)2 fines at surface or depth in spawning habitat2, turbidity high

*East-side references federal lands east of the cascade mountains, i.e., the project area.

PIBO data (table 155), on Wolf Creek (the only PIBO site in the project area), illustrates that average % fines <2mm was measured at 37.7 in 2006 and fell to 18.2 in 2011 within the Functional at Risk range. It is important to note that these data were the result of a single survey in a single location. The same survey recorded streambank stability to be nearly 100% up from 93.2% in 2006 indication an improving trend consistent with the decrease in % fines in the substrate.

Table 154. PIBO data for Wolf WA.

Stream	Year	PoolPct	WDTrans	PTFines2	Stab	LWFrq	Stream
Wolf	2011	58.6	11.7	18.2	100	22.9	Wolf
Wolf	2006	63	14.3	37.7	93.2	58.2	Wolf
Wolf	2001	57.2	37.4	No data	92.9	23.7	Wolf

Water Temperature and Stream Shade

The existing condition for stream shade and temperature has been analyzed in the Hydrologist Report.

Stream temperature and flow vary considerably both seasonally and spatially, despite the spring-fed nature of many of these streams. In the winter months, water temperatures throughout the watershed are typically cool and certain shallow reaches may freeze completely (particularly those with excessively high width: depth ratios and reduced riparian vegetation). State standards for temperature are often exceeded in the summer months from June to September when stream flows are low and incoming solar radiation is high. The Oregon Department of Environmental Quality (ODEQ) stipulates that, for support of resident fish, the average of the daily maximum stream temperature during any seven consecutive days shall not exceed 64°F (ODEQ). The maximum seven-day average stream temperatures from those streams listed in table 171 have consistently surpassed the 64°F standard; table 172 (Hydrologist Report) displays the 303(d) listed streams in the analysis area.

Temperatures of 60 degrees F are considered ideal for rapid growth of rainbow trout (Leitritz and Lewis 1980). For the Wolf project area, water temperatures are above 60 degrees F during the hottest time of the year (July and August) and are below 56 degrees F during the cooler months of October to March prior to fish spawning. Females are most productive when they are in water where temperatures do not exceed 56 degrees F for six months before spawning (Leitritz and Lewis 1980). It is generally understood that inland rainbow (redband) trout are most successful in habitats with temperatures of 70 degrees or slightly lower, but can survive if there is cooler, well-oxygenated water into which they can retreat as the surface waters warm over 70 degrees F. Water temperatures of 70 degrees F or higher, except under otherwise ideal conditions may cause stress to fish, which may lead to disease or in some cases death for all age categories.

For aquatic ecosystems, particularly those containing rare salmonids, stream temperature is a critical variable structuring species distributions, patterns of abundance, and life history characteristics (Brannon and others 2004; Portner and Farrell 2008: Wenger and others 2011a). Both climate change and fire have strong influences on the energy balance of streams, primarily increasing temperatures, meaning that shifts to stream temperature regimes are among the principal processes driving changes to fish populations (Dunham and others 2003; Rieman and others 2007; Isaak and others 2010).

The literature suggests (Luce and others, 2012) that stream warming, through a variety of means, is predicted to shrink the extent of habitat patches for cold-water fish of conservation concern and increases the isolation of populations by pushing them farther into headwater streams. At the same time, decreases in lows flows and increased debris flood responses in steep tributaries may shrink habitats from above, further restricting populations and increasing the potential for debris flows disturbances. If decreases in low flows and temperature related growth and productivity changes also decrease the number of migratory fish from these areas, the populations may increase in their vulnerability to individual fire or flood events.

Shade: While shade from vegetation and topography are the primary factors regulating the amount of solar energy reaching the stream surface, several other features such as the surface area of the stream (i.e., width to depth ratios) can effect water temperatures. Width to depth ratios tend to increase with lateral instability. That is, as streambanks erode or are trampled, the stream becomes wider and this ratio increases. A wider stream has greater exposure to sunlight and can become warmer in summer and cool faster in winter if no mitigating factors are present. Across the project area, with the exception of Wolf tributary 16 R2 (2009), the Forest standard of 80 percent surface shade is not being met. As described in the WA, riparian vegetative potential (and associated stream shade) is assumed to be much greater than what currently exists.

Increasing riparian vegetation and LWD improve RHCA conditions by increasing root mass, increasing channel roughness, decreasing stream velocity, and decreasing trampling of banks. An increased amount of riparian vegetation will increase lateral stability leading to a narrower stream that will be exposed to less surface area open to solar radiation, thus decreasing the potential for high stream temperatures.

More specifically, it is the root mass of riparian hardwoods that provides structure that contributes to the lateral stability to streambanks which prevents excessive erosion and sloughing. Roots of hardwoods also provide roughness to a stream which decreases its erosive power while also promoting sediment deposition and the building up of streambanks. Embedded LWD can function similarly as the roots of riparian hardwoods serving as an energy dissipater and flow deflector. Riparian vegetation and LWD can also reduce grazing and browsing impacts on bank stability by limiting access.

Riparian Vegetation

Outer Zone: The majority of this project area, including RHCAs outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition that was often dominated by large trees of fire tolerant species. Today large trees are less abundant, stands are denser, within stands, spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. Currently, about 64 percent of the area within RHCAs is in a condition considered to be at high risk to insects and disease (see Silviculture report).

According to the Wolf Watershed Analysis (2012), more of the watershed is covered by dense stands of small trees than were present historically. Stands that were thinned and burned in the 1980s and 90s are in need of thinning and burning to maintain low surface fuels and ladder fuels, or the risk of crown fire would increase. For the Wolf project, Fire Regime I is characterized by ponderosa pine,

Douglas- fir, and dry grand fir vegetation types. It has a fire frequency of 0-35 years with low to mixed fire severity. These fires generally replaced less than 25% of the dominant overstory (low severity), but could have replaced as much as 75% of the overstory during a mixed severity fire event (see Fuels report). Fire Regimes I and II are present within the Wolf project area. Of the 20,897 acres of forested land within the project area, there are 16,762 acres in Fire Regime I and 4,135 acres in Fire Regime II. The remaining 3,598 acres are considered non-forested. Fire regimes were not calculated for RHCA because they are intended to be analyzed on the landscape scale, but it is assumed that because of the small sizes of most streams in the project area (<10' wide with the exception of mainstem Wolf Creek), vegetation in RHCA is generally represented by the project level fire regime analysis.

Condition classes in the Wolf project area are based on the Fire Rating Condition Class (FRCC) methodology, Field Sampled Vegetation (FSVeg) analysis, Lidar data, and site visits. Using this information, 27% of the 20,897 forested acres in the project area is low departure CC1, while 44% is moderate departure CC2 and 29% is high departure CC3. Similarly, condition classes were not calculated for RHCA, but it is assumed that because of the small nature of most streams in the project area (<10' wide), vegetation in RHCA is generally represented by the project level condition class ratings. Reference the Fuels report for complete description of project area Fire Regimes, Condition Classes and methodology.

Inner zone: As described in the Water Temperature and Stream Shade section, Silviculture and Botany reports and in the Wolf WA (2012), in many areas hardwoods have declined due to competition from conifers, big game and livestock grazing and stream down-cutting. Riparian vegetative potential (and associated stream shade) is assumed to be much greater than what currently exists. A large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition. These ratings were based upon the Vegetation Condition Attribute of the Watershed Condition Framework (see Hydrologist report). Riparian woody species (long rooted species) bind the soil together and create a stable streambank; these woody species also create a shaded climate for fish, frogs and insects. Woody species provide hiding cover from predators for redband trout and Columbia spotted frogs.

Aquatic Habitat

Besides stream flow and temperature (and by extension, shade), the greatest factors affecting redband trout life history within the project area are aquatic habitat parameters. Several physical attributes of stream channels can be used to describe the amount and quality of habitat available to fish. The data is derived from surveys conducted on the Paulina RD using the Region 6 Level II protocol and Bottom Line Surveys. Physical habitat parameters such as width: depth ratios, bank stability, flood frequencies, and sediment inputs have a significant influence on fisheries populations. However, those metrics are generally a result of geophysical processes acting upon the landscape at the basin or sub-basin scale and are reflective of the current climatic regime, lithology, and discharge but can nonetheless be influenced by management activities. By contrast, large woody debris inputs are more a function of site-specific factors that lead to vegetative heterogeneity within sub-watersheds. Although large wood can certainly alter pool frequencies within a stream reach, pool spacing at the sub-basin scale is more often a function of slope and bankfull width (Rosgen 1996). These parameters are all linked by common processes acting within the watershed to produce the stream channel habitat and riparian conditions that we observe today. Cumulatively, these indices provide important quantitative information that can be used to describe the overall channel conditions throughout the watershed. By quantifying the extent and quality of stream habitat we can examine the broader relationship of management activities to fish populations in a watershed.

Large Woody Debris

Large woody debris (LWD) is an important factor in fish habitat creation in forested stream systems. It can have a significant effect on channel morphology, especially in small, lower gradient channels with unconfined reaches (Beschta and Platts 1986); these are quite common in the lower portions of the sub-watersheds. LWD often creates pools, provides cover and rearing habitat for adult and juvenile fish, stores sediment, decreases flow velocity, helps retain additional organic material important for macroinvertebrate production, and is itself a source of organic input to the system. In areas subject to livestock grazing, LWD also provides microsites for riparian plants to thrive, protects banks and provides wildlife habitat.

Most trees, snags and rootwads that exist on the floodplain and in the riparian zone are potentially available to the active channel. When a tree becomes entrained by the stream's flow, it is routed and decomposed within the system, or becomes part of the bank. In turn, this can affect channel morphology by changing the pattern (e.g., meander pattern), profile (gradient), and dimension (bankfull width) at all spatial scales. These physical effects are well summarized by Montgomery (Montgomery et al. 2003) who states that wood can have geomorphic effects at small scales such as roughness and bed-surface grain size, to large scales of channel-reach morphology and the formation of valley-bottom landforms. The stability, longevity, and the degree to which wood can influence channel morphology depends on its abundance, size, length of submersion, orientation, degree of burial, and its anchorage within the bank (Bisson et al. 1987).

Large woody material provides an important interaction with episodic disturbances creating aquatic habitats and shade for streams. Redband trout, like many other salmonids have evolved in stream systems in which large woody material helps retain organic and inorganic particulate matter that is important for channel stability, biological diversity and productivity (Nakamura and Swanson 1993). Large woody debris can influence habitat for fish and other aquatic organisms by serving as energy dissipaters, flow deflectors, and dams. These down trees also reduce grazing and browsing impacts on bank stability by reducing accessibility to the riparian vegetation. LWD in streams and the adjacent flood plain provides streambank stability, decreases flow velocities, increases storage time (decreases downstream flood risk), stores sediment, and forms pools in the stream channel. The deep water of the pools lowers water temperature. Fish use pools for hiding cover from predators, to seek refuge in cooler water during the summer months and as resting areas while feeding. Typically, higher densities of LWD within the bankfull channel lead to increased pool frequency, cutbank protection and fish densities.

Levels of LWD are influenced by living, dead and dying trees within, and potentially outside, the riparian corridor. Trees with a height to distance from stream ratio of greater than one will directly influence the stream if they fall towards the stream channel. In western Oregon and Washington, the probability that a falling tree will enter the stream is low at distances greater than about one tree height away from the stream channel (McDade and others 1990; Van Sickle and Gregory 1990). Similarly, the effectiveness of upland forests to deliver large wood to riparian areas is expected to decline at distances greater than about one tree height from the upland forested edge and depends on steepness of slope. Timber harvest adjacent to riparian buffers can eliminate large wood recruitment to the riparian area while increasing the potential for windthrow (Grizzel and Wolff 1998).

The extent and type of impacts that LWD has also varies by channel type and local wood availability. Rosgen (1996) observes that A, B, and G stream types generally respond to a reduction of LWD input with an increase in both channel scour and pool spacing. Thus, a decrease in LWD input would likely produce a reduction in available pool habitat for fish. It is this interaction between LWD, the channel and the floodplain that greatly impacts the quantity and quality of habitat available to fish and other aquatic organisms.

In heavily forested areas, the density and location of large wood has proven a useful indicator of complexity (Stuart et al 2007). Cordova (1995) found that 63% of the pools were formed by 11% of the pieces of LWD he measured. The density of LWD as a factor in pool formation was more important in moderately constrained channels. In addition, larger sizes of LWD were significantly more likely to form pools than small sizes of LWD. In surveys of headwater streams in the Crooked River basin, Stuart et al 2007, found a lack of deep pools and a paucity of LWD, particularly large sized wood. Table 157 below summarizes the amount of large woody debris measured in seven streams of the Wolf project area (FS land only). Only those pieces that are >12 inches in diameter at 35 feet from the base were counted (INFISH 1995). Approximately 22.7 miles of stream were included in this analysis.

Table 155. LWD in selected streams of the Wolf Creek watershed.

6th field WA/Stream	Length (miles surveyed)	Channel type*	Pieces LWD/mile	Meets INFISH standard (≥20) Y/N	% of standard	Meets reference standard (≥69 pieces per mile) Y/N	Year data collected
Wolf							
Wolf	5.5	Variable (unknown)	22.8	Y	114	N	2006
East Wolf	3.4	A	7.2	N	36	N	2011
East Wolf	1.3	Unknown	6.8	N	34	N	2006
East Wolf	3.1	N/A	**89.8	Unknown	N/A	N	1993
Miles	2.9	N/A	**15.8	Unknown	N/A	N	1993
East Wolf Trib.	0.5	N/A	8.8	N	44	N	2006
North Fork Wolf							
Wolf Trib. (16)-clear Creek	2.1	B	10	N	50	N	2009
North Fork Wolf	4.9	C/E	10.7	N	54	N	2011
Widow	3.9	B	9	N	45	N	2009

*Survey data was only sufficient to determine coarse-level channel type generalizations

**Surveys conducted prior to 1996 counted LWD differently and may be an over-estimation of total LWD.

It is clear from this data that there is an overall lack of wood in these streams. With the exception of mainstem Wolf Creek, remaining streams within the project fails to meet the INFISH standard of ≥20 pieces LWD per mile. Values range from 45 – 114% of this standard, suggesting that streams are either in poor condition or that the standard is inappropriate for this area. No streams meet reference Standards (Cordova 1995 – table 158); reference stream survey data files. It appears that both the number and volume of LWD has decreased between 2006 and 2011 in Wolf Creek (table 155 - PIBO). This is likely the result of natural processes, i.e., LWD decaying and being transported downstream.

Table 156. Natural amounts of large, woody material in the Blue Mountains (Cordova 1995).

Large Woody Debris Size	Amount per mile
>12 inches diameter >35 foot length[1]	>69 pieces/mile (Class 1, 2, 3)
>12 inches diameter >35 foot length[1]	>48 pieces/mile (Class 4)

Pool Frequency

Pools provide a number of benefits to fish including cover, rearing habitat, and slow water for resting and feeding. In addition, of particular importance in the Crooked River sub-basin, deep pools provide thermal refugia from cold-winter and high-summer temperatures. Since many Wolf Creek tributaries dry-up during the summer on NF lands, larger, deeper pools become particularly important to redband trout and non-game species alike. Fish may become stranded in isolated pools until either flows return or food and oxygen resources are used up, in which case they die. Therefore, streams with a greater number of high-quality pools provide more individuals opportunities to survive and prosper.

In general, pool frequency and size (i.e., area, residual pool volume) are dependent on stream gradient and drainage area. Pool frequency is inversely related to stream size; that is, larger streams have fewer pools (Stack and Beschta 1989). There is a considerable amount of information on pool spacing in both the fisheries and hydrology literature. Leopold (Leopold et al. 1964) states that in the most general sense, both meandering and straight channels exhibit near-regular pool-riffle spacing of approximately 5 to 7 channel widths. Although this can vary considerably in different channel types and over short distances, this figure is useful for evaluating the approximate ratio that we might expect in this area. It is also worth noting that channels that have changed from one [Rosgen] type to another due to climatic or human-induced disturbances will undergo short-term changes but will usually return to this [5 to 7 widths] equilibrium if the causal mechanisms are discontinued. While this value is particularly useful in pool-riffle reaches, streams with other bed features (such as a step-pool configuration) are often somewhat different, however. The following table describes the expected pool spacing for the generalized stream types of the Wolf project area.

Table 157. Pool spacing by channel type (derived from Rosgen 1996).

Channel type	Expected distance between pools (no. bankfull widths)
A	1.5 – 3.0
B	4.0 – 6.0
C	5.0 – 7.0
E	5.0 – 7.0
F	4.0 – 5.0
G	5.0 – 7.0

Unfortunately, resource and data limitations prevent us from accurately determining the pool spacing in streams of the Wolf Creek watershed. However, a simpler surrogate can be measured—pools per mile—for which INFISH (USFS 1995) provides targets under its interim Riparian Management Objectives (RMO). The number of pools per mile varies according to a stream's wetted width. Although most pool scour occurs at flows near or above bankfull, INFISH uses wetted widths since field technicians can measure it more easily.

The pool frequency RMO does not specify a target for those streams with wetted widths (ww) less than 10 feet. However, a smaller stream would be expected to have more than 96 pools per mile. Thus, the following table illustrates that Wolf Creek tributary streams are considerably below the target, even though all streams measured were less than 10 feet in width with the exception of Wolf and North Wolf (<20 feet). In other words, we would expect ≥ 96 pools per mile for streams with a wetted width <10 and ≥ 56 pools per mile for streams with a wetted width <20.

Table 158. RMO objectives and observed values for pool frequency.

Stream	RMO pools per mile objective *(wetted width)*	Observed pools per mile *(wetted width)*	(average) Bankfull width	% of standard	Year data collected
Wolf	56 *(20)*	n/a	19.6	n/a	2006
East Wolf	96 *(10)*	3.2	18.5	3.3	2011
East Wolf	96 *(10)*	n/a	n/a	n/a	2006
Wolf Trib (16)	96 *(10)*	2.9	17.1	3	2009
North Fork Wolf	96 *(10)*	1.3	9.8	2	2011
Widow	96 *(10)*	0.1	16.3	<1	2009

Most of these stream surveys were conducted during annual flow of mid- to late-summer. Hydrographs in this area are generally single-peaked (i.e., snowmelt driven), although rain-on-snow events can occur frequently below about 4500 ft. in elevation. Thus, it is accurate to state that flows tend to vary considerably from season-to-season and even within the same stream. Hence, bankfull width is a more accurate descriptor of stream size and since summertime field surveys continue to be used, we should base expected pool frequencies on channel type and bankfull width values. Yet, even if we use the INFISH standard for pool frequency based on the bankfull width (bfw) of these streams, still none comes close to the objective of 56 pools per mile (for a ww of 20 ft.). All of these streams are <10% of the objective and would seem to be lacking sufficient pool habitat to support robust fish populations. As in the case of LWD, this data suggests that streams in the watershed are either not providing good habitat or the INFISH standard for pool frequency is inappropriate for the area. The pool percentage data measured in PIBO (table 155) has been relatively consistent over the monitoring period (within 10%).

Streambank Condition (bank stability and width to depth ratio)

Turbidity/Bank Stability

Oregon State water quality standards require that turbidity levels not cumulatively increase by more than 10% as a result of any proposed activities (relative to a control point immediately upstream). The Ochoco LRMP mandates that this will be accomplished by maintaining streambank stability (since bank erosion is often the most significant contributor to higher turbidity levels) and implementing BMP's (Best Management Practices). The LRMP states that stream channel cutbank disturbance should not exceed 20% for any given stream drainage. Likewise, the RMOs established by the INFISH require that the amount of unstable streambank in any reach not exceed 20%. Management activities cannot increase current levels of unstable banks if they are above 20% and Forest activities must not inhibit the "near natural rate of recovery." Therefore, by measuring the amount of cutbank disturbance, one can develop an indication of turbidity levels and the degree of sediment impacts that exist within the watershed.

As described in the Water Quality (sediment) discussion above, percent cutbanks are exceeded in Wolf Creek, North Wolf Creek, Tributary 16 to Wolf Creek, and East Wolf Creek. Many of these streams currently have active headcuts that are migrating upstream; contributing sediment, eliminating pools, and simplifying stream habitat. Additionally, many of these streams have segments that can be classified as G and F-type channel segments although the overall reach is classified differently. G and F-type channels are those that have entrenched and would not likely have existed

prior to stream and riparian modifications. Continued down cutting will occur until the source of the problem(s) is addressed and vegetation is established on streambanks to provide roughness and establish a new floodplain.

Occurrence of more than 20% of unstable banks can be an indication of degraded aquatic habitat resulting in changes in substrate composition, and reduced ability of woody and riparian plants to increase and expand (USDA 1995[a] [b]). Unstable banks can result from management or acute natural disturbance event. Increases in fine sediment in streams due to erosion from unstable banks, and corresponding reduction in spawning and rearing success are indirectly tied to the amount of unstable banks within stream drainages.

Turbidity sampling has not been done on the Paulina RD; however, ocular surveys of turbidity have shown that streams are generally "clear" during summer months. It is believed that turbidity increases during higher flows, particularly downstream of actively eroding streambanks, road crossings, and areas of heavy livestock use (e.g., water-gaps).

Table 159. Stream channel characteristics for the Wolf Project Area (2005-2011).

Stream	Reach	Year	Rosgen Stream Type	Average Entrenchment	Ave. Bkf Depth	Ave. Bkf. Width	Average Bankfull W/D Ratio	Average Sinuosity	Map Gradient %	Cutbanks %
Wolf Creek *	R1	2005	C3	4.2922	1.18	27.14	22.9712	1.1429	1	26.145
Wolf Creek *	R2	2005	C3	2.352	1.69	29.43	17.4512	1.2365	2	10.335
Wolf Creek *	R3	2005	C3	3.0222	1.33	29.22	21.9381			26.76
Wolf Creek *	R5	2006	B3	3.1274	1.09	22.64	20.8334	1.0213	4	4.165
Wolf Creek *	R6	2006	B3	3.2744	1.00	15.28	15.2858	1.0323	5	7.455
North Wolf Creek*	R1	1991	C		0.46	10.33	22.3347			
North Wolf Creek	R1	2011	C4	2.7432	0.56	11.5	20.438	1.0052	3	15.155
North Wolf Creek	R2	2011	C4	2.4868	0.57	9.61	16.7721	1.0091	4	20.94
North Wolf Creek	R3	2011	E4	2.5098	0.66	8.36	12.6961	1.0104	5	71.235
Widow Creek	R1	2009	B4	3.787	0.84	15.77	18.7587	0.9976	3	4.55
Widow Creek	R2	2009	B4	2.3809	0.65	12.46	19.0573	0.9903	4	12.59
Widow Creek	R3	2009	B4	3.3901	0.50	5.57	11.1657	1.0299	7	5.675
Wolf Creek Trib 16	R1	2009	B4	2.0084	0.75	15.1	20.1901	1.0247	5	10.805
Wolf Creek Trib 16	R2	2009	B4	2.7813	0.86	12.04	13.957	1.0524	5	42.12
E. Wolf Creek Trib*	R1	2006	A4	4.3138	0.79	6.16	7.8349	1.0115		6.9
East Wolf Creek*	R1	2006	A4	3.8603	0.99	11.6	11.7623	1.027	13	18.045
East Wolf Creek*	R2	2006	A4	1.8774	0.58	14.67	25.2522	1.1	9	52.755
East Wolf Creek*	R1	2011	A4	2.6156	0.64	11.31	17.6697	1.0255	4	3.39
East Wolf Creek*	R2	2011	A4	1.8979	0.60	9.77	16.2605	1.0028	5	7.32
East Wolf Creek*	R3	2011	A4	1.4482	0.39	8.37	21.5714	1.0117	5	40
Standard	n/a	n/a	A	<1.4	n/a	n/a	<12	<1.2	4-9.9	<20
	n/a	n/a	G	<1.4	n/a	n/a	<12	>1.2	2-3.9	
	n/a	n/a	F	<1.4	n/a	n/a	>12	>1.2	<2	
	n/a	n/a	B	1.4-2.2	n/a	n/a	>12	>1.2	2-3.9	
	n/a	n/a	E	>2.2	n/a	n/a	<12	>1.5	<2	
	n/a	n/a	C	>2.2	n/a	n/a	>12	>1.2	0.1-2	
	n/a	n/a	D	n/a	n/a	n/a	>40	v. low	0.1-2	

*Data analysis and interpretation may be subject to adjustments due to inconsistencies discovered during preliminary analysis. Inconsistencies are due to errors in spatial attributes as well as errors in electronic extraction of the data. Efforts were made to correct the data but not completed. Figures highlighted in red exceed standard.

Width to Depth Ratios

Width to depth ratios naturally vary by channel-type (Rosgen 1996) and are often very sensitive to management actions. For example, removal of riparian vegetation due to timber harvest or excessive browsing can reduce a stream's ability to withstand high flows. Floods will then erode streambanks and increase the width to depth ratio. A channel in dis-equilibrium that is degrading, aggrading, or experiencing changes in its flow regime due to nearly any factor, anthropogenic or natural, will usually exhibit changes in its width to depth ratio. Therefore, an examination a stream's width to depth ratio, by channel type, and its trend can be very expressive indicators of watershed condition.

RMOs defined in INFISH, recommend that width to depth ratios be less than 10 for all stream types; however, these ratios naturally vary by stream type (Rosgen, 1996). A, E, and G stream types

generally have width to depth ratios of less than 12 and B, C, and F stream types generally are greater than 12.

Currently, width to depth ratios are not within a natural range of variability for each stream type, where they are within range, it is likely that many of these channels have been converted to types different than their historic condition. As previously described, many streams within the watershed have down-cut and not laterally migrated (e.g., C to G to F to B) or have lost their riparian vegetation and become laterally unstable (e.g., C to D or C to G to F to C) and thus are not maintaining a reasonable width to depth ratio. Some stream reaches on are excessively wide and have not yet re-achieved a stable equilibrium.

Table 160. Width to depth ratio by channel type (Rosgen 1996; Silvey 1998).

Channel Type	A	B	C	D	DA	E	F	G
Width/Depth Ratio	<12	>12	>12	>40	<40	<12	>12	<12

Environmental Effects

For purposes of this analysis, short-term is defined as up to 10 years – the approximate duration of project implementation activities. Long-term is defined as 11-100 years; unless otherwise stated. Effect Common to All Alternatives can be found in Appendix E.

Alternative 1

Alternative 1 is the No Action alternative. No vegetation or fuels management activities (PCT, Rx burning) would be implemented to accomplish project goals. There would be no stand density management treatments or associated road (temporary) construction or utilization of the road network from implementation activities, i.e., timber haul. Stands would continue to incur mortality and large diameter trees would continue to be at risk of loss due to competition among trees. LOS stands would remain multi-strata with dense stand conditions causing competition for resources among trees. Large diameter trees, such as ponderosa pine, would remain at a high risk of mortality. Aspen stands, riparian and upland grass and shrub communities would continue to decline (see Silviculture, Botany and Range sections). Departure from HRV and FRCC would remain elevated across the landscape including within RHCAs. Landscape resiliency including within riparian areas would continue to be stressed. There would be no fuels reduction treatments. Areas would continue to accumulate fuels with the potential for a wildfire causing unwanted damage to forested stands including riparian areas, wildlife habitat, soils, and water quality. Fire suppression activities can be harmful to fish and their habitats; many fire retardants are toxic to fishes (Norris et al, 1991) and physical disruption resulting from construction of roads, fire breaks, and other activities can affect aquatic habitats.

No riparian restoration activities (stream restoration, headcut repair, hardwood stand improvement, planting and protection, culvert replacement) and road closure and decommissioning would occur. This alternative serves as a baseline for comparison of the effects of all of the alternatives. Routine activities such as road maintenance and suppression of unplanned fires would continue. Activities authorized under separate decisions would also continue. These activities include livestock grazing, noxious weed treatments, recreational use of the area, including camping, hunting and fishing and motorized and non-motorized use, would continue.

Effects of Wildfire: The immediate and short-term effects of fire to fish are commonly harmful to individual fish and even local populations, but the intensity of the effect varies. Direct heating of water by fire and dissolution of ammonia and other chemicals from smoke have resulted in fish kills (Minshall and others), but fish also appear to simply avoid affected areas if refuge is available (Rieman and Clayton 1997). Introductions of toxic materials and ash flows shortly after fire have resulted in in local extirpations (Rinne 2003). The response of fish populations to these impacts is varied. Some extirpations are permanent while some locations see re-establishment of fish populations within a relatively short time frame (Howell 2006). Sublethal temperature increases after

canopy removal has been observed to alter the growth and maturation of fish (Dunham and others 2007). Fine sediment increases can also interfere with life stages that use gravel interstices.

It should be noted that many aquatic organisms (such as salmonids) have evolved strategies to survive perturbations occurring at the frequency of wildland fires (greater than 100 years) (USDA – GTR-231, 2010). The long-term benefits of fire effects have been noted as well. The renewal of spawning gravels is cited (e.g., Reeves and others 1995; Benda and others 1998). Inputs of nutrients released by fires may also provide at least a temporary boost in productivity (Spencer and others 2003). Fires are one of the many disturbances that regulate sunlight coming to streams; so they contribute to maintaining a diversity of invertebrates that use both algae growing in streams as well as detritus falling from riparian forests (Minshall 2003). The legacy left behind by fire, including both the renewed material availability and the presence of fish to use those materials, is important in the net benefit of a fire (USDA 2012).

Direct and Indirect Effects:

Measure 1: Direct impacts to fish and frogs

Short-term risks from implementation activities specifically, exposure to direct impacts to frogs at stream crossings would not occur. Similarly, no short-term impacts that have potential to injure or kill fish and frogs would occur from stream restoration and other active riparian restoration activities. Short and long-term, there is an increased risk of harm to aquatic species from fire suppression activities.

Measure 2: Water Quantity and Quality

Water Quantity and Quality was analyzed in the Hydrologist Report and has been incorporated into the analysis below.

Water Quantity

Effects are summarized in the hydrologist and soils sections. There is potential for indirect effects to occur under this alternative. Over time, continued forest health deterioration and fuels build-up within the project area could lead to stand-replacing wildfires in the planning area that have the potential to change peak/base flows and water yield because of decreased infiltration. Changes in flow would depend on variables such as size, timing, location, and severity of fire, and climatic conditions post-fire. A fire of high severity, which results in severe heating of soils, reduces ground cover and can form a water repellant layer (hydrophobic) that restricts infiltration and percolation, can result in increased surface runoff. Severely burned soils are more likely to occur in the mixed conifer stands rather than the ponderosa pine dominated stands because of the greater ground fuels accumulation. The potential for hydrophobicity of the ash dominated soils within the RHCA's of the project area is generally considered to be low. In addition, reduced evapo-transpiration and interception by the tree canopy could compound runoff (Ice, 2003). However, hydrologic changes would be limited because of the groundwater influenced nature of the landscape and moderately permeable soils within the forested draws of the scab stringer landscape, and the moderate near-stream slopes in much of the drainage that results in restricted surface runoff. Forested stands in the project area are more likely to experience a crown fire than a surface dominated high severity fire under existing conditions. Watersheds would remain susceptible to a moderate risk of uncharacteristic wildfire that may result in measurable increases in peak flows that could affect fish and frogs by scouring redds, altering habitats, and dislodging individuals into downstream habitats.

However, no short-term risks from implementation activities that might impact water yield (vegetation treatments, roads and Rx fire) would occur but no short and long-term benefits that reduce the hydrologic net (road closures and decommissioning) would occur. Similarly, no riparian restoration activities (stream restoration, headcut repair and culvert replacement) that would

reconnect streams with their floodplains, increase and stabilize stream flows would occur, leaving fish and frogs more vulnerable to the effects of uncharacteristic wildfire and climate change.

Water Quality:

Sediment & Turbidity: The overall potential sediment delivery for the existing condition has been calculated to be approximately 13.7 tons/year. This takes into account the current condition of the vegetation, fuels and roads – see Hydrologist section. Alternative 1 has no proposed treatments and would result in no additional ground disturbance that could result in potential effects to sediment delivery. However, increased risk of uncharacteristic wildfire could lead to consumption of riverbank vegetation, decreased riverbank stability, increasing bank erosion and sediment introduction (Shakesby and Doerr 2006) that could increase turbidity until riverbank vegetation and stability recover. The Hydrologist analysis modeled potential sediment delivery in Alternative 1 to be above background levels and illustrates a six-fold increase above background levels in the event of an uncharacteristic wildfire. The prevailing winds are from the west and southwest which would lend itself to driving a fire up the drainage with a chimney effect into the upper elevation mixed conifer stands with steeper sideslopes and greater accumulations of surface fuels; fire severity would be greater here with increased adverse effects to riverbank stability and overland flow of sediments.

In the event of an uncharacteristic wildfire, turbidity may be increased from toppling of trees that are growing on the riverbank, introducing sediment as they fall. Turbidity from this action is likely to result in minimal increases in turbidity and may be immeasurable in the streams. Rashin and others (2006) found that windthrow trees were a minor contributor to the total extent of chronic (long term small inputs) sediment delivery from harvest sites. A weather storm that resulted in heavy precipitation soon after a fire could introduce overland flow of sediments within the RHCA into project area streams that would measurably increase turbidity. Chronic inputs of sediment from the RHCA that increase turbidity could continue for several years until vegetation groundcover is re-established. Chronic sediment inputs would likely be immeasurable in the river due to limitations of equipment and techniques of sampling. However, fine sediment volumes within substrates of streams may show a measurable increase after several years. In the lower watersheds, moderately permeable soils and gentle slopes within much of the RHCA within the project area would limit the volume of sediments introduced into the streams from overland flow. Elevated turbidity levels can be harmful to fish and other aquatic organisms.

The pathways for sedimentation and the effects of the fire on sedimentation are similar to those listed under turbidity above. Sedimentation occurs as suspended and other larger sediments deposit on and in the river substrate. Because fine sediments are likely elevated in the substrate in project area streams, additional sedimentation could have negative impacts to fish spawning, survival and habitat alteration.

No short-term risks from vegetation implementation activities (vegetation treatments, roads and stream crossings and Rx fire) that might impact sediment and turbidity would occur but no short and long-term benefits from improvements in sediment delivery from post-harvest PDF (tree felling/pushing, road closures and decommissioning would occur either). Similarly, no riparian restoration activities (stream restoration, headcut repair, culvert replacement, hardwood stand treatments and planting) that stabilize stream flows, decrease bank instability thereby reducing sediment delivery and ultimately turbidity would occur, leaving fish and frogs and their habitats more vulnerable to the effects of uncharacteristic wildfire and climate change.

Shade and Stream Temperature:

As analyzed in the Hydrologist report, Alternative 1 has no proposed treatments and would result in no vegetation treatments, road utilization or riparian restoration actions that could result in potential effects to stream shade or temperature. Due to past management of RHCAs in the project area, few stream reaches are currently meeting INISH standards for shade.

Under this alternative, most streams would continue to be below the shade RMO and summer water temperature would remain above allowable Oregon DEQ and Ochoco National Forest standards. Aquatic habitats would remain in this condition due to the low densities of hardwoods, over-grazing of hardwoods that are present, and the overstocked densities of conifers inhibiting expansion and establishment of riparian plants. Riparian vegetation (hardwood) recovery would slowly occur (up to 15 years) as grazing conditions incrementally improve from changes in management activities due to Southside AMP EA. The Southside AMP EA was completed in 2009 and encompasses grazing allotments in the Wolf Creek WA; reference Range report. However, conifers would continue to suppress hardwoods. Also reference discussion on W/D ratios below (Measure 4) for effects related to stream temperature.

There is increased potential for adverse effects to water quality if an uncharacteristic wildfire occurs due to the amount of stands in the project area that are in Fire Condition Class 2 or 3. The zone of riparian vegetation adjacent to project area streams varies from ~100' in the lower floodplain along mainstem Wolf Creek, to ~3 ft. in upper headwater streams. This zone of inner riparian vegetation is composed of primarily grasses and sedges with sparse woody shrubs. In all places but lower mainstem Wolf Creek, the riparian area would likely experience fire behavior and severity similar to upland conditions. The following is a description of effects to water quality should stand replacing wildfires occur near streams in the planning area.

In the event of an uncharacteristic wildfire within the RHCA, water temperature may be increased from the heat of the fire itself. The increase in temperature would depend on the intensity of the fire, size of the fire, proximity to streams, discharge at the time of the fire, and duration of the fire. Post-fire, shade would be reduced, which would allow increased solar radiation and increased water temperatures in the summer and decreased winter temperatures due to the loss of buffering capacity. Albin, 1979, found that water temperatures increased an average of 1.5° C in a burned watershed 35 years after the fire. This research was conducted on small 1st and 2nd order streams similar to numerous streams in the project area. Summer maximum water temperatures have been shown to remain significantly elevated for at least a decade following wildfire (Dunham, et al 2007). During the course of wildfire dissolved oxygen would be decreased as water temperatures increase. Post-fire, dissolved oxygen would be decreased as water temperatures increase from the lack of shade until vegetation recovers to heights capable of shading. Full shade recovery could take several decades. Oxygen could also be depleted from metabolism of increased runoff of organic matter, until ground cover becomes re-established to limit runoff.

With the no action alternative, forested stands within the RHCAs would be at increased risk of insect and disease damage and reduced vigor and growth (see Silviculture report). Presently, the stocking exceeds the Upper Management Zone in all the RHCA units. Many forested stands within the project area have not previously been thinned and fire has been excluded. These stands are currently at risk of insect and disease damage. Increased mortality of trees would reduce shade, potentially increasing water temperature, and would in turn increase the severity of wildfire effects discussed above.

Aquatic species would likely continue to be exposed to existing temperature stress and lower dissolved oxygen and degraded habitat that suppresses populations of fish and frogs. However, short-term risks from implementation activities, specifically RHCA treatments and riparian restoration activities would not occur. Conversely, none of the other benefits to stream shade short and long-term

from implementation of riparian restoration activities (stream restoration and headcut repair, hardwood stand enhancement including riparian planting and protection) would occur either.

Measure 3: Riparian Vegetation

Outer Zone: Under this alternative no activities would occur that would improve RHCA stand resiliency. The amount of area that is at high risk to unwanted disturbance would remain unchanged and increase over time as fire intolerant understories continue to develop and large fire tolerant trees are lost due to within stand competition. Tree mortality would potentially contribute to large down wood but over time inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. High intensity wildfire could also contribute to loss of existing down wood. Lack of active management (commercial treatments, PCT and Rx fire and riparian restoration) within forested stringers and RHCA would leave these stands exposed to risks from uncharacteristic wildfire and climate change as described above under Measure 2.

Inner Zone: As described in the existing condition section, a large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition. Existing shade would be maintained at current levels; however shade generated by hardwood species is expected to decline as these species are replaced by conifers. In the event of high intensity wildfire or insect epidemic, high amounts of existing shade may be lost. Lack of active management (riparian restoration activities: stream restoration, head cut repair, hardwood stand improvements and riparian planting) would not occur. Recovery of this zone of riparian vegetation including hardwoods would take several decades, if at all (in areas with severe channel incision), forgoing short and long-term benefits and leaving riparian vegetation susceptible to uncharacteristic wildfire and climate change.

Measure 4: Aquatic Habitat

Large Woody Debris *(number of large wood pieces/mile)*

No change to existing in-stream LWD or recruitment rates would occur as a result of this alternative that would allow natural and human induced processes to continue. As discussed under Measure 3 (Riparian Vegetation), tree mortality would potentially contribute to large down wood over time, but inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. In dense young stands, development of large wood would be retarded due to inter-tree competition. Severe wildfire could reduce the availability of future large trees if riparian areas burn even though it would initially create a large pulse in available down wood. Growth and development of large trees greater than 21 inches dbh requires 100 to 120 years on these sites. Potentially, there could be a shortage of future large wood available in the event of stand replacing fire.

Densities of LWD would continue to be below RMO minimums established by INFISH and reference conditions as updated under the 2012 Wolf Watershed Analysis. Lack of active management within forested stringers and RHCA would leave these stands exposed to risks from uncharacteristic wildfire and climate change. Increasing stand density and accumulating fuels both in the uplands and within RHCAs increase fire hazard and reduce growth on individual trees. LWD recruitment would remain unchanged from current trajectories because no stream restoration and LWD felling/tipping within RHCA units would occur.

Pool Frequency (pools/mile & Pool Quality)

Under this alternative, there would be no short-term (1-10 years) changes to pool frequency and quality. Generally, pool habitat would continue to be insufficient and would likely become scarcer as the current channel form is maintained. Pool frequency would not change because no actions would be taken to change large wood recruitment (in the near future) to form pools; the rate of pool development would remain slow. Similarly, no short and long-term benefits from active riparian

restoration would occur; up to 2.2 miles of stream restoration, headcut repair, and unit by unit LWD placement. Conversely, there would be no negative short-term changes to pool quality in the Wolf project area because active restoration would not occur. As described in Measure 2, elevated risks to sediment production from moderate risk of uncharacteristic wildfire would remain.

Streambank Condition (% stream bank stability, channel width to depth ratio)

In streams where hardwoods exist in closed canopy forests, expanding conifer cover would prevent growth and development of hardwood riparian vegetation. As a result, stream banks would continue to lack well rooted riparian plants that stabilize banks, reduce sedimentation and prevent further increases in width-to-depth ratios and subsequent increases in temperature. Similarly, no short and long-term benefits from active riparian restoration (unit by unit LWD placement, stream restoration, head cut repair, hardwood stand improvements and riparian planting) would occur.

Conversely, there would be no negative short-term effects to streambank conditions in the Wolf project area because no change would occur to the riparian vegetation, channel processes or utilization of roads and crossings. As described in Measure 2, uncharacteristic wildfire could also contribute to decreases in bank stability after riparian vegetation is consumed, and increased w/d ratios from loss of existing down wood and potential increases in sediment.

Since there are no direct and indirect effects there would be no cumulative effects.

Alternative 1 -- Determination for Redband trout and Columbia spotted frog

There would be 'No Impact' to redband trout and Columbia spotted frog species or habitat because there would be no vegetation treatment and associated road construction or utilization in RHCAs or in the uplands. As described above, no potential short-term negative effects to individual fish and frogs and RMO's would occur but there would be no long-term benefits to RMOs and fish and frog populations because no commercial treatments would occur in RHCA including subsequent LWD additions, riparian restoration activities, road closure and decommissioning and culvert replacement. Because of poor water quality and habitat conditions, redband trout and spotted frogs would continue to have low growth rates, low spawning and rearing survival rates, and depressed population densities (ODFW 1996, Wolf WA 2012, ONF MIS report 2011 and Stuart et al 2007). The relatively vulnerable fish and frog populations within the project area would continue to be less resilient to the potential affects from moderate risks to uncharacteristic wildfire and climate change.

Alternatives 2 and 3

Measure 1: Effects to individuals and sub-populations of fish and frogs

Direct and Indirect Effects

Vegetation management: Proposed activities within RHCAs are planned to improve fish and frog habitat features and meet and improve RMOs (INFISH 1995). For commercial treatments, site specific prescriptions were developed on a unit by unit basis based on slope, aspect, stream condition, soil conditions and existing vegetation (table 14). These site specific prescriptions include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled/tipped to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMOs already identified in INFISH as well as provide for a potentially minimal increase in the potential for sediment delivery.

Site specific prescriptions were developed for all units adjacent to class I, II and III streams and numerous class IVs. PDF were developed that would maintain RMO for the remainder of the units adjacent to class IV streams and for class IV streams that are unmapped and discovered as a result of implementation activities. Within RHCAs, equipment restrictions would exclude ground disturbance within the 'inner riparian zone' (zone of obligate riparian species e.g., sedges, willows, etc.) and limit

stream crossings, thereby substantially limiting the risk of direct impacts to fish and frogs. As part of the PDF, this project would be implemented during low-flow periods (July, August, and September), or in some cases in winter (over frozen ground), to avoid effects to spawning fish or incubating embryos and fry as well as breeding frogs. Frog habitat is represented by class I-III streams. There are approximately 474 acres (15% of RHCA within project area) of treatment proposed in these areas; the project area contains 3,153 acres of RHCA along class I-III streams. The remainder of treatments (115 acres) would occur in class IV streams which are not fish bearing or primary frog habitat, only marginal summer frog foraging habitat. Class IV streams are intermittent and would generally be dry during project implementation. In the unlikely event treatment activities do disturb frogs, individuals would likely relocate to another part of the stream to seek refuge.

Within RHCAs, potential direct effects to frogs are possible where felled or pushed trees may strike individual frogs during thinning operations. However, risk would be extremely low due to the limited scope of operations (small amount of thinning adjacent wet areas) and application of PDFs. In most cases, primary frog habitat would be protected by PDFs that require a min. 50 ft. but up to 100 ft. no equipment buffer adjacent streams. Risk to sub-populations would be especially low when considering the size of the proposed action in relation to the amount of untreated areas within the watershed.

Roads and stream crossings: PDFs are included to protect frogs; such as prohibiting operations within the channel migration zone (outside of March 1st – May 31st –Programmatic PDC). However, mortality of frogs may occur on haul routes and stream crossings when adult frogs are traveling to new feeding/breeding locations and driven over by vehicles. Potential interactions with frogs at stream crossings would pose the highest risk to frogs. Roads have been implicated in reducing amphibian dispersal (Gibbs 1998), increased mortality (Fahrig and others 1995), and reduced genetic diversity (Reh and Seitz 1990).

In the Wolf project area, the amount of roads are high in RHCAs. There are 29 miles of road in RHCAs; 17 designated as open and 12 designated as closed (see Transportation report). No new permanent/system roads would be constructed in the project area. However, 19.4 miles of temporary roads would be constructed; 17.6 miles on existing disturbance and 1.8 miles of new temporary road. Of those totals, 3.2 miles of temporary road on existing disturbance and 0.2 miles of new temporary roads would be in RHCAs. Using small spur roads within RHCAs would prevent building new roads or opening longer segments of roads that would increase exposure and potential of more sediment entering the stream and reducing vegetation. With implementation of road closure and decommissioning, the miles of road (closed) in RHCA would be decreased by 3 miles in Alternative 2 and 3.6 miles in Alternative 3 of the existing condition.

The additional amount of road and commensurate stream crossings during project implementation would incrementally increase exposure of Columbia spotted frog (CSF) to mortality, but the effects would be short-term when considering the temporary nature (1-3 years) of road utilization, timing, and the amount of currently open roads. No direct effects to fish are anticipated because unimproved stream crossings (temporary roads and skid trails) would dry during implementation.

Riparian Restoration and Enhancement Activities: One mile of stream restoration and 5 headcut repair/hardwood enhancement units would be accomplished in Alternative 2. In Alternative 3, an *additional* 1.2 miles of stream restoration, headcut repair (6 total), and an additional 5 miles road closure and 1 culvert replacement on North Wolf Creek would be accomplished. Implementation of stream restoration and headcut repair may cause incidental mortality of fish and frogs (approximately 1 month per year/10 years) from in-channel physical disturbance (mechanized equipment). Potential impacts would be minimized with application of PDF. Direct impacts to fish and frogs would be anticipated to be very low from proposed road closure and decommissioning because of the small amount of roads in RHCA or adjacent primary habitats. Short (post-implementation) and long-term

benefits to fish and frogs from implementation of these activities would occur as habitat conditions improve substantially over the current condition. In addition, fish and frog populations would be less exposed to impacts from wildfire, fire suppression and climate change via these actions because of riparian restoration activities e.g., improved habitat and connectivity between populations.

Cumulative Effects

The area of analysis for cumulative effects is the Wolf project area.

A foreseeable future action is the Ochoco Summit Trail project. The project is not anticipated to measurably impact fish and frogs via numerous proposed stream crossings because impacts would be minimized by overall project design (avoidance of sensitive areas including fish bearing streams) and PDC, including armored crossings and utilization of bridges.

Livestock grazing under the Southside EA (2009) has the potential add cumulatively to the Wolf project via trampling of young fish and frogs. Because the project area is located within and near streams, there are substantial ongoing human activities including vehicular traffic (project and non-project related) that may occasionally result in mortalities of individual frogs.

There are 33.5 acres currently proposed for treatment under the Deschutes and Ochoco Invasive Plant EIS (2012). The majority of the weed sites are located along Wolf Creek, its upper tributaries, and East Wolf Creek. In addition to these acres, the EIS enables the Forest to chemically treat new weed infestations. To protect aquatic species and water quality, PDF in the weed EIS prohibit most chemical treatments near perennial streams (USDA 2012). Manual treatments are applied between stream and chemical application buffer to reduce potential impacts; in most cases, this buffer is 15 ft. (USDA 2012). Therefore, chemical treatments are not expected to impact frogs and fish, especially when considering the very small amount of treatments dispersed across the project area. Together, the projects may impact a few individual fish or frogs, but impacts but would not likely contribute to any long-term (months to years), negative trends in population dynamics.

A minimal number of mortalities of fish and frogs could result from present and reasonably foreseeable projects. Under Alternatives 2 and 3, this projects could add cumulatively to these incidental mortality; however, the project duration is short term (approximately three years/10 years) and of a small area within RHCAs, limiting any potential cumulative effects to fish and frogs. In the long-term (>10 years), it is anticipated that direct impacts would be decreased to below baseline levels due to conclusion of project activities and closure/decommissioning of roads; decreasing potential effects to fish and frogs. Riparian restoration activities may have limited short-term effects to fish and frogs during implementation and long-term benefits. Short-term impacts to fish and frogs would be slightly increased in Alternative 3 because of the additional riparian restoration work, but more beneficial long-term

Measure 2 (Water Quality and Quantity)

Direct and Indirect Effects

Effects to water quantity and quality have been analyzed in the Hydrologist Report. Those results have been incorporated into the effects discussion below.

Water Quantity

Vegetation management and roads: A change in timing or peak flow magnitudes may affect fish via scouring redds or embedding them (USDA 2010). In Alternatives 2 and 3, EHA values could increase up to 12.7% and 12.6% respectively, but would still be below the Forest Plan Standard of 25% for the project area (Wolf Creek Watershed). EHA values would increase during the initial phases of implementation (year 2) and decrease over the course of project implementation. This increase in EHA illustrates the potential to increase peak flows. However, through the application of the PDF and BMP there are no expected measureable adverse effects to flow (reference Hydrologist report).

Though the potential for increases in peak flow and overland flow from road and skid trail crossings are acknowledged, potential effects would be largely minimized using BMPs and PDFs. Therefore, increases in peak flows are not expected to negatively impact fish and fish habitat (substrate). The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the no action alternative, thus decreasing the potential for changes in peak/base flows or water yield as a result of uncharacteristic wildfires, although changes would be limited. As described under the no action alternative, the potential for changes in peak flows would be limited by the moderately porous soils on the landscape.

Riparian Restoration and Enhancement Activities: Road closures and decommissioning would incrementally reduce the hydrologic net over the short and long-term. Riparian restoration activities (stream restoration, headcut repair and culvert replacement) would reconnect streams with their floodplains and would, overtime, stabilize stream flows. These projects would help to reduce scour-related mortality (and increase survival) of eggs and alevins, reduce involuntary downstream movement of juveniles during freshets, increase substrate interstitial spaces used for refuge by fry, restore timing of discharge-related life cycle cues (e.g., migrations), and increase spatial structure. These actions would reduce the vulnerability of fish and frogs to uncharacteristic wildfire and climate change.

Water Quality – Sediment & Turbidity

Vegetation management: Indirect effects include potential sediment delivery to streams that are inhabited by fish and frogs from overland flow during and after harvest activities, temporary road construction, re-use of closed roads, open road utilization including associated stream crossings and prescribed fire and riparian restoration activities. Elevated sediment delivery to streams increases suspended sediment and turbidity levels, fine sediments in streams can degrade channel form; reference below (Measure 4) for effects to channel form (pools and streambank condition). Increases in fine sediment in streams can negatively affect salmonids and other aquatic biota (Meehan, 1991; Rhodes et al., 1994; Waters 1995.) and may be more problematic in degraded systems.

The extent to which hillslope and riparian soils are disturbed and mobilized to the stream channel can decrease the survival of incubating salmonid eggs (Reiser and White 1990). Elevated turbidity and suspended sediment levels can impair sight feeding by fish and, at higher levels, causes gill damage in fish (Rhodes et al., 1994). Gravel embeddedness of less than 20% is essential to maintain healthy salmonid population, especially in those areas identified as potential or existing spawning areas (Bjorn and Reiser 1991). If sediment exceeds 20%, the spaces between the rocks in the substrate can be filled leading to less available oxygen for fish eggs. However, unlike many other land uses that disturb soil for long periods, any increase in sediment yields from timber management activities is usually short-lived. Surface soil disturbances provide a sediment supply, but once the finer materials are transported and revegetation occurs, the site is less apt to continue eroding. Pulling the trees out of the RHCA would cause a temporary removal of vegetation from the top of the soil for the first one to three months until vegetation regrows. Vegetation would return (after one full growing season) to the disturbed sites eventually restabilizing any disturbed areas. Sediment yields or measured suspended sediment concentrations decrease over time as a negative exponential (Beschta 1978).

Roads and stream crossings: The majority of sediment from timber harvest activities is related to roads and road construction (Chamberlin and others 1991; Furniss and others 1991; Megahan and Hornbeck 2000) and associated increased erosion rates (Beschta 1978; Meehan 1991; Rhodes and others 1994). Serious degradation of aquatic habitat can result from poorly designed, constructed, or maintained roads (Furniss and others 1991; MacDonald and others 1991; Rhodes and others 1994). Road networks interact with stream networks and lake basins at the landscape scale and affect biological and ecological processes in stream and riparian systems (USDA 2010). Roads and associated ditch systems increase watershed drainage networks, intercept overland flow, and shift

timing of peak flows. During precipitation events, fine sediments can be washed from the road surface into streams. This is especially true for poorly maintained roads. Roads constructed in close proximity to streams constrain the stream channel and eliminate the stream's access to its floodplain.

Streams that have the following characteristics are the most sensitive to increases in fine sediment: steep terrain, granitic geology, significant mass erosion, snow melt dominated hydrology, relatively arid climates, low gradient streams, and low frequency of large woody debris (Everest et al., 1987). Habitat for redband trout in the planning area have several of these characteristics, primarily the latter, and therefore, may be generally more susceptible to increases in fine sediment. Similarly, potential negative effects of mechanized fuels treatments may be worse in areas where riparian conditions are already degraded by a variety of past and ongoing activities including grazing, logging, and roads (Leopold 1937;, USFS et al; Henjum et al; CWWR, 1996; Moyle, 1996a; b; Espinosa et al., 1997; NRC, 1996; 2002; and Beschta et al 2004). Habitat degradation has also compromised the ability of riparian areas to buffer the effects of upslope disturbance (Rhodes et al 1994). Dwire et al in (USDA 2010), notes the lingering effects of land management prior to the establishment of buffers are likely to influence the structure and composition of riparian areas for decades to centuries (Young and others 1994). Legacies of past management within watersheds could potentially confound responses to fuel reduction treatments (USDA 2010).

The Hydrologist report modelled the combined overall potential maximum sediment delivery to be 34.8 tons during implementation, or a 154% increase above the existing condition annual rate. For Alternative 3, it would 33.1 tons during implementation, or a 143% increase (see Hydrology report for additional details).

Closed and temporary roads would be rehabilitated after the project has occurred, thus the minor increase in road density, and therefore effects, would be short-term. Long-term, Alternative 2 has the potential to improve conditions over existing condition because all reopened closed roads (within RHCA and potential sediment delivery zone) would be closed and rehabilitated. Alternative 3 would close an additional 5.8 miles of road in the project area. Some roads that do not receive recurring maintenance, primarily low standard roads (ML 2) would see some improvements in their ability to handle surface runoff and the resultant sediment; this would result in an improvement over the existing condition.

In terms of road related sediment, both alternatives have the potential to improve conditions over the existing condition. In the long-term, for Alternative 2, sediment delivery would be reduced to 7.2 tons or 36% less than the existing condition while for Alternative 3, sediment delivery would be reduced to 7 tons or 38% less than the existing condition (see table 175). Associated benefits include the following: eliminating or reducing erosion and mass-wasting hazards associated with roads; eliminating or reducing human access and use-disturbance associated impacts to aquatic systems. Actions such as subsoiling or ripping of road surfaces, outsloping, waterbarring, fill removal, sidecast pullback, re-vegetating with native species and placement of large woody material and/or boulders are included. There may be a short-term increase in sediment from implementing closure and rehabilitation but, PDFs are included to reduce the potential for these types of adverse effects from occurring. Additionally, BMPs related to roads include road location, road design, time of use, road construction and maintenance, and road obliteration would be applied. In the long-term (upon project completion), re-closing and rehabilitating temporary roads would decrease watershed drainage networks, eliminate some stream-road crossings, and reduce areas of soil compactions improving watershed function and habitat conditions for fish and frogs.

As acknowledged in the Hydrologist report, temporary road construction, and reopening of closed roads for temporary use near streams would have short-term construction related effects (<1 up to 3 years) or during duration of implementation (1-10 years) that would include short-term (< 5 years) increases in turbidity and fine sediment inputs to streams. These are likely to happen during high

flow events within the drainage as fine sediments would only be moved during summer thunder storms or during spring snow melt.

All stream crossings would be limited to roads over culverts on perennial streams (Class I-III) and on existing roads that cross *dry* channels of class IV streams over a temporary culvert or an armored ford. The greatest potential for sediment contributions to streams would be associated with class IV crossings. Sediment contributions would be negligible and short-term (<2 years/project implementation); reference Hydrology report. To minimize effects, as few crossings as reasonable would be used in these streams and crossings would be rocked or a temporary culvert would be placed to reduce sediment transport. After proposed activities are completed, any placed culverts would be removed and the channel would be restored (reference PDF & Hydrology report).

Since channels in class IV streams would likely be dry during the project, minimal amounts of sediment would be moved into the channel. The addition of sediment, via dust and rain-induced erosion at road crossings may attribute to the movement of fine silt downstream during high flows. This may disturb individual redband trout or Columbia spotted frogs on a short-term basis (duration of activity, several days to weeks), but will not adversely affect them because of the relatively minor additional amounts and limited scope and duration of activities. In general, sediment that is displaced into streams would be dispersed through the streams during fall, winter and spring runoff events and would not adversely affect spawning/breeding or rearing redband trout and Columbia Spotted frogs. However, some sediment may accumulate in low in low gradient reaches and intermittent features (pool tail outs, channel margins, etc.) within the project area, but would likely be immeasurable.

Rx burning and fuels treatments: In both alternatives, prescribed fire (1,122 acres) and non-commercial thinning (253 acres) treatments are designed to reduce smaller fuels within RHCA, reduce stocking of conifer seedlings, and rejuvenate grass and shrub cover. The primary beneficial effect of reducing fuel loads in riparian areas is the reduced chance for uncharacteristic wildfire. This alternative proposes prescribed burning within riparian areas across the project area. Prescribed burns would increase species diversity and plant vigor. Some short term (1-5 years) negative effects from burning may include an increased potential for weedy species – see weed risk assessment and PDF. The objective of the aspen enhancements are to stimulate growth and prevent competition for aspen sprouts. In addition, there are incremental benefits to reducing fuel loads in riparian areas and reducing the risk riparian areas from more intense wildfires – see Measure 3.

As summarized above, prescribed burning has the potential to cause some short-term adverse effects on salmonids and their habitats. However, it is reasonably certain that individual fish behavior would not be affected directly by the patchy low-intensity fires caused by low to moderate behavior prescribed fires (Minshall and Brock 1991). Recent research (Beche, et al., 2005) indicates that fuels management in riparian areas can produce short-term (within the year) changes in water chemistry, macroinvertebrate composition and decreases in periphyton. These changes are unlikely to pose major threats to aquatic species because of the limited sizes of prescriptive burns, their short duration and low intensities (NMFS 2007). In a recent study, (Arkle and Pilliod 2010), it was found that no detectable changes in periphyton, macroinvertebrates, amphibians, fish and riparian and stream habitats when comparing burned and unburned controls three years after a prescribed fire treatment.

In general, effects from low to moderate intensity prescribed burns would be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996). Although dead salmonids have been discovered after severe wildfires (Minshall and Brock 1991), it is reasonably certain that individual fish behavior would be not be affected directly by the patchy low-intensity fires caused by this proposed activity. Indirect effects such as reduced forage for juvenile salmonids would be minor and last for a maximum of approximately one to two years after burning. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, low-intensity fires should not result in effects this severe.

Prescribed burning would be implemented over approximately 10 years and in different seasons resulting in reduced potential for sedimentation. Fuels treatments would occur in the spring and fall. Hand piles would be burned later in the year after the first snow. Residual slash and the unharvested areas are expected to filter loosened sediment before it reaches the streams. Sedimentation as a result of implementing fuels projects would be filtered through vegetation along the streambanks and throughout the RHCAs during overland flows due to the mosaic fire patterns in the area. For frogs, egg deposition occurs soon after snowmelt. Eggs are normally deposited in water at temperatures of approximately 57.2 degrees F. Fire does not burn well in wet, humid areas along streams and springs. Hand-dug firelines would be avoided through these areas. Summer foraging areas would not be affected by fuels treatments which would take place in the spring and fall.

Erosion resulting from prescribed burning is generally less than that resulting from roads, skid trails, and site preparation techniques that cause soil disturbance, which are often a necessary component of prescribed burn projects (EPA 2005). Application of PDC would likely minimize the risk of these activities. Therefore, effects from prescribed fire activities are not expected to adversely impact fish or frogs or measurably affect fine sediment delivery to streams. Also reference shade and stream temperature effects discussion below.

Riparian Restoration and Enhancement Activities: The amount of sediment that would be produced during the implementation of in-stream restoration and associated activities is unknown at this time. Therefore, minor, short-term (individual project implementation), effects from projects would occur, but would be minimized by scope and scale, staggered implementation and PDFs and BMPs. Short and long-term benefits from these activities (stream restoration and headcut repair, hardwood planting, protection and enhancement, weed treatments, road closures and decommissioning) that reduce sediment delivery long-term would occur. In the short-term, Alternative 3 would be more impactful but more beneficial long-term because of the increased amount of proposed restoration activities. Based upon the areas treated and types of restoration in Alternative 2 (5 headcut repairs, 1 mile of channel stabilization), for Alternative 3 (6 headcut repairs and 2.2 miles of restoration), it is estimated that sediment yield would be reduced by approximately 5-10 tons per year (Hydrologist report).

As described above (existing condition), limited information is available to measure fine sediment in the project area. Therefore, it is difficult to assess the existing condition and potential effects of the proposed action on aquatic resources. However, it would appear that, where data is available, project area streams may be approaching a 'threshold' for the amount of percent fines (<2mm) in the substrate. This project has the potential to elevate fine sediment in gravel substrates towards undesirable amounts.

However, due to the temporary nature of effects and through application of the PDF and BMP, it is anticipated that effects to substrate embeddedness and any potential negative effects to fish would be minimal and short-term (<2years/project implementation) in duration. As described in the Hydrology report, closing and rehabilitating roads would reduce sediment related impacts long-term; sediment levels would return to background levels upon project completion (<2 years/project implementation). Individual streams and reaches would return to below background (approximately 5-10 tons per year) levels as projects in those areas are completed.

Summary

Short-term (<2 years/duration of individual project – timber sale, stream restoration, etc.), indirect effects to fish and aquatic habitat (substrate) could occur from elevated sediment delivery during project implementation activities. Effects to fish and aquatic habitat (substrate) from inputs of fine sediments are very difficult to measure. Nonetheless, project activities may produce localized effects to redband trout immediately below project sites. However, PDF and BMPs including timing and

magnitude of these localized effects are not expected to result in measurable effects to fish and aquatic habitat (substrate). Upon project completion, effects to fish and aquatic habitat (substrate) would improve as sediment levels are reduced below the existing condition (pre-project) from closure and rehabilitation of roads in RHCAs. In addition, long-term (3-100+ years), sediment production would decrease due to tree felling/pushing, and riparian restoration activities that would serve to capture and reduce sediment and develop pool habitat including pool tailouts (spawning substrate). The proposed action would move the measure towards the desired future condition as described in the Wolf WA.

Stream Shade and Temperature

Effects to stream shade and temperature have been analyzed in Hydrology report.

Vegetation management: In Alternatives 2 and 3, commercial harvest in Class I, II and III RHCAs is not expected to reduce shading on perennial streams due to application of site specific unit PDFs that maintain the primary shade zone. One exception is the removal of conifers around incidental hardwoods encountered during implementation. The number of incidental hardwoods that would be encountered is expected to be very low and spatially infrequent. Therefore, no measureable short-term effect to shade is anticipated, especially considering the scope of activities (474 acres) that would occur in a small portion of those acres. Removing conifers from hardwood stands to improve alder or willow production in commercial units may incrementally reduce shade but should not result in a measurable increase in water temperatures.

Non-commercial thinning (NCT) would occur in 337 acres of RHCA. NCT includes 253 acres outside of commercial units, 16.2 acres juniper cutting and 68 acres of hardwood enhancement. The proposal for Alternative 3 is the same but would add an additional 15 acres of non-commercial hardwood thinning; unit 350 is a stream restoration unit that includes riparian planting and some limited thinning – see description in Proposed Action. Non-commercial thinning would occur to within five feet of stream channels. With the application of site specific unit PDF and shade 'setbacks', only trees that do not provide shade or provide bank stability would be removed so that the existing amount of stream shade is maintained with the exception of removal of conifers around incidental hardwoods encountered during implementation. Similar to above, the number of incidental hardwoods that would be encountered is expected to be low and spatially infrequent. Therefore, no measureable effect to shade is anticipated. Non-commercial thinning would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species. Non-commercial thinning would result in increased growth rates for both conifers and riparian shrubs.

Hardwood enhancement is proposed on 68 acres in both Alternative 2 and 3. Thinning in these stands would specifically target suppressed riparian hardwoods by thinning out encroaching conifers up to 15" dbh. Removing conifers from hardwood stands or to improve alder or willow production in these non-commercial units may reduce a minor, short-term (<5 years) amount of shade but should not result in a measurable increase in water temperatures. No measureable increase in temperature is anticipated, especially considering the scope of activities in relation to the size of the watershed.

Roads and stream crossings: Temporary road construction (existing and new) and re-use of closed roads would not measurably affect shade or stream temperature because the majority of roads occur outside the primary shade recruitment zone and in most cases would not have mature vegetation tall enough to affect shade. Similarly, no new crossings are planned for class I, II or III streams. Several stream crossings on existing disturbance would occur on class IV streams throughout the project area but would not measurably affect existing shade or temperature because of their limited number, intermittent spatial distribution across the project area and application of PDFs and BMPs. Selection of stream crossing locations would be coordinated with fish/hydro/soils and would be located in the

least impactful areas where minimal disturbance would occur, typically on previous disturbance. Stream crossings would be rehabilitated upon completion of activities.

Rx burning: In Alternative 2 and 3, prescribed fire is proposed in 1,122 acres of RHCAs. There is a risk that application of prescribed fire could reduce shade in RHCAs short-term. Although fire can have a wide range of effects on aquatic ecosystems ranging from minor to severe, prescribed burns are planned for spring and fall when fuel moisture and relative humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire (USDA 2010/GTR-231). Potential effects from low to moderate intensity prescribed fire in riparian areas include minor short term (<1 year) reductions in stream shade that would not measurably increase water temperatures, (Reiman et al. 2003). Effects from low to moderate intensity prescribed burns would be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996).

To meet RMOs, fire prescriptions for RHCAs would provide for a mosaic of burned and unburned areas to retain sufficient soil cover for infiltration and maintain vegetation that provides shade. Prescribed fire would be implemented with application of PDF and consistent with PDC and Programmatic BA for CSF that includes the following design criteria (see Appendix D). In many cases, there is considerable overlap between PDF, PDC and BMP that should allow for enhanced protections of aquatic resources.

In general, burning in RHCAs would be expected to burn 10-50% of the riparian area, while exposing less than 5% mineral soil. Mineral soil exposure would be expected to last less than one year. The above ground growth of grasses and shrubs in the burned areas would be killed but would respond with new growth within the first growing season after the burn. Observations of similar prescribed fire treatments show burned grasses begin to sprout with new growth within one to three months of the first growing season. Within the first year after burning, shrubs and grasses would be rejuvenated. The Wolf project Fuels and Botany reports contains a discussion of fire effects specific to common shrubs in the project area. Based on this discussion, most shrubs produce basal sprouting following disturbance or require mineral soil exposure to germinate and establish new plants. Prescribed fire and associated harvest and non-commercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA and reduce competition for resources between hardwoods and conifers. There would a risk of prescribed fire reducing shade, however short-term increases in temperature (up to 6 months) are allowed even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)).

With application of design criteria and BMPs, any reduction of stream shade would be spatially intermittent and short-term (<5 years) and would not be expected to measurably increase water temperatures. Short and long-term, it is anticipated that shade would increase over the next 5-10 years due to higher vigor of existing (and recently planted) hardwoods once some of the conifer canopy and understory is removed and/or consumed via implemntation activities (CT, PCT and Rx burning within RHCAs). Increased shade from the hardwoods would lead to incrementally lower temperatures in streams which is a critical element fish need for survival during low flow periods when air temperatures increase in the summer months.

Riparian Restoration and Enhancement Activities: minor, short-term (individual project implementation), effects from would occur but would be minimized by scope and scale, staggered implementation and application PDF and BMP. Riparian restoration activities (stream restoration and headcut repair, hardwood planting and protection, weed treatments, road closures and decommissioning) would provide for increased shading from development of riparian vegetation, narrower stream channels, deeper pools and reconnected water tables would reduce water temperature

short and long-term. Short-term, Alternative 3 would be more impactful but more beneficial long-term because of the increased amount of proposed restoration activities.

In summary, through the application of PDF, there would be no measurable increase in water temperatures resulting from any proposed activities (commercial and non- commercial thinning, Rx burning, road construction and stream crossings, or from elevated sediment). A minor amount of shade would be reduced short-term (<5 years) in the aspen/hardwood RHCA units (portions of) and potentially through Rx burning and riparian restoration, but no measurable increase in water temperatures resulting from these activities is anticipated. Short and long-term, the proposed action would move the measure towards the desired future condition as described in the WA. This actions would benefit fish and frogs and their habitats short and long-term through improving stream shade and potentially reducing stream temperature. Aquatic species would be exposed to less temperature stress and higher dissolved oxygen and degraded habitat that suppresses populations of fish and frogs.

Alternative 2 and 3would be consistent with the applicable INFISH and ONFLRMP standards and guidelines and state water quality standards. PDFs and BMPs would provide protection of water quality and avoid adverse effects to aquatic species.

Cumulative Effects

Water Quantity

The area of analysis for cumulative effects is the Wolf project area.

Projects with the potential to reduce peak flows and stabilize the hydrologic regime in the project area short and long-term include implementation of the Deschutes and Ochoco Travel Management EIS (2011). The Travel Management EIS reduces the potential for increasing peak flows and moving towards a more stable hydrologic regime long-term through restriction of vehicle access via hydrologic stabilization of closed roads. This project would help to reduce scour-related mortality (and increase survival) of eggs and alevins, reduce involuntary downstream movement of juveniles during freshets, increase substrate interstitial spaces used for refuge by fry, restore timing of discharge-related life cycle cues (e.g., migrations), and increase spatial structure.

The Wolf project could increase the potential for increasing peak flows in the short-term from project implementation activities including: commercial and non- commercial thinning including within RHCAs, Rx burning, road construction and stream crossings; however, long-term, it is anticipated that peak flows would be decreased to below baseline levels due to conclusion of project activities, specifically, riparian restoration activities and the closing and decomissioing of roads; therefore cumualtively, decreasing potential effects to fish, frogs and aquatic habitats over the no action alternative.

Water Quality – Sediment & Turbidity

The area of analysis for cumulative effects is the Wolf project area.

The Ochoco Summit Trail project could potentially affect sediment via numerous stream crossings but impacts would be minimized by overall project design (avoidance of sensitive areas including fish bearing streams) and PDC, including armored crossings and utilization of bridges.

Livestock grazing under the Southside EA (2009) has the potential to add cumulatively to the Wolf project sediment delivery from bank alteration and suppression of riparian hardwoods but PDC were developed to improve grazing conditions long-term. The Southside EA was signed in 2009 and implemented began in 2010. Annual indicator monitoring has been shown to meet standards and guidelines during the last 5 years.

There are 33.5 acres currently proposed for treatment under the Ochoco and Deschutes Invasive Plant EIS (2012). The majority of the weed sites are located along Wolf Creek, its upper tributaries, and

East Wolf Creek. In addition to these acres, the EIS enables the Forest to chemically treat any new infestations under the early detection rapid response process which will greatly help reduce the rate of spread into newly disturbed ground as a result of the proposed activities in the Wolf project area. Because project design features in the weed EIS prohibit most chemical treatment near perennial streams to protect aquatic species and water quality (USDA 2012), manual weed treatments are applied between stream and chemical application buffer. In most cases, this buffer is 15 ft. (USDA 2012). Manual treatments are not expected to measurably increase the amount of short-term soil disturbance that might increase sediment delivery to streams when considering the very small amount of treatments dispersed across the project area.

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs. These activities coupled with implementation of the project treatments may impact individual fish or habitat for short periods of time (days to weeks), but will not likely contribute to any long-term (months to years), negative trends in population dynamics.

Projects with the potential to reduce sediment delivery in the project area short and long-term include implementation of the Deschutes and Ochoco Travel Management EIS (2011). Implementation of the Travel Management EIS, along with road closures and decommissioning in the Wolf project, would restrict access to designated open roads, decreasing access and impacts to streams and would likely reduce the spread of noxious weeds. Short and long-term, weed treatments would improve native riparian plant communities and reduce sediment delivery over time via stabilization stream banks.

Still, the Wolf project would add cumulatively to present and foreseeable projects by increasing fine sediment delivery in the short-term from project implementation activities including: commercial and non- commercial thinning including within RHCAs, Rx burning, road construction and stream crossings. In the long-term (>10 years), it is anticipated that sediment would be decreased to below baseline levels due to conclusion of project activities, specifically riparian restoration activities; therefore decreasing potential effects to fish, frogs and aquatic habitats. Alternative 3 would be more impactful short-term but more beneficial long-term because of the increased amount of proposed restoration activities.

Stream Shade and Temperature

As summarized in the Hydrology report, historic logging and grazing practices contributed to the removal of deciduous woody vegetation and compaction of alluvial terraces. Under the Southside EA (2009), livestock grazing continues in the project area, but levels have been reduced from historic amounts and riparian vegetation is improving, but is still below desired conditions. Livestock are expected to continue to use riparian areas and are expected to consume some of the increased forage; however, more strict grazing management criteria are being implemented within the Southside EA and should, over the long term, improve riparian habitat. Under Southside implementation, riparian species have more protection from being overly utilized by cattle and will likely exhibit more vigorous growth due to the increased resources from thinning. Annual indicator monitoring has been shown to meet standards and guidelines during the last 5 years – see range report. Additionally, several treatment units have remnants of old livestock exclosures around portions of riparian areas. Riparian planting is proposed in some of these areas, but the young plants can be subject to browsing in areas that are not caged. Repairing old exclosures, along with planting and caging new young hardwoods along stream channels, would help restore/reestablish hardwoods in the proposed treatment units.

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs. These activities coupled with implementation of the

project treatments may reduce stream shade in a few very small dispersed locations, but will not likely contribute to any measurable long-term trends.

Projects that have the potential to improve shade include implementation of the Ochoco Travel Management EIS (2011). The Travel Management EIS may incrementally reduce negative impacts to riparian vegetation from motorized vehicles short and long-term buy restricting access of vehicles to the open road network and would likely reduce the spread of noxious weeds. Combined with the project activities proposed in the Wolf project, shade and stream temperature should improve.

Still, the Wolf project would add cumulatively to present and foreseeable future projects by decreasing shade in the short-term (1-15 years) by thinning out competing conifers in hardwood stands but on a very limited scale (see above), distributed across the watershed. Additionally, shade may be impacted by application of limited prescribed burning activities within RHCAs (1,122 acres) but any effects would likely be short-term (<1 year). There should not be any measurable increase in water temperatures in any fish bearing or non-fish bearing perennial streams in the planning area. In the long-term, it is anticipated that shade would be improved due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities. Alternative 3 would be more impactful short-term but more beneficial long-term because of the increased amount of proposed restoration activities.

Measure 3 – Riparian Vegetation

Direct and Indirect Effects

Vegetation management and Rx fire: Alternatives 2 & 3 includes commercial and noncommercial activities designed to improve vegetative resiliency and lessen the likelihood of uncharacteristic wildfire from occurring. Proposed treatments include protections for existing RMO as summarized in the unit by unit PDF (table 14). In Alternative 2, approximately 860 acres (22% of RHCAs in the project area) of silvicultural activities would occur with RHCAs. The proposal for Alternative 3 is the same but would add an additional 15 acres of non-commercial hardwood thinning.

The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term, but would increase the likelihood of a long term supply of large trees. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH LWD RMO – see proceeding LWD discussion under Measure 4. In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. Potential tree heights in the project area range from about 150 feet in the more productive lower reaches of Wolf Creek to approximately 75 to 100 feet in some of the upstream ponderosa pine sites. Within the driest pine and juniper zones, potential tree heights are limited to 75 feet or less. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width. These widths encompass roughly one third to one half of the entire potential wood recruitment zone (see unit specific project design features).

1,122 acres of underburning outside of commercial and noncommercial thinning units is proposed within this project. This activity is primarily focused on the reduction of existing ground fuels and includes design features which are intended to meet INFISH RMOs. It is anticipated that there would a minor amount of understory conifer mortality resulting from underburning. Reducing unwanted density of understory trees would complement the silvicultural activities and improve landscape resiliency, but is not expected to be of a magnitude that would meaningfully change this analysis.

Reducing stand densities, managing for more historic and fire tolerant species compositions, and reducing fuel loads would lessen the risk of a high intensity event such as a stand replacement

wildfire or insect epidemic occurring. Unit specific prescriptions were developed to maintain and improve RMO including class I –III so that no loss of shade would occur to streams that flow during summer months – see water quality discussion under Measure 2 above. Lessening the likelihood of a stand replacement event would help ensure that shade in the long term would be maintained or increased

As described in the existing condition section, riparian vegetation conditions within the inner zone are generally poor within the project area. Alternative 2 and 3 also enhances 68 acres and 83 acres, respectively, of riparian hardwoods (including riparian planting and protection). Both alternatives include incidental riparian hardwood enhancements encountered in the general RHCA NCT. These treatments account for a substantial amount of known hardwood stands (including aspen) within class I-III streams where hardwoods are most likely to be present. Maintaining and increasing hardwoods can also help improve bank stability as many of these species have rhizomatous root systems – see Measure 4 below.

Table 161. Acres of Silvicultural Treatment by RHCA Class – Alternative 2.

	Stream Class			
	1	2	3	4
Commercial harvest and noncommercial thinning	42	341	91	115
Noncommercial thinning outside of harvest units*	23	193	34	19

*Noncommercial thinning also includes juniper cutting.

Table 162 Acres of Silvicultural Treatment by RHCA Class – Alternative 3.

	Stream Class			
	1	2	3	4
Commercial harvest and noncommercial thinning	42	299	89	111
Commercial harvest with 21+" trees and noncommercial thinning	0	42	2	4
Noncommercial thinning outside of harvest units*	23	193	34	19

*Noncommercial thinning also includes juniper cutting.

Roads and stream crossings: As described under Measure 1 above, both alternatives would increase the amount of closed roads and road decommissioning within RHCAs by a small amount. Alternative 3 increases the amount of closed roads within RHCAs by 0.5 miles. These actions would help improve riparian vegetation (outer zone) conditions incrementally over the no action alternative.

Riparian Restoration and Enhancement Activities: Alternative 3 increases riparian vegetation above Alternative 2 by increasing the amount of restoration of streams and floodplains and ultimately water tables by 1.2 miles, includes an additional headcut repair site and culvert replacement. These activities would improve riparian vegetation by restoring water tables critical to the functionality of stream and riparian ecosystems. Minor, short-term (individual project implementation) disturbance from projects within RHCA would occur to inner riparian vegetative conditions but they would be

minimized by scope and scale, staggered implementation and PDFs and BMPs. Short and long-term benefits from riparian restoration activities that reduce impacts to RHCA and improve riparian vegetative conditions long-term would occur. Short-term, Alternative 3 would be more impactful but more beneficial long-term because of the increased amount of proposed restoration. Compared to Alternative 1, active management (commercial treatments, PCT and Rx fire and riparian restoration) within forested stringers and RHCA would reduce risks to riparian vegetation and increase resiliency from uncharacteristic wildfire and climate change.

Alternative 2 and 3 would be consistent with the applicable INFISH and ONFLRMP standards and guidelines and Forest Plan Amendments (RMO). BMPs and PDF developed for the project area would provide protection and avoidance of sensitive areas within RHCAs.

Cumulative Effects

The Ochoco Summit Tail project would not measurably impact riparian vegetation because impacts would be minimized by overall project design (avoidance of sensitive areas including fish bearing streams) and PDC, including armored crossings and utilization of bridges.

The Ochoco Travel Management EIS (2011) would restrict vehicle access including within RHCA across the project area. Short and long-term benefits, when combined with the Wolf project proposals, would be anticipated provided that, overtime, closed roads are hydrologically stabilized prior to closure.

Livestock grazing under the Southside EA (2009) has the potential to add cumulatively to the Wolf project via degradation of riparian vegetation but PDFs were developed to improve grazing conditions long-term – see Measure 2.

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs but not at a scale that would meaningful on a watershed scale.

The Powell Timber Sale (2010) did not include acres with any stream RHCAs. There are approximately four acres of a class IV RHCA which are inside of units proposed for noncommercial thinning in the Upper Beaver EIS (2010). The amount of treatment proposed in the Upper Beaver EIS is small, and given the project design features, there are no anticipated additional effects to RHCAs which would meaningfully change this analysis.

The Deschutes and Ochoco Invasive Plant EIS (2011) proposes to treat 33.5 acres of weeds in RHCAs within the project area. These weed sites are in RHCAs located primarily along Wolf Creek, its upper tributaries, and East Wolf Creek. In addition to these acres, the EIS enables the Forest to chemically treat any new infestations under the early detection rapid response process which will greatly help reduce the rate of spread into newly disturbed ground as a result of the proposed activities in the Wolf planning area. Weed treatments would improve riparian vegetation short and long-term. These activities coupled with implementation of the project treatments may contribute to impacts to riparian vegetation in the short-term, but will not likely contribute to long-term negative impacts to riparian vegetation.

As described above, a minimal amount of disturbance to riparian vegetation may result from present and future project activities. Under Alternatives 2 and 3, this project could add cumulatively to these impacts; however, the project duration is short term and of a relatively small area within RHCAs, limiting any potential cumulative effects. In the long-term (>10 years), it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities including closure/decommissioning of roads and riparian restoration activities. Riparian restoration activities would have limited short-term effects to riparian vegetation but substantial long-term benefits.

Alternative 3 would be more impactful short-term to riparian vegetation but more beneficial long-term because of the additional ripairan restoration work.

Measure 4 – Aquatic Habitat

Large Woody Debris

Vegetation management: Commercial harvest in Alternative 2 and 3 is proposed in portions of 88 units[3] totaling 589 acres within RHCAs. As described in Measure 3, Alternative 2 proposes approximately 860 acres (22% of RHCAs in the project area) of silvicultural activities within RHCAs (includes CT, NCT and Non-commercial hardwood thinning). The proposal for Alternative 3 is the same but would add an additional 15 acres of non-commercial hardwood thinning*. RHCA treatments were developed with an IDT (interdisciplinary team) with the goal of improving RMOs and reducing risk from uncharacteristic wildfire. The treatments described in table 14 (PDF) were designed to protect RHCAs while carefully managing to attain RMOs. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs; site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be protected.

As described in the Silviculture report, commercial harvest of conifers is combined with NCT and underburning to promote the attainment of Forest Service standards and guides for forest and stream health. When combined with NCT, commercial harvest[4] can lead to increased conifer tree growth which would increase future recruitment of large woody material. Commercial harvest and associated treatments would also benefit riparian-associated trees along streams, meadows and wetlands. Commercial harvest in RHCAs would reduce competition among conifers by thinning overstocked, live trees, which would lead to increased growth rates of the trees that remain. The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term, but would increase the likelihood of a long term supply of large trees. Trees that remain would contribute to stream LWD over the long-term (present-100 years) as they mature to greater size, die and blow/fall over into the stream.

As described in the existing condition discussion, the project area is depauperate of in-stream LWD. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH LWD RMO – see below. In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. Potential tree heights in the project area range from about 150 feet in the more productive lower reaches of Wolf Creek to approximately 75 to 100 feet in some of the upstream ponderosa pine sites. Within the driest pine and juniper zones potential tree heights are limited to 75 feet or less. For purposes of this analysis, the LWD recruitment zone is defined as up to 150 feet of stream channels (>1 site potential tree height); this zone protects the primary LWD recruitment zone which maintains approximately 90% of LWD recruitment (USDA 2010/GTR-231). In many class I & II RHCAs, treatments were designed to occur in the outer-most zone (150-300 feet) of the RHCA, e.g., upslope of a road.

Thinning prescriptions also include maintaining skips, gaps, and clumps that would maintain natural rates of LWD recruitment in portions of treated areas; skips, gaps and clumps are estimated to be 5-10% of each unit – see Silviculture report. Other leave areas include protections for sensitive plants and archaeological sites. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width, primarily to protect the primary shading zone – see Measure 2 above. These widths

[3] Units with >1 acre of proposed activity.
[4] Reference PDF (Silvicultural activities in RHCAs)

encompass roughly one third to one half of the entire potential wood recruitment zone (see unit specific project design features). However, due to application of PDC 'shade setbacks'(see measure 2) this would only apply to trees between 50 and 100 feet because PDC limit harvesting trees greater than 9" within 50 feet of stream channels (class I-III). In class IV streams, harvesting of trees may be reduced relative to class I-III streams because PDC are less restrictive. Additional PDF include felling of snags (if determined to be a hazard during implementation) towards stream channels that may facilitate LWD recruitment.

In all RHCA units where treatments are proposed within the primary LWD recruitment zone (150 ft.), trees would be felled or pushed over to meet the minimum INFISH RMO. For purposes of this analysis, it is assumed all project area streams are deficient in LWD. The amount of individual tree recruitment would vary by unit as determined by the distance of stream within the unit. For example, a unit that encompasses 0.25 miles of stream would require 5 trees to be felled/pushed to meet the PDF. Approximately 84 trees would be felled/pushed into primary fish and frog habitat (class I-III streams) in Alternative's 2 and 3 (see table 165). While it is recognized that reference conditions for LWD in project area streams is higher than the INFISH standard (as determined by watershed analysis), the active recruitment of trees to meet the INFISH standard combined with the existing LWD present in streams, would move the RMO towards the DFC or reference standard as described in the WA. Additionally, INFISH recognized that in many cases interim RMO would not be met instantaneously, but would be achieved over time (INFISH A-2). Table 165 displays the amount of LWD to be added to streams as result of unit by unit PDF for the project area.

Table 163. LWD by stream class per PDF in Alternatives 2 and 3.

RHCA treatment units	Stream Class	# of trees >12" dbh
	Class I	N/A
	Class II	39
	Class III	45
	Class IV	188
Total	**All streams**	**272**

In most cases, standing trees would be recruited from 25-75 feet from the edge of streams to function effectively as in–stream LWD while protecting bank stability. Trees recruited for LWD would be of appropriate size for the stream channel. Trees of variable species, heights and dbh would be recruited, generally, larger streams i.e., mainstem Wolf Creek would require larger trees to function effectively as LWD, while small tributaries would require smaller trees. Large wood strongly influences channel form in small streams, creating pools and waterfalls and affecting channel width and depth (Montgomery and others 2003).

The presence of LWD in streams affects erosion, transport and deposition of sediment, the creation of growth and gravel bars and channel and floodplain sedimentation (Montgomery and others 2003). Dams formed by accumulations of LWD increase channel complexity and facilitate deposition of organic matter, thus providing a food source for numerous invertebrate species and contributing to nutrient cycling and retention (Bilby and Bisson 1998; Wondzell and Bisson 2003; Montgomery and others 2003. All trees would be >12" dbh to meet the criteria for LWD in INFISH. As a general rule, pushing or tipping trees would be favorable to felling trees as whole trees with rootwads attached are more effective in achieving project objectives e.g., sort and store bedload, including fines, pool formation and as fish habitat.

There would be no reduction in the amount of LWD as a result of proposed thinning activities in RHCA due to application of INFISH RHCAs and PDF. Proposed riparian restoration activities would provide additional LWD inputs – see below.

Rx burning and fuels treatments: Prescribed fire (1,122 acres) and non-commercial thinning (337 acres) treatments are designed to reduce smaller fuels within RHCAs, reduce stocking of conifer seedlings, and rejuvenate grass and shrub cover. Prescribed fire, commercial and non-commercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA. Reducing fuels protects large wood on the ground and standing trees for future large wood recruitment needed for fish habitat and riparian function. While some LWD may be consumed, fire would be expected to kill some standing trees that over time would be recruited as LWD in to streams. Reducing competition would promote the growth of residual trees that would be future large woody debris. LWD creates slow water habitats, side-channels, and off-channel alcoves critical for fish rearing and amphibian breeding. With more pool habitat, water temperatures can decrease (due to reduction of surface area compared to riffles) and more complex habitat is created for fish and frogs. Redband trout, like many other salmonids have evolved in stream systems in which large woody material helps retain organic and inorganic particulate matter that is important for channel stability, biological diversity and productivity (Nakamura and Swanson 1993). Additionally, humidity created by the increase in cover (e.g. LWD, hardwoods, and riparian forbs) and the increase in pool numbers would improve habitat conditions for frogs.

PDFs have been developed to maintain RMO including protection of in-stream LWD and to maintain future recruitments. The application of prescribed fire would be consistent with the Programmatic BA that includes the following PDF: underburning would occur within the RHCA but outside the riparian vegetation. Ignition of burns would occur outside of RHCA, but could be allowed to creep into riparian vegetation, Ignition of burns would occur outside of RHCA (except hand piles), and no fireline construction in the RHCA. Additionally, PDF includes site specific treatments for noncommercial thinning that includes felling trees up to 16” to provide for LWD – these typically occur adjacent small streams. General PDFs also include felling trees up to 12” and in some cases up to 15” (hardwood stands) towards stream channels; NCT would generally increase the recruitment of small woody debris to edges of stream channels. Perhaps more importantly, thinning debris would protect streambanks and riparian plants by increasing streambank roughness and reducing livestock access – see streambank condition below.

As described above and in subsequent measures, fire can have a wide range of effects on aquatic ecosystems ranging from minor to severe (Reiman et al. 2003); prescribed burns would be planned for spring and fall when fuel moisture and relative humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire. Potential effects from low to moderate intensity prescribed fire in riparian areas include minor short term (<1 year) reductions in large woody debris recruitment. However, in some cases, large woody debris levels would increase due to prescribed fire (Chan 1998). Local monitoring conducted on the ONF revealed similar results (reference Fuels report).

Roads and stream crossings: Temporary road construction and re-use of existing temporary roads within RHCAs (0.2 miles), re-use of closed roads (3.2 miles) could affect LWD recruitment (short and long-term >150 years) by limiting recruitment from these areas via vegetative disturbance, i.e., road clearing and improvement. However, when considering that vegetation on closed roads is typically small in size due to the age of past road construction (20-50 years old) and subsequent regeneration, most of the trees would not be of sufficient size to be recruited as LWD >12” dbh. Potential effects from construction of temporary roads on LWD recruitment would be limited by the scope and scale of proposed activities: <2 acres within RHCA, less acres within LWD recruitment zone. Therefore, LWD recruitment is not anticipated to be measurably affected via road construction

and utilization. In regards to stream crossings, LWD could be increased incrementally short-term if crossings need to be improved and displaced trees would be used upon rehabilitation of crossings. PDF state LWD would be incorporated, where possible, into the rehabilitation of the disturbed areas.

Riparian Restoration and Enhancement Activities: Alternative 3 increases the amount of LWD inputs in streams above Alternative 2 by increasing the amount of restoration of streams and floodplains and ultimately water tables by 1.2 miles, including an additional headcut repair, a culvert replacement and an additional 15 acres of non-commercial hardwood thinning. These activities would increase the amount of LWD added to streams, improve fish habitat and ultimately the functionality of stream and riparian ecosystems. Short and long-term, Alternative 3 would be more beneficial because of the increased amount of proposed restoration activities; Alternative 2 would add approximately 185 pieces of LWD, while Alternative 3 would add approximately 335.

In summary, through application of PDFs, and the effects described above, effects to LWD and long-term recruitment would be beneficial short and long-term. There may be a short and long-term increase as some thinned material (small (<6" dbh) and medium (12-15"dbh) size classes) is recruited to the stream including areas where standards are not currently met from NCT thinning. Underburning may cause minor reductions (PDF limit to <20% loss) in LWD (short-term) but would be off-set with an increase due to recruitment of fire killed trees and windthrow (including thinning) over time (short and long-term). Long-term (duration of avg. fire return interval) fire resiliency would be increased in all treatment areas. Active management (commercial treatments, NCT and riparian restoration) in RHCAs as proposed in Alternatives 2 & 3 would increase the amount of LWD and maintain LWD recruitment substantially over the Alternative 1. Alternatives 2 & 3 would reduce risks of reducing LWD recruitment and existing in-stream LWD from impacts to uncharacteristic wildfire and impacts from climate change – thereby providing more resilient aquatic habitats over the no action alternative. The proposed action would move the measure towards the desired future condition as described in the WA.

Pool Frequency/Pool Quality

Vegetation management, Rx fire and roads and stream crossings: As described in the existing condition section, pool densities are low in project area streams due to increased W/D ratios, sedimentation from accelerated bank erosion and lack of LWD. As described above, elevated sediment delivery reduces the quality and volume of pools and impedes pool development via several mechanisms. Fine sediment tends to be deposited and sequestered in pools during low flows, reducing pool volume and quality (Buffington et al., 2002). The loss of pool depth from sedimentation has been shown to be correlated with increased levels of fine sediment in streams caused by increased sediment delivery (Appeaser, 2002). Increased sediment delivery increases stream width and decreases stream depth in depositional reaches (Dose and Roper, 1994), which is also associated with reduced pool dimensions (Buffington et al., 2002). The loss of pool volume and quality can negatively affect native salmonids. Pools provide multiple habitat functions and are an essential habitat feature of native salmonids at a variety of life stages (McIntosh et al., 2000). Furthermore, studies have repeatedly shown that salmonid production is positively correlated with pool quality, volume, and frequency (Meehan, 1991; McIntosh et al., 2000).

The extent to which hillslope and riparian soils would be disturbed and mobilized to the stream channel would potentially reduce pool habitats (McIntosh and others 1994, 2000). As described in Measure 2, RHCA treatments would not be anticipated to negatively affect pool frequency or quality due to the buffer zones and no treatment areas (PDF) and limited scope of activities - < 15% of RHCA within project area. Residual slash and the unharvested areas are expected to filter loosened sediment before it reaches the streams. Sediment transport as a result of implementing vegetation treatments including Rx burning, would be filtered through vegetation along the streambanks and throughout the RHCAs during overland flows due to the limited scope of treatments and their

proximity to streams (reference Hydrologist report). For areas outside of RHCAs, analysis conducted in the Hydrologist report indicates that Alternative 2 and 3 could potentially elevate sediment delivery above background during project implementation. However, with application of PDFs and BMPs, fine sediment inputs are expected to be minor and likely negligible (reference Hydrologist report). Prescribed burning would be implemented over approximately 10 years and in different seasons resulting in reduced potential for sedimentation; reference Measure 2. In addition, LWD additions as described in the site specific PDF would increase pool quantity and quality as described below. Reconstruction of roads within RHCAs and potential sediment delivery zone (PSDZ) would improve drainage and reduce sedimentation from the existing condition via installation of temporary culverts and/or armored drainage dips. Some of the road reconstruction or improvements would occur at stream crossings; reference Measure 2.

Riparian Restoration and Enhancement Activities: Alternative 3 increases the amount of LWD inputs in streams above Alternative 2 by increasing the amount of restoration to streams by 1.2 miles, includes an additional headcut repair (six total), a culvert replacement and an additional 15 acres of non-commercial hardwood thinning. These activities would increase the amount of LWD added to streams, which would in turn increase the amount and quality of pools thereby improving fish and frog habitat short and long-term. Many species use pools formed by large wood as habitat and in-stream wood for cover (Bilby and Bission 1998; Wondzell and Bisson 2003). Short and long-term, Alternative 3 would be more beneficial because of the increased amount of proposed restoration activities.

In summary, minor, short-term (<2 years/project implementation period) impacts to pool frequency and quality could occur in streams across the project area from elevated sediment delivery during project implementation but effects would likely be negligible and immeasurable; reference Measure 2. Pool frequency and quality would be expected to *increase* in the short and long-term due to restoration work and PDFs. After completion of the project, pool frequency and quality would improve as as sediment levels are reduced below the exisitng condition (pre-project) from closure and decommissioning of roads in RHCAs. Reducing the density of conifers within the RHCAs would likely lead to an increase in density of riparian species that can reduce sediment transport and create additional refuge for fish, thus improving quality and the quantity of pool habitat for aquatic species. In addition, long-term (3-100+ years), pool frequency and quality would increase due to large trees falling into the channel, capturing sediment and developing pool habitat. The proposed action would move the measure towards the desired future conditon as described in the WA.

Active management (commercial treatments, PCT and riparian restoration) in RHCAs as proposed in Alternatives 2 & 3 would increase the amount of LWD and maintain LWD recruitment and ultimately pool quantity and quality substantially over the no action alternatives. Alternatives 2 & 3 would reduce risks of reducing LWD recruitment and existing in-stream LWD from impacts to uncharacteristic wildfire and impacts from climate change – thereby providing more resilient aquatic habitats over the no action alternative. The proposed action would move the measure towards the desired future condition as described in the WA.

Streambank Condition *(% stream bank stability, channel width to depth ratio)*

Vegetation management: The proposed treatments inside RHCAs and across the project area would not be expected to measurably affect streambank stability and channel width-to-depth ratios. In RHCAs, treatments would not affect bank stability or channel width-to-depth ratios because of the limited scope of activities and proximity to streambanks. PDFs stipulate that all logging equipment and off road vehicles would be kept to a minimum of 50 feet, typically 75 to 100’ away from stream banks on class I, II and III streams and generally 25 feet from the banks on low gradient class IV streams and 50 ft. on steeper streams (>10% slope). In some cases, equipment would be permitted to be within 5 feet of class IV’s. In a few cases it was determined that 5 feet would be an effective buffer

to maintain bank stability on an intermittent stream channel less than 5 feet wide, with zero to less than 5% slope and sparse conifer vegetation .

Bank stability would increase due to denser stands of hardwoods and other riparian plants along the stream channel once the conifer canopy is reduced. With an increase in hardwoods and other riparian plants (over the next 5-15 years), the width-to-depth ratio would decrease as the channels narrowed (over the next 10-20 years) due to sediment being captured by the reestablishing riparian plants and other woody debris. PDFs include felling/tipping trees to minimize the effects of limited timber harvest from large wood recruitment zones; trees would be recruited from 25-75 ft. away from streambanks. These additional trees would facilitate bank stability and decrease w/d ratios overall short and long-term. Non-commercial thinning would not cause soil or bank disturbance.

Elevated sediment delivery to streams can also degrade channel form, i.e., width-to-depth ratios; increased sediment delivery increases stream width and decreases stream depth in depositional reaches (Richards, 1982; Dose and Roper, 1994). Both width and depth can respond rapidly to changes in sediment load and/or discharge. Whether a stream erodes downward or outward is influenced by both local shear stresses and whether the bed or banks are the most easily eroded. As described in Measure 2, potential, (short-term) effects from elevated sediment delivery and increase in peak flows may occur but would be not be expected to affect width to depth ratios in the project area.

Roads and stream crossings: In class I, II and III streams, mechanized equipment would be limited to existing disturbance, only existing skid trails, crossings and landings are allowed between 50 and 100 feet from stream channels. In class IV streams, there would be a short-term reduction in bank stability at stream crossings associated with project activities (reference Measure 2) but effects would be minimized by placing temporary culverts or armoring crossings and restoring banks through planting, seeding and placing LWD to reestablish banks and narrow the stream channel.

Rx burning: Impacts from prescribed fire activities are not expected to impact bank stability (or w/d ratios) due to application of PDFs.

Riparian Restoration and Enhancement Activities: Alternative 3 increases the amount of riparian restoration activities in streams above Alternative 2. Restoration activities would improve bank stability and w/d ratios directly via channel reconstruction and restoration, headcut repair, culvert replacement and additional thinning. Additionally, thinning debris from NCT activities would reduce pressure on banks, improve site conditions for riparian vegetation and facilitate reductions in w/d ratios. Minor impacts would occur short-term from implementation of these activities but short and long-term benefits would be provided.

In summary, minor, short-term impacts may occur to bank stability at stream crossings and during implementation of riparian restoration projects. Additionally, potential short-term impacts via elevated sediment delivery and, to a lesser extent, higher peak flows during project implementation. Similarly, small, incremental changes to w/d ratios in localized areas may occur during project implementation but would not likely be measurable. Long-term improvements (post implementation) to bank stability and width-to-depth ratios would occur overtime as crossings are rehabilitated, improvement of riparian vegetative condition, roads are closed and rehabilitated, peak flows and potential elevated sediment delivery reduces to below background levels, LWD is recruited and channels narrow and riparian restoration activities are implemented. The proposed action would move the measure towards the desired future condition as described in the WA.

Reconstruction of roads within RHCAs and potential sediment delivery zone (PSDZ) would improve drainage and reduce sedimentation from the existing condition via installation of temporary culverts and/or armored drainage dips. Some of the road reconstruction or improvements would occur at stream crossings; reference Measure 2.

Alternative 2 and 3 would be consistent with the Programmatic BA, and applicable INFISH and ONFLRMP standards and guidelines and proposed Forest Plan Amendment. BMPs and PDFs developed for the project area would provide protection to aquatic habitat parameters and improve habitat conditions for fish and frogs.

Cumulative Effects (Aquatic Habitat)

The area of analysis for cumulative effects to aquatic habitat is the project area.

Large Woody Debris

Projects with the potential to affect LWD recruitment and in-channel LWD include the Deschutes and Ochoco Travel Management EIS (2011), the Ochoco Summit Trail project, ongoing recreation and the district firewood program. Implementation of Alternatives 2 and 3 would allow for increased growth rates of large trees that are within the area of recruitment of LWD to streams (up to 150 feet) and additions from tree felling/pushing (approximately 272 trees) [table 165] as outlined in PDF which would help attain the RMO for LWD in the future.

There are several dispersed camping sites located along streams throughout the project area that are used during the spring, summer and fall months. Incidental manipulations to aquatic habitat or factors that may impact aquatic habitat may occur at these sites. Manipulations of streamside vegetation and bank trampling can result in changes to fish habitat. The ONF Firewood Program prohibits firewood cutting within 150 ft. of streams, springs, ponds, wet areas or floodplains. This restriction adequately protects the primary LWD recruitment zone (up to 150') which maintains approximately 90% of LWD recruitment. The amount of class IV (intermittent) stream channels adequately protected by the restriction is unknown. Additionally, illegal firewood cutting has likely, reduced LWD recruitment within the project area and has occasionally removed in-channel LWD across the planning area (personal observation). These activities coupled with implementation of the project treatments may impact aquatic habitat parameters, but the limited size and scope of impacts will not likely contribute to any measurable impacts short and long-term.

Projects that may *improve* LWD recruitment include implementation of the Travel Mangement EIS (2011) and the Deschutes Ochoco Invasive Weed EIS (2012). Implementation of the Ochoco Travel EIS would restrict access to designated open roads, decreasing access and impacts to streams, and possibly reduce illegal wood cutting. Implementation of the Invasive Plant EIS would improve all aquatic habitat parameters by increasing the amount of native riparian vegetation that would serve to increase bank stability, LWD recruitment (hardwoods) and pool creation, narrow stream channels, and reduce sediment delivery through stabilization of disturbed/denuded areas. Combined with the management actions proposed in the Wolf project, like the felling of trees, it is anticipated there would be a beneficial cumulative effect.

Still, the project could add cumulatively to decreasing LWD (minor amounts) in the short-term from application of prescribed fire, along 1,122 acres of RHCAs. However, impacts would be relatively minor when considering scope of the project area, timing of implementation and distribution of activities across the watershed. These potential impacts would be off-set by short and long-term recruitment from prescribed fire, riparian thinning PDF and from implementation of riparian restoration activities.

Pools and Streambank Condition

Similar to Measure 2, the Ochoco Summit Trail project could potentially affect pool quantity and quality and streambank condition via sediment delivery at numerous stream crossings but impacts would be minimized by overall project design (avoidance of sensitive areas including fish bearing streams), including armored crossings, use bridges, etc. Livestock grazing under the Southside Allotments EA (2009) has the potential to add cumulatively to reductions in pool quantity and quality

and w/d ratios via localized fine sediment delivery and bank alteration. However, grazing conditions are expected to incrementally improve from changes in management activities due to Southside AMP EA initiated in 2010. As discussed under effects to LWD, dispersed recreation activities have the potential to negatively impact pool quantity and quality and streambank condition from manipulations of streamside vegetation and bank trampling. Illegal firewood cutting can reduce the amount of LWD and retard pool formation.

Projects that may improve pool frequency and quality and streambank condition include implementation of the Ochoco Travel Management EIS (2011) and the Deschutes and Ochoco Invasive Weed EIS (2012). Implementation of the Ochoco Travel EIS restricts access to designated open roads, decreasing access and impacts to streams, reduce the spread of noxious weeds and possibly reduce illegal wood cutting. Implementation of the Invasive Plant EIS incrementally improves bank stability, pool creation and narrow stream channels (reduce w/d ratios) through recovery of native vegetation and stabilization of disturbed/denuded areas.

Still, this alternative may add cumulatively to increasing, minor, short-term impacts to pool frequency and quality from elevated sediment delivery during project implementation and impacts to streambank condition. However, impacts would be relatively minor when considering the scope of the project area, duration of implementation (up to 10 years), and distribution of activities across the watershed. Long-term (post project completion), pool frequency and quality and streambank condition would improve as sediment levels are reduced below the existing condition (pre-project) from closure and rehabilitation of roads in RHCAs. LWD is expected to narrow stream channels over time, thus incrementally reducing w/d ratios and potentially increasing bank stability. Peak flows and potential elevated sediment delivery reduces to below background levels, and LWD is recruited and channels narrow therefore reducing impacts to streambank stability and width-to-depth ratios short and long-term (5-100 years). In addition, potential negative impacts would be off-set by short and long-term recruitment of LWD from thinning (NCT) hardwood stands, prescribed fire, riparian restoration, and Ochoco TMR but somewhat diminished from illegal firewood cutting activities. The proposed action would move the measure towards the desired future condition as described in the WA.

Alternative 4

Measure 1: Effects to individuals and sub-populations of fish and frogs

Effects would be similar to Alternatives 2 and 3 except that there would be a reduced potential of impacts to fish and frogs because there would be no commercial vegetation treatments and associated roads, skid trails and stream crossings in RHCAs. Specifically, there would be a less risk to impacting frogs because no vegetation treatments would occur near primary habitats. Mortality of frogs may still occur on haul routes and stream crossings when adult frogs are traveling to new feeding/breeding locations and are driven over by vehicles and logging equipment but at a reduced rate because there would be fewer crossings over closed roads and skid trails commensurate with the reduction in commercial harvest in RHCA.

Riparian restoration activities are the same as Alternative 3 but would be more than Alternative 2. Short-term risks to injury and death of fish and frogs would remain from implementation of in-stream restoration. However, short (post-implementation) and long-term benefits to fish and frogs from implementation of these activities would occur as habitat conditions improve substantially over the current condition. Fish and frog populations would be more exposed to impacts from wildfire, fire suppression and climate change than compared to Alternatives 1 -3, but riparian restoration activities would still reduce risk to fish and frogs from wildfire and climate change because of improved habitat and connectivity between populations.

Alternative 4 would be consistent with the applicable INFISH and ONFLRMP standards and guidelines (Appendix A). BMPs and PDF developed for the project area would provide protection and avoidance of fish and frog and their habitats.

Cumulative Effects

Effects would be similar to Alternatives 2 and 3. A minimal number of mortalities of Columbia spotted frog (CSF) could result from project activities. Under Alternative 4, this project could add cumulatively to these incidental deaths; but those risks would be less than Alternative 2 and 3 but more than the no action alternative.

Measure 2-Water Quality and Quantity

Water Quantity

Effects would be similar to Alternatives 2 and 3. In Alternative 4, the potential effects of impacts to fish and frogs from increased peak flows would be reduced over Alternatives 2 and 3 because there would be no commercial vegetation treatments and less road construction/utilization skid trails and stream crossings project wide and within in RHCAs. The slight increases in NCT and Rx burning would not be expected to have a measurable affect over Alternatives 2 and 3. The increased amount of riparian restoration in Alternative 4 would have further beneficial effects over Alternative 2. The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the no action alternative, but less than would be accomplished by Alternatives 2 and 3 thus decreasing the potential for changes in peak/base flows or water yield as a result of uncharacteristic wildfires, although changes would be limited.

Water Quality – Sediment & Turbidity

Effects would be similar to Alternatives 2 and 3. In Alternative 4, the potential effects of impacts to fish and frogs and their habitats from increased sediment yield would be reduced over Alternatives 2 and 3 because there would be no commercial vegetation treatments and less road construction/utilization skid trails and stream crossings within in RHCAs and throughout the project area. Analysis conducted in the Hydrologist report illustrates the combined overall potential maximum sediment delivery to be 21 tons during implementation, or a 53% increase above the existing condition annual rate. The slight increases in Rx burning would not be expected to have a measurable affect over Alternatives 2 and 3. Post implementation (>5-10 years) potential sediment delivery is expected to be reduced to approximately 9.6 tons, or a decrease of 30% below that of the existing condition – see Hydrologist report. The increased amount of riparian restoration in Alternative 4 would have further beneficial effects over Alternative 2. The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the no action alternative, but slightly more than Alternatives 2 and 3 thus decreasing the potential for increases in sediment delivery as a result of uncharacteristic wildfires, although changes would be limited. The proposed action would move the measure towards the desired future condition as described in the Wolf WA.

Stream Shade and Temperature

Effects would be similar to Alternatives 2 and 3. In Alternative 4, the potential effects to fish and frogs from reduced shade and increased temperatures would be reduced over Alternatives 2 and 3 short-term because there would be no commercial vegetation treatments, within in RHCAs. Long-term, Alternative 4 would be less beneficial to increasing shade and reducing temperature because RHCA stand conditions would continue to depress hardwoods, stands would remain at risk to insect and disease and uncharacteristic wildfire. Similarly Alternative 4 would be more beneficial short and long-term than Alternative 2 because there would be less riparian restoration. The potential for severity of fire effects as manifested by decreased riparian vegetation is decreased over that of the no

action alternative, but slightly more than Alternatives 2 and 3 thus decreasing the potential for reductions in shade and increases in temperature as a result of uncharacteristic wildfires, although changes would be limited. The proposed action would move the measure towards the desired future condition as described in the Wolf WA.

Alternative 4 would be consistent with the applicable INFISH and ONFLRMP standards and guidelines. BMPs and PDF developed for the project area would provide protection and avoidance of sensitive areas.

Cumulative Effects

Effects would be similar to Alternatives 2 and 3. Minor increases in peak flows and water yield, sediment delivery and very small impacts to shade could result from present and foreseeable future projects (see cumulative effects discussion in Alternatives 2 and 3), but would likely be minimized by PDFs and BMPs. Still, Alternative 4 could add cumulatively to these effects; but potential impacts to water quantity and quality would be less than Alternative 2 and 3 but more than the no action alternative. The increased amount of riparian restoration in Alternative 4 would have more potential beneficial effects to water quality and quantity over Alternative 2.

Measure 3 -Riparian Vegetation

Effects would be similar to Alternatives 2 and 3. In Alternative 4, the potential effects from riparian vegetation would be decreased over Alternatives 2 and 3 short-term because there would be no commercial vegetation treatments within in RHCAs. The slight increases in Rx burning and NCT within RHCAs would not be expected to have a measurable effect over Alternatives 2 and 3 but would compliment long-term benefits to increasing landscape resiliency. Long-term, Alternative 4 would be less beneficial to improving riparian vegetation because RHCAs would continue to be at risk from insect and disease and uncharacteristic wildfire, and depressed hardwood vegetation would be maintained. Similarly, Alternative 4 would be more beneficial short and long-term than Alternative 2 because there would be more riparian restoration. The potential for severity of fire effects is decreased over that of the no action alternative, but slightly more than Alternatives 2 and 3 thus decreasing the potential for negative impacts to riparian vegetation and riparian areas as a result of uncharacteristic wildfires. The proposed action would move the measure towards the desired future condition as described in the Wolf WA.

Alternative 2 and 3 would be consistent with the applicable INFISH and ONFLRMP standards and guidelines and the Forest Plan Amendment (RMO). BMPs and PDFs developed for the project area would provide protection and avoidance of sensitive areas within RHCAs.

Table 164. Acres of Silvicultural treatment by RHCA Class – Alternative 4.

	Stream Class			
	1	**2**	**3**	**4**
Commercial harvest with noncommercial thinning	0	0	0	0
Noncommercial thinning outside of harvest units*	41	223	65	34

*Noncommercial thinning also includes juniper cutting.

Cumulative effects

Similar to Alternatives 2 & 3, a minimal amount of disturbance to riparian vegetation may result from project activities. Under Alternatives 4, this project could add cumulatively to these impacts; however, the project duration is short term and of a relatively small area within RHCAs, limiting any potential cumulative effects. In the long-term (>10 years), it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities including closure/decommissioning of roads and riparian restoration activities. Riparian restoration activities would have limited short-term effects to riparian vegetation but substantial long-term benefits. Alternative 4 would be more impactful short-term to riparian vegetation but more beneficial long-term because of the additional ripairan restoration work.

Measure 4-Aquatic Habitat

Effects would be similar to Alternatives 2 and 3. In Alternative 4, the short-term potential for alteration to aquatic habitats would be decreased over Alternatives 2 and 3 because there would be no commercial vegetation treatments within in RHCAs. The slight increases in Rx burning and NCT within RHCAs would not be expected to have a measurable affect over Alternatives 2 and 3 but would provide for incremental increases in large tree recruitment over time, hardwood stand improvement and small woody debris felling towards streams. Alternative 4 would be less beneficial to improving aquatic habitat short and long-term because RHCAs would continue to be at risk from insect and disease and uncharacteristic wildfire, and depressed hardwood vegetation would be maintained. Alternative 4 would be more beneficial short and long-term than Alternative 2 because there would be more riparian restoration. The potential for severity of fire effects is decreased over that of the no action alternative, but slightly more than Alternatives 2 and 3 thus increasing the potential for negative impacts to riparian areas and aquatic habitat parameters as a result of uncharacteristic wildfires. Similarly, aquatic habitat would be less resilient long-term because no RHCA treatments and subsequent tree felling/tipping would occur to improve habitat and buffer against potential effects from climate change. The proposed action would move the measure towards the desired future condition as described in the Wolf WA.

Alternative 4 would be consistent with the applicable INFISH and ONFLRMP standards and guidelines. BMPs and PDF developed for the project area would provide protection and avoidance of aquatic habitat within RHCAs.

Cumulative Effects

Similar to Alternatives 2 & 3, a minimal amount of disturbance to aquatic habitat parameters may result from present and foreseeable actions (see above cumualitve effects discussion) . Under Alternative 4, this project could add cumulatively to these impacts; however, the project duration is short term and of a relatively small area within RHCAs, limiting any potential cumulative effects. In the long-term (>10 years), it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities including closure/decommissioning of roads and riparian restoration activities. Riparian restoration activities would have limited short-term effects to aquatic habitat paramters e.g., bank stability but substantial long-term benefits to all parameters. Alternative 4 would be more beneficial short and long-term than Alternative 2 because there would be more riparian restoration.

Aquatic Species Determination Summary

Summary of Determinations

Redband trout & Columbia spotted frog

Alternative 1

- Determination for Alternative 1 is **NI, no impact** to redband trout as there are no proposed vegetative, fuels or road projects.
- Determination for Alternative 1 is **NI, no impact** to Columbia spotted frogs as there are no proposed vegetative, fuels or road projects.

Alternative 1 may not meet INFISH RMOs for riparian vegetation, water temperature, large wood, pool frequency, width depth ratios or stream bank stability as rapidly as the action alternatives because no commercial treatments would occur in RHCA including subsequent LWD additions, riparian restoration activities, road closure and decommissioning and culvert replacement.

Alternatives 2 & 3

- Determination for Alternatives 2 and 3 is MIIH, **may impact individuals or habitat of redband trout, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Application of PDFs and BMPs would substantially minimize detrimental effects to redband trout. Vegetation treatments would generally occur outside spawning periods (April to June) and riparian restoration would occur during the in-water work period (ODFW 2008) thereby reducing risks to sensitive species.
- Determination for Alternatives 2 and 3 is MIIH, **may impact individuals or habitat of Columbia spotted frog, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Application of PDFs and BMPs would substantially minimize detrimental effects to frogs. Treatments activities would occur outside breeding season (March 1 to May 1) within channel migration zone to reduce vulnerability of frogs to any possible effects. These dates are also within the in-water work period (ODFW 2008).

Alternative 4

- Determination for Alternative 4 is **MIIH, may impact individuals or habitat of redband trout, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Vegetation treatments would generally occur outside spawning periods (April to June) and riparian restoration would occur during the in-water work period (ODFW 2008) thereby reducing risks to sensitive species.
- Determination for Alternative 4 is **MIIH, may impact individuals or habitat of Columbia spotted frog, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Treatments activities would occur outside breeding season (March 1 to May 1) within channel migration zone to reduce vulnerability of frogs to any possible effects. These dates are also within the in-water work period (ODFW 2008).

Monitoring

Implementation monitoring would occur as directed by the ONFLRMP. BMP Implementation and Effectiveness monitoring would occur as described in the Hydrologist report. The ONFLRMP states "Evaluate monitoring results and mitigate where necessary to minimize impacts from activities where BMP's do not perform as expected (4-236). In addition, PIBO effectiveness monitoring would continue (every 5 years), COFMS (Central Oregon Fire Management Service) Riparian Fire Effects Monitoring on selected sites and Region 6 Level II stream surveys would be conducted (w/in 10-15 years).

Hydrology

This section summarizes the Hydrology report; information has been included almost verbatim, but some appendices were not included. The entire report and appendices are located in the Wolf project file, Prineville, Oregon.

Management Direction

Management of the Wolf Fuels and Vegetation Management Project, as it relates to hydrologic and riparian function, is directed by the Ochoco Land and Resource Management Plan (LRMP 1989), the Inland Native Fish Strategy (INFISH 1995), the Clean Water Act (1972) and Executive Orders 11988, 11990, and 12088. Additional scientific guidance and background information is available within the Wolf Creek Watershed Analysis Update (2012), the National Best Management Practices for Water Quality Management on National Forest System Lands (April 2012), the Joint Aquatic and Terrestrial Programmatic Biological Assessment (2010-2013) and the Watershed Condition Framework (WCF) process (2011).

Existing Condition

Characterization of the Planning Area

Watersheds

The project analysis area consists of the northern most parts of two 12th field subwatersheds, North Wolf and Wolf subwatersheds, within the Lower Beaver Creek 10th-Field watershed. Lower Beaver Creek watershed drains 81,362 acres of land including four 12th-field subwatersheds (see Table 167). Subwatersheds include North Wolf Creek, Wolf Creek, Alkali Creek, and Drift Canyon-Beaver Creek. The Lower Beaver Creek watershed drains from the north and from the south into Beaver Creek, which eventually flows into the Crooked River. These systems are all within the Beaver-South Fork Sub-basin, and the larger Deschutes River Basin.

Table 165. Watersheds Associated with the Planning Area

Fld	Area	Name	Hydrologic Unit Code	Area (ac.)	Stream Miles
2nd	Region	Pacific Northwest	17	-	-
4th	Sub-Region	Middle Columbia River	1707	-	-
6th	Basin	Deschutes River	170703	-	-
8th	Sub-Basin	Beaver-South Fork	17070303	-	-
10th	Watershed	Lower Beaver Creek	1707030309	81362	414
12th	Sub-Watershed	North Wolf Creek	170703030901	12394	57
12th	Sub-Watershed	Wolf Creek	170703030902	21505	97
12th	Sub-Watershed	Alkali Creek	170703030903	26714	138
12th	Sub-Watershed	Drift Canyon-Beaver Creek	170703030904	20749	122

The Wolf project area follows Lower Beaver Creek watershed boundary delineation in the north and the Forest boundary in the south. The analysis area is approximately 24,506 acres, ranging in elevation from approximately 4,100 feet in the south, to 5,840 feet in the north. The project area lies within the upper elevation boundary of the rain-on-snow zone (approx. 3,500-5,000 ft.).

Climate and Precipitation

The climate of the Lower Beaver Creek Watershed has evolved from a warm moist tropical regime (60 million years ago) to the temperate four distinct seasons of today. Most precipitation occurs between October and March in the form of snow. Precipitation in the summer months is dominated by convective thunderstorms resulting in short duration, high intensity storms, as well as dry lightning storms. Annual precipitation within the Wolf project area ranges from 14 inches at the lower

elevations to 27 inches at higher elevations. Winter precipitation usually occurs as snow. Precipitation levels are highly variable, both within and between years. Periods of drought and temperatures in excess of 90 degrees Fahrenheit are common during the summer months. Mean temperatures range from approximately 20-40 degrees Fahrenheit during the winter to 40-70 degrees during the rest of the year with the driest and hottest weather occurring during July and August.

Stream System/ Hydrologic Conditions

There are five named streams in this watershed: Wolf, North Wolf, East Wolf, Widow, and Miles Creeks, see table 168.

Table 166. Miles of Stream, by Class in the Analysis Area (2.87 miles are on private in-hold lands).

	Class I	Class II	Class III	Class IV	Totals
North Wolf Creek Subwatershed					40.34
North Wolf Creek		4.06		.02	4.08
Window Creek			2.36		2.36
Unnamed Creek(s)		9.0	3.52	21.37	33.89
Wolf Creek Subwatershed					64.91
East Wolf Creek		2.76			2.76
Miles Creek			1.95		1.95
Wolf Creek	5.58	2.32			7.90
Unnamed Creek(s)		24.43	3.15	24.73	52.31

Within this project area there are treatment units within RHCAs as described in table 14. It is important to note that approximately 30% of these units are on sections of stream that are dry during peak summer temperatures even though they are designated as perennial. Sometimes referred to as “interrupted”, it is the nature of the streams in the project area to have sections of seasonally dry streambed with perennial sections upstream and downstream from these sections. Since the extent of these dry sections is unknown, whole reaches are designated as perennial. Because these perennially interrupted (dry) sections of streams go dry before peak water temperatures occur in the watershed, similar to that of intermittent streams, they are often managed like intermittent streams.

Riparian Habitat Conservation Areas

In accordance with the Ochoco NF LRMP and INFISH (USFS 1995) all streams, wetlands and other water features in the Wolf project area have designated Riparian Habitat Conservation Areas (RHCA’s). The streams and RHCA’s in the project area were recently updated and reclassified for this project. Table 169 provides detail for each RHCA type within the project area. For purposes of these calculations, Drift Canyon-Beaver Creek subwatershed acres were not included.

Table 167. RHCA and Stream Class Information by Subwatershed

	North Wolf Creek Subwatershed			Wolf Creek Subwatershed			Total		
	8829.6	analysis acres		15659.3	analysis acres		24488.9	analysis acres	
RHCA Class	(RHCA acres)	(% of subwatershed analysis area)	(% of RHCA subwatershed analysis area)	(RHCA acres)	(% of subwatershed analysis area)	(% of RHCA subwatershed analysis area)	(RHCA acres)	(% of analysis area)	(% of RHCA analysis area)
Stream Class I	0	0%	0%	422.16	2.70%	18.12%	422.16	1.72%	11.00%
Stream Clas II	951.3	10.77%	63.10%	1121.74	7.16%	48.15%	2073.04	8.47%	54.02%
Stream Clas III	226.92	2.57%	15%	372.18	2.38%	15.97%	599.1	2.45%	15.61%
Stream Clas IV	322.18	4%	21%	363.1	2.32%	15.58%	685.28	2.80%	17.86%
Water Points	0.9	0.01%	0.06%	1.4	0.38%	0.06%	2.3	0.01%	0.06%
Wetlands	6.4	0.07%	0.42%	49.3	13.25%	2.12%	55.7	0.23%	1.45%
Total RHCA	**1507.70**	**17.08%**		**2329.88**	**14.88%**		**3837.58**	**15.67%**	

Stream Flow

Snowmelt is the principal source for run-off from the watershed. Elevated flows and groundwater recharge occur from February through May, with greatest runoff usually occurring in April. Stream flow during the summer months may be attributed almost entirely to groundwater discharge (baseflow). As summer groundwater levels decline, discharge from springs and seeps decrease and flow in low-ordered channels become intermittent. Stream losses to groundwater and evaporation become apparent in lower-elevation reaches. Flows vary annually.

There are no established United States Geological Survey (USGS) stream discharge gauging stations within the watershed. Historic flows from 1942 to 1954 were recorded on N.F. Beaver Creek; it is the closest to the analysis area. A combined review of the data indicates that flows generally followed a snowmelt hydrograph with a primary peak in March or April. However, the individual water years 1943, 1948, and 1954 more closely resembled a rain-on-snow hydrograph (meaning multiple peaks in flow). Within these years, multiple peak flows occurred from December through April. More recent flow data from Ochoco Creek, collected on the western side of the Forest also depicts a rain-on -snow hydrograph. These data also compares a wet and a dry year, which illustrates that flow can vary annually. North Fork Beaver Creek had peak flows ranging from 383 to 955 cubic feet per second (cfs) between 1942 to 1954. The average peak flow over the 12 years was 633 cfs. All the streams within the project area are tributaries to the main stem of Beaver Creek and flow at fractions of these amounts.

Base Flow

The monthly average base flows for the Lower Beaver Creek watershed are unknown. The extent of perennial (streams that flow year around) and intermittent streams are unknown.

Base flows related to detention storage capacity (the ability of soil to store and slowly release water) are important in providing cold-water discharge to streams during summer low-flow conditions when streams are typically warm. Detention storage capacity is particularly important in wet meadows and at spring sources. There are many known stream reaches within the watershed where entrenchment has occurred (downcutting) and water detention storage capacity has been reduced. Generally, storage capacity is reduced as the water table loses enough elevation that it comes in contact with a control point such as bedrock. Known downcutting has occurred in segments of creeks within the Wolf Creek and North Wolf Creek subwatersheds.

Water Yield

Annual water yield for the Wolf project area, measured in acre feet calculated from precipitation and area is estimated to be approximately 66% of the whole watershed. Most of the water yield originates from within the project area, even though the project area is only 31% of the whole and has only 24% of the stream miles. The project area is at a higher elevation and receives more precipitation than

evapotranspiration. A deficit occurs for most of the area outside the project boundary. This area is at lower elevation and receives less precipitation than evapotranspiration.

Peak Flow

Peak flows can be highly variable within the watershed but primary runoff typically occurs sometime between late-March and mid-May. In the summer months it is not uncommon for many of the streams on Forest Service Lands within the watershed to become interrupted, intermittent, or dry up.

Most high stream flows in the Lower Beaver watershed result from snowmelt sometimes in combination with direct rainfall. About 87 percent of the annual runoff occurs during the months of January through May. High intensity summer rainstorms are also common.

Anderson and Hobba (1959) found that when about 10% of a drainage was harvested, an increase in storm runoff could be detected. In a worldwide literature review, Hibbert (1965) determined that at least 20% of a drainage had to be deforested before a statistically significant increase in runoff could be detected. Hibbert attributed this to increased water use by the remaining trees and vegetation and with experimental errors associated with base line data. Research by Brown et al (1974), Rich and Thompson (1984), and Troendle and Leaf (1980) indicate that measurable changes in runoff occur when 20-30 percent of a drainage is in a cutover condition. Water quality, quantity & timing may all be affected. These changes may be negative and often are cumulative.

Water Rights

Private water rights currently exist on Wolf Creek. Irrigation withdrawal on Wolf Creek is approximately 10 acre/feet. For further water rights information in the Lower Beaver Creek Watershed contact the Ochoco National Forest Headquarters Special Uses Specialist or go to http://www.wrd.state.or.us.

Water Sources

Water sources that may be used during implementation are identified in the Ochoco National Forest Water Conservation Plan 1996. The Forest Water Conservation Plan (June, 1996) has been implemented to reduce impact on surface water sources. The water sources would be used for road construction, maintenance and fire needs. Morgan Well (D 2.2) and Sugar Creek (D2.4) are the water sources adjacent to the analysis area.

Morgan Well (D 2.2)is located on the northern edge of the analysis area (T 14 S, R 24 E, Sec. 29) is 426 feet deep with a static water level of 330 feet, estimated 15 gpm flow. The well location is on Road 4276-010. A pump has been installed and the pond constructed by modifying the abandoned material source. Drilled in Picture Gorge basalt, the water bearing zone is located between 380 and 420 feet. With modification, an inactive material source provided the pond for the well water. The pond has a capacity of 400,000 gallons. The well head has been installed and is ready for use. The Morgan well has been used for a variety of road reconstruction projects in the past 15 years. Maintenance will need to be done on both the well head and the pond bottom prior to use. With coordination, it could also be used for activities in the Lower Beaver Creek watershed.

Just outside the planning area is the Sugar Creek (D2.4) pumper chance, located in T 15 S, R 24 E, Section 26 SW 1/4 on Road 5810-100.

All of the water sources are available for use in the analysis area for activities proposed for the area, like road reconstruction and maintenance needs or fire suppression.

Analysis Background/Environmental Consequences

The primary factors that are assessed in this analysis are those hydrologic features that are directly and indirectly influenced by vegetation management and other activities outlined in the action

alternatives. The critical features that may be affected by vegetation manipulation are stream discharge characteristics (which may lead to changes in channel morphology), less vegetative interception and decreased evapotranspiration, increased overland flow due to soil compaction, sediment delivery to streams from ground disturbing activities and increases in stream temperature through the reduction of riparian shade. This analysis will be quantitative and qualitative and will describe effects and differences between alternatives in terms of relative magnitude and trend. The effects within this analysis are based on the completion of all design features outlined in Chapter 2 of the EIS.

The following paragraphs discuss the hydrologic parameters of peak flow, sediment delivery and stream temperature as they are affected by the proposed project. Table 170 displays the potential effects and the measurement indicator used to analyze the potential effect(s).

Table 168. Potential effects associated with the Wolf Project and the measurement parameter used to assess the degree of the effect.

Parameter	Potential Effects	Measure
Peak Flow	Increased Peak Flows from Timber Harvest and Fuels Treatment	Equivalent % of Forested Area Harvested (EHA)
Sediment Delivery (surrogate for Turbidity)	Sediment Delivery to Streams from Soil Disturbance by Proposed Vegetation Treatments and Road Activities	Sediment Yield % difference from the Existing Condition
Stream Temperature	Increased Stream Temperatures from Shade reduction by the Proposed Vegetation Treatments	Acres of RHCA within one site potential tree height (approximately 70') on Ochoco RHCA Class I-III streams

Peak Flow

Harvest treatments and associated activities have been shown to alter stream discharge conditions and overland flow conditions. Altered stream flow conditions are important to recognize as they can lead to changes in sediment input to streams and alteration of stream channel morphology (i.e. width to depth ratios, entrenchment, sinuosity, etc.).

Literature indicates that there may be a threshold around 20-30% of a watershed that can be "equivalently clearcut" before there is an effect on flow (J. Seymour 2008). Watershed thresholds can vary depending on a variety of physical attributes that include but are not limited to topography, elevation, soil type, and precipitation regime. The Ochoco LRMP (1989) established a 25% threshold of Equivalent Harvested Area (EHA) for the Lower Beaver watershed based on these physical attributes.

Sediment Delivery and Turbidity

Increased sediment delivery and turbidity in streams have been documented following vegetation manipulation and associated activities. Sediment effects from anthropogenic disturbance are primarily due to changes in the quantities and patterns of overland flow, and the increased mobility of soils due to ground disturbing activities. Studies of buffer effectiveness have shown varying results but have found that buffers of less than 200 feet wide were effective in controlling sediment delivery under most harvest and road building activities. Most of the studies found the highest risk of sediment delivery resulted from ground disturbing activities less than 30 to 10 meters (98.4-32.8 feet). (Broderson, 1973; Lynch et al., 1983; Clinnic, 1985; Rashin et al., 2006; Heade, 1990).

Overland flow is a naturally occurring process in portions of the planning area depending on factors of soils, topography, geology, antecedent moisture conditions, and the timing and magnitude of storm events. It is often an occurrence in scab stringer land type areas. The magnitude and frequency of overland flow can be increased in areas where infiltration rates have been reduced, such as compacted or frozen areas, or where there is increased snowpack from canopy removal. Overland flow can occur from a reduction in evapotranspiration due to timber harvest activities, some of which can and has resulted in elevated rates of sheet and rill erosion and sediment delivery. However, recent studies suggest that current forest harvest procedures and Best Management Practices are largely effective in reducing rilling and sediment delivery (Litschert 2009).

For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur. This zone was delineated to encompass the dominant sediment contributing area for the project area. This determination was based on field observations and professional judgment, and was supported by the findings from peer-reviewed literature and research.

The analysis focuses on the amount of sediment delivered from surface erosion and mass soil movement outside the stream channel dependent on existing and proposed ground disturbance, soil erodibility, slope, and distance to the stream. Because areas within 200 feet of the stream have largely been unaffected by management activities besides road building, existing condition levels of sediment from surface erosion was modeled using existing roads including those not used for the proposed activities or for haul.

Forest Plan standards for sediment and turbidity correspond with State of Oregon standards. There is no quantitative standard for sediment in the Oregon DEQ water quality rules. Narrative Criteria (section 340-041-0007-12) states that activities can not result in the formation of appreciable organic or inorganic deposits deleterious to fish or other aquatic life. Currently, there are no streams listed for sedimentation/turbidity on the Oregon 303(d) list within the analysis area.

State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. Turbidity is the degree to which suspended material in the water impedes light penetration and is expressed in Nephrometric Turbidity Units (NTUs). Because turbidity typically only fluctuates during storm or peak flow events, while it may affect beneficial uses such as domestic use, it is not an enduring condition that affects the longevity of individual aquatic organisms, or the viability of populations. Most measurable effects to aquatic life result from sediment instead of turbidity. For this reason, this analysis will focus on sediment. There are currently no streams in the project area on the Oregon 303(d) list of impaired waters for sediment or turbidity. However, current stream surveys have measured percent fines in some stream channels in the project area to be relatively high. Some streams in the watershed are inherently high in sediment due to local soil types and geology, but documented streambank instability, high embededness, and the occurrence of ground disturbing activities that have the potential to produce and deliver sediment, indicate that sediment levels are likely above historic values.

Stream Temperature

Three streams within the two sub-watersheds are on Oregon DEQ's 303(d) list due to elevated summer water temperature (table 171). Water temperatures over the 18.0ºC (64.4ºF) threshold are not to be increased further except in accordance with Water Quality Standards direction. Table 171 shows the 7 day average maximum water temperatures for stations in the Wolf project area measured from 1995 through 2008. Water temperatures over threshold are indicated by bold lettering. Water temperature monitoring data from 1995 through 2009 are on file at the Paulina Ranger District and are currently being uploaded into a national database.

Table 169. Seven day average maximum water temperatures (degrees Fahrenheit) 1995-2009 for streams in the Wolf project area.

Wolf Creek	1995	**71.4**
Wolf Creek	2003	**83.2**
Wolf Creek	2008	**73.8**
East Wolf Creek	1995	**68.0**
East Wolf Creek	2005	**57.4**
No Name	1995	**69.8**
No Name	1995	**72.6**
No Name North Wolf Creek	1995	**67.6**
North Wolf Creek	1995	**77.5**
North Wolf Creek	1997	**79.3**
North Wolf Creek	1998	**80.6**
North Wolf Creek	1999	**77.5**
North Wolf Creek	2005	**67.6**
Wolf Creek	1995	**73.9**
Wolf Creek	1997	**75.8**
Wolf Creek	2000	**77.4**
Wolf Creek	2001	**70.0**
Wolf Creek	2006	**78.5**
Wolf Creek	2007	**83.3**
Wolf Creek	2009	**73.9**

Table 170. ODEQ 303(d) listed streams

Stream river mile	Season	Pollutant	Beneficial Uses	Status	Criteria
East Wolf Creek 0 to 3.3	Year Around (Non-spawning)	Temperature	Salmon and trout rearing and migration	Cat 5: Water quality limited, 303(d) list, TMDL needed	Exceeds 18.0 degrees Celsius 7-day-average maximum
North Wolf Creek 0 to 10.3	Year Around (Non-spawning)	Temperature	Salmon and trout rearing and migration	Cat 5: Water quality limited, 303(d) list, TMDL needed	Exceeds 18.0 degrees Celsius 7-day-average maximum
Wolf Creek 0 to 17.1	Year Around (Non-spawning)	Temperature	Salmon and trout rearing and migration	Cat 5: Water quality limited, 303(d) list, TMDL needed	Exceeds 18.0 degrees Celsius 7-day-average maximum

Shade from vegetation and topography have the largest effect on stream temperatures and are the primary factors regulating the amount of solar energy reaching the stream surface. Hardwood shrubs are particularly effective at shading the stream as they provide a dense canopy close to the water surface, while conifers usually have lighter foliage that is farther above the surface of the water. Narrow valley-bottoms, often in concert with vegetation, can also provide significant shading. The Ochoco LRMP (1991) requires that shade along streams will generally correspond to provisions for more than 80 percent of the surface shaded. Where this cannot be attained, 100 percent of the potential for shade is the standard. On average, across the analysis area the Forest standard of 80 percent surface shade is not being met (see table 173).

Table 171. Average percent shade for creeks within the planning area.

Stream	Year Surveyed	Average Total Shade (%)	Average Total hardwood (%)
East Wolf Creek	2011	72.2	15.1
North Wolf Creek	2011	54.9	0.6
Wolf Tributary 16 (Clear Creek)	2009	77.6	0.4
Widow Creek	2009	49.2	no data
East Wolf Creek	2006	69.1	0
Tributary to E. Wolf	2006	47.7	0
North Wolf Creek	1995	61.6	0.125
East Wolf Creek	1993	50.7	no data
Miles Creek	1993	52	no data

While shade from vegetation and topography are the primary factors regulating the amount of solar energy reaching the stream surface, other features such as the surface area of the stream (i.e., width to depth ratios) can effect water temperatures. Width to depth ratios tend to increase with lateral instability. That is, as streambanks erode or are trampled, the stream becomes wider and this ratio increases. A wider stream has greater surface area exposure leading to higher temperatures. Lateral instability (which can lead to high width to depth ratios contributing to high stream temperatures) can be reduced by improving the overall condition of the RHCA.

Increasing riparian vegetation and LWD improve RHCA conditions by increasing root mass, increasing channel roughness, decreasing stream velocity, and decreasing trampling of banks. An increased amount of riparian vegetation will increase lateral stability leading to a narrower stream that will be exposed to less surface area open to solar radiation, thus decreasing the potential for high stream temperatures.

More specifically, it is the root mass of riparian hardwoods that provides structure that contributes to the lateral stability to streambanks, prevent excessive erosion and sloughing. Roots of hardwoods also provide roughness to a stream which decreases the erosive power of a stream and also promotes sediment deposition and the building up of streambanks. Embedded LWD can function similarly as the roots of riparian hardwoods serving as an energy dissipater and flow deflector. Riparian vegetation and LWD can also reduce grazing and browsing impacts on bank stability by limiting access.

Hydrology Measure #1 – Peak Flow

Affected Environment

The flow regimes within the project area are driven primarily by spring snow-melt in March and April. However, peak annual flows resulting from rain on snow events in early winter have produced some of the highest flows in the project area over the last 50 years. High flows can also result from intensive convective thunderstorms that cause flash floods during the spring and summer. Flash flooding is not a major factor in the Lower Beaver Creek watershed due to prevalent vegetation and ground cover and the buffering effect of the forest canopy.

However, peak flows are probably earlier and higher than they were historically owing to channel entrenchment, soil loss, soil compaction, timber harvest, and road construction which, taken together, cause flashier hydrological responses. This has been offset somewhat by increased understory canopy cover.

Base flows were probably higher prior to watershed alterations which have occurred over the last 150 years. Stream entrenchment has reduced storage potential in alluvial aquifers. Upland storage has been lost due to road construction, erosion, and compaction. Prior to European settlement, frequent

fires maintained lower evapotranspiration and interception rates by maintaining very open stands and substantially reducing juniper and marginal conifer stands. Water storage in wetlands and beaver ponds also contributed to higher base flows. Currently, many of the conifer stands are overstocked and conifers and juniper have moved into formerly un-forested areas and wet meadows.

Measure

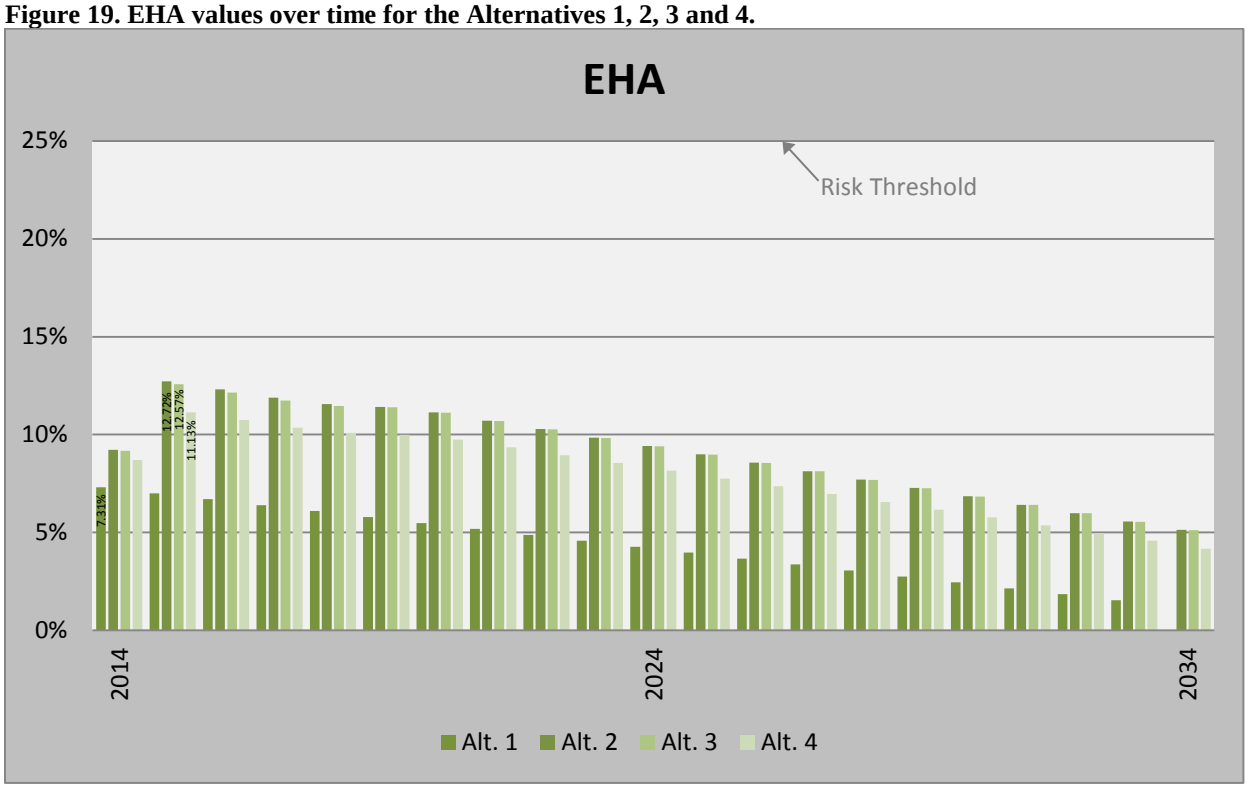
The Equivalent Harvest Area (EHA) model was used to determine the relative effects of timber harvest activities and forest vegetative conditions within the watershed. See Appendix C for EHA procedure. The EHA model is based on the principal that reduced stand density will reduce interception and evapotranspiration and may result in an increase in runoff and/or overland flow and snow accumulation. The EHA risk threshold should not be interpreted as a point above which detrimental impacts will occur but as a point above which detrimental impacts may occur should a 10-year or greater storm or runoff event take place. EHA is defined as that area, when harvested, which produces hydrologic effects similar to one acre of clearcut. The Ochoco Land Management Plan assigned an EHA threshold of 25 percent for the Lower Beaver Watershed and is the point at which there is potential increase in flows for the watershed (Anderson 1989).

Figure 18 displays the EHA values for the existing condition. The figure displays recovery over-time and the future projections of these EHA values are incorporated into the EHA calculations of each alternative.

Figure 18. EHA values over time for the existing condition.

See Figure 19 for the EHA values over time for each alternative. For analysis purposes, the EHA calculations assume for Alternatives 2, 3, and 4 that one-third of the commercial harvest entries would occur in 2014 and two-thirds would occur in 2015, followed by noncommercial and prescribed fire activities. Other assumptions are that all sales would start on schedule, would take one year to complete and associated roadwork would occur as specified in the design criteria.

Figure 19. EHA values over time for the Alternatives 1, 2, 3 and 4.



Direct and Indirect Effects

Alternative 1

The current EHA value for the watershed is 7.6 percent. The overall recovery of the watershed has improved by five percentage points since the last treatments in the 1990s. With no treatments proposed within this alternative, the EHA value would continue to decrease over time, as displayed in Figures 18 and 19, assuming no large scale disturbance events occur. The risk of catastrophic wildfire would remain unchanged as no vegetative treatments would occur. No treatments would occur to improve stand resiliency. Ladder fuels would not be reduced by noncommercial thinning and ground fuels outside the historic range of variability would not be treated. Noncommercial thinning would not be accomplished to reduce stocking levels of small diameter trees and promote recovery or riparian vegetation. If a wildfire was to occur, there would be an increase in EHA commensurate with the size and intensity of the fire. Such an event could have substantial adverse impacts to RHCAs in terms of changes in flow. The risk of vegetation mortality to disease would also remain unchanged. If this vegetation condition were to contribute to a wildfire, EHA values for the watershed could increase considerably.

Although this alternative displays the lowest EHA value (well below the 25% threshold) when compared to Alternatives 2,3, and 4, it has no activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs) described in Inland Native Fish Strategy (INFISH) (1995). In the short term (<5 years) this alternative would be consistent with standards and guidelines and with the Clean Water Act and Executive Orders 11988, 11990, and 12088. However, in the long term if no restoration activities were to take place within RHCAs, resource conditions would continue to trend away from management objectives for these areas.

Direct and Indirect Effects

Alternatives 2 and 3

Through the implementation of the proposed vegetation treatments in Alternative 2 or Alternative 3, EHA values are calculated to increase from 7.6 to 12.7 or 12.6 respectively. Although an increase in EHA is anticipated, the expected EHA value for these alternatives is well below the established threshold of concern of 25% as specified for the watershed. The increase in EHA may result in small scale alteration of runoff/overland flow, but the degree is still well below threshold and is not expected to result in measureable adverse effects to peak flows or stream condition from erosion.

Following implementation, it is anticipated that the effects to stream discharge and overland flow from project implementation would decrease to levels near pre-harvest conditions by the year 2030. The rate of recovery in the EHA model assumes that recovery would take place through natural processes of vegetation regeneration, increased ground cover, and restoration of soil properties conducive to site productivity and hydrologic function through mechanisms described in the Soils Report.

The EHA model does not account for the implementation of restoration measures that would be included in this project. Restoration activities that are included in this project include decompacting soil, seeding, and placing slash at the completion of the project on lengths of temporary roads, and lengths of re-opened closed roads within 200 feet of all streams would all hasten recovery. While the value of these projects cannot be calculated using the EHA model, it is assumed that these activities would advance recovery periods.

While the EHA model accounts for treated acres throughout the watershed, the potential for increased peak flows can be augmented if treated units occur directly adjacent to, or in close enough proximity to stream channels that a direct hydrologic connection of surface runoff from the unit to the channel is created. A portion of the RHCAs within the watershed are proposed to be treated. For Alternative 2 and 3 there are 589 acres of proposed commercial treatment within RHCAs that would employ mechanical means of tree harvest. However, commercial harvest has limited site specific prescriptive buffers for all RHCA units. Machinery would be limited to existing roads, trails, landings and crossings. Commercial harvest would also be limited to areas outside of prescribed buffer for class IV streams with machinery limited to existing roads, trails, landings, and crossings. This limits the potential for new disturbance and a direct hydrologic connection to stream channels. In addition to commercial harvest, there are 253 acres of traditional noncommercial treatments, and 1,122 acres of natural fuels treatments. For Alternative 2 there are 75.5 acres of hardwood noncommercial treatment which differs from Alternative 4 which has 90.5 acres of noncommercial hardwood treatments. These treatments would occur by hand, and would not lead to significant ground disturbance that would contribute to peak flows beyond what is accounted for in the EHA model. Treatments within the RHCA are designed to enhance RMOs and improve watershed condition. Any potential for hydrologic connectivity from RHCA treatment units will be minimized through the implementation of project design criteria and BMPs.

Roads and skid trails also have the potential to contribute to peak flows by conveying overland flow to streams. All existing, reconstructed, and temporary roads within the project area that would be used to implement Alternatives 2 or 3 would be improved or designed to minimize hydrologic connectivity using PDFs and BMPs. Except for the 1.8 miles of new temporary road construction, roads and skid trails developed for the project would be placed in areas of existing disturbance. The potential for concentrated flow on road and skid trail surfaces would be dissipated through the implementation of road design features that include but are not limited to ditch relief culverts, dips, water bars and out sloping. Dissipation areas would be armored or located in areas with favorable gradient, surface

roughness, and surface cover to avoid overland flow concentration, erosion and hydrologic connection to natural channels. Temporary roads and skid trails would be obliterated following use. The objectives and design considerations of these practices are described in the National U.S. Forest Service National Best Management Practices Program technical guide (USDA, 2012). Research and review of the effectiveness of individual practices in protecting soil and water resources has been shown to be effective to varying degrees, with overall effectiveness increasing with redundancy in implementation (Ice, 2009). Because of the application of multiple conservation practices, the contribution of roads and trails to potential increases in peak flows through the implementation of Alternatives 2 and 3 would be non-measurable.

Overall, Alternatives 2 and 3 would be consistent with the standards and guidelines in the Ochoco LRMP pertaining to EHA and flow and consistent with INFISH RMOs pertaining to channel condition. This alternative would be consistent with the Clean Water Act and Executive Orders 11988, 11990, and 12088. There are no expected measureable adverse effects to runoff and stream flow from Alternatives 2 and 3.

Alternative 4

Alternative 4 proposes non-commercially treatment followed by prescribed fire and fuels treatments as summarized in Chapter 2. In this alternative, there would be no commercial treatment within RHCAs. The difference in EHA values between Alternative 4 and Alternatives 2 and 3 is primarily due to no commercial harvest within RHCAs in this alternative. Alternative 4 would elevate EHA values from 7.6 to 11.1, (compared to Alternatives 2 and 3 that elevate EHA from 7.6 to 12.7 and 12.6, respectively). The values for the alternatives are well below the established threshold of 25% specified in the Forest Plan. With no RHCA commercial harvest in Alternative 4, there is a slightly lower potential for an effect to flow regimes than Alternatives 2 and 3. With this alternative, it is anticipated that the effects to stream discharge and overland flow from project implementation would decrease to levels near pre-harvest conditions by the year 2027. The potential for increases in peak flow and overland flow from road and skid trail crossings are basically the same for Alternatives 2, 3 and 4 and would be mitigated by using BMPs and design criteria.

Alternative 4 would be consistent with standards and guidelines in the Ochoco LRMP pertaining to EHA and flow and consistent with INFISH RMOs pertaining to channel condition. This alternative would be consistent with the Clean Water Act and Executive Orders 11988, 11990, and 12088. This alternative would do less to meet the purpose and need than Alternative 2 and 3 but would also have a slightly lower risk for an effect to flows. There are no expected measureable adverse effects to runoff and stream flows from this alternative as the EHA value is well below threshold.

Cumulative Effects

The area of analysis for cumulative effects is the Wolf project area.

Projects with the potential to reduce peak flows and stabilize the hydrologic regime in the project area short and long-term include implementation of the Deschutes and Ochoco Travel Management EIS (2011) Upper Beaver Project EIS and older vegetation management activities.

The Travel Management EIS reduces the potential for increasing peak flows and moving towards a more stable hydrologic regime long-term through restriction of vehicle access throughout the project area.

Within the cumulative effects boundary, the Upper Beaver EIS (2010) is limited in scope (less than 50 acres of commercial harvest) and the expected direct or indirect effects of the action alternatives and are well below the threshold of concern. Therefore, there is no expectation for deleterious cumulative effects to peak flow from the implementation of this project.

Hydrology Measure #2 - Sediment and Turbidity

Affected Environment

For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur as a result of this project. This zone was delineated to encompass the dominant sediment contributing area for the project. This determination was based on field observations and professional judgment, and was supported by the findings from peer-reviewed literature and research.

The analysis focuses on the amount of sediment delivered from surface erosion and mass soil movement outside the stream channel dependent on existing and proposed ground disturbance, soil erodibility, slope, and distance to the stream. Because areas within 200 feet of the stream have largely been unaffected by management activities besides road building, existing condition levels of sediment from surface erosion was modeled using existing roads – including those not used for the proposed activities or for haul.

Measure

The Water Erosion Prediction Project (WEPP) model was used to model the potential effects of sediment impairment to water quality.

WEPP models the potential erosion and sediment delivery based on ground disturbance, slope, climate, soil type, and buffer composition. For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur. This zone was delineated to encompass the dominant sediment contributing area for the project area. This analysis does not include changes in total sediment yield or sediment delivery from bank erosion.

In terms of the overall watershed, this project proposes harvest treatments as summarized in Chapter 2. A portion of those treatment acres are proposed to occur in RHCAs. While RHCA treatment acres are sometimes used for discussion purposes, they are not equivalent to the acres used to calculate WEPP because 200 feet was the zone designated for potential sediment delivery. More specifically, for Class I and II streams, only 200 feet of the 300 foot RHCA buffer is within the sediment delivery zone. For Class III streams and wetlands great than 1 acre, there is an additional 50 feet included in the WEPP sediment delivery zone that is beyond the 150 foot RHCA buffer. And finally, for Class IV streams and wetlands less than 1 acre, there is an additional 150 feet included in the WEPP sediment delivery zone that is beyond the 50 foot RHCA buffer. Therefore, although Alternative 4 does not include commercial harvest in RHCAs, commercial harvest is included in the WEPP analysis for Alternative 4 in the areas that are beyond the RHCA buffer but still within the sediment delivery zone.

The amount of roads located in the vicinity of streams is not uncommon for this watershed due to the nature of the scab stringer landscape. A majority of the resources, like streams and timber are located in the stringers, which has resulted in a network of roads in close proximity to streams. Due to the amount of roads it was not possible to model precisely how far away each was. Instead, the minimums and maximum scenarios were the closest approximation possible. It is presumed that the true value lies between the minimum and maximum values. The minimum value is a scenario where all roads are 200’ from a stream except for the portions that cross streams. The maximum value is a scenario where all roads are 50’ from a stream except for the portions that cross streams. In order to consistently compare alternatives, the maximum value is used, although the actual value is definitely less.

Additionally, the model assumes that all of a road is contributing sediment when in reality there could be less. For instance, a break in slope, a water bar, or other run-off dissipating/ erosion prevention

feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

Because of integrated project design features for the actions of the proposed action alternatives, there is a potential for a long term net decrease in sediment below that of the existing condition levels of the no action alternative following the implementation of the project. This potential net decrease in sediment delivery would be -36%, -37%, and -30% for Alternatives 2, 3, and 4 respectively. The project design feature that this net decrease is largely attributed to is the requirement to hydrologically stabilize all temporary roads, skid trails, and re-opened closed roads within the RHCA and sediment delivery zone. Hydrologic stabilization would include culvert removal, decompaction, seeding, water bars, and/or applying slash. Many of the riparian roads and crossings that would be reopened for temporary use under an action alternative are currently in a bare and compacted condition, are in various stages of disrepair, and may be accessible by motor vehicles. Therefore by implementing this project, the long term field condition of these roads would be much improved.

Table 174 displays the results of the WEPP analysis performed for this project. The purpose of this analysis was to compare the effects of the proposed action alternatives (during and post implementation) to the existing condition. These results take into account the condition of the vegetation, fuels and roads during and post action implementation as compared to the existing condition.

Table 172. Summary of the total potential sediment delivery (tons/year)

	Existing Condition	**Wildfire (in the current condition)**	**Proposed Action During Implementation**	**Proposed Action Post Implementation**
Alt. 1	13.7	89.6	n/a	n/a
Alt. 2	13.7	89.6	34.8	8.8
Alt. 3	13.7	80.3	33.1	8.5
Alt. 4	13.7	80.6	21.0	9.6

To better compare the action alternatives, they were compared to the existing condition for during and post action implementation. The percent differences from the existing condition were calculated and the results are displayed in table 175.

It is important to note that the results used to compare alternatives are potential maximum values. Actual sediment delivery would be much less because the results of the WEPP analysis for the action alternatives do not reflect the implementation of BMPs or any site specific design criteria. These would be implemented in order to decrease the potential sediment delivery to streams. On the Idaho Panhandle National Forest, standard BMPs that are similar to those that would be implemented on this project were shown to be at least moderately effective (75%) at reducing effects to soil and water (USDA, 2006). Precipitation regimes within the project area are at least one third that of northern Idaho, so effectiveness rates would be anticipated to be higher in this area. A majority of the proposed treatment areas would also receive site specific project design features based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations.

Table 173. Action alternatives comparison during and implementation.

	Maximum potential sediment delivery produced from fuels management	Maximum potential sediment delivery produced by roads. Stream crossings not included.	Maximum potential sediment delivery produced at stream crossings. Skid trail crossings not included.	Maximum potential sediment delivery from skid trails and other disturbance associated with commercial harvest activities	**Total potential sediment delivery summary comparison**
During Implementation					
Alt. 2	14%	46%	1%	93%	**154%**
Alt. 3	14%	46%	1%	82%	**143%**
Alt. 4	16%	32%	2%	4%	**53%**
Post Implementation					
Alt. 2	-5%	-30%	-0.5%	n/a	**-36%**
Alt. 3	-5%	-32%	-0.6%	n/a	**-37%**
Alt. 4	-6%	-24%	-0.4%	n/a	**-30%**
Not included in the WEPP analysis are the restoration activities such as channel stabilization, headcut repair, LWD placement, or culvert replacement. Additionally, PDFs. And BMPs are not included. All of these aforementioned activities would be expected to reduce sediment input.					

Direct and Indirect Effects

Alternative 1

The overall potential sediment delivery for the existing condition has been calculated to be approximately 13.7 tons/year. This takes into account the current condition of the vegetation, fuels and roads.

Existing stand conditions, dense and overstocked, limit the effectiveness stream buffers. The potential sediment delivery to streams from the adjacent forested hillslopes were modeled to be 2.1-2.3 tons annually or 190-309% increase beyond background levels of 0.7-1.2 tons. Background values have been included to provide context to the existing condition and are not intended as a goal that can be easily achieved, if at all.

The risk of stand replacement wildfire would remain unchanged as no vegetative treatments would occur. No treatments would occur to improve stand resiliency. Ladder fuels would not be reduced by noncommercial thinning and ground fuels outside the historic range of variability would not be treated. Noncommercial thinning would not be accomplished to reduce stocking levels of small diameter trees and promote recovery or riparian vegetation. If a wide spread high intensity wildfire was to occur, sediment delivery would potentially increase to 80.3-89.6 tons (see table 174). This would be an increase in sediment that is approximately 490-555% more than the annual rate of the existing condition.

This alternative would continue to contain hydrologically connected roads and stream crossings in various unknown states of disrepair. At a minimum, existing roads are potentially contributing 0.8 tons and a maximum of 11.3 tons annually, including crossings. It is the maximum road value of 11.3 that accounts for 83% of the sediment in the overall existing condition.

The current road density of 8.84 mi/sq. mi. within the 200' sediment delivery zone would remain unchanged with Alternative 1. The amount of roads located in the vicinity of streams is not uncommon for this watershed due to the nature of the scab stringer landscape. A majority of the resources, like streams and timber are located in the stringers, which has resulted in a network of roads in close proximity to streams.

Alternative 1 would allow for a gradual recovery to portions of closed roads, temporary roads, and previously disturbed areas within the sediment delivery zone providing that the success of this type of passive restoration is possible at a site. This gradual hydrologic recovery would provide decreased stream turbidity, decreased embeddedness, and a lower percentage of fine sediment within spawning gravels and pool habitats.

When compared to Alternatives 2, 3, and 4, Alternative 1 has no activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs). In the short term (<5 years) this alternative would be consistent with standards and guidelines and with the Clean Water Act and Executive Orders 11988, 11990, and 12088. However, in the long term if no restoration activities were to take place within RHCAs, resource conditions would continue to trend away from management objectives for these areas. This alternative would not address the purpose and need of the project.

Alternatives 2 and 3

WEPP analysis of Alternative 2 shows the combined overall potential maximum sediment delivery to be 34.8 tons during implementation, or a 154% increase above the existing condition annual rate. For Alternative 3, it would 33.1 tons during implementation, or a 143% increase. The projected increase above the existing condition for these alternatives during implementation comes from a combination of commercial, noncommercial, and fuels treatments as well as prescribed fire and road activities associated with the project. A majority of the increase for Alternative 2 (93%) and Alternative 3 (82%) is attributable to commercial, noncommercial, and fuels treatments. For both Alternatives, prescribed fire accounts for 14% which can be attributable to poor stand conditions. While 46% is produced by roads a majority can be attributable to the existing condition of the roads.

For Alternative 2, post implementation (>5-10 years) potential sediment delivery is expected to be reduced to approximately 8.8 tons, or a decrease of 36% below that of the existing condition. For Alternative 3, sediment would be reduced approximatley 8.5 tons or a decrease of 37% below that of the existing decision. A majority of the decrease for Alternative 2 (30%) and Alternative 3 (32%) is attributable to the improvement of roads and crossings while the remainder of the decrease (5-6%) is attributable to improvements in stand conditions.

Existing stand conditions, dense and overstocked, limit the effectiveness stream buffers and thereby lead to elevated sediment delivery. In the existing condition, the potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be 2.2 tons annually for Alternative 2 and 2.1 tons annually for Alternative 3. Post implementation, stand conditions would be much improved. The potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be 1.5 tons for both Alternatives annually or a 30-32% decrease from the existing condition, resulting in the overall decrease of 5-6% discussed above.

The intent of the harvest and fuels treatment activities is to reduce the amount of area susceptible to high intensity wildfire and at high risk from insects and disease through commercial, noncommercial, and fuels treatments. In the exisitng condition, the effects of a widespread high intensity wildfire were calculated to increase overall sediment delivery in Alternative 2 to 89.6 tons and in Alternative 3 to 80.3 tons. For Alternative 2 this would be a pulse of sediment that is approximately 555% more than the annual rate of the existing condition; for Alternative 3 it would 490% more.

Focusing on the sediment delivery zone of 200', the existing condition roads and crossings are estimated to potentially contribute a maximum of 11.3 tons of sediment annually. It is assumed that the majority of the roads miles are beyond 50' except for crossings. For Alternative 2 and 3, the proposed road activities are estimated to potentially contribute 17.6 tons of sediment during implementation, or an increase of 55% beyond the existing condition. However, these are the maximum values from the model where all roads are 50' from a stream except for the portions that cross streams. Roads are located at various distances away from streams and are often further than 50' from the channel so this model is an over estimate that is the closest approximation. Additionally, the model is assuming that all of a road is contributing sediment when in reality there could be less. For instance, a break in slope, a water bar, or other run-off dissipating/ erosion prevention feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

Furthermore, many of the roads and crossings that are planned to be re-opened are a risk to aquatic resources in their current condition, (see Wolf WA Roads Analysis). The project action alternatives propose to improve these roads in ways that minimize potential sediment delivery during operations followed by rehabilitation utilizing practices consistent with the Project Design Criteria, leaving the select roads and crossings hydrologically inert to the extent practical.

In terms of road related sediment, both alternative have the potential to improve conditions over the existing condition. In the long-term, for Alternative 2, sediment delivery would be reduced to 7.2 tons or 36% less than the existing condition while for Alternative 3, sediment delivery would be redued to 7 tons or 38% less than the existing condition. It is estimated that the stream crossings in Alternative 2 and 3 used in implementation have the potential to produce approximately 0.3 tons of sediment which is approximately 100% more than the existing condition. However, for Alternative 2, post implementation, the sediment delivery from crossings is expected to decrease to 0.07 tons which is 50% less than the existing condition; for Alternative 3, it expected to decrease 0.06 tons which is 57% less than the existing condition. Project associated design criteria would include BMPs, but would also include hydrologic stabilization and/or culvert removal, decompaction of all temporary roads, skid trails, and re-opened closed roads within the RHCA and sediment delivery zone, as well as seeding and applying slash. Many of the riparian roads and crossings that would be reopened for temporary use under an action alternative are currently in a bare and compacted condition, are in various stages of disrepair, and may be accessible by motor vehicles. While the opening and use of these roads for project implementation may result in small, short term (< 5 years) sediment generation, the long term field condition of these roads would be much improved.

Existing temporary roads, new temporary roads, and re-opened closed roads within the RHCA and sediment delivery zone (200 feet of Class I-IV streams), utilized during implementation are to be specified in the timber sale contract to have adequate practices conducted after the completion of harvest activities in order to minimize the long-term potential for sediment delivery. Even though the best management practices are planned for use during operations, there would still be sediment produced associated with crossings during the installation and rehabilitation of these crossings. There would be an increase with the first sale, over the first sale's area, the first year, after the completion of commercial harvest activities and rehabilitation. This would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season. Then there would be an increase with the second sale, over the second sale's area, the second year, after the completion of commercial harvest activities and rehabilitation. This also would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season.

Actual anticipated sediment produced would be less because local site conditions vary, ranging from sites that are well armored to sites that are more sensitive and susceptible to disturbance. Sensitive

areas would be avoided. Examples of sensitive areas are: channels that have bed and banks composed of finer material; channels that have a high bank height; channels that have a vertical bank angle; all of which would be susceptible to bank erosion, compaction, collapse and/or channel widening. Conversely, there are areas that are naturally armored and would not require as much (if any) structural improvement, hence less susceptible to disturbance. These types of areas are channels whose bed and banks are well armored by large cobble, boulders and/or bedrock, whose bank angle and bank height are low enough to provide a smooth transition through the channel, thus not requiring the installation of a structure that would have disturbance associated with it, and are channels that are dry for portions of the season.

Minor amounts of sediment would be produced during the installation and/or removal of crossing structures, improvements, or fords; which can also contribute to temporary increases in turbidity during spring melt. For both alternatives, during commercial harvest operations, stream crossings and roads within the sediment delivery zone could potentially contribute to an approximate maximum increase of 17.9 tons, or 58-59% more than the existing condition. This increase is not expected to persist beyond the years which the commercial harvest activities are to occur, 2014-2015. It is the intention of the Project Design Features and practices to prevent sediment production and delivery where practicable, to reduce the potential for sediment delivery to minimal or somewhat negligible amounts, and to restore areas that otherwise could have the potential to contribute so that the ground is left better than it is, in the long-term.

A majority of the proposed treatment areas would also receive site specific project design criteria based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations. Through the combination of these site specific project design criteria and BMPs, the redundancy of conservation activities would reduce the potential for sediment delivery in the short-term for both alternatives during implementation to quantities that are the least amount practicable in order to achieve the purpose and need of the project and would be immeasurable.

It is estimated that most of the sediment load in the project area is coming from in-channel erosion such as cutbanks, headcuts, and scour with a total of at least 60+ tons of sediment per year. The amount of sediment that would be produced during the implementation of in-stream restoration and associated activities is unknown at this time. Detailed sediment calculations are performed prior to each restoration project's implementation and are submitted to the Division of State Lands. However, based upon the areas treated and types of restoration in Alternative 2 (5 headcut repairs, 1 mile of channel stabilization), for Alternative 3 (6 headcut repairs and 2.2 miles of restoration), it is estimated that sediment yield would be reduced by approximately <5-10 tons per year.

When compared to Alternative 1, Alternatives 2 and 3 proposes activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs). This alternative would address the purpose and need of the project.

These alternatives would be consistent with standards and guidelines in the Ochoco LRMP and RMO's, the Clean Water Act and Executive Orders 11988, 11990, and 12088.

Direct and Indirect Effects

Alternative 4

WEPP analysis of Alternative 4 shows the combined overall potential maximum sediment delivery to be 21 tons during implementation, or a 53% increase above the existing condition annual rate. The

projected increase above the existing condition for this alternative during implementation comes from a combination of commercial, noncommercial, and fuels treatments as well as prescribed fire and road activities associated with the project. While 32% is produced by roads, a majority of that can be attributable to the existing condition of the roads. Prescribed fire accounts for 16%, which can be attributable to poor stand conditions. The remaining 4% is attributable to commercial, noncommercial, and fuels treatments.

Post implementation (>5-10 years) potential sediment delivery is expected to be reduced to approximately 9.6 tons, or a decrease of 30% below that of the existing condition.

A majority of the decrease (24%) is attributable to the improvement of roads and crossings while the remainder of the decrease (6%) is attributable to improvements in stand conditions.

Existing stand conditions, dense and overstocked, limit the effectiveness stream buffers. The potential sediment delivery to streams from the adjacent forested hillslopes were modeled to be 2.3 tons annually in the existing condition. Post implementation, stand conditions would be much improved. The potential sediment delivery to streams from the adjacent forested hillslopes were modeled to be 1.5 tons annually or 34% decrease from the existing condition, resulting in the overall decrease of 6% discussed above.

The intent of the harvest and fuels treatment activities is to reduce the amount of area susceptible to high intensity wildfire and at high risk from insects and disease through commercial, noncommercial, and fuels treatments. The effects of a widespread high intensity wildfire were calculated to increase overall sediment delivery to 80.6 tons in the existing condition. This would be a pulse of sediment that is approximately 487% more than the annual rate of the existing condition.

Focusing on the sediment delivery zone of 200’, the existing condition roads and crossings are estimated to potentially contribute a maximum of 11.3 tons of sediment annually. It is assumed that the majority of the roads miles are beyond 50’ except for crossings. Alternative 4 road activities are estimated to potentially contribute 15.8 tons of sediment during implementation, or an increase of 39% beyond the existing condition. However, these are the maximum values from the model where all roads are 50’ from a stream except for the portions that cross streams. Roads are located at various distances away from streams and are often further than 50’ from the channel so this model is an over estimate that is the closest approximation. Additionally, the model is assuming that all of a road is contributing sediment when in reality there could be less. For instance, a break in slope, a water bar, or other run-off dissipating/ erosion prevention feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

Furthermore, many of the roads and crossings that are planned to be re-opened are a risk to aquatic resources in their current condition, (see Wolf WA Roads Analysis). The project action alternatives propose to improve these roads in ways that minimize potential sediment delivery during operations followed by rehabilitation utilizing practices consistent with the Project Design Criteria, leaving the select roads and crossings hydrologically inert to the extent practical.

In terms of road related sediment, this alternative has the potential to improve conditions over the existing condition. In the long-term, sediment delivery would be reduced to 8 tons or 29% less than the existing condition. It is estimated that the stream crossings in Alternative 4 used in implementation have the potential to produce, approximately 0.2 tons of sediment which is approximately 100% more than the existing condition. However, post implementation, the sediment delivery from crossings is expected to decrease to 0.07 tons which is 42% less than the existing condition. Project associated design criteria would include BMPs, but would also include hydrologic stabilization and/or culvert removal, decompaction of all temporary roads, skid trails, and re-opened

closed roads within the RHCA and sediment delivery zone, as well as seeding and applying slash. Many of the riparian roads and crossings that would be reopened for temporary use under an action alternative are currently in a bare and compacted condition, are in various stages of disrepair, and may be accessible by motor vehicles. While the opening and use of these roads for project implementation may result in small, short term (< 5 years) sediment generation, the long term field condition of these roads would be much improved.

Existing temporary roads, new temporary roads, and re-opened closed roads within the RHCA and sediment delivery zone (200 feet of Class I-IV streams), utilized during implementation are to be specified in the timber sale contract to have adequate practices conducted after the completion of harvest activities in order to minimize the long-term potential for sediment delivery. Even though the best management practices are planned for use during operations, there would still be sediment produced associated with crossings during the installation and rehabilitation of these crossings. There would be an increase with the first sale, over the first sale's area, the first year, after the completion of commercial harvest activities and rehabilitation. This would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season. Then there would be an increase with the second sale, over the second sale's area, the second year, after the completion of commercial harvest activities and rehabilitation. This also would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season.

Actual anticipated sediment produced would be less because local site conditions vary, ranging from sites that are well armored to sites that are more sensitive and susceptible to disturbance. Sensitive areas would be avoided. Examples of sensitive areas are: channels that have bed and banks composed of finer material; channels that have a high bank height; channels that have a vertical bank angle; all of which would be susceptible to bank erosion, compaction, collapse and/or channel widening. Conversely, there are areas that are naturally armored and would not require as much (if any) structural improvement, hence less susceptible to disturbance. These types of areas are channels whose bed and banks are well armored by large cobble, boulders and/or bedrock, whose bank angle and bank height are low enough to provide a smooth transition through the channel, thus not requiring the installation of a structure that will have disturbance associated with it, and are channels that are dry for portions of the season.

Minor amounts of sediment would be produced during the installation and/or removal of crossing structures, improvements, or fords; which can also contribute to temporary increases in turbidity during spring melt, however turbidity levels are not expected to expected to increase more than 10% beyond background levels. During commercial harvest operations, stream crossings and roads within the sediment delivery zone could potentially contribute to an approximate maximum increase of 16 tons, or 42% more than the existing condition. This increase is not expected to persist beyond the years which the commercial harvest activities are to occur, 2014-2015. It is the intention of the Project Design Features and practices to prevent sediment production and delivery where practicable, to reduce the potential for sediment delivery to minimal or somewhat negligible amounts, and to restore areas that otherwise could have the potential to contribute so that the ground is left better than it is, in the long-term.

Through the combination of these site specific project design criteria and BMPs, the redundancy of conservation activities would reduce the potential for sediment delivery in the short-term from the proposed action during implementation to quantities that are the least amount practicable in order to achieve the purpose and need of the project and would be immeasurable.

It is estimated that most of the sediment load in the Project area is coming from in-channel erosion such as cutbanks, headcuts, and scour with a total of at least 60+ tons of sediment per year. The amount of sediment that would be produced during the implementation of in-stream restoration and

associated activities is unknown at this time. Detailed sediment calculations are performed prior to each restoration project's implementation and are submitted to the Division of State Lands. However, based upon the areas treated and types of restoration, i.e. 6 headcut repairs, 2.2 miles of channel stabilization, and 1 culvert replacement, it is estimated that sediment yield would be reduced by approximately >5-10 tons per year.

Compared to Alternatives 1 and 2, Alternatives 3 and 4 would have more non-commercial hardwood thinning, 2.2 miles of channel stabilization, 6 headcut repairs, and the undersized culvert on North Wolf Creek would be replaced. Alternative 4 has more traditional noncommercial and noncommercial hardwood thinning than Alternative 3. However Alternative 4 does not contain any commercial treatments in RHCAs which would not make stands as resilient as those that would be treated in Alternatives 2 and 3.

Alternative 3 would decrease potential sediment delivery in the long-term by 30%, which is less than Alternatives 2 and 3 but more than Alternative 4.

Alternatives 2, 3, and 4 all consist of activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs). However, Alternative 4 would address the purpose and need of the project less than Alternative 3 and more than Alternative 2.

This alternative would be consistent with standards and guidelines in the Ochoco LRMP and RMO's, the Clean Water Act and Executive Orders 11988, 11990, and 12088.

Cumulative Effects

The area of analysis for cumulative effects is the Wolf project area.

Implementation of the Deschutes and Ochoco Travel Management EIS (2011), along with road the closures and decommissioning proposed in the Wolf project, would restrict access to designated open roads; thereby, decreasing access and impacts to streams and would likely reduce potential sediment delivery to streams. Short and long-term, limiting travel access paired with rehabilitating and/or eliminating areas of road in disrepair would improve sediment filtration buffers of native riparian plant communities and reduce sediment delivery over time.

Livestock grazing under the Southside EA (2009) has the potential to add cumulatively to the Wolf project sediment delivery via bank alteration and suppressing sediment filtration buffers of native riparian plant communities but PDC were developed to improve grazing conditions long-term. The Southside EA was signed in 2009 and implemented began in 2010. Annual indicator monitoring has been shown to meet standards and guidelines during the last 5 years.

The Ochoco Summit OHV trail system project could potentially affect sediment via numerous stream crossings but impacts would be mitigated by overall project design (avoidance of sensitive areas including fish bearing streams) and PDC, including armored crossings and utilization of bridges.

There are 33.5 acres currently proposed for treatment under the Ochoco and Deschutes Invasive Plant EIS (2012). The majority of the weed sites are located along Wolf Creek, its upper tributaries, and East Wolf Creek. In addition to these acres, the EIS enables the Forest to chemically treat any new infestations under the early detection rapid response process which will greatly help reduce the rate of spread into newly disturbed ground as a result of the proposed activities in the Wolf planning area. Because project design features in the weed EIS prohibit most chemical treatment near perennial streams to protect aquatic species and water quality (USDA 2012), manual weed treatments are applied between stream and chemical application buffer. In most cases, this buffer is 15 ft. (USDA 2012). Manual treatments are not expected to measurably increase the amount of short-term soil disturbance that might increase sediment delivery to streams when considering the very small amount of treatments dispersed across the project area.

Hydrology Measure #3 - Stream Temperature

One aspect of INFISH is to ensure maintenance and improvement of water quality through the development of RHCAs. However, since the Forest Service began managing stream corridors with buffers zones along aquatic habitats, Forest managers have been reluctant to continue to actively manage RHCAs (USFS and BLM 2010). As a consequence, most of the RHCAs within the Wolf project area have become overstocked with small diameter conifers and in several areas are at in increased risk for uncharacteristic wildfire; reference Fuels and Silviculture Reports. The overstocked densities of conifers in the RHCAs prevent hardwoods such as alder, willow, aspen, and other shrubs from expanding due to competition for sunlight, nutrients and water. This competition for resources makes it difficult for hardwoods to reestablish. Without the hardwood component, stream banks lack strong root masses that can stabilize banks, make channels narrower, reduce water velocity during high flow events as well as provide quality habitat for aquatic species such as trout and amphibians.

As outlined in the Wolf WA, there is a need to manage coniferous vegetation through commercial and noncommercial treatments within RHCAs to promote the growth of hardwoods (e.g., aspen, willow, alder) in order to increase the overall condition of riparian areas. In some areas, these treatments would coincide with other riparian restoration actions including: in-stream restoration work, large wood placement, a culvert replacement, road closure and decommissioning, and several stream crossing rehabilitations. The objective of these additional restoration actions would be to address the limiting factors of prohibiting the expression of robust riparian plant communities.

Stream shade provided by conifers comes from a primary and a secondary shade zone and trees could be thinned, and continue shading the stream, from RHCAs as long as the critical shading vegetation is left (USFS and BLM 2010). The Northwest Forest Plan Temperature Total Maximum Daily Load (TMDL) Implementation Strategies (2010) also identifies that thinning which reduces stream shade may lead to a short-term increase in temperature, but will ultimately lead to a long-term benefit in shade production by hardwoods, and a long-term decrease in stream temperature, if given adequate protection from grazing. Additionally, INFISH (1995) says to prohibit timber harvest within RHCA unless silvicultural practices can be used to acquire desired vegetation characteristics that will aid in attainment of RMOs while avoiding adverse effects to inland native fish species. Considering these findings and Forest Service guidelines, vegetation management would occur inside the RHCA buffer zones described in INFISH to commercially and non-commercially harvest conifers under Alternatives 2 and 3 on a limited scale. Unit by unit site specific prescriptions would be applied to all RHCA units and were developed with the guidance from table 14. The Primary Shade Zone is a minimum distance from which a tree of a determined height on a determined slope is providing shade during the period when peak temperatures occur. The Primary Shade Zone of 70 feet for slopes up to approximately 30-35% were used for this project and were incorporated into detailed design criteria.

Table 174. Minimum Width of Primary Shade Zone (feet) based on Slope (percent) and Tree Height (average height of stand in feet) (USFS & BLM. 2010).

Height of Tree	Primary Shade Zone (ft.)
Trees < 20 feet	12
Trees 20 to 60 feet	28
Trees >60 feet to 100 feet	50
Trees >100 to 140 feet	70

For this analysis, the focus will be on treatment activities within RHCAs and the Primary Shade Zone (PSZ) of 70 feet from stream channels as the area for potential effects to occur.

The highest potential for a reduction in shade would be commercial treatments and noncommercial hardwood thinning units within the PSZ on perennial streams. It is important to note that approximately 30% of these units are on sections of stream that are dry during peak summer temperatures even though they are designated as perennial. Sometimes referred to as "interrupted", it is the nature of the streams in the project area to have sections of seasonally dry streambed with perennial sections upstream and downstream from these sections. Since the extent of these dry sections are unknown, whole reaches are designated as perennial. Because these perennially interrupted (dry) sections of streams go dry before peak water temperatures occur in the watershed, similar to that of intermittent streams, they are often managed like intermittent streams.

Listed in the PDC are unit by unit site specific prescriptions for almost all units that have a potential shade concern. For class I, II, III streams, efforts were made to ensure that activities did not occur within the primary shade zone and in many cases further, since the PSZ was considered a minimum. Special cases/exceptions may have been made and should have noted rationale, i.e., hardwood treatments.

Measure

To compare alternatives, the amount of commercial and noncommercial hardwood thinning acres within the primary shade zone of perennial streams were used to model the potential effects to stream temperature. Refer to the data from the following tables.

Table 175. Treatment Acres within the PSZ.

Vegetation Treatments	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Commercial Treatments	0	88	88	0
Non-commercial Hardwood Thinning	0	38	49	49

Table 176. Number of Units within the PSZ.

Vegetation Treatments	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Commercial Treatments	0	57	53	0
Non- commercial Hardwood thinning	0	14	15	16

Direct and Indirect Effects

Alternative 1

Alternative 1 has no proposed treatments and would result in no vegetation treatments, road utilization or riparian restoration actions that would result in potential effects to stream shade or temperature. Due to past management of RHCAs in the project area, few stream reaches are currently meeting INISH standards for shade. Under this alternative, most streams would continue to be below the shade RMO and summer water temperature would remain above allowable Oregon DEQ and Ochoco National Forest standards. Aquatic habitats would remain in this condition due to the low densities of hardwoods, over-grazing of hardwoods that are present, and the overstocked densities of

conifers inhibiting expansion and establishment of riparian plants. Riparian vegetation (hardwood) recovery would slowly occur (up to 15 years) as grazing conditions incrementally improve from changes in management activities due to the Southside AMP EA. However, conifers would continue to suppress hardwoods and the risk of uncharacteristic wildfire, insects and disease would remain high. Short-term (1-5 years) effects to shade from implementation activities, specifically RHCA treatments and riparian restoration actions would not occur. Conversely, none of the other benefits to stream shade short and long-term from implementation of riparian restoration activities (stream restoration and headcut repair, hardwood stand enhancement including riparian planting and protection) would occur either.

Direct and Indirect Effects

Alternatives 2 and 3

Proposed activities within RHCAs are designed to improve attainment of RMOs. In Alternative 2 and 3, commercial harvest would occur in 589 acres in RHCAs in addition to the fuels treatments. As stipulated in the unit by unit PDF, LWD would be felled/pushed to meet RMO. These trees would generally be recruited from within the PSZ (25 – 75 ft.) so that they would function effectively as in-stream LWD (reference Aquatic Species Report). Very minor, likely immeasurable shade reductions would occur when considering the scope of activities across the planning area. Additionally, there would be 253 acres of traditional noncommercial thinning (NCT) in both alternatives. In Alternative 2 there would be 68 acres of noncommercial hardwood thinning and 82.7 acres in Alternative 3. Underburning would occur on an additional 1,122 acres.

There are approximately 474 acres (15% of RHCA within project area) of treatment proposed in these areas; the project area contains 3,153 acres of RHCA along class I-III streams. The remainder of treatments (115 acres) would occur in class IV streams. The ratio of the amount of treatments within RHCAs and within the primary shade zone is similar. In Alternative 2 and 3, commercial treatments would occur on 88 acres and non-commercial hardwood thinning would occur in 38-49 acres within 70 feet of perennially designated streams. Units for both alternatives have been planned and analyzed for in a manner consistent with BMPs. Site specific design criteria were developed for all RHCA units. Overlaying the unit boundaries with the PSZ highlights the areas where extra planning efforts developed design features regarding the effects to shade. These design features include some basic factors, not easily modeled that subdue concerns about stream temperature:

- Several of these units occur on sections of streams that are dry when peak stream temperatures are a concern. These sections of dry, perennially interrupted streams were field verified and noted, and would be treated as intermittent.
- Treatment boundaries are preliminary and have not been laid out in the field. Detailed unit by unit site specific design criteria would be followed for units on perennial sections of stream that do not go dry. Therefore, only trees that do not provide shade or provide bank stability would be removed so that the existing amount of stream shade is maintained.
- Hardwood units on streams that do not go dry are spatially intermittent and discontinuous so as to not have a concentrated reduction in shade.
- On well-shaded stream reaches there may be a small amount of commercial units that would reduce a small portion of potential shade producing vegetation. There would be few of these units, spread out spatially over the project area, and the amount of shade reduction would not result in a measurable increase in stream temperature.
- Only trees that do not provide shade or provide bank stability would be removed so that the existing amount of stream shade is maintained, unless hand thinning benefits hardwoods.
- Non-commercial thinning would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species.

Removing conifers from hardwood stands to improve alder or willow production may reduce shade in a very minor amount but should not result in a measurable increase in water temperatures. These treatments would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species. Thinning would result in increased growth rates for both residual conifers and riparian shrubs. In terms of hardwood treatments, Alternative 3 has slightly more potential to decrease shade than Alternative 2, while Alternative 2 has less hardwood stands that would be improved. Removing conifers from hardwood stands or to improve alder or willow production in these units may reduce a minor, short-term (<5 years) amount of shade but should not result in a measurable increase in water temperatures, especially considering the scope of activities in relation to the size of the watershed (see Figures 20 and 21).

Although prescribed fire has the potential to reduce shade, this potential would be diminished through the implementation of PDCs and BMPs, The application of prescribed fire proposed in Alternatives 2 and 3 would be consistent with standards and guidelines, underburning would occur within the RHCA but outside the riparian vegetation. Ignition of burns would occur outside of RHCA, (except hand piles) but could be allowed to creep into riparian vegetation. To meet RMOs, fire prescriptions for RHCAs would provide for a mosaic of burned and unburned areas to retain sufficient soil cover for infiltration and maintain vegetation that provides shade. In general, burning in RHCAs would be expected to burn 10-50% of the riparian area, while exposing less than 5% mineral soil. Mineral soil exposure would be expected to last less than one year. The above ground growth of grasses and shrubs in the burned areas would be killed but would respond with new growth within the first growing season after the burn. Observations of similar prescribed fire treatments show burned grasses begin to sprout with new growth within one to three months of the first growing season. Within the first year after burning, shrubs and grasses would be rejuvenated. Prescribed fire and associated harvest and non-commercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA and reduce competition for resources between hardwoods and conifers. There would be a risk of prescribed fire reducing shade, however short-term increases in temperature (up to 6 months) are acceptable even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)).

With application of design criteria and BMPs, any reduction of stream shade would be spatially intermittent and short-term (<5 years) and would not be expected to measurably increase water temperatures. Long-term, it is anticipated that shade would increase over the next 5-10 years due to higher vigor of existing (and recently planted) hardwoods once some of the conifer canopy and understory is removed and/or consumed via implementation activities (CT, PCT and Rx burning within RHCAs). Increased shade from the hardwoods would lead to incrementally lower temperatures in streams which is a critical element fish need for survival during low flow periods when air temperatures increase in the summer months.

Temporary road construction (existing and new) and re-use of closed roads would not measurably affect shade or stream temperature because the majority of roads occur outside the PSZ and in most cases would not have mature vegetation tall enough to affect shade. The majority of stream crossings would occur on existing disturbance would occur on class IV streams where stream temperature is not a concern because these streams are generally dry during peak temperatures. Stream crossings would be rehabilitated upon completion of activities.

Minor, short-term (individual project implementation), effects from would occur but would be mitigated by scope and scale, staggered implementation and application PDF and BMP. Riparian restoration activities (stream restoration and headcut repair, hardwood planting and protection, weed treatments, road closures and decommissioning) would provide for increased shading from development of riparian vegetation, narrower stream channels, deeper pools and reconnected water tables would reduce water temperature short and long-term. Short-term, the potential to reduce shade

would be would be slightly higher in Alternative 3, but more beneficial long-term because of the increased amount of proposed restoration activities.

In summary, through the application of PDC s there would be no measurable increase in water temperatures resulting from any proposed activities (commercial and non- commercial thinning, Rx burning, road construction, stream crossings, or elevated sediment). A minor amount of shade would be reduced short-term (<5 years), but no measurable increase in water temperatures resulting from these activities is anticipated. In terms of hardwood treatments, Alternative 3 has slightly more potential to decrease shade than Alternative 2, while Alternative 2 has less hardwood stands that would be improved. Alternatives 2 and 3 would be consistent with standards and guidelines. Alternatives 2 and 3 would move the measure towards the desired future condition, Alternative 3 slightly more so than Alternative 2.

Alternative 2 and 3would be consistent with the applicable INFISH and ONFLRMP standards and guidelines and state water quality standards. PDF and BMPs would provide protection of water quality and avoid adverse effects to aquatic species.

Figure 20. Alternative 2- Select Commercial and Hardwood Units within the PSZ.

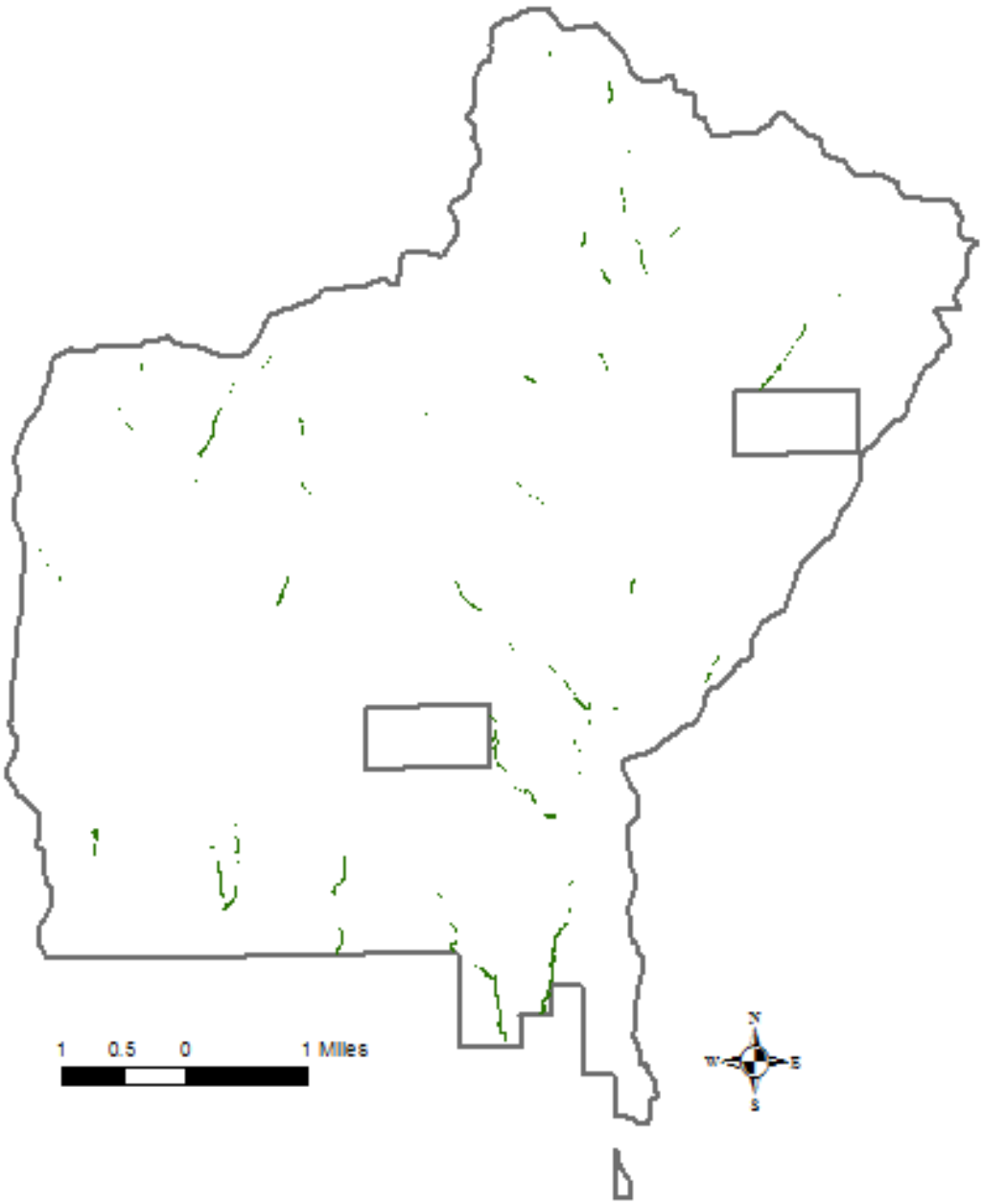
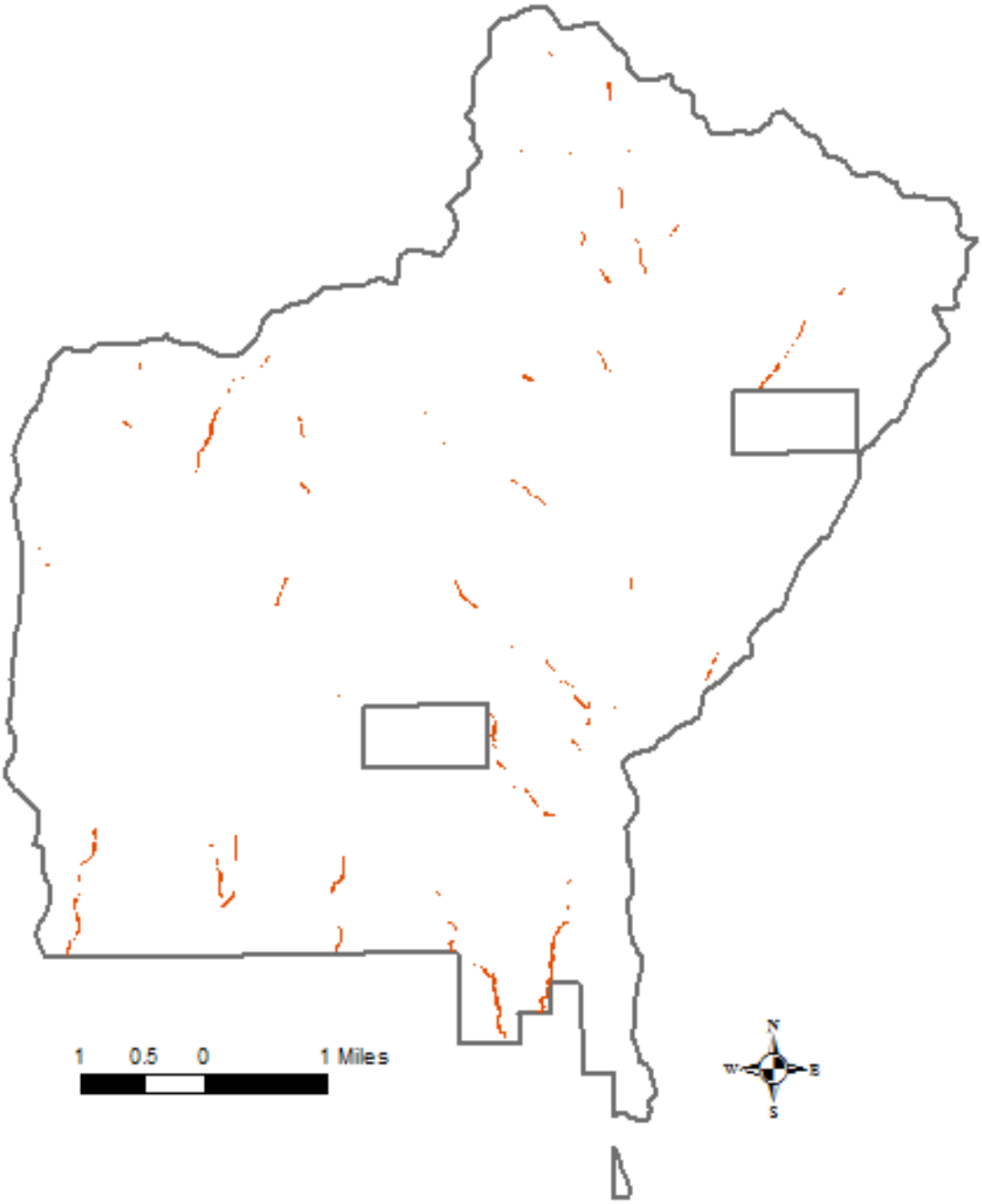


Figure 21. Alternative 3- Select Commercial and Hardwood Units within the PSZ.



Direct and Indirect Effects

Alternative 4

A portion of the RHCAs within the watershed are proposed to be non-commercially treated followed by prescribed fire and fuels treatments as summarized in Chapter 2. While in this alternative there would be no commercial treatment within RHCAs or the primary shade zone, there would be noncommercial hardwood thinning and fuels treatments. Proposed activities within RHCAs are similar to those in Alternatives 2&3 and are planned to improve attainment of RMOs.

Risk to affecting stream shade and subsequently temperature would be reduced primarily through the reduction of the amount of hardwood treatments and prescribed burning. Similarly, beneficial effects to promoting hardwoods, increasing shade long term, thus incrementally reducing temperature, would be reduced over Alternatives 1, 2 & 3.

Alternative 4 would move the measure towards the desired future condition but would be less than that of Alternatives 2 or 3.

Alternative 4 would be consistent with applicable INFISH and ONF LRMP standards and guidelines.

Cumulative Effects Common to all Action Alternatives

The cumulative effects boundary is defined by the Wolf project area. Present and foreseeable future projects that may negatively affect stream temperature via reductions in stream shade in the project area include: livestock grazing under the Southside Allotments EA (2009), Ochoco Summit OHV trail, and ongoing recreation. The Ochoco Summit OHV trail system project is not expected to measurably effect stream shade or temperature because project design features stipulate that no shade producing vegetation would be removed during to construct trails and crossings; reference Ochoco Summit OHV Trail DEIS.

Historic grazing practices contributed to the removal of deciduous woody vegetation and compaction of alluvial terraces. Livestock grazing continues in the project area, but levels have been reduced from historic amounts and riparian vegetation is improving, but is still below desired conditions. Activities within some RHCAs would likely attract livestock because removing small trees as well as surface and ladder fuels would remove barriers to livestock movement. In other areas higher slash levels and downed trees retained in RHCAs may impede cattle access to the streams. Increasing sunlight to the ground by removing some of the canopy cover would also increase growth of grasses, shrubs, and hardwoods. This would increase the amount of forage available which would attract livestock. Livestock are expected to continue to use riparian areas and are expected to consume some of the increased forage. However, more strict grazing management criteria are being implemented within the Southside Range Analysis as discussed previously and in the Range Specialist Report.

Under Southside implementation, riparian species have more protection from being overly utilized by cattle and will likely exhibit more vigorous growth due to the increased resources from thinning. Annual indicator monitoring has been shown to meet standards and guidelines during the last 5 years – see range report. Additionally, several treatment units have remnants of old livestock exclosures around portions of riparian areas. Riparian planting is proposed in some of these areas, but the young plants can be subject to browsing in areas that are not caged.

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs. These activities coupled with implementation of the project treatments may reduce stream shade, but will not likely contribute to any measurable long-term reductions in shade or increases in stream temperature.

Projects that have the potential to improve stream shade include implementation of the Deschutes and Ochoco Travel Management EIS (2011) and the Deschutes and Ochoco Invasive Plant EIS (2012).

Implementation of the Travel EIS may incrementally reduce negative impacts to riparian vegetation from motorized vehicles short and long-term buy restricting access of vehicles to the open road network including stream crossings (reference Transportation Report) and would likely reduce the spread of noxious weeds. Invasive plant treatments would improve native riparian plant communities and reduce sediment delivery via stabilization stream banks short and long-term. Cumulatively, with the implementation of riparian restoration efforts proposed in the Wolf project, riparian condition should improve.

Still, in Alternatives 2 and 3, the project would add cumulatively to decreasing shade in the short-term (<10 years) by thinning out competing conifers in hardwood stands but on a very limited scale (see above), distributed across the watershed. Additionally, shade may be impacted by application of limited prescribed burning activities within RHCAs (1,122 acres) but any effects would likely be short-term (<1 year). There should not be any measurable increase in water temperatures in any fish bearing or non-fish bearing perennial streams in the planning area. In the long-term, it is anticipated that shade would be improved due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities. Alternative 3 would be more impactful short-term but more beneficial long-term because of the increased amount of proposed restoration activities.

For Alternative 4, the impacts to shade are less than Alternatives 2 and 3, the potential cumulative effects; therefore, the potential cumulative would be less.

Recreation

This section includes the Recreation Report in its entirety. This section describes the effects of the proposed alternatives to the Ochoco National Forest's recreational visitors.

Recreational use in the Wolf project area includes wildlife viewing, hunting, sightseeing, camping, hiking, biking, horseback riding, snowmobiling, and off-highway vehicle use. See Map 14 for locations of some recreation features in the Wolf project area.

The Wolf project area includes two developed recreation sites including: Wolf Creek Campground, and Salter's Cabin Group Site Campground and general forest dispersed sites. There are no trails with ¼ mile of any treatment unit or within any practical distance to warrant further analysis of effects to any of the proposed alternatives.

The vision of Ochoco National Forest is to promote healthy watersheds, healthy communities, and sustainable ecosystems while providing abundant recreational opportunities. Visitors are invited to "discover their own special place," thus there are an abundance of dispersed recreation opportunities.

The central part of the Forest is easily accessible from Prineville on Forest Road 22 and Forest Road 42. From city of John Day access is by County Rd 42 and 58. From Prineville, the watershed boundary is about an hour and a half drive east of town on well-maintained paved road. Approximately 80 percent of the total recreation use on the Ochoco National Forest is represented by dispersed recreation (National Visitor Use Monitoring Results, September 2001, Ochoco National Forest, table 12). The Wolf project area, has been receiving a static amount of recreation use over the last 10 years primarily concentrated during holiday weekends and hunting season from September through November.

Dispersed Camping

Dispersed recreation camping sites are located throughout the Forest but are generally located along roads with many situated near riparian areas and streams. The site applies to the barren core of centered activity and the influence area immediately around it. As stated in the Ochoco National Forest Management Area (LRMP), "The dispersed campsites will exhibit a relatively natural appearance, even though management activities (such as timber harvest) may be highly visible nearby". There are 10 dispersed campsites, as identified by the Ochoco Land and Resource Management Plan within Wolf project area treatment units (see tables 179 and 180). It is likely that other dispersed camping sites have not been identified at this time due to the fact that users are continually creating new sites while others may be abandoned over time. Within the Wolf project area, dispersed sites tend to concentrate near the major travel routes and streams such as FS Road 12, 38, 42, and 5810.

Table 177. Dispersed Campsites within Treatment Units- Alternative 2 and 3 are identical

Treatment Type	Unit #s	# of campsites
Commercial Thinning	12,17,29,36,41,60,118,153,155,179	12
Noncommercial Thinning	12,17,29,36,41,60,118,153,155,179, 274, 286	14
Fuels Treatments	12,17,29,36,41,60,118,153,155,179, 274, 286, 342	15

Table 178. Dispersed Campsites within Treatment Units-Alternative 4

Treatment Type	Unit #s	# of campsites
Commercial Thinning	17,29,36,41,60,118,153,155,179	11
Noncommercial Thinning	12,17,29,36,41,60,118,153,155,179, 274, 286	14
Fuels Treatments	12,17,29,36,41,60,118,153,155,179, 274, 286, 342	15

Alternative 1

There would be no direct effect on dispersed camping sites in the project area. Use of these sites is not expected to change. This alternative does not include any treatment units. Over time, the visual character of the areas would change as understory trees are allowed to grow and stands become denser. Large diameter ponderosa pine would become less common. Associated risk of overstock stands could increase risk to disease, insect infestation and wildfire, which if occurs, would alter the character of the recreation experience at these sites.

Alternatives 2, 3 and 4

Treatment would improve the long-term health of timber stands adjacent to the above camping areas; however, short-term impacts (3-5 years) to the affected camping areas from commercial harvest activities would include increased noise from tractors, and dust from logging operations; increased traffic for log hauling; reductions in visual quality from logging slash, stumps, and post-logging treatments; slash from noncommercial thinning treatments; smoke and blackened ground and vegetation from under burning activities. Some dispersed site users may be temporarily displaced due to loss of access during harvest activities. This could increase camping use at other dispersed sites. Using developed campgrounds and heavily used dispersed sites for industrial camps would not be allowed. Visual evidence of treatment activities may be apparent to the casual forest visitor at or near some of these camping areas.

Noncommercial thinning and underburning activities would have short-term impacts on users such as noise from thinning activities, smoke during underburning, and visible blackened ground and vegetation. There are 14 recognized dispersed sites within proposed noncommercial thinning units and those plus a 15th within natural fuels under burn units. Visual evidence of treatment activities may be apparent to the casual forest visitor at or near some of the camping sites.

Developed Recreation Sites

There are two developed recreation facilities within the Wolf project area. The objective of these management areas is “to provide safe, healthful, and aesthetic facilities for people to utilize while they are pursuing a variety of recreational experiences within a relatively natural outdoor experience”. Timber activities will normally not be visually evident, but may be used for safety and visual enhancement. Facilities, roads, and trails will have a well maintained appearance and provide a safe recreational environment.

Wolf Creek Campground is a fee site facility containing 15 sites located 68 miles SE of Prineville. There are two loops and are on either side of FS Rd 42. With mature over-story ponderosa pine and Douglas-fir and white fir, this campground provides a shaded, quiet creek side forested landscape. The campground lacks potable water and motor home utility hookups. Therefore, due to its distance from population centers, lack of trails and other destination values, and amenities, this facility

receives only a small fraction of its seasonal capacity, less than five percent. This campground receives little public use throughout the spring and summer. Hunting season in fall into early winter encompasses the majority of use which generally is moderate with campsites still available.

Dust, noise, smoke, and hauling activity may be observed during times of treatment for short durations that would include a portion or entire length of stay. Depending on location and timing of treatment activity, hunting and scenic values may be affected in specific locations. There are 16 units within ¼ mile of Wolf Creek Campground that would have some type of treatment under both the proposed and Alternative 3 and 18 units with treatment under Alternative 4. See tables 182 and 182.

Table 179. Proposed Action and Alternative 3 Treatments within 1/4 mile of Wolf Campground are same.

Treatment Type	Unit #s
Commercial Thinning	24, 25, 26, 27, 28, 29
Noncommercial Thinning	24, 25, 26, 27, 28, 29, 202, 203, 204, 205, 206, 217, 218, 253
Fuels Treatments	24, 25, 26, 27, 28, 29, 202, 204, 205, 206, 217, 218, 329, 338

Table 180. Alternative 4 Treatments within 1/4 mile of Wolf Campground

Treatment Type	Unit #s
Commercial Thinning	24, 26, 27, 28, 29
Noncommercial Thinning	24, 25, 26, 27, 28, 29, 202, 203, 204, 205, 206, 217, 218, 253, 356, 357
Fuels Treatments	24, 25, 26, 27, 28, 29, 202, 203, 204, 205, 206, 217, 218, 329, 338, 356, 357

Salter's Cabin Group Site is a free recreation facility containing one group site with opportunity for other dispersed sites adjacent though not formally delineated. Salter's Cabin is a small cabin not available for overnight use. Public use for the site is first come-first served, no reservations. Salter's is located 68 mi. SE of Prineville on Forest Road 42, one mile south of Wolf Campground.

Dust, noise, smoke, and hauling activity may be observed during times of treatment for short durations that would include a portion or entire length of stay. Depending on location and timing of treatment activity, hunting and scenic values may be affected in specific locations. There are 10 units within ¼ mile of Salter's Cabin Group Site that would have some type of treatment for both the proposed Alternative and Alternative 3 and there would be 12 units of treatment under Alternative 4 (see tables 183 and 184).

Table 181. Proposed Action and Alternative 3 Treatments within 1/4 mile of Salter's Cabin Group Site are same.

Treatment Type	Unit #s
Commercial Thinning	26, 27, 28, 29

Noncommercial Thinning	26, 27, 28, 29, 202, 204, 218, 253, 256
Fuels Treatments	26, 27, 28, 29, 202, 204, 218, 256, 328

Table 182. Alternative 4 Treatments within 1/4 mile of Salter's Cabin Group Site

Treatment Type	Unit #s
Commercial Thinning	26, 27, 28, 29
Noncommercial Thinning	26, 27, 28, 29, 202, 204, 218, 253, 256, 356, 357
Fuels Treatments	26, 27, 28, 29, 202, 204, 218, 256, 328, 356, 357

Alternative 1

This alternative does not include any treatment units and over time, the visual character of the areas would change as understory trees are allowed to grow and stands become denser. Large diameter ponderosa pine would become less common. Associated risk of overstock stands could increase risk to disease, insect infestation and wildfire which if occurs would alter the character of the recreation experience at these sites.

Alternatives 2, 3 and 4

Activities in Alternative 2, 3 and 4 would have direct and indirect activity in the general location and visitors would experience some temporary noise and smoke depending on treatment type during their stay. Parts or whole recreation sites may be temporarily closed for public safety when activity is occurring. All three alternatives would present no long term direct changes to these facilities for its uses. Observations of treatment activity from these facilities would be limited to the time frames necessary to complete and would reasonably include only those treatments at and within a half mile.

Cumulative Effects for all Alternatives

Ochoco Summit Trail System EIS:

A final decision on the Ochoco Summit OHV Trail EIS is pending. There are three alternatives identified and all have slightly different mileage; trail lengths with the project area would be approximately 10-12 miles. Cumulatively, the effects of the Wolf project activities, along with the potential of increase in OHV traffic could negatively impact the recreational experiences of both dispersed and developed users.

Deschutes and Ochoco National Forests Travel Management Project (Motorized Vehicle Use Map):

This decision was signed in 2011, and is currently being implemented. Motorized vehicle use is allowed on designated routes only. Change of use patterns or use statistics are currently unknown. Due to an increase of public education and awareness with OHV access and legal use, reduced cross country travel and delineation of current campsites within 300 feet of accessible roads are expected. However, coupled with thinning and prescribed burning activities, illegal OHV use may increase due to more open vegetation adjacent to roads.

Heritage Resources and Plants of Cultural Value

Affected Environment

Native Americans

Early inhabitants of the Wolf project area were well adapted to the unique ecosystems of central Oregon. However, in contrast to the surrounding geographic regions, very little systematic archaeological data recovery has been conducted in the Ochoco uplands. Nonetheless, the limited archaeological investigations that have been conducted in the area suggest that Indian people have visited those uplands for thousands of years (Aikens 1993). That conclusion is further supported by hundreds of Federal cultural resource inventories that have identified diagnostic flaked stone tools dating from the early archaic period to post-historic times during the course of Forest archaeological surveys (approximately 9,000 years ago to the late 1800s).

Due to cold winters and snowfall, the Ochoco uplands were primarily visited during the spring, summer, and fall. Such scheduling extended and expanded seasonal hunting and gathering opportunities not available in lowland settings. The area offered edible roots, berries, game, and fish. Harvest times were later than in the adjacent lowlands and thus extended the season of availability for food resources. Upland settings also offered materials necessary for daily life, including materials for tool and utensil making, basketry, mats, clothing, shelter, medicines and foods. To the south and southeast of the project area, the North and South Fork of the Crooked River provided north-south access routes between obsidian resources to the south and upland prairies and meadows.

Central Oregon and the Ochoco uplands are within the traditional territory of the Hunipuitoka band of the Northern Paiute people (D'Azevedo 1986; Minor et. al. 1987; Ellis et.al. 2002). The area was also of tribal interest to ancestors of tribal members of the Confederated Tribes of the Warm Springs Reservation, the Klamath Tribe, and the Confederated Tribes of the Umatilla Indian Reservation. Archaeological investigations show a preference for sites along the main stem of the Crooked River and associated meadows or prairies. Isolated tools have been documented on the steeper timbered slopes indicative of hunting and resource procurement activities. Lower elevation areas like the Crooked River valley and the present town site of Prineville were good wintering areas.

A variety of site types represent a mobile hunting and gathering lifeway dependent on upland resources as part of indigenous peoples' seasonal rounds. Site types vary and include, but are not limited to, surface lithic scatters, and complex sites with formed tools and features such as house pits, camas ovens and peeled trees. However, it is more important for the management of cultural resources to recognize the patterns of land use and ecological adaptations, specifically subsistence round, settlement patterns and social ties as manifested through material remains (Lebow et. Al. 1990).

The introduction of Euro-American culture brought abrupt changes to the hunting and gathering life ways for the Plateau and Great Basin groups. Congress affirmed Indian land title in Oregon in 1848 and between 1850 and 1877 implemented treaty policies. By 1850, traditional life ways were significantly interrupted. The 1855 Treaty with the Tribes of Middle Oregon established the Warm Springs Indian Reservation. The treaty also reserved usual and accustomed rights and interests on lands ceded to the government. Those reserved rights protect and retain tribal rights and privileges for hunting, fishing, gathering roots and berries, and pasturing stock. The boundary of lands ceded to the government in the 1855 Treaty extends from the Cascade Mountains through Central Oregon and up to the Columbia River inclusive of all lands within the Ochoco National Forest and Crooked River National Grassland. The Confederated Tribes of the Warm Springs Reservation (CTWSR) entered into a 2003 Memorandum of Understanding with neighboring forests to work in cooperation towards the development and implementation of policy, program recommendations and actions affecting lands and natural resources. The agreement recognizes the need to be consistent with Tribal concerns for

water, fish, wildlife and roots. The Warm Springs Tribal Code Chapter 490, Ordinance 68 (Confederated Tribes of Warm Springs N/D) sets forth the protection, preservation and encouragement of tribal and Indian history, culture, tradition, and heritage.

Euro-American Settlement

Exploration, fur trapping, mining, and settlement are common themes of the American West. In the 1820s and 1830s, fur seekers traveled through the Deschutes Basin. Trappers gained familiarity with the landscape as noted in their diaries. Government sponsored exploratory expeditions brought John C. Fremont to central Oregon in 1843. In 1845, Stephen H. L. Meek led nearly 200 wagons of overland emigrants through eastern and central Oregon on an ill-founded effort to open a wagon road through the area to the Willamette Valley.

The discovery of gold brought mining efforts into the Ochoco Mountains. Although mining continued into the 1900s, gold mining efforts faded and cinnabar mines and the production of mercury flourished into the 1940s.

Euro-American settlers found their way to Central Oregon following promotion of tall grasses and lush forage, plentiful water and open lands. Liberal land policy spurred settlement and residents came ready to stake their claim and make a living with livestock, farming and ranching. The Homestead Act of 1862 opened the area for settlement and the arrival of the railroad in the 1880s brought more intensive settlement to the area.

By the early 1900s, populations had increased, communities were established with transportation systems and the supply of goods and services was in place. Communities like Prineville and Mitchell were developing. Post offices commonly started in one of the ranch houses establishing the "community" by name. Communities flourished in the early 1900s but economics and social patterns changed by the 1930s and 40s. Individual families sold parcels and ranches became larger. The community of Prineville grew and smaller communities joined the rural landscapes.

The Western Division of the Blue Mountain Forest Reserve established their headquarters in Prineville, Oregon in 1906. In 1908, executive orders changed the Forest Reserves to National Forests and Prineville became the headquarters for the Deschutes National Forest. Subsequent boundary changes were made and Prineville became headquarters for the Ochoco National Forest in 1911.

The Ochoco National Forest took responsibility for land management decisions such stock grazing, posting boundaries, coping with bark beetle infestations and making administrative improvements. Rangers worked closely with stockmen revising stock grazing allotments. The forest played a key role in settling disputes in addition to establishing grazing allotments and pastures. Grazing allotments were established and permit numbers were based on the carrying capacity of the base ranch, generally located on the adjacent private lands. Stock driveways were designated to cross the Ochoco Mountain in an attempt to settle controversial competition for forage while crossing the forest. Springs were developed with log watering troughs and a few of these unique troughs are still in use today. Sheep herders and cattlemen can be traced through their names and dates carved into the aspen stands throughout the Ochoco Mountains (Terry Holtzapple 2009).

Unique Features

Unique features in this portion of the Ochoco National Forest contain segments of two historic linear features within the project boundary; the "Beaver Creek to Dayville Road" and the "Summit Trail". The Beaver Creek to Dayville Road traveled between the communities of Paulina and Dayville. Site record information suggests that the road may also have been referred to by early settlers as the "Apple Road", as residents of Paulina would often travel the road to Dayville with the express purpose of purchasing apples, squash and whatever other produce was seasonally available. Site record information implies that the road was most commonly used between 1890 and the 1920s.

Most of the road today has been incorporated into Forest Service road 5810. A segment of the Summit Trail is located along the northern margins of project area just south of Forest Service road 38. This early transportation route, established in 1908, traversed the crest of the Ochoco Mountains from Prineville to the South Fork of the John Day River. It was originally used to move livestock across the forest as a stock driveway and provide access to fire lookouts across the forest. Over the years, much of the road has been modified through widening, rocking and paving. The segment within the project boundary has had little modification through time. The entire trail is considered eligible for listing on the National Register of Historic Places.

Cultural Plants and First Foods

Tribes of Warm Springs Reservation and other neighboring tribes have a strong and valued connection with the land and continue their cultural traditions and practices to preserve, protect, and promote tribal culture and heritage today. The Ochoco Mountains are within ancestral and aboriginal lands of interest to The Burns Paiute, The Confederated Tribes of the Umatilla Indian Reservation and The Klamath Tribes.

Traditional cultural plants or First Foods is the name of the Confederated Tribes of the Warm Springs Indian Reservation program for maintaining cultural practices and traditional plants. Many of these plants and their habitat are present in the Ochoco National Forest and continue to be gathered today. The following represent some of the representative First Foods present in the Ochoco National Forest and within the Wolf project area.

Blue camas (Camassia quamah) or “Wa -ka-mo” likes wet meadows and blooms in the early summer.

Bitter root (Lewisia redivivia) or “piaxi” is a root crop that likes shallow soils known as lithosols. Wild celery (Lomatium nudicale) or “cum-see”, Biscuit root (L. cous) or “cous” and Desert Parsley (L. canby)i or “luks” have a broader habitat but still like shallow soils.

Indian carrot (Perideridia gairdneri) or “sawitk” has a broad distribution and is found in open and forest areas.

Black lichen or hanging black moss (Alectoria sp. or Bryoria femontii) or “k’unc” is present in many tree species and is most desirable in mature Ponderosa pine (Confederated Tribes of Warm Springs, ND).

Cultural traditions are involved with the timing for collecting and gathering, and traditional gatherers are often identified or appointed by the Tribe. Gathering is also a family tradition and the location of these traditional gathering areas is highly valued. Habitat has been identified and shared in an attempt to offer non-reservation areas for traditional gathering areas. Although names common to the CTWSR have been given, these cultural plants are of interest to several neighboring Tribes including the Burns Paiute, Umatilla and Klamath Indians.

Environmental Effects

The effects analysis is based on the potential for damage to artifacts, features, environmental settings and alteration of the surface and subsurface arrangement by machinery, fuel loadings, potential temperatures and duration of fire treatment. Prior to the Wolf project, nine previous cultural resources surveys, totaling 15,871 acres, had been conducted within the boundaries of the current analysis area. Cultural resources survey for the Wolf project undertaking entailed examining fifteen survey units and eleven short segments of new temporary roads for a combined total of 288 acres. When previous and current cultural resource survey coverage is combined, a total of 16,159 acres have been examined for the presence of archaeological resources within the project boundaries. During the course of those past and present surveys, 51 archaeological sites have been discovered and documented. Twenty five of those archaeological sites are associated with the historic era while the remaining 26 are prehistoric sites.

Dominant historical themes are largely represented by archaeological sites associated with stock grazing between 1880s and the 1950s, transportation routes ranging from the 1890s to the present and Agency administration. Site types associated with the stock grazing theme include stock driveway routes, log water troughs, inscribed aspen trees, refuse scatters, a cabin and a historic water feature. Transportation routes include 2 historic roads; the Beaver Creek to Dayville Road (1890s to 1920s) and the Summit trail (1908 to present) foot, horse, stock and vehicle route that originally crossed the Ochoco National Forest from the community of Prineville to the South Fork of the John Day River. The primary site associated with Agency administration is the Summit Trail as well as a historic phone line and drift fence that are associated with the Summit Trail. Lithic scatter sites, or those locations where stone debris was produced as a result of stone tool manufacture, are represented by slightly more than 50% of the documented archaeological sites within the Wolf Vegetation Management project boundary. Lithic scatter sites in this area are generally located where various resources could be exploited and/or harvested. Those sites are largely open-air, surface sites consisting of debris left behind after the production of flaked stone tools. However, some of those sites have the potential for subsurface, cultural deposits.

In the past, the historic Summit Trail corridor represented a travel corridor for moving stock and as a transportation route along the high elevation summit of the Ochoco Mountains. The road is still in use today and has been upgraded in many areas by widening, rocking and, in some places, paving the original road bed. The route has been determined eligible for listing on the National Register of Historic Places and is managed to retain physical features and the natural setting along the route. Segments are rated by their integrity and the setting is managed through preservation, retention or partial retention objectives. The Summit Trail segment and its associated features (a drift fence and phone line) in this project area lay just south of Forest Service road 38.

Artifacts, features and their locations within the project area may be negatively affected by ground disturbing activities caused by logging methods and equipment, road construction, fuels treatments (under-burning and mechanical thinning of young trees) and unplanned wildfires. Machinery may crush artifacts and disturb the spatial arrangement of a cultural site or feature. The temperature, duration and intensity of wild land fire and prescribed fire may melt stone artifacts and alter the hydration bands on obsidian. Such conditions would be expected in wild land fire situations with high severity fire or where fuels are concentrated, such as machine piles. Prescribed fire conditions can be designed and implemented to achieve low burning temperatures and short duration fire and not adversely affect lithic scatter sites. Methods used for dating archaeological materials and environmental conditions rely on relatively stable environmental conditions and high burning temperatures can “reset” chronological indicators. Research has shown obsidian is altered with temperatures ranging from 200 to 300 degrees Celsius and greater (Lloyd, et. Al. 2002). The fire intensity and duration of burning are highly variable and dependent on the nature of existing fuels as well as weather conditions.

Traditional cultural areas are used today by tribal members for hunting, gathering, collecting, fishing and practicing traditional life ways. Ground disturbance from machinery may adversely affect those areas and habitats. The use of fire before plants are dormant may reduce plant populations and their abundance, making the timing of fire very important. Prescribed fire may also improve plant habitat and benefit plant populations when used during the appropriate plant cycle.

Access to use certain areas is a concern for neighboring tribes and activities such as closing roads may restrict or limit access. Similarly, limiting or controlling access from vehicles and all-terrain vehicles (ATVs) would reduce surface disturbances and potentially reduce vandalism and looting at cultural sites resulting in a positive effect.

Alternative 1

Existing management practices would continue under the No Action Alternative but no new vegetative treatments would be scheduled. Levels of natural fuels would continue to accumulate. Densely stocked understory trees would not be treated and thinning of larger trees would not occur. Untreated fuels under this alternative would increase the potential for unplanned high intensity wild land fire. Catastrophic stand replacement fire would have a negative effect on both surface and subsurface archaeological resources as well as natural settings.

Archaeological sites within the project area would continue to degrade from stock grazing, weathering, erosion, wild land fire suppression, recreational events, firewood cutting, vandalism and surface artifact collecting. Natural fuels would continue to accumulate, exposing lithic tool sites to heat from fires and possible damage from suppression activities. Fuel loading would not be reduced using commercial harvest methods and natural fuels burning along the Summit Trail. These types of conditions would increase the risk of unplanned wildfire and the subsequent need for fire suppression activities. Suppression activities have the potential to be more damaging than fire alone. The Summit Trail, and its associated features, eligible for listing on the National Register of Historic Places, would continue to degrade and deteriorate from natural causes.

Tribal access, gathering and collection activities would continue under the No Action alternative because there would be no change to the current road system or current condition of vegetation.

Alternatives 2, 3 and 4 (Action Alternatives)

Alternatives 2, 3 and 4 would have the potential to disturb archaeological sites. However, design criteria built into this proposed project would protect those qualities of a site that make it eligible to the National Register of Historic Places (NRHP). For those archaeological sites within proposed harvest units, buffers would be placed around them to protect them from ground disturbing activities. All skid trails and landings near sites would need approval before harvesting. Vulnerable historic sites would also be protected from fuel reduction activities proposed for the action alternatives. Those site types would either have fuel lines dug around them for avoidance from flames, or fuels surrounding the site would be pulled back to reduce threats from heat and flames. Road construction and stream restoration projects would avoid all eligible sites. In view of the design criteria developed for the protection of archaeological and historic sites, Alternatives 2, 3 and 4 conform to those Federal laws, regulations and guidelines that provide for the protection of NRHP-eligible sites. These alternatives would have no impact to the traditional life ways of local, federally recognized tribal members because no roads would be closed that may affect access to known traditional use areas.

Summit Trail

The historic Summit Trail corridor (MA-F7) is managed to retain the natural setting as well as physical features associated with this trail. Under all action alternatives, the historic Summit Trail (F.S. road 090) would be managed to protect and retain all cultural features and manage vegetation within the visual management areas. Harvest would be allowed to thin young trees adjacent to the trail, and noncommercial thinning of young trees, hand piles and under burning would be allowed to reduce fuels and benefit long term fire protection. Thinning slash in the foreground areas would be hand piled.

The features, integrity and natural setting of the historic Summit Trail would benefit from those treatments in the long-term. Harvesting smaller diameter trees in the foreground, adjacent to the 090 road, would return the environment of the route to a more historic setting, similar to its appearance in the early part of the 20th century, when the trail traveled through a forest dominated by large, old growth ponderosa pine. Fuels would be reduced and the potential for stand replacement fires would decrease. The natural setting would be modified in the short-term due to timber harvest, mechanical removal of young trees and hand piles. The casual visitor would see stumps from the removal of

young trees, skid trails, log landings, hand piles, scorched bark and black or yellow needles from under burning in the short-term (1-3 years). With the passage of time, those signs of disturbance would gradually diminish providing the forest visitor with the feeling, environmental setting and travel design of how the trail appeared during the early 1900s.

Cumulative Effects

Alternative 1 – No Action

Surface and subsurface cultural materials on the Paulina Ranger District, both historic and prehistoric, have felt the effects of both natural and human-caused activities for thousands of years, sometimes since the day the materials were deposited in the archaeological record. Wildfires, flooding, erosion, and weathering are just some of the agents that cause natural damage and deterioration to archaeological sites. The human induced, cumulative effects of logging, road building, grazing, surface collecting and/or illegal digging, and natural fuels reductions accelerate the effects from natural causes. All those activities would still be reflected in the integrity of those sites. Early site records, dating from the 1970s, often document the disturbance of surface archaeological sites from logging activities, both past and present. Beginning in the mid-1980s, surface sites were given more protection in order to obtain a clearance for a proposed project with the State Historic Preservation Office (SHPO). However, those sites still reflect damage today. With this Alternative, archaeological sites would continue to be damaged from natural and human caused agents unless protective measures were implemented.

Alternatives 2 – 4

The Heritage design criteria for this undertaking would diminish damage that might affect archaeological sites for proposed projects under these alternatives. Nevertheless, natural elements, logging, road building, grazing, surface collecting and/or illegal digging for archaeological resources, recreation, firewood cutting, off-road activities and natural fuels reductions could still be reflected in archaeological sites.

Scenic Quality

This section includes the Scenic Quality analysis in its entirety.

The existing scenery has a variety of disturbed and undisturbed areas. Human-caused activities have altered the natural-appearing landscape. Diverse vegetation stands and species (with various age, size classes, and health conditions) can be found throughout the project area. These vegetation stands include: ponderosa pine, lodgepole pine, western larch, Douglas-fir, white fir, and riparian species. They provide strong diverse lines and textural and color patterns most densely located on Northern slope and drainages while broken up by occasional view openings of dry upland scab flats into the foreground landscape.

Although the existing forest conditions may appear natural to a casual visitor, the forest conditions are not natural. Older trees are being suppressed by the densely stocked understory due to the change in fire regime caused by fire suppression. Densely stocked forest and canopy closure, due to the lack of low intensity fire regime, has led to the loss of the open, park-like ponderosa pine stands historically found within the area. Overstocked and dense stands in parts of the project area have led to increased fire risk. The more recent Black Canyon fire of 2008 is a good example for this discussion. The natural processes can no longer function as they did historically because of these dense stand conditions. The competition for available space, nutrients, and the encroachment from shade-tolerant understories is prevalent, especially along the travel and scenic corridors (within 0.25 miles). The depth-of-field view deep into the forest is restricted to mostly the immediate foreground area of the landscape due to the high level of vegetation density.

Forest Roads 12, 22, 38 and 42 and 4210 are visual corridors as directed in the Ochoco LRMP and are popular routes for pleasure driving. They are within proximity to Prineville and John Day and provide for opportunities for scenic landscapes, wildlife viewing, etc. These management areas provide opportunities for scenic vistas, wildlife viewing, and access to dispersed and developed camping. Maintaining a natural appearance and protection of natural resources along these roads accommodates visitors seeking of natural scenery and provides a high quality recreational experience. The general emphasis in these areas is to maintain the natural-appearing character of the forest.

Alternative 1

Under this alternative, the existing vegetation within the project area would not be altered or changed by any management activity.

Scenery would remain essentially the same during the short-term duration (0-5 years) and may be adversely altered through time (5 years and longer) as multi-strata conditions continue to increase. Encroachment by shade-tolerant species would continue and stand densities would continue to increase. Views of open, park-like stands of older and larger ponderosa pine would become less frequent. Risk to disease and stand replacement high intensity wildfire would continue to increase.

Alternatives 2, 3 and 4

To the casual forest visitor, the differences between Alternatives 3 or 4 would not be noticeable. Therefore, both alternatives are being presented together. The Forest visitor could expect to see stumpage, hand piles, blackened woody debris from under burning and slash pile activity. Burning evidence would be evident from 1-3 years with fuel reduction benefits lasting much longer. After the short term effects of treatment activities recovered, the diverse scenic views would be expected to enhance a visitor's experience along visual corridors. Field of view would increase more consistently while traveling within these visual corridors. Multi- strata stands would decrease as overstory selections are retained. With field of view enhanced, more topographic features may be observed.

Management activities would occur within the Scenic Corridors, within Retention and Partial Retention visual management allocations. The long term (20 years and longer) scenic quality within the treatment areas may improve slightly or would remain the same as the existing condition. Less alteration to the scenery would occur due to the removal of smaller, understory trees.

Historic Summit Trail

A portion of the Historic Summit Trail resides in the current location of road 3800090 along Wolf Ridge as Partial Retention and approximately one mile of road 1250 as Retention within the Wolf project area. The Ochoco Plan designated this historic trail as "partial retention and retention" with an emphasis of protecting the integrity of the Summit Trail. The visual management boundary would not exceed 600 feet either side of road. As stated in the Ochoco Plan Desired Condition: "The Summit Trail would be a place where Forest visitors can enjoy the cultural and recreational resources offered in a visually pleasing environment. Vegetation may appear manipulated in widely dispersed areas in order to enhance the cultural and recreational resources, but would generally not dominate the landscape."

Traveling FS Road 3800090 and 1250, the observer would expect to see commercial thinning and possibly under burning. Noise and thinning activity exposure would be temporary during treatment. See above "General Discussion" for anticipated visual change descriptions.

Visual Management Corridors

FS Road 12, 38, 42, 5810: Emphasis for these corridors is to maintain the natural appearing character of the Forest along major travel routes, where management activities are usually not evident or are visually subordinate to the surrounding landscape. The management boundary would not exceed 600 feet either side of road. Partial Retention objective would result in long term management where

activities may be evident but are visually subordinate to the characteristic landscape. Vegetation would be manipulated but would reflect a natural forest setting.

Common observations may view within the 600 feet of roadway, cut stumps, hand piles, and blackened remains from burning to be visible for 1-3 years. Noise and hauling traffic would be present at varying times of year summer and winter. Approximately nine miles of Rd 22 would experience burning prescriptions. Such treatments would vary over length of time and seasons. Recovery of grass, forbs and perennials would also vary differing stages of recovery contributing to a tapestry of open mosaics.

Forest Plan direction for Scenic Resources would be met with the retention of residual trees, post-treatment cleanup activities, implementation of design elements, and on-site monitoring. There are a combined total of ten dispersed campsites along these routes.

Air Quality

This section includes the entire air quality analysis. The Oregon Department of Environmental Quality is responsible for assuring compliance with the Clean Air Act. The DEQ monitors the emissions from prescribed fire through the Oregon State Department of Forestry smoke management program. (State of Oregon, 2005) Site specific fuels data is entered into a state database along with observations of environmental conditions taken while burning. This data is used to determine the amount of emissions produced statewide by prescribed fire, and maintain compliance with the Clean Air Act.

The Oregon Administrative Rules regarding smoke management encourages using wood or other biomass for making products or for energy production in order to reduce emissions from prescribed fire (OAR 629-048-0200(1)). Slash piles would be available for market. As the market for biomass increases, more piles would be removed from the forest, reducing the smoke from pile burning.

The OARs define Smoke Sensitive Receptor Areas as areas that are provided the highest level of protection under the smoke management plan because of their history of smoke incidents, density of population or other special legal status related to visibility. (OAR 629-048-0005(26)) The nearest SSRAs to the project area are Redmond, 65 miles to the west, and John Day, 45 miles to the east.

The OARs define Class I Areas as wilderness areas designated by Congress that are subject to visibility protection under the Environmental Protection Agency's Regional Haze Rule and the federal Clean Air Act. (OAR 629-048-0005(5)) The nearest Class I wilderness to the Wolf project is the Strawberry Mountain Wilderness, 45 miles to the east.

Due to distance, prevailing winds, and the short duration and low volume of smoke from prescribed fire, smoke from burning in the Wolf project area would not likely effect Class I wilderness areas or Smoke Sensitive Receptor Areas. There is no history of smoke from burning in the Wolf project area effecting Class I wilderness areas or Smoke Sensitive Receptor Areas.

Smoke from prescribed fires has occasionally pooled in the Paulina valley. Pooling occurs in the late evening/early morning hours as cold stable air settles into the valley bottoms, and generally lifts by mid-day as the valley heats up. Smoke from prescribed fires could impact hunter camps and forest roads, for the same reason. Prescribed burning would be suspended during persistent inversion conditions to avoid having smoke pool in the valley for more than a few days.

A high percentage of wildfire smoke (by mass) is within the PM 2.5 particle class size. These are respirable particles less than 2.5 micrometers in diameter which are of the most concern to human health because they can be inhaled deeply into the lungs. (Ottmar, 2001) The example below compares the production of PM 2.5 from a wildfire before treatment and from a wildfire after treatment. The example Fire Regime I unit has fuels conditions characteristic of Condition Class 3;

closed canopy, heavy surface fuels and ladder fuels. Condition Class 1 is the condition in the unit after it has been harvested, which opens the canopy; thinned, which reduces ladder fuels, and; burned, which reduces surface fuels.

Table 183. Smoke Production (PM 2.5). (USFS, 2005)

High Hazard/CC 3 **Wildfire before treatment**	Low Hazard/CC 1 **Wildfire after treatment**
.16 tons per acre PM 2.5 (total consumption 17.4 tons per acre)	**.08** tons per acre PM 2.5 (total consumption 9.7 tons per acre)

Wilderness, Potential Wilderness Areas, Inventoried Roadless Areas, and Other Undeveloped Lands

This section of the EIS includes the entire analysis of affected environment and environmental consequences for wilderness areas, potential wilderness areas (PWAs), Inventories Roadless Areas (IRAs) and other unroaded or undeveloped lands.[5]

Wilderness

Affected Environment

A wilderness area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. Wilderness is undeveloped Federal land retaining primeval character and influence without permanent improvements or human habitation. The Ochoco National Forest contains about 36,200 acres of designated wilderness in three Wilderness Areas: Black Canyon (13,400 acres), Bridge Creek (5,400 acres) and Mill Creek (17,400 acres) (Forest Plan p. 4-46).

Environmental Consequences – All Alternatives

There are no designated wilderness areas within or directly adjacent to the Wolf project area; the closest wilderness area, Black Canyon is several miles away. Activities proposed in the action alternatives would have no effect on the wilderness character, including solitude, on any Wilderness Area on the Ochoco National Forest because of the distance between the Wolf project area and the nearest wilderness. No activities would occur adjacent to or within any designated wilderness area.

Inventoried Roadless Areas

Affected Environment

Inventoried Roadless Areas (IRAs) were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas. Most IRA boundaries are substantially identical to those identified as 'Roadless Areas', referred to in the 1982 planning rule (36 CFR 219.17) and identified by the Forest Plan, FEIS, Appendix C; however some localized, minor differences in boundaries may exist.

[5] The term 'other undeveloped lands' is presented and used in this document to provide a consideration for lands that do not contain roads and evidence of timber harvest.

All roadless area acres were allocated to various management area strategies as disclosed in the Ochoco Forest Plan FEIS. Some management area strategies were intended to retain the undeveloped roadless character of the roadless area and some management area strategies were intended to develop the lands with timber harvest and road building activities; thus forgoing roadless character.

Environmental Consequences – All Alternatives

There are no IRAs within or directly adjacent to the Wolf project area. The closest IRA (Rock Creek/Cottonwood Creek) is located approximately four miles to the north of the project area. The area separating the Wolf project and Rock Creek/Cottonwood Creek IRA is extensively roaded. Due to the distance to the nearest IRA, the Wolf project would have no direct, indirect or cumulative effects to any IRA.

Environmental Consequences – All Alternatives

No commercial thinning activities are proposed within the Green Mountain Roadless Area. There are about 2,294 acres of non-commercial, restoration-based activities proposed within the Green Mountain Roadless Area that are common to all three action alternatives; these include juniper cutting (with jackpot burning), noncommercial thinning and prescribed burning. These activities would be done manually (without ground-based equipment) and would not require use of temporary roads. These non-commercial activities would result in improved health and resiliency in treated stands, and would improve forage for big game and for livestock. See discussion in the “Wildlife” and “Range” sections of this FEIS for more information.

The GIS that summarized activities proposed in the Green Mountain Roadless Area identified about 9 acres of commercial harvest. This is due to mapping error; commercial harvest units were designed to be outside the boundary of the Green Mountain Roadless Area.

Potential Wilderness Areas

Affected Environment

Potential wilderness areas (PWAs) are identified using inventory procedures found in Forest Service Handbook (FSH) 1909.12 Chapter 71. The inventory is conducted by the Forest Service with the express purpose of identifying potential wilderness areas in the National Forest System. Potential wilderness areas are identified during the forest planning process.

Potential wilderness areas are not a land designation decision, they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Chapter 72), and lastly they are not preliminary administrative recommendations for wilderness designation (Chapter 73). The inventory of PWAs does not change the administrative boundary of any IRA.

Typically, PWAs substantially overlap, and/or are contiguous with IRAs, and PWAs also may be contiguous with wilderness. Some newly inventoried PWAs may be stand-alone areas that were not identified as ‘roadless areas’ in Appendix C of the 1989 Ochoco Forest Plan and ‘inventoried roadless areas’ as identified in a set of maps in the 2001 Roadless Area Conservation Rule (RACR). PWAs overlap inventoried roadless areas only where those acres of land are consistent with the inventory criteria (FSH 1909.12 Chapter 71) and may extend beyond IRA and wilderness boundaries consistent with inventory criteria.

Methodology for Potential Wilderness

District Databases for the existing road system and past harvest were combined with local knowledge of the area and examination of aerial photography to make this analysis. Seven areas were identified within the Wolf project area as candidate areas to be analyzed. These areas range in size from 293 acres to 1010 acres. Table 186 depicts these candidate areas.

Table 184. Areas to be analyzed for inclusion in potential wilderness inventory.

Unroaded Analysis Area	Acres Inside Wolf Project Area
Area 1	430
Area 2	293
Area 3	358
Area 4	446
Area 5	397
Area 6	570
Area 7	1010
Area 8	571
Total	4075

The Wolf interdisciplinary planning team analyzed the eight areas against the "Wilderness Inventory Criteria" found in Forest Service handbook 1909.12 Chapter 71.1. Each area was examined against the following criteria:

- Area is more than 5,000 acres in size or;
- Area contains less than 5,000 acres but can meet one or more of the following:
  a) Areas can be preserved due to physical terrain and natural conditions.
  b) Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
  c) Areas are contiguous to existing wilderness, primitive areas, Administration-endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.
- Areas do not contain forest roads (36 CFR 212.1) or other permanently authorized roads, except as permitted in areas east of the 100th meridian (see FSH 1909.12, section 71.12).

Additionally, the Handbook provides guidance when it is acceptable to include areas with past management actions.

As indicated in table 187, none of the areas meets the criteria for potential wilderness.

Table 185. Summary of analysis of unroaded areas against potential wilderness "inventory criteria."

Area	More than 5,000 acres	Can be preserved or is self-contained	Contiguous to existing wilderness, IRA, etc.	Evidence of past harvest or road construction	Summary
1	No 430 ac.	No Area is small in size	No	Yes Past harvest units/road prism	Does not meet criteria due to size, physical terrain, easy access, and past harvest is recognizable.
2	No 293 ac.	No Area is small in size, existing roads allows for easy access	No	Yes Past harvest/road prism	Does not meet criteria due to size, physical terrain, easy access, and past harvest is recognizable

Area	More than 5,000 acres	Can be preserved or is self-contained	Contiguous to existing wilderness, IRA, etc.	Evidence of past harvest or road construction	Summary
3	No 358 ac.	No Area is small in size, physical terrain and vegetation allow for easy access.	No	Yes Limited past harvest/ decommissioned road prism.	Does not meet criteria due to small size, easy access and physical terrain while conspicuous decommissioned road prisms and past harvest permeate the area.
4	No 446 ac.	No Area is small in size, physical terrain, vegetation and roads allow for easy access.	No	Extensive past harvest/decommissioned road prism	Does not meet criteria due to easy access and physical terrain while both decommissioned road prisms and past harvest are extensive and easily recognizable.
5	No 397 ac.	No Area is small in size, physical terrain and vegetation allows for easy access, area cannot be preserved.	No	Extensive past harvest/ road prisms.	Does not meet criteria due to easy access and physical terrain while both decommissioned road prisms and past harvest are extensive and easily recognizable.
6	No 570 ac.	No Area is small in size, physical terrain and vegetation allows for easy access and dissected by private land. Area cannot be preserved as it lacks associated attributes.	No	Limited past selection harvest/ road prisms and is dissected by roads and private land.	Does not meet criteria because it is small in size while physical terrain and vegetation allows for easy access.
7	No 1010 ac.	Area is small in size and it is dissected by an existing road system which provides access to the interior and it is bordered by Private Land.	No	Some past selection harvest/ Much of the areas is non forest and is dissected by roads and bordered by private land.	Does not meet criteria because it is small in size while physical terrain and vegetation allows for easy access.

Area	More than 5,000 acres	Can be preserved or is self-contained	Contiguous to existing wilderness, IRA, etc.	Evidence of past harvest or road construction	Summary
8	No 571 ac.	Area is small in size and it is dissected by an existing road system which provides access to the interior and it is bordered by Private Land.	No	Some past selection harvest/ Much of the areas is non forest and is dissected by roads and bordered by private land.	Does not meet criteria due to easy access and physical terrain while both decommissioned road prisms and past harvest are extensive and easily recognizable.

Summary

Within the area planned for activities, there are no Inventoried Roadless Areas or potential wilderness areas as defined by Forest Service handbook 1909.12 Chapter 71.1 "Wilderness Area Criteria." The eight unroaded/undeveloped areas were, in general, altered by past management activities; those activities proposed in the action alternatives would have no measurable effect, and in many cases would improve characteristics of forest health over the long term. The closest Wilderness Area, Black Canyon, is located approximately five miles to the northeast of the project area. The area separating the Wolf project and Black Canyon Wilderness is extensively roaded and activities within the Wolf project would have no effect on the Black Canyon Wilderness.

Other Unroaded/Undeveloped Lands

These areas of land should have no modern history of harvest activity, should not contain forest roads, and are not classified as a wilderness area, potential wilderness area, or IRA.

The criteria used to analyze for these areas are contained in the Roadless Rule 294.11 "Roadless Area Characteristics." These are as follows:

High quality or undisturbed soil, water, and air: These three key resources are the foundation upon which other resource values and outputs depend. Healthy watersheds catch, store, and safely release water over time, protecting downstream communities from flooding; providing clean water for domestic, agricultural, and industrial uses; helping maintain abundant and healthy fish and wildlife populations; and are the basis for many forms of outdoor recreation.

Sources of public drinking water: National Forest System lands contain watersheds that are important sources of public drinking water. Maintaining these areas in a relatively undisturbed condition saves downstream communities millions of dollars in water filtration costs.

Diversity of plant and animal communities: Roadless areas are more likely than roaded areas to support greater ecosystem health, including the diversity of native and desired non-native plant and animal communities due to the absence of disturbances caused by roads and accompanying activities. Inventoried roadless areas also conserve native biodiversity by serving as a bulwark against the spread of non-native invasive species. Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: roadless areas function as biological strongholds and refuges for many species.

Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: Roadless areas function as biological strongholds and refuges for many species. Roadless areas support a diversity of aquatic habitats and communities.

Primitive, Semi-Primitive Non- Motorized, and Semi-Primitive Motorized classes of dispersed recreation opportunities: Roadless areas often provide outstanding dispersed recreation opportunities such as hiking, camping, hunting, fishing, nordic skiing and canoeing. While they may have many wilderness-like attributes, unlike Wilderness, mountain bikes and other mechanized uses are often allowed.

Reference landscapes: Knowledge about the effects of management activities over long periods of time and on large landscapes is very limited. Reference landscapes of relatively undisturbed areas serve as a barometer to measure the effects of development on other parts of the landscape.

Natural appearing landscapes with high scenic quality: High quality scenery, especially scenery with natural-appearing landscapes, is a primary reason that people choose to recreate.

Traditional cultural properties and sacred sites: Traditional cultural properties are places, sites, structures, art or objects that played an important role in the cultural history of a group. Sacred sites are places with special religious significance to a group. Traditional cultural properties and sacred sites may be eligible for protection under the National Historic Preservation Act. However, many of them have not yet been inventoried, especially those that occur in inventoried roadless areas.

Other locally identified unique characteristics: Roadless areas may offer other locally identified unique characteristics and values. Examples include uncommon geological formations, valued for their scientific and scenic qualities, or unique wetland complexes.

Affected Environment/Environmental Effects Unroaded/Undeveloped: The areas analyzed for these unroaded/undeveloped characteristics are identified in table 188.

Table 188 summarizes the activities proposed within these areas and the environmental effects of the alternatives on these characteristics. The complete analysis and maps of these areas are available in the Wolf project record.

Table 186. Unroaded/Undeveloped Attribute Evaluation.

Area	Alt. 1 - No Action	Alt. 2 – Proposed Action	Alternative 3	Alternative 4
Area 1 430 ac.	No activities proposed. The landscape has been altered past harvest and associated road construction is apparent.	Commercial and noncommercial thinning and fuel treatment of (39ac.), would have some short-term impacts with long-term benefits.	Commercial and noncommercial thinning and fuel treatment of (39ac.), would have some short-term impacts with long-term benefits.	Commercial and noncommercial thinning and fuel treatment of (32ac.), would have some short-term impacts with long-term benefits.
Area 2 293 acres.	No activities proposed. The landscape has been altered by some past harvest and associated road construction.	Commercial thinning, noncommercial and Rx burning (.61 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning, noncommercial and Rx burning (.61 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning, noncommercial and Rx burning (.61 ac.) would have some short-term impacts with long-term benefits.
Area 3 358 acres	No activities proposed. The landscape has been altered by past selective harvest and road construction.	Commercial thinning (19 ac.), noncommercial thinning and Rx fire (32 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (19 ac.), noncommercial thinning and Rx fire (32 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (15 ac.), noncommercial thinning and Rx fire (28 ac.) would have some short-term impacts with long-term benefits.

Area	Alt. 1 - No Action	Alt. 2 – Proposed Action	Alternative 3	Alternative 4
Area 4 446 acres	No activities proposed. The landscape has been altered by past commercial harvest and road construction.	Commercial and noncommercial thinning and Rx burning of (39 ac.) would have some short-term impacts with long-term benefits.	Commercial and noncommercial thinning and Rx burning (39 ac.) would have some short-term impacts with long-term benefits.	Commercial and noncommercial thinning and Rx burning (38 ac.) would have some short-term impacts with long-term benefits.
Area 5 397 acres	No activities proposed. The landscape has been altered by past commercial harvest and road construction.	Commercial thinning and Rx burning of (66 ac.), and noncommercial thinning of (86 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning and Rx burning of (66 ac.), and noncommercial thinning of (86 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (57 ac.), noncommercial thinning (77 ac.), and Rx burning of (66 ac.), would have some short-term impacts with long-term benefits.
Area 6 570 ac.	No activities proposed. There is evidence of past selective harvest.	Commercial thinning (75 ac.), and noncommercial thinning and Rx burning of (134 ac.), would have some short-term impacts with long-term benefits.	Commercial thinning (75 ac.), and noncommercial thinning and Rx burning of (134 ac.), would have some short-term impacts with long-term benefits.	Commercial thinning (41 ac.), noncommercial thinning (46 ac.), and Rx burning of (100 ac.), would have some short-term impacts with long-term benefits.
Area 7 1010 ac.	There are no treatments proposed. Much of the area is Juniper-sage non-forest scab.	Commercial thinning (270 ac.), noncommercial thinning (424 ac.), Rx burning (965 ac.), Juniper thinning of (162 ac.), Hardwood treatment (25 ac.), would have short term impacts and long term benefits.	Commercial thinning of (270 ac.) noncommercial thinning (424 ac.), Rx burning (965 ac.), Juniper thinning of (162 ac.), Hardwood treatment (25 ac.), would have short term impacts and long term benefits.	Commercial thinning of (196 ac.) noncommercial thinning (362 ac.), Rx burning (967 ac.), Juniper thinning of (162 ac.), Hardwood treatment (25 ac.), would have short term impacts and long term benefits.
Area 8 571 ac.	There are no treatments proposed. Much of the area is Juniper-sage non forest scab.	Commercial thinning (89 ac.), noncommercial thinning (147 ac.), Rx burning (214 ac.), Juniper thinning of (67 ac.), would have short term impacts and long term benefits.	Commercial thinning (89 ac.), noncommercial thinning (147 ac.), Rx burning (214 ac.), Juniper thinning of (67 ac.), would have short term impacts and long term benefits.	Commercial thinning (40 ac.), noncommercial thinning (141 ac.), Rx burning (223 ac.), Juniper thinning of (67 ac.), would have short term impacts and long term benefits.

Summary

The analysis showed that the eight identified areas were less than 5000 acres in size and, in general or in part, altered by past management activities and that activities proposed in the action alternatives in the Wolf project would not affect existing roadless/undeveloped characteristics.

Climate Change and Carbon Cycling

Global Climate Change

Although El Niño/Southern Oscillation and the Pacific Decadal Oscillation comprise the primary factors for climate variability in the Pacific Northwest (Intergovernmental Panel on Climate Change [IPCC], 2007), the influence from global climate change is a growing concern. Warming of the global climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level (IPCC, 2007). Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. On average, the Pacific Northwest has warmed approximately 1° C since 1920, mostly since 1950, and winter has warmed faster than summer (Mote et al. 2005). Decadal variability, rather than trends, is the hallmark of Pacific Northwest 20th century precipitation. However, the past 100 years show an increase in precipitation in the Pacific Northwest (Mote et al. 2003). Winter temperature increases have caused winter precipitation to change from snow to rain at mid- and low- elevation sites. 30-60% declines in April 1 snow water equivalent have been observed in the Olympic and Cascade Ranges (Mote et al. 2005). The timing of spring runoff in the western US was 10-30 days earlier in 2000 compared to 1948 (Stewart et al. 2004). Changes in disturbance regimes have been documented; spring and summer warming and earlier spring snowmelt have been linked to increased wildfire activity in the west (Westerling et al. 2006); and increased insect activity (Logan et al 2003).

There is still a great deal of uncertainty about future climate change and associated impacts. Uncertainty means that more than one outcome is consistent with expectations. There is an expectation that advances in climate science and computational resources will eventually reduce this uncertainty and allow more accurate and precise projections about the future at finer spatial scales. However, accuracy of climate predictions is limited by fundamental, irreducible uncertainties (limitations in knowledge, randomness, and from human actions e.g., future greenhouse gas emissions) (Dessai et al. 2009).

In North America, annual mean warming is likely to exceed the global mean warming in most areas (IPCC 4th Assessment Report: Working Group 1, Chapter 11). Warming in western mountains is projected to cause decreased snowpack, more winter flooding and reduced summer flows, exacerbating competition for over-allocated water resources. Seasonally, warming is likely to be largest in winter in northern regions and in summer in the southwest. Minimum winter temperatures are likely to increase more than the average in northern North America.

For the Pacific Northwest, most climate projections include warmer, drier summers, even if annual precipitation increases (Mote et al. 2003, Littell et al. 2009). Researchers expect some areas to be warmer and drier and other areas to be warmer and wetter, but the current state of modeling does not allow them to predict what is the more likely scenario for areas, including the Ochoco National Forest, that are at scales smaller than the Pacific Northwest.

Disturbances such as wildfire and insect outbreaks are increasing and are likely to intensify in a warmer future with drier soils and longer growing seasons. Although recent climate trends have increased vegetation growth, continuing increases in disturbances are likely to limit carbon storage, facilitate invasive species, and disrupt ecosystem services. Warmer summer temperatures are expected to extend the annual window of high fire ignition risk by 10-30%. Over the 21st century, pressure for species to shift north and to higher elevations will fundamentally rearrange North American ecosystems. Differential capacities for range shifts and constraints from development, habitat fragmentation, invasive species, and broken ecological connections will alter ecosystem structure, function and services (from the IPCC 4th Assessment Report: Working Group 1, Chapter 14).

Whether and how increasing temperatures resulting from global climate change would alter predicted forest response to the proposed commercial thinning under Alternatives 2 , 3 and 4 would depend on specific site conditions in relation to temperature and soil moisture availability on tree growth. If temperature were to increase while precipitation changes minimally, as predicted by the Climate Impacts Group, tree evapotranspiration would increase nonlinearly, leading to more frequent drought stress. Douglas-fir, in particular, is sensitive to low soil moisture (Climate Impacts Group 2004). The proposed commercial thinning could decrease competition for water during the summer while limiting additional evaporation from the soil and transpiration from the understory in the summer. Such thinning could also maximize the duration of snowpack in spring by having an open enough canopy that more snow accumulates on the ground rather than on the forest canopy, yet is still shaded from the sun in the spring, which would delay melting. The resulting increased available moisture, in turn, could reduce the risk of dead or drought-stressed trees created by increasing temperatures and changes in precipitation caused by climate change and that would be susceptible to fire and disease in the near-term.

The range of species within the analysis area over the past few hundred years appears to have been similar to today, based on the variety of species of the older trees. While there is much discussion among scientists about global climate change, the reality for management of existing forests is that they are a result of the past and present climatic influences (Shugart et al, 2003). The current climate limits what can be done with forest trees at this point in time. To be able to respond to the influences of global climate changes, it is best to maintain the full range of native species now present and in conditions that help promote increased resiliency to multiply, interacting forest stresses of fire, insects, and climate changes, on this analysis area. Regardless of the climatic changes, a full suite of species remaining on the analysis area ensures adaptability for a wide range of climatic conditions. Reducing stress is a key recommendation for adaptation by most scientists. Alternatives 2, 3 and 4 would create resiliency to climate change by reducing competition, fire, and insect and disease hazards.

Carbon Storage

Forests play a major role in the carbon cycle. The carbon stored in live biomass, dead plant material, and soil represents the balance between CO2 absorbed from the atmosphere and its release through respiration, decomposition, and burning. Over longer time periods forests will continue to absorb carbon. The sink of carbon sequestration in forests and wood products can help to offset sources of carbon dioxide to the atmosphere, such as deforestation, forest fires, and fossil fuel emissions.

The Forest Service recognizes that carbon and sequestration are important issues both nationally and regionally. Currently, Forest Service national policy and guidance for managing carbon and sequestration does not exist. The tools for estimating carbon and sequestration are not fully developed at this time. A quantitative analysis and comparison between the alternatives of trade-offs between the amounts of carbon stored or greenhouse gases emitted is not possible at the current project scale. It would be very difficult to determine the effects of this project on greenhouse gases directly, and therefore climate change indirectly, as there are currently no Federal statutes, regulatory standards, or policy direction on such effects. Until the agency adopts meaningful thresholds against which to weigh any project-related greenhouse gas emissions, it will not be possible to determine a specific project’s effects on GHGs or climate change. Attempts to place this project in the context of global warming would have to focus on portions related to carbon fixing, storing, and releasing. The scale of this action will likely be immeasurable when considered at a global scale.

Sustainable forestry practices can increase the ability of forests to sequester atmospheric carbon while enhancing other ecosystem services, such as improved soil and water quality Planting new trees and improving forest health through thinning and prescribed burning are some of the ways to increase forest carbon in the long run. Harvesting and regenerating forests can also result in net carbon

sequestration in wood products and new forest growth. Increasing rotation age and reducing harvest rates can increase carbon storage (Hudiberg et al, 2009).

Published research suggests that management actions can have a positive effect on carbon storage. Hurteau et al (2008) point out that in forests where fire suppression has caused fuel accumulation (such as in the Wolf project area), forest fuel reduction treatments can diminish the risk of stand-replacing fire, thereby promoting carbon storage. The basis for this work is four large recent fires, including the Biscuit Fire in southwest Oregon and the Hayman Fire in Colorado. The authors also point out that thinning treatments such as those proposed in the Wolf project could, by exposing more ground, snow, and grass, cause an increased surface albedo and thereby increase surface reflectance leading to a net cooling effect.

Because of the small scale of the Wolf project and similar projects in the global atmospheric context and because greenhouse gasses readily mix into the global pool, and since the proposed management actions in this project would leave the treated stands fully stocked after implementation (fully capable of utilizing the available moisture, nutrients, and growing space on the treated sites), vegetation would continue normal respiration processes and effects to atmospheric CO2 levels would be expected to be inestimable on a regional, national, or global scale.

Conclusions

It is predicted that the Pacific Northwest will face increasing temperature and most likely less precipitation (Climate Action Group 2004). However, researchers also note that at scales smaller than the entire Northwest, it may be warmer and drier, or warmer and wetter; therefore it is not possible to predict the best approach for the project area. It can be said, though, that thinning of stands under both action alternatives would reduce competition for resources and favor drought-tolerant species (ponderosa pine), which would reduce the impacts of future drought cycles on tree mortality and increase resistance to insect and fire mortality (Ritchie 2008). In the balance, based on the best available science it appears that to be able to respond to the influences of global climate changes, it is best to maintain the full range of native species now present on this analysis area. Regardless of the climatic changes, a full suite of species remaining on the analysis area ensures adaptability for a wide range of climatic conditions. Alternatives 2, 3 and 4 both embody this philosophy.

Civil Rights and Environmental Justice

Civil Rights legislations, especially the Civil Rights Act (CR) of 1964, Title VI, prohibit discrimination in Forest Service program delivery. The underlying principal behind the Civil Rights Act is that no activity shall negatively affect minorities, woman, or persons with disabilities by virtue of their race, color, sex, national origin, religion, age, disability, or material or familial status.

Environmental Justice, Executive Order 12898, demands the fair treatment and meaningful involvement of all people. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from the execution of our actions. Environmental Justice focuses on minority, low income groups, and subsistence lifestyles (including Indian Tribes). The purpose of involving these groups and analyzing the effects upon them is to determine whether adverse civil rights impacts are anticipated, or whether disparate or disproportionate impacts associated with the alternatives is anticipated on any of these groups.

With this project, there is no known potential for disparate or disproportionately effects, or to discriminate or negatively impact any individual or subset of the population described above. The vegetation treatments in the action alternatives would provide for easier access to firewood (landing/harvest units) which should positively affect low-income, older, or those with disabilities, who are not able to afford the type of vehicle needed to access, or physically manage gathering

firewood from anything but very accessible sites. Also, the types of employment opportunities provided by the alternatives, timber harvest activities (logging, hauling, etc.), prescribed burning, noncommercial thinning, and millwork, etc., would have positive effects on the categories of individuals and population groups these laws and regulations are intended to protect.

The action alternatives would provide for human health and safety of all members of the public by reducing the risk of falling snags along travel ways, as well as reducing the risk of wildfire. The road closure and decommissioning, given the nature of the project area, there would still provide ample access throughout the project area. The actions proposed under Alternatives 2, 3 and 4 would not have any measurable impacts on Tribal rights (ceded lands) or Tribal traditional uses. The project is not located in a minority community nor would it affect residents of low or moderate income. Any impacts would not affect any specific subset of the American population at a disproportionately higher rate than others.

The effects of this project on the social and economic context of these groups are within those described in the Forest Plan. The benefits and risks associated with implementation of the proposed action are provided to all members of the public. Therefore, the project would not pose disproportionately high or adverse effects to minority communities or to low income groups. As a result, no formal Civil Rights Impact or Environmental Justice Analysis was undertaken.

Short-term Uses and 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 the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated 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 action alternatives propose short-term harvest of timber, while enhancing the long-term health of forested stands. Existing conditions are outside the HRV and may not be sustainable over the long term. Proposed treatments including prescribed fire, in part, mimic natural disturbance processes and move conditions toward a balance of sustainable vegetative conditions. Soil and Water are two key factors in ecosystem productivity and protection of these resources is provided by the design features discussed in Chapter 2. Sustainable wildlife habitat, water quality and other resources depend on maintaining the long-term soil productivity upon which vegetation relies. Quality and quantity of water from the project area would fluctuate as described previously, but no long-term effects to water resources are anticipated as a result of commercial harvest, noncommercial thinning, and fuels reduction treatments. All alternatives provide fish and wildlife habitat at levels necessary to maintain viable populations of the species within the project area. The amounts of suitable habitat vary with the level of density management in each alternative.

The stability of the toe slopes of the dormant landslide terrain along the creeks would be protected and maintained through the use of riparian buffers. Reducing slope erosion, due to mass wasting, would serve to maintain long-term productivity of the land.

Unavoidable Adverse Effects

All of the alternatives considered result in some adverse effects. Many of these adverse effects would be minimized through implementation of design features and resource protection measures identified in Chapter 2 or through mitigation measures. Even with implementing these measures, there would still be adverse effects that cannot be avoided.

Soils

Additional detrimental soil conditions are expected as a result of implementing any of the action alternatives. The use of ground-based tractor logging would result in additional compaction and displacement. The design criteria described in Chapter 2 provide resource protection measures to minimize these unavoidable adverse effects. The alternatives were designed to limit the amount of detrimental soil conditions consistent with R6 Supplement 2500-98-1 (Regional Guidelines), effective August 24, 1998.

Road construction would also result in adverse effects on soils. Temporary road construction results in soil compaction and displacement. On temporary and decommissioned roads, the road surface can be revegetated, but soil productivity is reduced because of compaction. These adverse effects to soils cannot be avoided.

Invasive Plants (Noxious Weeds)

The potential for introduction and spread of noxious weeds exists under every alternative considered, including no action. A noxious weed risk assessment concluded that the potential for introducing and spreading noxious weeds cannot be completely avoided. Both action alternatives create conditions that are conducive to the introduction and spread of noxious weeds. Implementation of design features and resource protection measures would minimize these adverse effects. However, proposed activities such as temporary road construction, commercial timber harvest, and prescribed fire would result in conditions conducive to the introduction and spread of noxious weeds.

Sedimentation/Turbidity

Both action alternatives propose new and temporary roads. Most sediment delivered to streams would come from stream crossings, road drainage close to streams and harvest and fuels treatments adjacent to Class IV streams and in ephemeral draws.

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 rights-of-way or road.

Irreversible commitments are decisions affecting nonrenewable resources such as soils, wetlands, roadless areas, and cultural resources. Such commitments are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at great expense or because the resource has been destroyed or removed.

The construction of roads, to provide access to timber, is an irreversible action because of the time it takes for a constructed road to revert to natural conditions. Alternatives 2 and 3 propose some level of road construction.

Removing aggregate (gravel) from mineral material sources would result in an irreversible commitment of resources. Once aggregate is removed from material source sites and placed on roads, it cannot be renewed except over long periods of time.

Irretrievable commitments of natural resources involve the loss of production or use of resources. This represents opportunities foregone for the period of time that the resource cannot be used.

Timber stands that are not managed at this time present an irretrievable loss of growth potential. Although the lost growth is irretrievable, it is not irreversible because the stands could be managed at a later date.

Cumulative Effects

Cumulative effects have been discussed throughout this chapter. As discussed in the June 24, 2005, Council on Environmental Quality Memorandum on Guidance of the Consideration of Past Actions in Cumulative Effects Analysis, past actions that warrant consideration because they are continuing to cause identifiable effects in the project area have been considered. For example, past harvest was considered in the sections on LOS and wildlife species such as the goshawk and pileated woodpecker. Past activities that have changed the environmental baseline have been included in the description of the affected environment. For example, in the analysis of effects to soils, past harvest activities using ground-based equipment resulted in detrimental soil conditions. The unit-by-unit analysis for soils contained in Appendix B describes the existing amount of detrimental soil conditions by alternative. Much of the detrimental disturbance was caused by past harvest. Other activities in the project area such as grazing and implementation of new allotment management plans are also discussed where appropriate. Table 189 summarizes other projects in the vicinity of the Wolf project area.

Table 187. Projects that overlap with the Wolf project area in space and/or time.

Project/ Activity	Description	Effects in the Wolf project area	Status
Ochoco Summit Trail System project	Action alternatives propose designation of varying miles of trail for Class I, II, and III off-highway vehicles.	Implementation of this project could reduce recreation use of illegal off-road motorized travel within the project area.	Planning; decision anticipated in Fall, 2013
Deschutes and Ochoco Invasive Plants EIS (2012)	Decision authorized treatment of invasive plants using chemical, manual and cultural method, as well as “early detection/rapid response” (EDRR) treatments of new weed populations.	Weed treatment has been ongoing and will continue in the project area; treatments appear to be successful in limiting populations. If new populations are discovered in the project area, EDRR may be successful in limiting or eradicating them.	Implementation
Deschutes and Ochoco Travel Management EIS (2011)	Decision permits motorized travel only on designated routes.	Decision precludes off-highway vehicles from travelling cross-country in the project area. Effects from such travel are still evident in the project area, and some illegal off-road use is still occurring.	Implementation
Southside EA (2009)	The decision reauthorized cattle grazing on three allotments, one of which has acreage within the project area. 98% of the project area is comprised of the Wolf Creek Allotment. The decision included adaptive management for livestock management and a pasture division fence in the Widow pasture.	Cattle distribution is expected to improve; riparian condition is expected to improve in localized areas; standards and guidelines for condition of upland and riparian range are expected to be met.	Implementation

Project/ Activity	Description	Effects in the Wolf project area	Status
Upper Beaver Project Timber Sales (1999)	The decision authorized a variety of activities, including timber harvest, noncommercial thinning, prescribed fire, stream channel restoration, bank stabilization/headcut repair, and placement of large woody debris.	About 43 acres commercial harvest activities (Powell Timber Sale) and an additional 142 acres of noncommercial thinning are within the Wolf project boundary.	Implementation
Older vegetation management	Approximately 5,000 acres of harvest, including clear cut, single-tree selection, group selection, overstory removal and stand improvement, has been accomplished within the project area historically.	Late and old structure habitat has been reduced in the project area. Very little of the project area does not show evidence of past harvest and associated road building	Completed
Adjoining BLM land (15S, R24E sec 30)	Approximately 640 acres. Part of the Congleton Allotment. Permitted from 4/16-11/15 with 197 AUMs.	Cattle grazing could add cumulatively to effects of grazing under the Southside EA	Implementation

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders."

National Environmental Policy Act

NEPA establishes the format and content requirements of environmental analysis and documentation. The entire process of preparing the environmental impact statement was undertaken to comply with NEPA.

National Historic Preservation Act

The Wolf Vegetation Management EIS project area was reviewed for heritage resources under the terms of the 2004 Programmatic Agreement among the USFS R6, ACHP, and SHPO. The project complies with Section 106 of the National Historic Preservation Act by meeting Stipulation III (B) 1 (Undertaking meets the criteria in the PA for a No Historic Properties Affected determination).

The *Wolf Vegetation Management EIS Cultural Resource Survey* (Report #2013060702013) was received by the Oregon State Historic Preservation Office (OSHPO) for review, via certified mail, on November 1, 2013. After a thirty (30) day review period, the Ochoco National Forest had not received comments about the proposed undertaking from the SHPO. In accordance with 36 CFR 800.4(d)(1)(i): "If the SHPO/THPO, or the Council, if it has entered the section 106 process, does not object within 30 days of receipt of an adequately documented finding, the agency official's responsibilities under section 106 are fulfilled."

Endangered Species Act

Biological Evaluations have been prepared to document possible effects of proposed activities on threatened and endangered species in the project area. There are no endangered species known or suspected to occur on the Ochoco National Forest. Threatened species that are known or suspected to

occur on the Ochoco National Forest include bull trout, mid-Columbia River steelhead, and Canada lynx.

On May 29, 2001 the Forest received concurrence from the U.S. Fish and Wildlife Service that implementation of any activities contained within the Forest Plan, as amended, is not likely to adversely affect the Canada lynx outside of an existing Lynx Analysis Unit. At the time this consultation took place there were, and continue to be, no Lynx Analysis Units existing on the Ochoco National Forest.

There would be no effect to bull trout.

Consultation with the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration is not applicable for the Wolf project area.

Clean Air Act

Both proposed alternatives are designed to be consistent with the Clean Air Act. The Oregon Department of Environmental Quality (DEQ) is responsible for assuring compliance with the Clean Air Act. In 1994, the Forest Service, in cooperation with DEQ, the Oregon Department of Forestry, and the BLM signed a Memorandum of Understanding to establish a framework for implementing an air quality program in Northeast Oregon. The Memorandum of Understanding includes a prescribed fire emission limit of 15,000 tons of PM-10 per year for the Malheur, Ochoco, Umatilla, and Wallowa-Whitman national forests. All prescribed burning on these forests is coordinated with DEQ through the State of Oregon smoke management program. All prescribed fire treatments in the selected alternative would be conducted in compliance with the State of Oregon Smoke Management System and would meet smoke management objectives for total emissions.

Clean Water Act

The selected alternative would comply with the Clean Water Act, as amended. This Act establishes a non-degradation policy for all federally proposed projects. The selected alternative meets anti-degradation standards through project, application, and monitoring of BMPs. The EPA has certified the Oregon Forest Practices Act and regulations as BMPs. The State of Oregon has compared Forest Service practices with State practices and concluded that the Forest Service practices meet or exceed State requirements. Site-specific BMPs have been designed to protect beneficial uses. Chapter 2 lists the design criteria and resource protection measures that have been developed for all action alternatives.

Chapter 3 documents the effects the proposed alternatives would have on streams listed on the 2012 State 303(d) list of Water Quality Limited Water Bodies for summer water temperature. These streams are Wolf, North Wolf, and East Wolf Creeks. Implementation of either proposed action alternative should not result in any measurable increase in water temperatures to fish bearing or non-fish bearing streams in the project area. Commercial timber harvest and non-commercial thinning activities were designed so that they do not reduce shade. There is a possibility that conifer thinning in aspen stands would cause short-term reductions in shade. However, these slight reductions in shade should not result in any measurable increase in water temperature because the area affects is small. There is a potential to increase water temperature in intermittent non-fish bearing streams (Class IV) when they are flowing, but this should not result in a violation of state water quality standards because these streams go dry before peak water temperature occurs in the project area. Analysis determined that the cut-and-leave prescriptions along Wolf project area streams that are authorized with this decision will limit access of livestock to project area streams, and therefore may reduce the amount of *E. coli* that is introduced to the creek through animal feces.

National Forest Management Act

To ensure consistency with the National Forest Management Act, the Ochoco National Forest Land and Resource Management Plan, as amended, was consulted. The Forest Plan contains several standards and guidelines that apply forest-wide or to specific management areas. Both forest-wide and management area specific standards and guidelines were reviewed. All alternatives were designed to be consistent with the Ochoco Forest Plan, except where noted in the following discussion. All of the action alternatives are consistent with long-term management objectives as discussed in the Forest Plan as amended. All alternatives are consistent with the seven management requirements listed in 36 CFR 219.29.

Forest Plan Amendments

Non-significant Forest Plan Amendments are allowed under the Forest Service Land and Resource Management Planning Manual (Forest Service Manual 1926.51) and can result from "Adjustments of...management prescriptions resulting from 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 plans".

The Eastside Screens (Regional Forester's Forest Plan Amendment No. 2) contain standards that indicate there should be no net loss of LOS if single-stratum LOS and/or multi-strata LOS stages are below HRV, that timber harvest activities should not be allowed to occur within LOS stages that are below HRV, and that all live remnant late and old seral and/or structural live trees 21" dbh or larger should be retained. In a letter dated June 11, 2003, the Regional Forester encouraged Forest Supervisors to consider site-specific Forest Plan amendments associated with increasing the number of large trees and LOS on the landscape.

Amendment #1: Eastside Screen Appendix B 6(d) Scenario A and Harvest Activities in Late and Old Stands Appendix B 6 (d) Scenario A of the Eastside Screens states " *Do not allow timber harvest activities to occur within LOS stages that are BELOW HRV."* Site-specific amendments to the Eastside Screens are proposed to: allow commercial harvest activity within 10 acres of an LOS stage that is currently below HRV (Douglas-fir multi-strata).

Need for Amendment and the Change Being Proposed

In response to the Purpose and Need, Alternatives 2 and 3 propose commercial activity within biophysical environments in which LOS are currently below HRV (Douglas-fir multi-strata; see LOS discussion in the "Forested Vegetation" section).

Commercial harvest is proposed in areas where the development of large trees is currently impeded, or existing large trees are at risk from fire or insects and disease. The objective of these treatments would be to improve conditions for the development and/or maintenance of large trees, thus retaining or enhancing LOS acreage in the long-term. All action alternatives propose commercial harvest within LOS stands to accomplish these objectives while implementation of Alternative 2 and 3 would require a site-specific amendment to Appendix B 6(d) Scenario A to allow timber harvest in an LOS stage (Douglas-fir multi-strata) which is currently below HRV.

Table 188. Existing LOS and Historic Ranges by PAG

PAG	LOS Type	Existing Acres	Historic Low Acres	Historic High Acres	HRV Status
DGF	multi	677	594	1,204	Within
	single	0	1,439	2,941	Below
	Total	677	2,034	4,145	Below
DF	multi	247	347	582	Below

	single	0	1,015	1,659	Below
	Total	247	1,362	2,241	Below
M Pine	multi	960	0	329	Above
	single	24	1,826	3,141	Below
	Total	984	1,826	3,470	Below
X Pine	multi	446	0	143	Above
	single	0	548	1,283	Below
	Total	446	548	1,426	Below
Total	multi	2,330	941	2,258	Above
	single	24	4,829	9,024	Below
	Total	2,354	5,770	11,282	Below

Table 189. Acres of Harvest within LOS Stands by Alternative and PAG

Alternative	Moist Grand Fir	Dry Grand Fir	Douglas-fir	Mesic Pine	Xeric Pine	Total
1	0	0	0	0	0	0
2	0	201	10	305	254	769
3	0	201	10	305	254	769
4	0	135	0	159	151	446

Amendment #2: Cutting of Trees over 21 Inches in Diameter

In Alternative 3 the project proposes a site-specific amendment to the *Interim Eastside Screens Appendix B 6(2.a*) 'Maintain all remnant late and old seral and/or structural live trees greater to or equal to 21inches in diameter that currently exist within stands proposed for harvest activities." The proposed amendment would allow a timber sale to cut and remove trees greater than or equal to 21 inches in diameter in limited, specific locations.

Need for Amendment and the Change Being Proposed

The amendment is being proposed on 384 acres in order to restore historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where old ponderosa pine are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. It would also be applied to remove conifer competition from aspen clones. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Removal of large young trees from the vicinity of old trees for approximately twice the canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

Amendment #3: Establish a new INFISH Riparian Management Objective (RMO) to guide vegetative treatments in RHCAS.

In Alternatives 2 and 3, the project proposes a site-specific amendment- the establishment of a new RMO- to the *Inland Native Fish Strategy (INFISH)* in order to address the vegetative component of the Riparian Conservation Areas (RHCAs). INFISH (E-3) encourages the establishment of "site specific RMOs based on watershed analysis or site specific analysis." The proposed RMO is as follows: *maintain and restore the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency.*

Need for Amendment and the Change Being Proposed

The amendment is being proposed because none of the RMOs described in INFISH apply directly to the vegetation management with RHCAs. Timber harvest within RHCAs is prohibited under INFISH standard TM-1 unless silvicultural practices can be applied to attain RMOs and adverse effects to inland native fish can be avoided.

During the completion of the Wolf watershed analysis, it was recognized that vegetation within RHCAs in the project area was not in a desired condition due to past timber harvest, fire exclusion, and other factors. RHCAs lack natural vegetative complexity, species compositions, and resiliency. Vegetative conditions exist which are not as resistant to disturbance as they were historically and there is an elevated risk of unwanted loss from stand replacement wildfire and/or insects and disease. Hardwoods have decreased in abundance or are completely lacking from areas where they occurred historically.

The majority of the RHCAs, outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition which was often dominated by large trees of fire tolerant species. Today, large trees are less abundant, stands are denser, within stand spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. In many areas hardwoods have declined due to competition from conifers, big game, livestock grazing, and stream down-cutting. Currently, about 64 percent of the area within RHCAs is in a condition considered to be at high risk to insects and disease.

Various silvicultural activities are proposed within RHCAs to meet the RMO of maintaining and restoring the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency. Specific objectives of these treatments are to:

1. Retain and increase the abundance of large trees by reducing competition and increasing tree vigor.
2. Restore fire tolerant species compositions.
3. Reduce risk to high severity wildfire.
4. Increase the abundance and vigor of hardwoods.
5. Restore meadow habitats that have become stocked with encroaching conifer species.

To meet these objectives, site specific prescriptions have been developed on a unit by unit basis (see tables 14-17) based on slope, aspect, stream condition, soil conditions, and existing vegetation. These include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMOs already identified in INFISH as well as provide for no increase in the potential for sediment delivery.

Determination of Significance

The Secretary of Agriculture's implementing regulation indicates the determination of significance is to be "[b]ased on an analysis of the objectives, guidelines, and other contents of the forest plan" (36 CFR 219.8). The Forest Service has issued guidance for Plan amendments when using planning regulations in effect before November 9, 2000. This guidance, in Forest Service Manual (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.

Four additional factors were considered in this analysis: timing; location and size; goals, objectives, and outputs; and management prescriptions. An analysis of these four factors is presented below.

Timing

The Forest Service Planning Handbook (1909.12, 5.32) indicates that a change is less likely to result in a significant plan amendment if the change is likely to take place after the plan period (the first decade). All three of these plan amendments would take place in the 24th year of the Forest Plan, would take place immediately, and are specific to this project.

Location and size

This factor takes into account the location and size of the area involved in the change and the affected area's relationship to the overall planning area. Generally, the smaller the area affected, the less likely the change is to be a significant change in the Forest Plan.

The first Forest Plan Amendment would allow for a timber sale within late and old structural stages (LOS) that is below HRV for Alternatives 2 and 3. This would occur on approximately 10 acres in both alternatives.

The second Forest Plan Amendment would allow cutting of trees 21" dbh, or greater, within 384 acres, or 1.6 %, of the project area.

The third Forest Plan Amendment affects less than 589 acres (acres of commercial harvest proposed for RHCAs in Alternatives 2 and 3), or 2.5 % of the project area.

Goals, Objectives and Outputs

This factor examines whether the change alters long-term relationships between the levels of goods and services projected by the Forest Plan. In most cases, changes in outputs are not likely to be a significant change in the Forest Plan unless the change would forego the opportunity to achieve an output in later years.

None of the proposed Forest Plan Amendments would 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 (before Forest Plan revision) that would move conditions away from the HRV. The proposed thinning, including removing trees greater than or equal to 21 and inch diameter, and vegetation management activities with RHCAs, would shorten the gap-in-time where large disease-free trees are absent on the landscape and provide the remaining trees (both overstory and understory) conditions that are conducive to development of old-growth structural characteristics and resiliency of forested stands, increasing the ability of trees able to survive for centuries.

Management Prescriptions

This factor accounts for whether the change in a management prescription is only for a specific situation or whether it would apply to future decisions throughout the planning. It evaluates how the change alters the desired condition of the land and resources or the anticipated goods and services to be produced.

These three amendments are being proposed to manipulate a very small percentage of the forest towards a long-term, healthy, disease-free environment. These amendments to the *Interim Eastside Screens, the Inland Native Fish Strategy,* and the *Ochoco Land and Resource Management Plan* standards and guidelines would not change the desired future condition for land and resources from that contemplated by the existing management direction in the Land and Resource Management Plan.

Management Indicator Species

Compliance with INFISH

Project activities were designed to comply with INFISH (see Tables 14 and 17 for unit-specific project design features in Alternatives 2 and 3, in Chapter 2 of this EIS). Moreover, the effects analysis disclosed in the "Hydrology and Aquatic Species" section of this EIS indicates that each action alternative is consistent with the Ochoco Forest Plan as amended by INFISH.

CHAPTER 4. CONSULTATION AND COORDINATION

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Glossary

Adverse Effects – INFISH defined adverse effects to fisheries as: Adverse effects include short- or long-term, direct or indirect management related impacts of an individual or cumulative nature, such as mortality, reduced growth, or other adverse physiological changes; harassment of fish; physical disturbance of redds; reduced reproductive success; delayed or premature migration; or other adverse behavioral changes. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival of native inland fish.

Albedo – A measure of reflectivity of the sun's radiation.

Alternative - In an EIS, one of a number of possible options for responding to the purpose of and need for action.

Arterial Road - Roads comprising the basic access network for National Forest System administrative and management activities. These roads serve all resource to a substantial extent, and maintenance is not normally determined by the activities of any one element. They provide service to large lands areas and usually connect with public highways or other Forest arterial roads to form an integrated network of primary travel routes. Usually they are developed and operated for long-term land and resource management purposes and constant service.

Basal Area – The area of the cross section of a tree stem including the bark, near its base, generally at breast height, or 4.5 feet above the ground.

Best Management Practices (BMPs) - Practices designed to prevent or reduce water pollution, including sedimentation.

Board Foot (bf) - A unit of wood that is 12 inches by 12 inches by 1 inch.

Canopy - In a forest, the branches from the uppermost layer of trees; in a shrub or grassland, the uppermost layer of shrubs; in a riparian area, the layers of vegetation that project over the stream.

Canopy Closure - The amount of ground surface shaded by tree canopies as seen from above. Used to describe how open or dense a stand of trees is, often expressed in 10 percent increments.

Closed Road - Generally local roads that are physically closed to public use.

Collector Road - Roads that serve smaller lands areas than a Forest arterial road, and usually connected to an arterial road or public highway. These roads collect traffic from local Forest roads and/or terminal facilities. The location and standard are influenced by both long-term multi-resource service needs, as well as travel efficiency. These roads may be operated for either constant or intermittent service, depending on land use and resource management objectives for the area.

Compaction - Packing together soil particles by exerting force at the soil surface and increasing soil density. Making soil hard and dense, decreasing its ability to support vegetation because the soil can hold less water and air and because roots have trouble penetrating the soil.

Connectivity - The arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation.

Cover - (1) Trees, shrubs, rocks, or other landscape features that allow an animal to partly or fully conceal itself. (2) The area of ground covered by plants, litter, and coarse fragments, including tree crowns and shrubs that are in direct contact with the ground.

Cultural Resources - The remains of sites, structures, or objects used by humans in the past. They may be historic, prehistoric, archaeological, or architectural in nature.

Cumulative Effects **-** Impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Decommissioned Road **-** A road that is no longer needed and is not planned to be used again. It has been closed and generally has been returned to production. For example, a road that has been ripped (tilled) and planted with vegetation.

Density (stand) **-** The number of trees growing in a given area, usually expressed in terms of trees per acre.

Developed Recreation **-** Recreation that requires facilities that in turn result in concentrated use of an area; for example, a campground.

Direct Effects **-** Impacts on the environment that are caused by an action and occur at the same time and place.

Dispersed Recreation **-** Recreation that does not occur in a developed recreation sites; for example, hunting or backpacking.

Eastside Screens (aka Regional Forester's Interim Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales) **-** Originally signed in 1994 and amended in 1995. The objective of this direction was to provide an approach for maintaining future planning options concerning wildlife habitat associated with late and old structural stages, fish habitat, and old forest abundance. The direction was intentionally restrictive, reflecting a conservative interpretation of riparian, wildlife, and ecosystem needs for the short term. The direction applies to timber sales.

Ecosystem **-** A complete, interacting system of living organisms and the land and water that make up their environment; the home places of all living things, including humans.

Endangered Species **-** A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA) **-** An act, passed by Congress in 1973, that directed all Federal departments and agencies to seek to conserve endangered and threatened species. Actions authorized, funded, or carried out by Federal departments and agencies should not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitat. The act also mandates conferencing with the appropriate agencies.

Environment **-** The combination of external physical, biological, social, and cultural conditions affecting the growth and development of organisms and the nature of an individual or community.

Environmental Impact Statement (EIS) **-** A statement of environmental effects of a proposed action and alternatives to it. A Draft EIS is released to the public and other agencies for review and comment. A Final EIS is issued after consideration of public comments. A Record of Decision (ROD) is based on the information and analysis in the Final EIS.

Fire Regime **-** The characteristics of fire in a given ecosystem, such as the frequency, predictability, intensity, and seasonality of fire. Fire regimes can be grouped into three severity regimes: Nonlethal, Mixed, and Stand Replacement. Nonlethal fires are of low to moderate intensity, creeping, surface fires that consume primarily understory grasses, forbs, and shrubs, and leave the overstory trees intact. Stand replacement fires are of high intensity and consume most of an existing stand. Mixed fires are of moderate intensity and consume the understory and some of the overstory.

Forest Plan (Land and Resource Management Plan) - A document that guides natural resource management and establishes standards and guidelines for a National Forest; required by the National Forest Management Act.

Fragmentation (habitat) - The breakup of a large land area (such as a forest) into smaller patches isolated by areas converted to a different land type. The opposite of connectivity.

GIS (Geographic Information System) - An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

Ground Cover - Perennial vegetation plus litter and coarse fragments (greater than 2 mm sizes), including tree crowns and shrubs, that are in direct contact with the ground. Based on the erosion hazard class, ***effective ground cover*** is between 20% and 75% of the ground covered the first year after management activities.

Habitat - A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Headcut – a characteristic of a stream where bank instability and increased water yields have resulted in an entrenched gully that migrates upstream as the stream abandons its associated floodplain.

Hydrologically Closed Road - A road that has been modified to remove water as soon as possible off the road surface to facilitate infiltration into the soil. Generally, sidecast materials and culverts will be removed; relief drainage will be provided to prevent resource damage if culverts plug or fail; and a closure device (barricade, earthen berm, logs, rocks, gates, etc.) will be installed at the entrance.

Hydrologically Stablized Road - A road that has been modified to remove water as soon as possible off the road surface to facilitate infiltration into the soil. Generally, sidecast materials and unstable landings will be removed and relief drainage will be provided to prevent resource damage if culverts plug or fail.

Inactivated Road - A road that is managed in a stored or closed category for long-term intermittent use. Generally, a single purpose type road that remains open to motorized off-highway vehicles. An inactivated road can be hydrologically stabilized or hydrologically closed.

Indirect Effects - Impacts on the environment that are caused by an action and are later in time or farther removed in distance.

Interdisciplinary Team (IDT) - A team of people that collectively represent several disciplines and whose duty it is to coordinate and integrate the planning process.

Intermittent Stream - A stream that flows only at certain times of the year when it receives water from other streams or from surface sources such as melting snow.

Irretrievable - A category of impacts that applies to losses of production or commitment of renewable resources. For example, while a linear piece of land is being used as a road, some or all of the timber production there is irretrievably lost. If the road was rehabilitated after use and soil compaction was reduced, timber production could resume; therefore, the loss of timber production during the time the road was in use is irretrievable but not irreversible, because it is possible for timber production to resume if the piece of land is no longer used as a road.

Irreversible - A category of impacts that applies to non-renewable resources, such as minerals and archaeological sites. Losses of these resources cannot be reversed. Irreversible effects can also refer to effects of actions on resources that can be renewed only after a very long period of time, such as the loss of soil productivity.

Issue - A matter of controversy, dispute, or general concern over resource management activities or land uses. To be considered a "key" EIS issue, it must be well defined, relevant to the proposed action, and within the ability of the agency to address through alternative management strategies.

Ladder fuels - Vertical fuels are called ladder fuels. These are trees in the forests understory which provide a ladder for fire to move from the forest floor to the forest overstory.

Late and Old Structure (LOS) - Late and old structure forested stands. See Late Successional and Old Structured.

Late Successional - Forest late seral stages wherein shade tolerant species begin to occupy codominant and eventually dominant positions in the canopy. Most standing dead and down material is small to medium sized, but some mature and recently overmature overstory trees have recently died and are developing as snags. Specific definitions are dependent on current and potential vegetation composition and arrangements.

Local Road - Local roads are usually one-lane roads constructed to serve a dominant use or resource. Local roads do not access large land areas since they are more site-specific than arterial and collector roads.

Management Direction - A statement of goals and objectives, management prescriptions, and associated standards and guidelines for attaining them.

Management Indicator Species (MIS) - Vertebrate species whose population changes are believed to best serve as an index of a biological community's response to the effects of land management activities or which are important for fishing, hunting, and trapping.

Multiple Use Management - The management of public lands and their various resource values so they are used in a combination that best meets the present and future needs of the public.

National Environmental Policy Act (NEPA) - An act, passed by Congress in 1969, that declared a national policy to encourage productive harmony between humans and their environment. This act requires the preparation of environmental impact statements for Federal actions that are determined to be of major significance. (See 40 CFR [Code of Federal Regulations] 1500-1508 for implementing regulations. See also FSH [Forest Service Handbook] 1909.15, the FS Environmental Policy and Procedures Handbook.)

National Forest Management Act (NFMA) - An act, passed by Congress in 1976, that amends the Forest and Rangeland Renewable Resources Planning Act. The act requires the preparation of Forest plans and regulations to guide that development. (Implementing regulations are codified at 36 CFR 219.)

No Action Alternative - The most likely condition expected to exist in the future if current management direction were to continue unchanged.

Obliterated Road - see Decommissioned Road.

Old Growth Management Area - Management area or allocation in the Land and Resource Management Plan intended to provide habitat for old growth associated species.

Old Structure - A forest stand dominated by large trees with early to late seral species compositions. There may be multiple or single canopy layers, dependent on the plant association group and site potential.

Overstory - The upper canopy layer.

Perennial - A plant that lives for three or more years.

Perennial Stream - A stream that flows water year round.

Plant Association Group (PAG) - A group of plant associations that share similar productivities, disturbance regimes, and responses to disturbance. Eight major plant association groups have been described on the Ochoco National Forest.

Preferred Alternative - The alternative identified in a draft environmental impact statement which has been initially selected by the agency as the most acceptable resolution to the problems identified in the purpose of and need for action.

Proposed Action - A proposal made by the Forest Service to authorize, recommend, or implement an action on National Forest System lands to meet a specific purpose and need.

Record of Decision (ROD) - A document, based on information disclosed in a final environmental impact statement, that identifies the alternative chosen, mitigation and monitoring measures to be implemented, and other information relative to the decision.

Riparian Area - An area with distinctive soil and vegetation between a stream or other body of water and the adjacent upland; includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Riparian Habitat Conservation Area (RHCA) - A portion of a watershed where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams, (2) providing root strength for channel stability, (3) shading the stream, and (4) protecting water quality. The following Categories of Riparian Habitat Conservation Area have been established by INFISH:

Category 1: **Fish-bearing streams:** Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slop distance (600 feet, including both sides of the stream channel), which ever is greatest.

Category 2: Permanently flowing non-fish bearing streams: Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet, including both sides of the stream channel), whichever is greatest.

Category 3: Ponds, lakes, reservoirs, and wetlands greater than 1 acre: Interim RHCAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of the seasonally saturated soil, or the extent of moderately and highly unstable areas, or to a distance equal to the height of one site potential tree, or 150 feet slope distance from the edges of the maximum pool elevation of constructed ponds and reservoirs from the edge of the wetland, pond or lake, whichever is greatest.

Category 4: Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide-prone areas: This category includes features with high variability in size and site-specific characteristics. At a minimum the interim RHCAs must include:

a. the extent of landslides and landslide-prone areas,

b. the intermittent stream channel and the area to the top to of the inner gorge,

c. the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation,

d. for Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest,

e. for watersheds not identified as Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

Scoping - The early stages of preparation of an environmental assessment or environmental impact statement used to solicit public opinion, receive comments and suggestions, and determine the issues to be considered in the development and analysis of a range of alternatives. Scoping may involve public meetings, telephone conversations, mailings, letters, and other contacts.

Sensitive Species - Species identified by a Regional Forester for which population viability is a concern either (a) because of significant current or predicted downward trends in population numbers or density, or (b) because of significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Seral Stage - A stage in the progression of an ecosystem from initial development to maturity; an age, structure, and development classification for a biological community.

Silviculture - The practice of manipulating the establishment, composition, structure, growth, and rate of succession of forests to accomplish specific objectives.

Species - A population or series of populations of organisms that can interbreed and reproduce freely with each other but not with members of other species.

Stand - A group of trees in a specific area that are sufficiently alike in composition, age, arrangement, and condition to be distinguishable from the forest in adjoining areas.

Stream Class - A classification system for streams according to their beneficial uses. **Class I** are perennial or intermittent streams containing one or more of the following characteristics: (1) are the direct source of water for domestic use; and/or (2) are used by large numbers of fish for spawning, rearing, or migration. **Class II** are perennial or intermittent streams containing one or more of the following characteristics: (1) are used by moderate numbers of fish for spawning, rearing, or migration; and/or (2) if fish are not present then flow enough water to have a moderate influence on downstream quality of a Class I or II stream. **Class III** are all other perennial streams not meeting Class I or II definitions. These streams are normally spring fed or have a length greater than 1¼ miles. No fish present due to gradient (steep) or physical or biological barriers. **Class IV** are streams with intermittent flow, defined channel and less than 1¼ mile in length. No fish are present or spring fed sources.

Subwatershed - An area mostly bounded by ridges or other similar topographic features contributing water, organic matter, dissolved nutrients, and sediments to a lake or stream.

Succession - A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance.

Surface fuels - Horizontally arranged fuels are called "surface" fuels. These are trees and other vegetation on the ground surface.

Threatened Species - Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Understory - Grass, small trees, shrubs, and other plants found beneath the overstory.

Uneven-aged Stand - A stand of trees in which there are considerable differences in the ages of individual trees.

Unroaded Area - An undeveloped area of land where there are no improved roads for travel by means of motorized vehicles intended for highway use.

Viable Ecosystems Management Guide - A system to classify vegetation on a landscape basis. This system compares existing vegetation with site potential. It focuses on relationships between combinations of vegetation structure and species composition, and habitat requirements for animals, insects, and plants. This guide was devised by the Ochoco National Forest Viable Ecosystem Quality Action Team. The Viable Ecosystems Management Guide describes a seral/structural matrix for characterizing forest vegetation by plant association groups (PAGs). Each plant association group is further characterized by seral and structural stages. There are three seral stages: E (early), M (middle), and L (late). There are five structural stages: 1 (grass/forb/shrub), 2 (seedling and sapling, trees less than 4.9 inches dbh), 3 (pole, trees between 5 and 8.9 inches dbh), 4 (small, trees between 9 - 20.9 inches dbh), and 5 (medium and large, trees greater than 21 inches dbh). The seral/structural classification is based on the dominant vegetative features on the site.

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References

Ahlenslager, K, and Potash, L. 2007. Conservation Assessment for 13 Species of Moonworts (Botrychium Swartz Subgenus Botrychium) USDA Forest Service Region 6 and USDI Bureau of Land Management, Oregon and Washington.

Anderson, J. W., R. A. Ruediger, and W. F. Hudson. 1984. Design, placement and fish use of instream structures in southwestern Oregon. Pages 165–180 in T. J. Hassler, editor. Proceedings: Pacific Northwest stream habitat management workshop. American Fisheries Society, Humboldt Chapter, Arcata, California.

Arno, S.F. 2000. Fire in western forest ecosystems. In: Brown, J.K., Smith, J.K., eds. Wildland fire in ecosystems: Effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 97-120. [36984]

Arrigoni, S.A., Greenwood, M.C., and Moore, J.N. 2010. Relative impact of anthropogenic modifications versus climate change on natural flow regimes of rivers in the Northern Rocky Mountains, United States. Water Resources Research, Vol. 46, W12542.

Asher, J.E., Dewey, S., Johnson, C., Olivarez, J. 2001. Reducing the spread of invasive exotic plants following fire in western forests, deserts, and grasslands. In: Galley, Krista. E. M.; Wilson, Tyrone P., eds. Proceedings of the invasive species workshop: The role of fire in the control and spread of invasive species; Fire conference 2000: the first national congress on fire ecology, prevention, and management; 2000 November 27 - December 1; San Diego, CA. Misc. Publ. No. 11. Tallahassee, FL: Tall Timbers Research Station: 102-103. Abstract. (40681)Anderson, N.H. 1976. The distribution and biology of the Oregon Trichoptera. Ore. St. Univ. Ag. Exp. Sta. Tech. Bull #134. 152 pp.

Barrett, J. 1981. Twenty-Year Growth of Thinned Ponderosa Pine in the Methow Valley of Northern Washington. PNW-RP-286. USDA Forest Service, Pacific NW Research Station: Portland, OR.

Barrett, J. 1982. Growth of Ponderosa Pine Saplings Thinned to Five Spacings in Central Oregon. PNW-RP-301. USDA Forest Service, Pacific NW Research Station: Portland, OR.

Barrett, J. 1989. Growth of Ponderosa Pine Poles Thinned to Different Stocking Levels in Central Oregon. PNW-RP-311. USDA Forest Service, Pacific NW Research Station: Portland OR.

Barrett, S.C.H. and Kohn, J.R. 1991. Genetic and Evolutionary Consequences of Small Population Sizes in Plants: Implications for Conservation. In: D.A. Falk and K.E. Holsinger (eds.) Genetics and Conservation of Rare Plants (New York: Oxford University Press). p. 3-30.

Belt, G.H., O'Laughlin, J., and Merrill, T. 1992. Design of forest riparian buffer strips for the protection of water quality: analysis of scientific literature. Idaho Forest, Wildlife and Range Policy Analysis Group, Report No. 8.

Belsky, A.J. 2000. Livestock Grazing and Weed Invasions in the Arid West. Oregon Natural Desert Association. Bend, OR.

Benda, L. Martin, D., Cummins, K., Bailey, J. and James, C. (accepted, 2011). Toward spatially explicit riparian management. Forest Science.

Benda, L. and Bigelow, P. (in prep, 2011). Recruitment, storage transport and function of wood in northern California streams. Journal of Forest Ecology and Management. Available Online:http://www.bof.fire.ca.gov/board_committees/monitoring_study_group/msg_supported_reports/2012_supported_reports/benda_bigelow_cawood1__final_.pdf

Beschta, R.L.; Bilby, R.E.; Brown, G.W.; Holtby, L.B.; Hofstra, T.D. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions.

Binns, N.A. 1999. A compendium of trout stream habitat improvement projects done by the Wyoming game and fish department, 1953-1998. Cheyenne, WY, Fish Division, Wyoming Game & Fish Department. 37+ pp.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams.American Fisheries Society Special Publication 19:83-138.

Brooks, P., Urban, K., Yates, G., Johnson, C. 1991. Sensitive Plants of the Malheur, Ochoco, Umatilla and Wallowa-Whitman National Forests. USDA Forest Service publication FSR6-WAW-TP-027-91.

Buffington, J.M., Montgomery, D.R., and Greenberg, H.M. 2004. Basin-scale availability of salmonid spawning gravel as influenced by channel type and hydraulic roughness in mountain catchments. Canadian Journal of Fisheries and Aquatic Sciences, Vol. 61, pp. 2085-2096.Carlson, C. E., and N. W. Wulf. 1989. Silvicultural Strategies to Reduce Stand and Forest Susceptibility to the Western Spruce Budworm. USDA Forest Service, Cooperative State Research Service. Agriculture Handbook No. 676.

California Herps. A guide to the amphibians and reptiles of California. Rana luteiventris. Available Online: http://www.californiaherps.com/frogs/pages/r.luteiventris.html

Callihan, R.H. and Evans, J.O. 1991. Weed dynamics on rangeland. Pages. 55-61. J.O. Evans, M.H. Ralphs, and R.D. Child, (editors). In, James, L. F., Noxious Range Weeds, Westview Press, San Francisco, CA.

Chornesky, E.A., Bartuska, A.M., Aplet, G.H., Britton, K.O., Cummings-Carlson, J., Davis, F.W., Eskow, J., Gordon, D.R., Gottschalk, K.W., and Haack, R.A. 2005. Science priorities for reducing the threat of invasive species to sustainable forestry. BioScience 55(4): 335-348.

Christy, J. 2006. Species Fact Sheet for *Tortula mucronifolia*. USDA Forest Service/USDI Bureau of Land Management. Interagency Special Status/Sensitive Species Program (ISSSSP), Oregon and Washington.

http://www.fs.fed.us/r6/sfpnw/issssp/planning-documents/species-guides.shtml

Christy, J. 2007a. Species Fact Sheet for *Helodium blandowii*. USDA Forest Service/USDI Bureau of Land Management. Interagency Special Status/Sensitive Species Program (ISSSSP), Oregon and Washington.

http://www.fs.fed.us/r6/sfpnw/issssp/planning-documents/species-guides.shtml

Christy, J. 2007b. Species Fact Sheet for *Tomentypnum nitens*. USDA Forest Service/USDI Bureau of Land Management. Interagency Special Status/Sensitive Species Program (ISSSSP), Oregon and Washington.

http://www.fs.fed.us/r6/sfpnw/issssp/planning-documents/species-guides.shtml

Cipollini, M.L., Drake, B.G., and Whigham, D. 1993. Effects of elevated CO_2 on growth and carbon/nutrient balance in the deciduous wood shrub *Lindera benzoin* (L.) Blume (Lauraceae). Oecologia 96: 339-346.

Climate Change Science Program. 2008. Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Julius, S.H.; J.M. West (eds.), J.S. Baron, B. Griffith, L.A. Joyce, P. Kareiva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scot (Authors)]. U.S. Environmental Protection Agency, Washington, D.C. 873 pp.

Croft, L., Owen, W. and Shelly, J. 1997. Interior Columbia Basin Ecosystem Management Project - Analysis of Vascular Plants.

Cochran, P.H., J.M.Geist, D.L. Clemens, R. R. Clausnitzer, and D. C. Powell. 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.

Cochran, P. H. and J. Barrett. 1993. Long-term Response of Planted Ponderosa Pine to Thinning in Oregon's Blue Mountains. Western Journal of Applied Forestry, Vol. 8, No.4, October 1993.

Cochran, P. H. and J. Barrett. 1999a. Thirty-Five-Year Growth of Ponderosa Pine Saplings in Response to Thinning and Understory Removal. PNW-RP-512. Portland, OR: USDA Forest Service, Pacific NW Research Station.

Cochran, P. H. and J. Barrett. 1999b. Growth of Ponderosa Pine Thinned to Different Stocking Levels in Central Oregon: 30-Year Results. PNW-RP-508. Portland, OR: USDA Forest Service, Pacific NW Research Station.

Cordova, J.J. 1995. Streamside forest, channel constraint, large woody debris characteristics, and pool morphology in low order streams, Blue Mountains, Oregon. M.S. thesis, Oregon State University, Corvallis, OR. 143 p.

Craig, D.L., Fallowfield, H.J., and Cromar, N.J. 2004. Use of microcosms to determine persistence of Escherichia coli in recreational coastal water and sediment and validation with in situ measurements. Journal of Applied Microbiology, Vol. 96, No. 5, pp. 922-930.

Crispin, V., House, R. & Roberts, D. 1993. Changes in instream habitat, large woody debris, and salmon habitat after the restructuring of a coastal Oregon stream. N. Am. J. Fish. Manage., 43: 96-102.

Croke, J.C. and Hairsine, P.B. 2006. Sediment delivery in managed forests: a review. Environmental Reviews, Vol. 14, pp. 59-87.

Currens, K. P., C. B. Schreck, and H. W. Li. 2007. Evolutionary diversity in redband trout. Pages 1–19 in R. K. Schroeder and J. D. Hall, editors. Redband trout: resilience and challenge in a changing landscape. American Fisheries Society, Oregon Chapter, Corvallis.

DeClerck-Floate, R. 1997. Cattle as dispersers of hound's tongue on rangeland in southeastern British Columbia. Journal of Range Management. 50:239-243.

Dewey, R. 2007. Draft conservation assessment for *Achnatherum hendersonii* and *Achnatherum wallowaensis* on the Ochoco National Forest. Ochoco and Deschutes National Forests. Bend, OR.

Dewey, R. 2008. Initial Bryophyte and Lichen Inventories, Ochoco National Forest, Part 2 Project Report by Rick Dewey. Deschutes National Forest, Bend, OR.

Dewey, R. 2011. Conservation Strategy for *Calochortus longebarbatus* Wats. var. *peckii* Ownbey. For Ochoco and Malheur National Forests and the Prineville BLM District. Ochoco National Forest. Prineville, OR.

DiTomaso, J.M. 1997. Risk analysis of various weed control methods. Proc., California Exotic Pest Plant Council Symposium 3:34-39.

Duan, X., Wang, Z., and Tian, S. 2008. Effect of streambed substrate on macroinvertebrate biodiversity. Frontiers of Environmental Science and Engineering in China, Vol. 2, No. 1, pp. 122-128.

Duff, D.A. 1979. Riparian habitat recovery on Big Creek, Rich County, Utah – summary of 8 years of study. Grazing and riparian/stream ecosystems, Forum Proceedings, Trout Unliminted, Vienna, Virginia, USA.

Dukes, J.S. and Mooney, H.A. 1999. Does global change increase the success of biological invaders? TREE 14(4): 135-139.

Ebersole, J.L., W.J. Liss, and C.A. Frissell. 2001. Relationship between stream temperature, thermal refugia, and rainbow trout (*Oncorhynchus mykiss*) abundance in arid-land streams, northwestern United States. Ecology of Freshwater Fish 10(1):1-11.

Elliot, W.J. 2000. Roads and other corridors. Drinking Water from Forests and Grasslands, General Technical Report SRS-39, Chapter 9.

Environmental Protection Agency (EPA). 2013. Online: (http://water.epa.gov/type/rsl/monitoring/vms54.cfm).

Everest, Fred H.; Reeves, Gordon H. 2006. Riparian and aquatic habitats of the Pacific Northwest and southeast Alaska: ecology, management history, and potential management strategies. Gen. Tech. Rep. PNW-GTR-692. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 130 p.

Farrar, D.R. 2006. Systematics of Moonworts Botrychium Subgenus Botrychium. Prepared for the Black Hills Moonwort Workshop. Iowa State University. Department of Evolution and Organismal Biology. Ames, IA.

Federal Register, Volume 78, Number 10 [FR Doc No: 2013-00700] January 15, 2013. National Marine Fisheries Service, 50 CFR Part 223. Endangered and Threatened Species: Designation of a Nonessential Experimental Population for Middle Columbia River Steelhead above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin.

Ferrari, V.C., Zebell, R.K., and Fiedler, P.L. 1996. Final Report Molecular Gene of Calochortus longebarbatus var. peckii. Research performed out of San Francisco State University, CA. Submitted to Lisa Croft, Forest Botanist, Ochoco NF, Prineville, OR.

Fettig, C. J., K. Klepzig, R. Billings, S. Munson, E. Nebecker, J. Negron, and J. Nowak. 2007. The Effectiveness of Vegetation Management Practices for Prevention and Control of Bark Beetle Infestations in Coniferous Forests of the Western and Southern United States. In *Forest Ecology and Management* 238 (2007) 24-53.

Fiedler, P.L. 1986. Concepts of Rarity in Vascular Plant Species, with Special Reverence to the Genus Calochortus Pursh (Lilliaceae). Taxon. 35 (3): p. 511.

Fiedler, P.L. 1987. Life History and Population Dynamics of Rare and Common Mariposa Lilies (*Calochortus* Pursh: *Lilliaceae*). Journal of Ecology 75: 977-995.

Filip, G. M. and C. L. Schmitt. 1990. Rx for Abies: Silvicultural Options for Diseased Firs in Oregon and Washington. General Technical Report PNW-252. USDA Forest Service, Pacific NW Research Station: Portland, OR.

Foltz, R.B., Copeland, N.S., and Elliot, W.J. 2009. Reopening abandoned forest roads in northern Idaho, USA: quantification of runoff, sediment concentration, infiltration, and interrill erosion parameters. Journal of Environmental Management, Vol. 90, pp. 2542-2550.

Gard, R. 1961. Creation of trout habitat by constructing small dams. J. Wildl. Manage., 52(4): 384-390.

Glavich, D. 2007. Conservation Assessment for *Dermatocarpon meiophyllizum* Vaino. USDA Forest Service/USDI Bureau of Land Management. Interagency Special Status/Sensitive Species Program (ISSSSP), Oregon and Washington.

http://www.fs.fed.us/r6/sfpnw/issssp/planning-documents/assessments.shtml

Goheen, E. M. and E. A. Willhite. 2006. Field Guide to Common Diseases and Insect pests of Oregon and Washington Conifers. R6-NR-FID-PR-01-06. Portland, OR: USDA Forest Service, Pacific Northwest Region. 327 p.

Gomi, T., Moore, R.D., and Hassan, M.A. 2005. Suspended sediment dynamics in small forest streams of the Pacific Northwest. Journal of the American Water Resources Association, August, pp. 877-898.

Goode, J.R., Luce, C.H., and Buffington, J.M. 2012. Enhanced sediment delivery in a changing climate in semi-arid mountain basins: Implications for water resource management and aquatic habitat in the northern Rocky Mountains. Geomorphology, pp. 139-140.

Gowan, D. and T.E. Burke. 1999. Conservation Assessment for Pristiloma arcticum crateris, Crater Lake Tightcoil. Originally issued as Management Recomendations October 1999 by Nancy Duncan. Reconfigured by N. Duncan in 2004. USDA Forest Service Region 6 and ISDI Bureau of Land Management, Oregon and Washington. 18 p.

Grace, J.M. 2003. Minimizing the impacts of the forest road system. Proceedings of the conference 34 international erosion control association, pp. 301-310.

Gregory, Stanley V., Frederick J. Swanson, W. Arthur McKee, and Kenneth W. Cummins. 1991. An ecosystem perspective of riparian zones. BioScience v. 41 n. 8: 540-551.

Graham, S. and F. Knight. 1965. Principles of Entomology. Forth Edition. McGraw-Hill.

Hagle, S. K., and C. G. Shaw III. 1991. Avoiding and Reducing Losses from Armillarian Root Disease. USDA Forest Service. Agriculture Handbook No. 691.

Hadfield, J. S., D. J. Goheen, G. M. Filip, C. L. Schmidt, and R. D. Harvey. 1986. Root Diseases in Oregon and Washington Conifers. USDA Forest Service. R6-FPM-250-86.

Hall, F.C. 1973. "Plant Communities of the Blue Mountain Area in Eastern Oregon and Southeastern Washington." USDA Forest Service. Pacific NW Region-Area Guide 3-1.

Halvorson, R. 2000. BLM Special Status Plant Habitat/Distribution Narrative. Bureau of Land Management, Prineville District. R. Halvorson was the botanical specialist for the Bureau of Land Management, Prineville District. Prineville, OR.

Halvorson, R. Personal communication 2003-2008 on BLM Special Status Plants. Bureau of Land Management, Prineville District. Prineville, OR.

Hawksworth, F. G., and C. G. Shaw III. 1987. Damage and Control of Major Diseases of Ponderosa Pine. Proceedings: Ponderosa Pine the species and its management (Spokane, WA, September 29 – October 1, 1987).

Hellamann, J.J., Byers, J.E., Bierwagen, B.G., Dukes, J.S. 2008. Five potential consequences of climate change for invasive species. Conservation Biology 22(3): 534-543.

Helliwell, R. 1992. Biological Evaluation for the Marks Cr. Planning Area. R. Helliwell was district botanist, Big Summit RD, Ochoco NF, Prineville, OR.

Helliwell, R. 1993. Memorandum to Ochoco NF botanists to share information on Calochortus longebarbatus Wats. var. peckii Ownbey.

Hitchcock, C.L. Cronquist, A. 1973. Flora of the Pacific Northwest. University of Washington Press. Seattle, WA.

Hopkins, W.E. and Garrett, S. 1990. Sensitive Plant-Animal and Noxious Weeds Guide for the Deschutes, Fremont, Ochoco and Winema National Forests-Area IV. USDA Forest Service, Pacific Northwest Region. R6-DES-TP-017-90.

Howell, J.M., Coyne, M.S., and Cornelius, P.L. 1996. Effect of sediment particle size and temperatures on fecal bacteria mortality rates and the fecal coliform/fecal streptococci ratio. Journal of Environmental Quality, Vol. 25, pp. 1216-1220.

House, R. 1996. An evaluation of stream restoration structures in a coastal Oregon stream 1981-1993. N. Am. J. Fish. Manage., 16: 272-281.

House, R., Crispin, V. & Monthey, R. 1989. Evaluation of stream rehabilitation projects - Salem District (1981-1988). Technical Note, T/N OR-6. Portland, OR, U.S. Dept. Interior Bureau of Land Management, Oregon State Office.

Ice, G.I. 2001. How direct solar radiation and shade influences temperatures in forest streams and relaxation of changes in stream temperature. National Council for Air and Stream Improvement. 34 p.

Johnson, C. G. Jr., and R. R. Clausnitzer, 1992. Plant Associations of the Blue and Ochoco Mountains. R6-ERW-TP-036-92. USDA Forest Service, Pacific Northwest Region.

Johnson, C.G. 1994. Forest Health in the Blue Mountains: A Plant Ecologist's Perspective on Ecosystem Processes and Biological Diversity. Gen Tech. Report. PNW Research Sta. Portland, OR.

Johnson, C.G. 1998. Vegetation Response after Wildfires in National Forests in Northeastern Oregon. USDA Forest Service. Pacific NW Region R6-NR-ECOL-TP-06-98, Portland, OR.

Jones, J.A., Swanson, F.J., Wemple, B.C., and Snyder, K.U. 2000. Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks. Conservation Biology, Vol. 14, No. 1, pp. 76-85.

Joyce, L.A., Blate, G.M., Littell, J.S., McNulty, S.G., Millar, C.I., Moser, S.C., Neilson, R.P., O'Halloran, K., and Peterson, D.L. 2008. National Forests. Pp. 3-1 to 3-127 In Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Julius, S.H.; J.M. West (eds.), J.S. Baron, B. Griffith, L.A. Joyce, P. Kareiva, B.D. Keller, M.A. Palmer, C.H. Peterson, and J.M. Scot (Authors)]. U.S. Environmental Protection Agency, Washington, D.C. 873 pp.

Kagan, J.S. 1996. Draft Species Management Guide for Calochortus longebarbatus Wats. var. peckii Ownbey

Kaufmann, J.B. 1990. Ecological relationships of vegetation and fire in Pacific Northwest Forests. In: Walstad, et al, Natural and Prescribed Fire in Pacific Northwest Forests. Oregon State University Press, Corvallis, OR

Kaye, T. and Rittenhouse, B. 1990, revised 1994 by Wooley, B. Conservation Strategy for Calochortus longebarbatus var. longebarbatus. Fremont National Forest.

Lacey, J., Husby, P., and Handl, G. 1990. Observations on spotted and diffuse knapweed invasion into un-grazed bunchgrass communities in western Montana. Rangelands 12:30-32.

La Marche, J.L. and Lettenmaier, D.P. 2001. Effects of forest roads on flood flows in the Deschutes River, Washington. Earth Surface Processes and Landforms, Vol. 26, pp. 115-134.

Langland, D. 2009. Personal communication on the seed bank viability of knapweed species and restoration potential using domestic grasses. D. Langland is noxious weed specialist for Oregon Department of Agriculture, Redmond, OR.

Larson, S., R. Oren, R. H. Waring, J. W. Barrett. 1983. Forest Science. Vol. 29, No. 2, pp. 395-402.

Lisle, Thomas E. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. 2002. Available Online: http://www.fs.fed.us/psw/publications/documents/gtr-181/009_Lisle.pdf

Lewis , S. L. 1969. Physical factors influencing fish populations in pools of a trout stream. Trans. Am. Fish Soc. 98(1):14-19.

Lopez, K. 2012. Monitoring forms for sensitive *Achnatherum* populations on Ochoco NF.

Luce, C.H. and Black, T.A. 2001. Spatial and temporal patterns in erosion from forest roads. Influence of Urban and Forest Land Uses on the Hydrologic-Geomorphic Responses of Watersheds, Edited by Wigmosta and S.J. Burges, Water Resources Monographs, American Geophysical Union, Washington, D.C. pp. 165-178.

Mafera, D. 2003. Botany Report for Deep Vegetation Management - Draft EIS. Paulina Ranger District, Ochoco NF, Paulina, OR.

Marcuson, P.E. 1977. "The Effect of Cattle Grazing on Brown Trout in Rock Creek, Montana." Fish and Game Fed. Aid Pro. F-20-R-21-11a.

Maze, J. and Robson, K.A. 1996. A new species of Achnatherum (Oryzopsis) from Oregon. Madrono 43:393-403.

McDade, M.H, F.J. Swanson, W.A. McKee, J.F. Franklin and J. Van Sickle. 1990. Source distances for coarse woody debris entering small streams in Western Oregon and Washington. Can. J. For. Res. 20:326-330.

McDonald, A. and Kay, D. 1981. Enteric bacterial concentrations in reservoir feeder streams: baseflow characteristics and response to hydrograph events. Water Research, Vol. 15, pp. 961-968.

McDowell, N., J. R. Brooks, S. A. Fitzgerald, and B. J. Bond. 2003. Carbon isotope discrimination and growth response of old *Pinus ponderosa* trees to stand density reductions. Plant, Cell and Environment. 26:631-644.

Meineke, R.J. 1995. Mimulus evanescens (Scrophulariaceae): A New Annual Species from the Northern Great Basin. Great Basin Naturalist. Pages. 249-257.

Meleason, Mark A., Stanley V. Gregory, and John P. Bolte. 2003. IMPLICATIONS OF RIPARIAN MANAGEMENT STRATEGIES ON WOOD IN STREAMS OF THE PACIFIC NORTHWEST. Ecological Applications 13:1212–1221. Available Online: http://dx.doi.org/10.1890/02-5004

Messier, M.S., Shatford, J.P.A., Hibbs, D.E. 2012. Fire exlusion effects on riparian forest dynamics in southwestern Oregon. Forest Ecology and Management, Vol. 264, pp. 60-71.

Meyer, K.A., Lamansky, J.A., and Schill, D.J. 2010. Biotic and abiotic factors related to redband trout occurrence and abundance in desert and montane streams. Western North American Naturalist, Vol. 70, No. 1, pp. 77-91.

Miller, R.F. and Rose, J.E. 1999. Journal of Range Management. 5:550-559.

Montgomery, David R., John M. Buffington, Richard D. Smith, Kevin M. Schmidt, and George Pess. 1995. Pool spacing in forest channels. Water Resources Research, vol. 31, no. 4: 1097-1105.

Montgomery, D.R., and J.M. Buffington, 1997, Channel-reach morphology in mountain drainage basins, Geological Society of America Bulletin, 109:596-611.

Moreau, J.K. 1984. Anadromous salmonid habitat enhancement by boulder placement in Hurdygurdy Creek, California. In T.J. Hassler, ed. Pacific Northwest Stream Habitat Management Workshop, pp. 97-116. Humboldt State University, Arcata, CA, American Fisheries Society, Humboldt Chapter.

Mote, P.W. and 18 co-authors. 1999. Impacts of climate variability and change: Pacific Northwest. A report of the Pacific Northwest Regional Assessment Group for the U.S. Global Change Research Program. JISAO/SMA Climate Impacts Group, University of Washington, Seattle.

Mote, P.W. 2004. How and why is Northwest climate changing? Pp. 11-22 In D.L Peterson, J.L. Innes, and K. Obrian (eds.). Climate change, carbon, and forestry in Northwestern North America: Proceedings of a Workshop. November 14-15, 2001. Orcas Island, Washington. USDA Forest Service, Pacific Northwest Research Station, Gen. Tech. Rept. PNW-GTR-614.

Muhlfeld, C.C. , Bennett, D.H. and Marotz, B. 2001. Summer Habitat Use by Columbia River Redband Trout in the Kootenai River Drainage, Montana, North American Journal of Fisheries Management, 21:1, 223-235.

Muhlfeld, C.C. 2002. Spawning characteristics of redband trout in a headwater stream in Montana. North American Journal of Fisheries Management, Vol. 22, pp. 1314-1320.

National Assessment Synthesis Team. 2000. Climate change impacts on the United States: The potential consequences of climate variability and change. US Global Change Research Program. Washington, D.C. 154pp.

National Marine Fisheries Service. August 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. Available online http://www.nwr.noaa.gov/Publications/ReferenceDocuments/upload/matrix_1996.pdf.

NatureServe Explorer. Various species. Available online http://www.natureserve.org/explorer/index.htm

Nehlsen, W. 1995. Historical Salmon and Steelhead Runs of the Upper Deschutes River and Their Environments. Prepared for: Portland General Electric.

Neitzel, D.A. and T.J. Frest. 1989. Survey of Columbia River Basin streams for giant Columbia River spire snail Flumincola columbiana and great Columbia River limpet Fisherola nuttalli. Tech. Rep. #PNL7103, Battelle Pacific Northwest Labs. 59 pp.

Oliver, W. W. 1979. Growth of Ponderosa Pine Thinned to Different Stocking Levels in Northern California. PSW – 147. USDA Forest Service, PSW Forest and Range Experiment Station: Berkeley, CA.

Olsen, E.A., R.B. Lindsay, and W.A. Burck. 1991. Summer steelhead in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife. Unpublished draft information report. Portland.

Olson, B.E. 1999. Impacts of Noxious Weeds on Ecologic and Economic Systems, p. 4-15, and Grazing and weeds. p. 85-96. In: Sheley, R. L. and Petroff, J. K., eds. Biology and Management of Noxious Rangeland Weeds. Oregon St. Univ. Press, Corvallis.

Omi, P. N. and E. J. Martinson. 2002. Effect of Fuels Treatment on Wildfire Severity. Submitted to the Joint Fire Science Program Governing Board.

Opperman, J., A. Merenlender and D. Lewis. 2006. Maintaining wood in streams: a vital action for fish conservation. Publication 8157. University of California.

Oregon Biodiversity Information Center (ORBIC, formerly ONHP). 2010. Rare, Threatened, and Endangered Species of Oregon. Portland, OR.

Oregon Department of Agriculture (ODA). 2001. Noxious Weed Policy and Classification System. Salem, OR.

Oregon Department of Agriculture (ODA). 2009. Plant Division, Noxious Weed Control - Houndstongue Salem, OR.

http://www.oregon.gov/ODA/PLANT/WEEDS/profile_houndstongue.shtml

Oregon Department of Environmentl Quality. Water Quality Standards: Beneficial Uses, Policites, and Criteria for Oregon. Available online: http://www.deq.state.or.us/wq/standards/standards.htm

Oregon Department of Environmental Quality. 2010. Oregon's 2010 Integrated Report and 303(d) list. http://www.deq.state.or.us/wq/assessment/2010Report.htm

Oregon Department of Fish and Wildlife. Goodson, Kevin. 2005 Oregon Native Fish Status Report. Available online: http://www.dfw.state.or.us/fish/onfsr/report.asp#documents

Oregon Department of Fish and Wildlife. 2010. Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment. Available online: http://www.dfw.state.or.us/fish/CRP/docs/mid_columbia_river/Oregon_Mid-C_Recovery_Plan_Feb2010.pdf

Paulson, D. 1999. Dragonflies of Washington. Seattle Audobon Society, Seattle, Washington. 31 pp.

Peterson, D. L., M. C. Johnson, J. K. Agee, T. B. Jain, D. McKenzie, and E. D. Reinhardt. 2005. Forest Structure and Fire Hazard in Dry Forests of the Western United States. General Technical Report PNW-GTR-628. Portland, Oregon. USDA, Forest Service. Pacific Northwest Research Station.

Pollet, J. and P. N. Omi. 2002. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. International Journal of Wildland Fire, 2002, 11, 1-10

Portland General Electric (website). Historic milestone: Adult spring Chinook released above Pelton Round Butte, completing migration cycle. http://www.deschutespassage.com/index.html

Powell, D. C. 1999. Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington: An Implementation Guide for the Umatilla National Forest. F14-SO-TP-03-99. USDA, Forest Service, Pacific Northwest Region. 25p.

Prichard, S. J. ,D. L. Peterson, and K. Jacobson. Fuel treatments reduce the severity of wilfire effects in dry mixed conifer forest, Washington, USA. Can. J. For. Res. 40: 1615 – 1626 (2010)

Pyke, C.R.; Thomas, R., Porter, R.D., Hellmann, J.J., Duke, J.S., Lodge, D.M., and Chavarria, G. 2008. Current practices and future opportunities for policy on climate change and invasive species. Conservation Biology 22(3): 585-592.

Raleigh, R. F., T. Hickman, R. C. Solomon, and P. C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish Wildl. Servo FWS/OBS-82/10.60. 64 pp.

Richards, C. and Bacon, K.L. 1994. Influence of fine sediment on macroinvertebrate colonization of surface and hyporheic stream substrates. Great Basin Naturalist, Vol. 54, No. 2, pp. 106-113.

Ringold, P.L., Van Sickle, J., Rasar, K., and Schacher, J. 2003. Use of hemispheric imagery for estimating stream solar exposure. J. American Water Resources Association, December, pp. 1373-1384.

Robison, E. G. and R. L. Beschta. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. Forest Science v. 36 n. 3:790-801.

Roni P., Beechie T.J., Bilby R.E., Leonetti F.E., Pollock M.M., and Pess G.R. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. North American Journal of Fisheries Management 22:1–20.Rosgen, D.L. and H.L. Silvey. 1996. Applied River Morphology. Wildland Hydrology Books, Fort Collins, CO.

Roni, P., T. P. Quinn. 2001. Density and size of juvenile salmonids in response to placement of large woody debris in western Oregon and Washington streams. Canadian Journal of Fisheries and Aquatic Sciences, 58:282-292.

Roth, L. F. and J. Barrett. 1985. Response of Dwarf Mistletoe-infested Ponderosa Pine to Thinning. PNW-RP-331. Portland, OR: USDA Forest Service, Pacific NW Research Station.

Scheuering, E. 2006. Columbia Clubtail (Gomphus lynnae) (dragonfly) species fact sheet. Interagency Special Status/ Sensitive Species Program (ISSSSP) webpage. USDA Forest Service/ USDI Bureau of Land Management, Oregon and Washington. Available Online: (http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml)

Scheuering, E. 2006. A caddisfly (Namamyia plutonis) species fact sheet. Edit update by R. Huff in 2007. Interagency Special Status/ Sensitive Species Program (ISSSSP) webpage. USDA Forest Service/ USDI Bureau of Land Management, Oregon and Washington. Available Online: (http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml)

Schmid, J. M., S. A. Mata, and R. A. Obedzinski. September 1994. Hazard rating ponderosa pine stands for mountain pine beetle in the Black Hills. USDA Forest Service Research Note RM-RN-529. Fort Collins, CO. Rocky Mountain Forest and Experiment Station. 4 p.

Sedell, J. R., G. H. Reeves, E. R. Hauer, J. A. Stanford, and C. P. Hawkins. 1990. Role of refugia in recovery from disturbances: Modern fragmented and disconnected river systems. Environmental Management 14: 7 1 l-724.

Shaw, D.C., P.T. Oester, and G.M. Filip. 2009. Managing Insects and Diseases of Oregon Conifers. Oregon State University Extension Service. EM 8980. Corvallis, OR. 98p.

Sheley, R.L, Olson, B.E., Larson, L.L. 1997. Effect of weed seed rate and grass defoliation level on diffuse knapweed. Journal of Range Management. 50:39-43.

Sheley, R.L., Manoukian, M., and Marks, G. 1999b. Preventing noxious weed invasion. Pages 69-72 in Sheley, R.L. and Petroff, J.K., eds. Biology and Management of Noxious Rangeland Weeds. Oregon St. Univ. Press, Corvallis.

Sheley, R.L., Petroff, J.K., and Borman, M.M. 1999c. Introduction p. 1, In: Sheley, R. L. and Petroff, J.K., eds Biology and Management of Noxious Rangeland Weeds. Oregon St. Univ. Press, Corvallis.

Sherer, B. M., J. R. Miner, J. A. Moore, and J. C. Buckhouse. 1992. Indicator Bacteria Survival in Stream Sediments. Journal of Environmental Quality, Vol. 21, pp. 591-595.

Sierra Nevada Adaptive Management Project web site http://snamp.cnr.berkeley.edu/about/snamp-glossary/

Simpson, M., D. Zalunardo, A. Eglitis, D.C. Wood, D.R. Roy, and S.J. Johnson. 1994. (draft) Viable Ecosystem Management Guide, Ochoco National Forest. USDA Forest Service.

Smith, H.G., Sheridan, G.J., Lane, P.N.J., Nyman, P., and Haydon, S. 2011. Journal of Hydrology, Vol. 396, pp. 170-192.

Solo-Gabriele, H. M., M. A. Wolfert, T. R. Desmarais, and C. J. Palmer. 2000. Sources of Escherichia coli in a coastal subtropical environment. Applied and Environmental Microbiology 66:230-237.

Stephenson, G. R. and R. C. Rychert. 1982. Bottom sediment: a reservoir for Escherichia coli in rangeland streams. J. Range Mgt 35:119-123.

Storck, P., Bowling, L., Wetherbee, P., and Lettenmaier, D. 1998. Applications of a GIS-based distributed hydrology model for prediction of forest harvest effects on peak stream flow in the Pacific Northwest. Hydrological Processes, Vol. 12, pp. 889-904.

Stromberg, J.C., Beauchamp, V.B., Dixon, M.D., Lite, S.J., and Paradzick, C. 2007. Importance of low-flow and high-flow characteristics to restoration of riparian vegetation along rivers in arid south-western United States. Freshwater Biology, Vol. 52, pp. 651-679.

Stuart, A. M, Grover, D., Nelson, T.K., and S.L. Thesfeld. 2007. Redband Trout Investigations in the Crooked River Basin - In Schroeder, R.K., and J.D. Hall, editors. 2007. Redband Trout: resilience and challenge in a changing landscape. Oregon Chapter, American Fisheries Society, Corvallis.Surfleet, C.G., Skaugset, A.E., Meadows, M.W. 2011. Road runoff and sediment sampling for determining road sediment yield at the watershed scale. C. J. of For. Res. Vol. 41, pp. 1970-1980.

Swank, Wayne T., Leonard F. DeBano, and Devon Nelson. Effects of Timber Management Practices on Soii and Water. Availabe Online: http://coweeta.uga.edu/publications/pubs_oct10/424.pdf

Sweka, J.A. and Hartman, K.J. 2001. Influence of turbidity on brook trout reactive distance and foraging success. Transactions of the American Fisheries Society, Vol. 130, No. 1, pp. 138-146.

Takken, I., Croke, J., and Lane, P. 2008. A methodology to assess the delivery of road runoff in forestry environments. Hydrological Processes, Vol. 22, pp. 254-264.

Tarzwell, C.M. 1938. An evaluation of the methods and results of stream improvement in the Southwest. Trans. Am. Fish. Soc., 3: 339-364.

Thurow, R.F., B.E Rieman, D.C. Lee, P.J. Howell, and R.D. Perkinson. 2007. Distribution and status of redband trout in the interior Columbia river basin and portions of the Klamath river and great basins. Redband Trout: Resilience and Challenge in a Changing Landscape. Oregon Chapter, American Fisheries Society. 19 p.

Tiedemann, A.R., Quigley, T.M., and Anderson, T.D. 1988. Effects of timber harvest on stream chemistry and dissolved nutrient losses in Northeast Oregon. Forest Science, Vol. 34, No. 2, pp. 344-358.

United States Congress. Federal Noxious Weed Act of 1974.

USDA Forest Service. 1984. Forest Service Manual (FSM), Title 2500 - Watershed and Air Management.

USDA Forest Service. 1988. General Water Quality Best Management Practices. Pacific Northwest Region. November, 1988.

USDA Forest Service. 1989. Land and Resource Management Plan, Ochoco National Forest and Crooked River National Grassland. U.S.D.A. Forest Service, Pacific Northwest Region (August 1989).

USDA Forest Service. 1995. Decision Notice and Finding of No Significant Impact, Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions.

USDA Forest Service. 1995. Implementation of the Inland Native Fish Strategy letter. Intermountain, Northern, and Pacific Northwest Regions.

USDA Forest Service. 1995. Decision Notice/Decision Record, Finding of No Significant Impact, Environmental Assessment, Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California.

USDA, Forest Service. 2006. McKay Creek Watershed Analysis. Ochoco National Forest.

USDA Forest Service. 2012. National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide. FS-990a. April 2012.

USDA Forest Service. 1989. Ochoco National Forest Land and Resource Management Plan. Reprinted 1991. Prineville, OR. Ch 4 p. 3, 36, 120, 121, 140, 141, 197, 247.

USDA Forest Service. 1990-2011. Region 6 Threatened, Endangered, and Sensitive Plant Sighting Forms and Survey records. Unpublished records on file at Lookout Mt. Ranger District Office, Ochoco National Forest. Prineville, OR.

USDA Forest Service. 1995a. Forest Service Manual 2670 -- Threatened, Endangered, and Sensitive plants and animals.

USDA Forest Service.1995c. Forest Service Manual Washington, D.C. Series 2000-National Forest Resource Management (Noxious weeds). Amendment No. 2000-95-5. Effective Nov. 29, 1995. Page 9. 2081.2.

USDA Forest Service. 1995d. Inland Native Fish Strategy Environmental Assessment and Decision Notice. Coeur d'Alene, ID.

USDA Forest Service. 1998. Environmental Assessment and Decision Notices for the Integrated Noxious Weed Management Program. Ochoco National Forest and Crooked River National Grassland. Ochoco National Forest. Prineville, OR.

USDA Forest Service. 1999. Western Juniper in Eastern OR. PNW-GTR-464

USDA. 2000. Federal Noxious Weed List.

http://www.aphis.usda.gov/ppq/permits/noxiousweed_list.html

USDA Forest Service. 2002b. Standards, Guidelines, and Amendments For Botanical Resources. Oct. 4, 2002. Forest Plan Standards and Guidelines.

USDA Forest Service. 2005. Final Environmental Impact Statement (FEIS) and Record of Decision for The Pacific Northwest Invasive Plant Program, Preventing and Managing Noxious Weeds. Pacific NW Regional Office. Portland, OR.

USDA Forest Service. 2006. Deschutes and Ochoco National Forests and Crooked River National Grassland Invasive Plant Prevention Practices. Deschutes NF, Bend, OR.

USDA Forest Service. 2011a (December). Regional Forester's (R-6) Special Status Species List and US Fish and Wildlife Service - Federally Threatened, Endangered, or Proposed species.

USDA Forest Service. 2011b. Series 2900-Invasive Species Management. Effective 12/05/2011. Washington, DC.

USDA Forest Service. 2012. Invasive Plant Treatments Final Environmental Impact Statement. Deschutes and Ochoco National Forests. Bend, OR.

USDA/USDI Forest Service/Bureau of Land Management. 2000. Interior Columbia Basin Supplemental Draft Environmental Impact Statement. Vol. 1, Ch. 2, p. 39, 243. 245, 246.

US Fish and Wildlife Service. 2009. Species Fact Sheet, Columbia spotted frog (Rana luteiventris). http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/

US Fish and Wildlife Service. 2011. SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM. Columbia spotted frog (Rana luteiventris).

Valley, S. 2010. Founder: Oregon Dragonfly Survey, Insect Imaging Specialist, Oregon Dept of Agriculture- Plant Division.

Van Pelt. R. 2008. Identifying Old Trees and Forests in eastern Washington. Washington State Department of Natural Resources, Olympia, WA. 166 p.

Veverka, C. 2010. Field guide to sensitive plants of the Deschutes and Ochoco National Forests. USDA Forest Service. Deschutes NF. Bend, OR.

Vrilakas, S. 1990. Draft Species Management Guide for Oryzopsis hendersonii. Unpublished report submitted to the Wallowa-Whitman National Forest.

Wallander, R.T., Olson, B.E., and Lacey, J.R. 1995. Spotted knapweed seed viability after passing through sheep and mule deer. Journal of Range Management. 48:145-149

Wemple, B.C., Jones, J.A., and Grant, G.E. 1996. Channel network extension by logging roads in two basins, Western Cascades, Oregon. American Water Resources Assocation, Water Resources Bulletin, Vol. 32, No. 6, pp. 1195-1207.

Woldie, D.W., Sidle, R.C., and Gomi, T. 2009. Impact of road-generated storm runoff on a small catchment response. Hydrological Processes, Vol. 23, pp. 3631-3638.

Young, M.K., Hubert, W.A., and Wesche, T.A. 1991. Selection of measures of substrate composition to estimate survival to emergence of salmonids and to detect changes in stream substrates. North American Journal of Fisheries Management, Vol. 11, No. 3, pp. 339-346.

Zika, P.F. 1994. Draft Management Plan for the Moonworts Botrychium ascendens, B. crenulatum, B. paradoxum, & B. pedunculosum in the Wallowa-Whitman, Umatilla, and Ochoco National Forests. Oregon Natural Heritage Program. Portland, OR

Ziska, L.H., Faulkner, S., and Lydon, J. 2004. Changes in biomass and root:shoot ration of field-grown Canada thistle (*Cirsium arvense*), a noxious, invasive weed, with elevated CO_2: implications for control with glyphosate. Weed Science 52:584-588.

Zwieniecki, M.A. and Newton, M. 1999. Influence of streamside cover and stream features on temperature trends in forest streams of Western Oregon. Western J. Applied Forestry, Vol. 14, No. 2, pp. 106-113.

APPENDIX A. EXPLANATION OF ACTIVITIES

Timeline

Based on the timelines of previous projects on the Ochoco, natural fuels underburning and thinning with fire in the Wolf project area would occur over the next 10 years, depending on climate and workload. Activity fuels burning would also occur over the next 10 years, depending on when commercial and noncommercial thinning occurs.

Silvicultural Treatments

Various silvicultural treatments are being proposed to meet the vegetative objectives for the area and move the landscape towards the historic condition. They have been proposed to meet stand specific conditions including density, species composition, and stand structure. Often two or more treatments, for example commercial thinning (harvest) followed by non-commercial thinning, is prescribed for the same unit. The major emphasis of the silvicultural treatments will be to:

1. Maintain existing large (21”+ dbh) trees of fire tolerant species and accelerate the development of additional large trees.
2. Maintain existing old growth trees, especially ponderosa pine.
3. Reduce stand densities to maintain large trees, favor early-seral/fire tolerant species, and reduce susceptibility to disturbance agents (insects, disease, and fire).
4. Select for species compositions that are closer to what occurred historically.
5. Increase the amount of acres in single strata stand structure.

Commercial thinning: This prescription would be used in overstocked stands with a surplus of merchantable sized trees between 7 and 20.9 inch DBH. Current stand conditions often include multiple canopies, a component of large (21+” DBH) trees, and dense stocking and may include all seral stages. The stands would be thinned, on average, to recommended stocking levels while retaining variable densities across the unit. Merchantable trees up to 20.9 inch DBH removed in a commercial thinning would be sold and removed from the stand. Following the commercial thinning most stands would be non-commercially thinned and the thinning slash would be treated, in most cases by prescribed fire. All of these treatments work together to attain the desired stand condition where future prescribed burning can safely be used as a forest management tool that mimics the role that fire historically had in these forests.

Variable density thinning prescriptions would be utilized all units except units 25 and portions of units 26 and 27. Units 25, 26, and 27 have developed recreation sites (Wolf Creek Campground and Salters Cabin) within them. Harvest at developed recreation sites would focus on removing safety concerns, maintenance of the facility, and providing for recreational needs. Typically, variable density prescriptions in use for the past several projects on the Ochoco National Forest have called for a mixture of individual trees, small clumps, and leave areas (skips) to be retained as well as the creation of small openings (or gaps). Skips and gaps usually amount to about five to ten percent of each unit respectively. Skips often occur around unique habitat features such as seeps or rock outcrops, or to preserve areas with high levels of downed logs, snags, or dense cover. Gaps often are placed to enhance natural openings or to remove undesired trees such as heavily mistletoe-infected understories. Gaps of up to 2 acres may be created in some units to promote regeneration of early seral species such as larch where these were removed in past harvest (units 71 and 127 for example).

The proposed variable density thinning is intended to generally follow the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

These treatments can create immediate stand structure and species composition shifts to that of a single-strata stand with early seral species composition because the treated stands would no longer be dominated by a dense understory and trees that are removed tend to be mid and late seral species. Overall, species diversity would be retained after harvest, but the proportion of early seral/fire tolerant species would increase. Most treated stands would retain some irregular or uneven-aged structure and age distribution, resulting from some clumps of trees remaining un-thinned or small gaps up to 2 acres being created. Remaining large trees would become more vigorous following the harvest since between-tree competition would be reduced. The increased growth rates in retained trees would eventually augment the number of large diameter trees, helping to increase the amount of late and old structure. Post-harvest residual basal area per acre would be approximately 30 to 60 square feet on drier sites (pine and Douglas-fir) and 50 to 100 square feet on more mesic sites (grand fir). Residual basal area per acre could exceed 100 square feet if numerous trees larger than 21 inches DBH or old growth trees are already present.

Recommended stocking levels vary depending on site quality, tree size and species. For example, the desired density range for an uneven-aged ponderosa pine stand on a grand fir-pinegrass site is 89 to 133 trees per acre when the average diameter is 10 inches DBH and the corresponding basal area would be between 49 and 73 square feet per acre. If the average diameter were larger, then fewer trees would be retained but the residual basal area would increase. Fewer trees would be retained on drier sites relative to moister sites. Recommended stocking levels are derived from "Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington: An Implementation Guide for the Umatilla National Forest" (Powell, 1999).

No live trees 21 inch DBH or larger or dead trees (snags) would be removed in commercial thinning units except for those which are safety hazards. Hazardous trees and snags which are within Riparian Habitat Conservation Areas would be felled but not removed.

Commercial thinning within RHCAs would include the felling of trees to provide large in-channel wood where this habitat feature is lacking or absent. Site specific large wood requirements have been developed on a unit by unit basis to meet INFISH RMOs. Trees which could contribute to large wood requirements would not be removed until down wood requirements are met.

Commercial thinning in Units 22 and 25 would be modified to improve Bald eagle habitat in consultation with the wildlife biologist. These prescriptions would include "doughnut" thinning around selected trees to provide future nest and/or roost trees.

Commercial thinning prescriptions would also require that trees with old tree characteristics be retained, regardless of size or condition. Identification of old trees is based on tree characteristics discussed in *Identifying Old Trees and Forests in Eastern Washington* (Van Pelt 2008). These include bark characteristics, branching structure, and crown form.

Commercial thinning with 21"+ trees: This prescription is similar to commercial thinning except that harvest would include the removal of some trees 21" DBH or larger. This treatment is proposed to help restore historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where there are old ponderosa pine that are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. It would also be applied to remove conifer competition from aspen clones. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Removal of large young trees from the vicinity of old trees for approximately twice the canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

Non-commercial thinning: The objective of this treatment is to reduce the amount of small non-merchantable trees (generally less than 9 inches DBH). No trees meeting old tree criteria would be felled during these operations. The number of small trees to be left varies by stand conditions, depending on the overall stocking objectives and the amount of existing overstory. Where the objective in the stand is to have single-storied LOS and many large diameter trees exist, then few small understory trees would be retained (40 or less per acre). Where few overstory trees exist, such as in young plantations, then the non-commercial thinning could retain 135 or more small trees per acre. Species selection usually retains ponderosa pine, western larch, and sometimes Douglas-fir, or removes species infected with or susceptible to insects/disease. Non-commercial thinning can occur either following a commercial entry or as the only treatment. Trees felled during this activity are usually left on site and the slash treated by a variety of fuels treatments. Within RHCAs trees up to 16 inches DBH may be felled into or towards stream channels and left intact to benefit hardwoods or to provide wood debris and roughness to meet site specific prescriptions.

Non-commercial thinning in unit 204 (24 acres) would be modified to enhance the development/retention of large ponderosa pines which can be available for future bald eagle nest trees. In this unit up to 12 large ponderosa pines would be selected as potential nest trees and non-commercial thinning would include the removal of live trees up to 18 inches DBH that are within 40 feet of the select tree. The larger trees may be cut down or may be pushed or pulled over with low impact machinery (such as a walking excavator). The larger trees would be available for placement in the adjacent headcut repair/stream restoration in Wolf Creek (Unit 253). A similar type of treatment would occur in unit 52 where up to 50 live trees up to 18 inches DBH would be removed for use in the adjacent stream restoration project (unit 350).

Hardwood Treatments: These treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. This includes planting of hardwoods where they are absent or sparse as well as reducing conifer competition by cutting down and/or girdling conifers that have encroached into hardwood communities and are shading out the hardwoods as well as occupying growing space. Conifers up to 16 inch DBH may be felled or girdled so long as they do not qualify as old trees. Conifer thinning would take place for an approximate distance of 75 feet from hardwoods to allow for sufficient sunlight, water, nutrient and growing space to be available.

Slash generated from this non-commercial activity would be left intact to provide protection to the hardwoods, lopped and scattered, or handpiled. Cut trees may also be felled or placed into stream channels for stream restoration purposes. To prevent browsing on hardwood seedlings and saplings, some form of protection would be installed such as fencing or individual cages. In some stands livestock fencing may be installed, in others big game fencing may be required. The type of fence needed would be determined on a site specific basis once implementation is underway. In some instances the cut conifers may be of sufficient size that they can be utilized to provide the protection needed.

When aspen clones are encountered in stands that are planned for commercial harvest or non-commercial thinning, the silvicultural prescription would be modified within and adjacent to the clone to promote the retention and growth of aspen.

Headcut repair/steam restoration projects have been proposed in conjunction with some hardwood restoration units to stop continued stream channel down-cutting and stabilize water tables where this is one cause of hardwood and riparian vegetation decline. For example in unit 253 up to 40 trees may be cut or pushed/pulled over to be used as stream structure material. These trees would range up to 20 inches in diameter. Tree selection would be coordinated with the wildlife biologist and silviculturist so that wildlife habitat needs and silvicultural objectives are met or enhanced.

Juniper cutting: This treatment is primarily proposed within the juniper woodland/steppe PAGs to reduce juniper density. Younger junipers up to 20.9 inch DBH would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size. Concentrations of slash would be burned. Burning is expected to occur in patches as a continuous fuel bed of slash is not anticipated due to the low density of juniper. The vegetative objective of this treatment is to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation.

The prescriptions for the juniper cutting would require that junipers with old tree characteristics be retained, regardless of size. Identification of old junipers is based on tree characteristics similar to those discussed in *Biology, Ecology and Management of Western Juniper* (Miller et al. 2005) and summarized in *Western Juniper Management: A Field Guide* (Barrett 2007). These include crown form, branching structure, bark, and decadence.

Fuels Definitions and Treatments

The following fuels treatments are proposed in the Wolf project area:

Natural Fuels Underburning would reduce naturally occurring debris on the forest floor and seedlings and saplings, maintaining low intensity fire conditions in stands that have been previously treated.

Activity Fuels Underburning would reduce the forest debris (slash) from harvest and noncommercial thinning.

Jackpot Burning would reduce concentrations (jackpots) of juniper slash under cool, wet conditions when fire will not spread between the jackpots.

Hand Piling would occur where thinning slash is too heavy to burn without damaging the residual stand.

Definitions:

Fuels: The greater the fuel load, the more intensely a fire can burn. Fine fuels (less than 1 inch in diameter) are the primary influence on rate-of-spread (how fast a fire moves) and flame lengths (measured in feet from the ground to the tip of the flame).

Surface fuels: Fuels lying on or near the surface, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low vegetation. The amount of surface fuel on a site is referred to as a fuel load, and is measured in tons per acre.

Ladder fuels: Fuels which provide vertical continuity between strata, allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate the continuation of crowning. As ladder fuels increase, crown fire risk increases. Ladder fuels are reduced by thinning trees mechanically (with chainsaws) and then underburning to treat the slash, or by underburning alone (thinning with fire). Underburning also prunes the lower branches of larger trees, increasing the canopy base height, which also reduces the risk of crown fire. Underburning is usually prescribed for reducing trees less than 3 inches in diameter.

Piles: Piling slash and burning the piles is proposed where fuel loadings are expected to be too high to underburn without scorching too much of the overstory. Piling and burning is usually followed by a low intensity underburn 2-3 years after pile burning. Piling can occur immediately after thinning, before the fuels dry out, reducing the duration of the short-term hazard that exists after thinning. Piling usually removes 60-70% of the fuel in any given area. Approximately 5% of the surface area of piled units is covered by piles.

Hand piles are 4-8 feet across and 4-8 feet high. Grapple piles consist of forest fuels that are stacked by a grapple piler (an excavator with a grapple on an articulating arm), are 5-10 feet high by 10-15

feet in diameter. Grapple pilers would operate on existing skidtrails, on slopes less than 35%. An average grapple pile unit has 12 piles per acre @ 150 square feet per pile, so grapple piles cover 18,000 square feet of a 10 acre unit.

Landing piles are a product of commercial harvest using whole tree yarding. The footprint of landing piles in a unit where whole trees were yarded disturbs considerably less soil than in a grapple pile unit. Harvest units have an average of 1 landing pile per 10 acres; an average landing pile covers 3000 square feet of a 10-acre unit. Piles are burned after drying for a year, unless there is a market for the piles and they are sold and removed for biomass. If burned, fire from burning piles could creep around the forest floor between the piles.

Prescribed Fire

The general objectives of prescribed fire are:

- To lessen the severity, resistance to control and cost of future wildfires by reducing natural fuels (naturally occurring forest debris), activity fuels (thinning slash) and ladder fuels (seedlings and saplings).
- To maintain forest health, reducing seedlings and saplings to maintain open stands, promoting fire tolerant species (ponderosa pine, western larch Douglas fir), and reducing fire intolerant species (western juniper, grand fir).
- To increase the quantity and vigor of native grasses, forbs and shrubs.

Prescribed Fire is the application of fire in pre-determined patterns and conditions in order to produce desired flame lengths, rates of spread, and fire effects. The combination of environmental conditions used to determine when to burn is called a “fire prescription”. The most common ignition technique involves igniting strips of fire across a unit on a contour, starting at the uphill end, or on the leeward side of a unit on flat ground, burning into the wind. Flame length and rate of spread is controlled by adjusting the distance between the strips and how fast they are lit. Based on past experience (Scholz, 1986-2013), 40 - 80% of the surface area of prescribed fire units is burned; mineral soil exposure usually occurs on less than 5% of a unit, usually where downed logs are consumed.

Juniper Thinning and Burning

During the past 130 years, western juniper has been expanding within its range at unprecedented rates compared to any time in the last 12,000 years. Western juniper woodlands in eastern Oregon have increased from 456,000 acres in 1936 to 2.2 million acres in 1988, causing increased soil erosion, reduced stream flows, reduced forage production, altered wildlife habitat, and changes in plant community composition. (Miller, Bates, Svejcar, Pierson, & Eddleman, 2005)

The purpose of juniper reduction is to reduce the risk of high severity wildfire, improve the vigor of native plants, improve spring flow (Deboodt, Fisher, Buckhouse, & Swanson, 2008), and increase forage for wildlife and livestock by using chainsaw cutting and prescribed fire. Each action alternative proposes juniper reduction on 481 acres.

Using hand cutting rather than broadcasting a prescribed fire to reduce junipers is proposed here because most of the junipers are too big to kill with a prescribed fire unless it occurred under very hot, dry and windy conditions, which would be too risky to implement next to the forest boundary, adjacent to private property. Also, many of the juniper stands have developed to the point where they are out-competing the native grasses needed to carry a prescribed fire under cooler conditions (phase 2 to phase 3 juniper). And, a very hot fire, wild or prescribed, would greatly increase the risk of the site being invaded by invasive annual grasses (medusahead and cheatgrass).

After the trees are cut, they would be burned under cool conditions when soils are wet or frozen. Burning cut juniper (jackpot burning) when soils are wet and frozen hastens the recovery of native grasses and shrubs compared to leaving cut juniper unburned (Bates & Svejcar, 2009), and would remove the hazard of unburned slash on the forest boundary.

Fire Regime Condition Class (FRCC)

"FRCC assessments determine how similar a landscape's fire regime is to its natural or historical state. Fire regime condition classes are broken down into three categories: 1, 2, and 3. Landscapes that fall within the category of FRCC 1 contain vegetation patterns and disturbance regimes characteristic of the natural regime; FRCC 2 landscapes are those that are moderately departed from the natural regime; and FRCC 3 landscapes reflect vegetation and disturbances that are uncharacteristic of the natural regime. So essentially, an FRCC 1 landscape has key ecosystem components intact, such as large old trees and soil characteristics that would naturally be found on that site. A landscape with an FRCC rating of 3 indicates that the land is very different from its natural regime in terms of its vegetation or disturbances or both. An FRCC 3 landscape has lost key ecosystem components; an example could be the loss of characteristic large trees due to uncharacteristic wildfires that occurred in uncharacteristic fuels." (http://www.frames.gov/partner-sites/frcc/about/)

Firelines (fuel breaks) are needed to control fire spread. Roads or natural fuel breaks are used where possible.

Handline is fireline constructed using handtools, and consists of clearing a 5-10 foot wide path of seedlings, saplings, brush and downed woody debris, and removing ground fuels (litter and duff layer) down to mineral soil, 1-3 feet wide.

Fire Hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that form a special threat of ignition and resistance to control. For this analysis, condition class is used to estimate fire hazard, demonstrating the potential level of loss of ecosystem components from uncharacteristic wildfire. This is based on vegetative (fuel) conditions and the resulting fire effects that could be expected from a fire burning in the 97th percentile weather conditions.

Fire Risk: The likelihood of undesirable fire effects at a given location on the landscape.

Fire Intensity: A description of the fire behavior level, more specifically, the amount of heat produced by a fire.

Fire Severity: A description of the level of effects from a fire on soil and vegetation. A product of a fires intensity and duration.

APPENDIX B. SOIL DISTURBANCE

Table B-1 summarizes unit-by-unit soil disturbance effects by harvest and alternative. All listed treatment units are ground based tractor commercial harvest (HTH) or sanitation harvest (HSA in units 81 and 82 for Alts 2 and 3). Acreages are rounded to the nearest whole acre.

Table B-1. Soil disturbance by alternative.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
2	15	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets standard
3	4	HTH	HTH	HTH	20-29	mod	0.5	20-29	Stay on existing trails, no net increase over 29%. Till 0.5acres. Meets standard.
4	3	HTH	HTH	NT	20-29	high	0.5	20-29	Riparian flat. Stay on existing disturbance, no net increase. Meets standard.
5	41	HTH	HTH	HTH	20-29	mod	2	25	East aspect. Stay on existing disturbance, no net increase over 29%. Till 2 acres. Meets standard.
6	21	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets standard.
7	3	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets standard
8	27	HTH	HTH	HTH	20-29	mod	0	25	Stay on existing disturbance, no net increase over 29%. Till 2 acres. Meets standard.
9	11	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails, no net increase over 29%. Till 0.5 acres. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
10	7	HTH	HTH	HTH	20-29	low	1	20-29	Stay on existing disturbance, no net increase. Till 1 acre. Meets S&Gs.
11	3	HTH	HTH	NT	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets S&Gs.
12	19	HTH	HTH	NT	20-29	mod	2	25	Stay on existing disturbance, no net increase. Till 1 acre. Meets S&Gs.
13	21	HTH	HTH	NT	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets S&Gs.
14	29	HTH	HTH	HTH	0-5	low	0	10-19	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.
15	13	HTH	HTH	NT	0-5	low	0	10-19	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.
16	15	HTH	HTH	NT	20-29	mod	0	20-29	Stay on existing disturbance, no net increase. Meets S&Gs.
17	15	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets S&Gs.
18	15	HTH	HTH	NT	20-29	low	0	20-29	Limit new disturbance to less than 30 percent. Meets S&Gs.
19	16	HTH	HTH	NT	0-5	mod	0	10-19	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
20	16	HTH	HTH	HTH	0-9	mod	0	10-19	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.
21	31	HTH	HTH	HTH	0-9	low	0	10-19	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.
22	161	HTH	HTH	HTH	20-29	mod	8	25	Stay on existing trails, no net increase. Till 8 acres. Meets standard.
23	39	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance, no net increase. Meets S&Gs.
24	21	HTH	HTH	HTH	20-29	mod	1	25	Stay on existing disturbance, no net increase. Till 1 acre. Meets S&Gs
25	6	HTH	HTH	NT	20-29	high			Stay on existing disturbance, no net increase. Till 1 acre. Meets S&Gs
26	33	HTH	HTH	HTH	30-39	high	3	30-32	Riparian terraces. Formerly farmed. Avoid impacts to ditch. Stay on existing trails, no net increase. Till 3 acres. Meets standard.
27	11	HTH	HTH	HTH	30-39	high	1	30	Riparian terraces. Formerly farmed. Avoid impacts to ditch. Stay on existing trails, no net increase. Till 1acre Meets standard.
28	26	HTH	HTH	HTH	20-29	mod	2	20-23	Southern half of unit formerly farmed. Stay on existing disturbance, till 2 acres in south. Meets S&Gs.
29	157	HTH	HTH	HTH	20-29	mod	8	25	Stay on existing disturbance, no net increase over 30%. Till 8 acres. Meets S&Gs.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
30	41	HTH	HTH	HTH	20-29	mod	2	25	Stay on existing disturbance, no net increase. Till 2 acres. Meets S&Gs.
31	11	HTH	HTH	NT	20-29	low	0.5	25	Stay on existing disturbance, no net increase. Till 0.5 ac. Meets S&Gs.
32	23	HTH	HTH	NT	20-29	low	0	20-29	Stay on existing trails, no net increase. Meets standard.
33	14	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails, no net increase. Meets standard.
34	17	HTH	HTH	HTH	20-29	mod	0.5	26	Stay on existing trails, no net increase. Till 0.5 acres. Meets standard.
35	16	HTH	HTH	HTH	20-29	mod	0.5	26	Stay on existing disturbance, no net increase. Till 0.5 acres. Meets S&Gs.
36	43	HTH	HTH	HTH	20-29	low	2	25	Stay on existing disturbance, no net increase. Till 2 acres. Meets S&Gs.
37	24	HTH	HTH	HTH	20-29	mod	1	20-29	Stay on existing disturbance, no net increase. Till 1 acre. Meets S&Gs.
38	8	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing disturbance. Meets standard.
39	44	HTH	HTH	HTH	20-29	low	1 to 2	25-27	Stay on existing trails. Till 1 to 2 acres. No net increase. . Meets standard.
40	30	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. . Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
41	81	HTH	HTH_21	HTH	20-29	low	2	27	Stay on existing trails. No net increase. Till 2 acres. Meets standard.
42	30	HTH	HTH_21	HTH	20-29	low	1	27	Stay on existing trails. No net increase. Till 1 acre. Meets standard.
43	30	HTH	HTH_21	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. . Meets standard.
44	13	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. . Meets standard.
45	30	HTH	HTH	HTH	20-29	mod	1 to 2	25	Stay on existing trails, no net increase. Till 1 to 2 acres in W portion. Meets standard.
46	34	HTH	HTH	HTH	20-29	low	1 to 2	25	Stay on existing trails, no net increase. Till 1 to 2 acres in E/far SE portion. Meets standard.
47	24	HTH	HTH	NT	20-29	low	0	20-29	Stay on existing trails. No net increase. . Meets standard
48	24	HTH	HTH	HTH	20-29	low	1	25	Stay on existing trails. Till 1 acre. Meets standard.
49	14	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. Meets standard.
51	8	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. Meets standard.
54	3	HTH	HTH	HTH	20-29	low	0	20-29	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
55	6	HTH	HTH	NT	20-29	mod	0	20-29	Stay on existing trails. No net increase. Meets standard.
56	16	HTH	HTH	NT	30-40	mod	1.5	32	Stay on existing trails. Till 1.5 acres. Meets standard.
57	17	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
58	18	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.
59	13	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.
60	143	HTH	HTH	HTH	20-30	low	3	20-28	Stay on existing trails. No net increase over 30%. Avoid steep ground over 35% areas in south central portion of unit. Till 3 acres. Meets standard.
61	40	HTH	HTH_21	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.
62	28	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.
63	24	HTH	HTH_21	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.
64	7	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 20%. Meets standard.
65	17	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
66	63	HTH	HTH	HTH	20-30	low	0	20-25	Stay on existing trails. No net increase over 30%. Avoid steep ground over 35% areas. Till 3 acres. Meets standard.
67	16	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing disturbance. No net increase. Meets S&Gs.
68	44	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
69	17	HTH	HTH	HTH	20-30	high	1	20-25	Stay on existing trails. Till 1 acre. No net increase over 25%. Meets standard.
70	44	HTH	HTH	NT	20-30	low	1	20-28	Stay on existing trails. Till 1 acre. No net increase. Meets standard.
71	14	HTH	HTH	NT	20-30	high	0.5	20-30	Stay on existing trails. Till 0.5 acre. No net increase. Meets standard.
73	19	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
74	11	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
75	57	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
76	55	HTH	HTH_21	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
77	21	HTH	HTH_21	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
78	39	HTH	HTH_21	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
79	12	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
80	36	HTH	HTH	HTH	20-30	mod	2	20-28	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
81	115	HTH	HTH	HTH	20-30	mod	3	20-25	Stay on existing trails. Till 3 acres. No net increase. Meets standard.
82	3	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard
83	10	HTH	HTH	HTH	20-30	mod	0.5	20-25	Stay on existing trails. Till 0.5 ac. No net increase. Meets standard
84	7	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
85	3	HTH	HTH	NT	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
86	10	HTH	HTH	NT	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard
87	7	HTH	HTH	NT	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
88	6	HTH	HTH	NT	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
89	6	HTH	HTH	NT	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
90	120	HTH	HTH	HTH	20-30	low	0	20-27	Stay on existing trails. Till 3 acres in eastern half. No net increase. Meets standard.
91	108	HTH	HTH	HTH	20-30	mod	2	20-28	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
92	23	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
93	34	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
94	10	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase Meets standard.
95	8	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
96	12	HTH	HTH	HTH	20-30	mod	1	23	Stay on existing trails. No net increase. Till 1 acre. Meets standard.
97	20	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
98	3	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
99	3	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
100	62	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails, steep tractor ground in north and center of unit. No net increase. Meets standard.
101	45	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase . Meets standard.
102	27	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase over 30%. Old cat terracing in NW part of unit. Meets standard
103	10	HTH	HTH	NT	20-30	low	0.5	20-25	Stay on existing trails. Till 0.5 acre. No net increase. Meets standard.
104	8	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
105	6	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
106	52	HTH	HTH	HTH	20-30	low	2	20-30	Stay on existing trails. Till 2 acres. No net increase. Meets standard
107	8	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard
108	2	HTH	HTH_21	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
109	14	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
110	28	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
111	5	HTH	HTH	HTH	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
112	28	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
113	20	HTH	HTH	HTH	20-30	mod	1	20-25	Stay on existing trails. Till 1 acre. No net increase. Meets standard.
114	17	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
115	33	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
116	18	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
117	33	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
118	10	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
119	9	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
120	15	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
121	31	HTH	HTH_21	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
122	36	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
123	20	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
124	13	HTH	HTH	HTH	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
125	11	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
126	9	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
127	16	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
128	51	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
129	59	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
130	13	HTH	HTH	HTH	20-30	mod	0.5	25	Stay on existing trails. Till 0.5 acres. No net increase. Meets standard.
131	10	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
132	14	HTH	HTH	NT	20-30	mod	1	20-30	Stay on existing trails. Till 1 acre. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
133	10	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
134	5	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
135	7	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
136	31	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
137	34	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
138	21	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
139	41	HTH	HTH	HTH	20-30	low	1	20-28	Stay on existing trails. Till 1 acre. No net increase. Meets standard.
140	7	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
141	44	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
142	29	HTH	HTH	HTH	20-30	mod	2	20-25	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
143	27	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
144	8	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
145	45	HTH	HTH	HTH	20-30	low	2	20-25	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
146	56	HTH	HTH	HTH	20-30	low	2	20-27	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
147	21	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
148	39	HTH	HTH	HTH	20-30	low	2	20-25	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
149	23	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
150	31	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
151	34	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
152	36	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
153	41	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
154	70	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. Steeper tractor unit. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
155	46	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. Steep tractor southern 2/3rds. No net increase. Meets standard.
156	33	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. Steep tractor. No net increase. Meets standard.
157	18	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
158	21	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. Steeper tractor. No net increase. Meets standard.
159	21	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
160	18	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
161	8	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
163	15	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
164	15	HTH	HTH	HTH	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.
165	36	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
166	25	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
168	32	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. Steeper tractor unit. No net increase. Meets standard.
169	16	HTH	HTH	HTH	20-30	mod	1	20-25	Stay on existing trails. Till one acre. No net increase. Meets standard.
170	115	HTH	HTH	HTH	20-30	mod	5	20-27	Stay on existing trails. Till 3 acres. No net increase. Meadow in south. Meets standard.
171	21	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
172	58	HTH	HTH	HTH	20-30	low	2	20-26	Stay on existing trails. Till 2 acres. No net increase. Meets standard.
173	10	HTH	HTH	NT	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
174	32	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
175	19	HTH	HTH	NT	20-30	mod	0.5	20-25	Stay on existing trails. Till 0.5 acre. No net increase. Meets standard.
177	30	HTH	HTH	HTH	20-30	mod	1	20-27	Stay on existing trails. No net increase. Meets standard.
178	12	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
179	11	HTH	HTH	HTH	20-30	mod	0	20-30	Stay on existing trails. No net increase. Meets standard.

Unit	Size (acres) Alt2 PA	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
181	6	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
182	6	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
183	5	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
184	24	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
185	33	HTH	HTH_21	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.
186	6	HTH	HTH	HTH	30-40	low	0	30-40	Stay on existing trails. No net increase. Meets standard.
346	6	HTH	HTH	HTH	20-30	low	0	20-30	Stay on existing trails. No net increase. Meets standard.

HSL – Uneven aged Management
HTH – Commercial Thinning
HTH_21—Commercial Thinning Harvest with some trees over 21 inch DBH thinned to maintain larger trees.
HIM – Improvement Cut
GP – Grapple Pile
M – Mobile Yarder
NH – No Harvest
S – Skyline system
T – Tractor yarding
L-H – Horse logging

Tillage Potential
25%– Low (not good candidate for tillage because soil and physical features)
50% – Moderate
75-100% – High

APPENDIX C. GUIDELINES RELATIVE TO WATER QUALITY

The Project Design Features in this document were developed to comply with the National Core BMPs. These core BMPs are meant to provide direction in the development of project specific practices such as the Project Design Features in this document. An extensive list of project applicable BMPs are included in the Hydrology Report on file. The following table summarizes the objectives of the National Core BMPs that are applicable to the Wolf EIS.

Table C-1. National Core BMPs applicable to the Wolf project

Title	Activity	Objective
Plan-1	Forest and Grassland Planning	Use the land management planning and decision-making processes to incorporate direction for water quality management consistent with laws, regulation and policy into Forest and Grassland Plans.
Plan-2	Project Planning and Analysis	Use the project planning, environmental analysis and decision-making processes to incorporate water quality management BMPs into project design and implementation.
Plan-3	Aquatic Management Zone (AMZ) Planning	To maintain and improve or restore the condition of land around and adjacent to waterbodies in the context of the environment in which they are located recognizing their unique values and importance to water quality while implementing land and resource management activities.
AqEco-1	Aquatic Ecosystem Improvement and Restoration Planning	Reestablish and retain ecological resilience of aquatic ecosystems and associated resources to achieve sustainability and provide a broad range of ecosystem services.
AqEco-2	Operations in Aquatic Ecosystems	Avoid, minimize, or mitigate adverse impacts to water quality when working in aquatic ecosystems.
AqEco-4	Stream Channels and Shorelines	Design and implement stream channel and lake shoreline projects in a manner that increases the potential for success in meeting project objectives and avoids, minimizes or mitigates adverse effects to soil, water quality and riparian resources.
Fire-1	Wildland Fire Management Planning	Use the fire management planning process to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources during wildland fire management activities.
Fire-2	Use of Prescribed Fire	Avoid, minimize or mitigate adverse effects of prescribed fire and associated activities on soil, water quality and riparian resources that may result from excessive soil disturbance as well as inputs of ash, sediment, nutrients and debris.
Min-1	Minerals Planning	Use the minerals planning process to develop measures to avoid, minimize or mitigate adverse effects to soil, water quality and

		riparian resources during minerals exploration, production, operations and reclamation activities.
Min-3	Minerals Production	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources caused by physical and chemical pollutants resulting from mineral development, production and associated activities.
Min-5	Mineral Materials Resource Sites	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when developing and using upland mineral materials resource sites or in-stream sand and gravel deposits.
Min-6	Ore Stockpiles, Mine Waste Storage and Disposal, Reserve Pits and Settling Ponds	Avoid, minimize or mitigate adverse effects to soil, surface water, groundwater and riparian resources from physical and chemical contaminants originating from ore stockpiles, storage and disposal of mine waste, and construction and use of reserve pits and settling ponds.
Min-7	Produced Water	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by appropriately managing water produced during the extraction of minerals, geothermal energy, oil and gas.
Road-1	Travel Management Planning and Analysis	Use the travel management planning and analysis processes to develop measures to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources during road management activities.
Road-2	Road Location and Design	Locate and design roads to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources.
Road-3	Road Construction and Reconstruction	Avoid or minimize adverse effects to soil, water quality and riparian resources from erosion, sediment and other pollutant delivery during road construction or reconstruction.
Road-4	Road Operations and Maintenance	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by controlling road use and operations and providing adequate and appropriate maintenance to minimize sediment production and other pollutants during the useful life of the road.
Road-5	Temporary Roads	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from the construction and use of temporary roads.
Road-6	Road Storage and Decommissioning	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by storing closed roads not needed for at least one year (Intermittent Stored Service) and decommissioning unneeded roads in a hydrologically stable manner to eliminate hydrologic connectivity, restore natural flow patterns and minimize soil erosion.
Road-7	Stream Crossings	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when constructing, reconstructing or maintaining temporary and permanent waterbody crossings.

Road-8	Snow Removal and Storage	Avoid or minimize erosion, sedimentation, and chemical pollution that may result from snow removal and storage activities.
Road-9	Parking and Staging Areas	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when constructing and maintaining parking and staging areas.
Road-10	Equipment Refueling and Servicing	Avoid or minimize adverse effects to soil, water quality and riparian resources from fuels, lubricants, cleaners and other harmful materials discharging into nearby surface waters or infiltrating through soils to contaminate groundwater resources during equipment refueling and servicing activities.
Road-11	Road Storm-Damage Surveys	Monitor road conditions following storm events to: detect road failures; assess damage or potential damage to waterbodies, riparian resources, and watershed functions; determine the causes of the failures; and identify potential remedial actions at the damaged sites and preventative actions at similar sites.
Veg-1	Vegetation Management Planning	Use the applicable vegetation management planning processes to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources during mechanical vegetation treatment activities.
Veg-2	Erosion Prevention and Control	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by implementing measures to control surface erosion, gully formation, mass slope failure and resulting sediment movement before, during, and after mechanical vegetation treatments.
Veg-3	Aquatic Management Zones	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when conduct mechanical vegetation treatment activities in the AMZ.
Veg-4	Ground-Based Skidding and Yarding Operations	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources during ground-based skidding and yarding operations by minimizing site disturbance and controlling the introduction of sediment, nutrients, and chemical pollutants to waterbodies.
Veg-6	Landings	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from the construction and use of log landings.
Veg-7	Winter Logging	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from winter logging activities.
Veg-8	Mechanical Site Treatment	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by controlling the introduction of sediment, nutrients, chemical, or other pollutants to waterbodies during mechanical site treatment.
WatUses-1	Water Uses Planning	Use the applicable authorization and administrative planning processes to develop measures to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources during construction, operation, maintenance and restoration of water use infrastructure.

WatUses-2	Water Wells for Production and Monitoring	Avoid, minimize or mitigate adverse effects to soil, water quality, groundwater and riparian resources from excessive withdrawals and/or contamination transmitted from or by water-well and monitoring-well developments.
WatUses-3	Administrative Water Developments	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when developing and operating water sources for Forest Service administrative and/or resource management purposes.
WatUses-4	Water Diversions and Conveyances	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from construction, operation and maintenance of water diversion and conveyance structures.

Watershed Condition Framework (WCF)

The WCF process is part of the USDA's Strategic Plan for FY 2010-2015 which targets the restoration of watershed and forest health as a core management objective of the National Forests and Grasslands. To achieve this goal the Forest Service (FS) is directed to restore degraded watersheds by strategically focusing investments in watershed improvement projects and conservation practices at landscape and watershed scales (USDA 2010). The process focuses on twelve Watershed Condition Indicators (with various attributes evaluated within the indicators). The primary intent of doing so is to establish a systematic process for determining watershed condition class that all national forests could apply consistently and to improve Forest Service reporting and tracking of watershed condition.

The product of the WCF effort was a baseline watershed condition class established for every subwatershed on every national forest. With that in mind, the goal with every upcoming project (ie Marsh) should be to look at existing baseline data and assess where there are opportunities to improve upon the overall watershed condition rating. The assessment consisted of 12 total indicators with 24 total attributes (the indicator value is an average of its corresponding attribute values). A summary of the WCF results for the Wolf EIS Project area (which includes the Wolf Creek and North Wolf Creek subwatersheds) are displayed in table C-2. A more extensive description of the WCF analysis results are on file in the Hydrology report.

Table C-2. Summary of the Watershed Condition Framework results for the Wolf Creek and North Wolf Creek Subwatersheds.

WCF Measurement Indicators	WCF Rating
Aquatic Biota	Fair
Riparian/Wetland Vegetation	Poor
Water Quality	Fair/Poor
Water Quantity	Good/Fair
Aquatic Habitat	Poor
Road and Trail	Fair
Soil	Good
Forest Cover	Good

Forest Health	Good
Terrestrial Invasive Species	Good
Rangeland	Fair
Fire Regime or Wildfire	Fair
Overall WCF Rating on USFS land	Functioning at Risk

'Good' equates to 'Functioning Properly', 'Fair' equates to 'Functioning at Risk', 'Poor' equates to 'Not Functioning Properly'.

The WCF results indicate that the subwatersheds are functioning at risk primarily due to the three indicators that rated out as Poor: Riparian/Wetland Vegetation, Water Quality Condition, and Aquatic Habitation Condition. The specific conditions of the attributes for each of these three indicators are listed below in detail. There are opportunities to improve upon the attributes of these WCF indicators with the implementation of the Wolf Vegetation Management EIS, i.e. RHCA hardwood thinning, channel stabilization, LWD placement.

- **Riparian/Wetland Vegetation** – This indicator addresses the function and condition of riparian vegetation along streams, water bodies, and wetlands. Stream systems that are largely structurally controlled have riparian vegetation that is in good condition. Unstable stream banks are directly correlated with early seral riparian vegetation components and indicate locations where water relationships have been altered. Vertical instability (stream incision) indicates places where much of the riparian vegetation has been replaced by upland or more xeric vegetation types. The subwatersheds rate as Poor. A large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition. These ratings were based upon the Vegetation Condition Attribute.

    - For the Vegetative Condition Attribute, the subwatersheds rate as Poor. Native vegetation is vigorous, healthy and diverse in age, structure, cover and composition on <75% of the riparian/wetland areas in the watershed. Native vegetation demonstrates a noticeable loss of vigor, reproduction and growth, and changes in composition as compared with the site potential communities throughout areas most susceptible to human impact. In these areas, cover and composition are strongly reflective of early seral species dominance although there will be late seral and mid seral species present, especially in pockets. Mesic dependent herbaceous vegetation is limited in extent with many lower terraces dominated by xeric species most commonly associated with uplands. Reproduction of mid and late seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects this loss of available soil water.

- **Water Quality Condition** – This indicator addresses the expressed alteration of physical, chemical, and biological components of water quality. For Water Quality the subwatersheds in the Project area rated out between Fair and Poor. This is due to Minor to Significant impairment of beneficial uses to the water bodies in the watersheds based upon two attributes: Impaired Waters and Water Quality Problems.

    - The subwatersheds rated out as Poor for the Impaired Waters attribute because the subwatersheds had >10% listed water bodies for stream temperature; therefor rated as Impaired.

    - The project area rated out as Fair/Functioning at risk for Water Quality Problems because it contains a moderate number of streams with lateral or vertical stability

issues were assumed to also exhibit some degree of abnormal sedimentation/bedload issues.

- **Aquatic Habitation Condition** – This indicator addresses aquatic habitat condition with respect to habitat fragmentation, large woody debris, and channel shape and function. In general there is focus on aquatic habitat that was either perennial OR fish bearing. There are some drainages that naturally have no surface water now or in the past and are considered as functional. All subwatersheds support small amounts of continuous high quality aquatic habitat but most stream channel conditions show evidence of being degraded by disturbance and therefor rate as Poor based upon three attributes: Habitat Fragmentation; Large Woody Debris; and Channel Shape and Function.

    - The subwatersheds rated out as Poor for the Habitat Fragmentation attribute due to a barrier at the mouth of the watershed, isolating the entire watershed form the meta population downstream.

    - A Fair rating was given for the Large Woody Debris Attribute. In aquatic and riparian systems that evolved with wood, large woody debris is present but is recruited into the system at less than natural rates due to riparian management activities.

    - For the Channel Shape and Function attribute, a Poor rating was given to Wolf and North Wolf Creek subwatersheds. More than 75% of channels have width-to-depth ratios greater than expected under near-natural conditions. The size and extent of gullied sections of channels are extensive, currently increasing, or have increased recently. Many streambanks show signs of active erosion above that expected naturally. Channel degradation and/or aggradation are evident and widespread due to unstable streambed and banks. Many (>50%) of the stream channels are disconnected from their floodplain or are braided channels due to increased sediment loads.

APPENDIX D. PROJECT DESIGN FEATURES FOR RIPARIAN RESTORATION ACTIVITIES – ADOPTED FROM NMFS AND USFWS ARBO

Design Criteria -- LWD and Boulder Placement

1. Place LW and boulders only in those areas where they would naturally occur and in patterns that closely mimic that which would naturally occur for that particular stream type.

2. LW includes whole conifer and hardwood trees, logs, and root wads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5 x bankfull channel width, while logs without rootwads should be a minimum of 2.0 x bankfull width. Place wood in a manner that most closely mimics natural accumulations of LW for that particular stream type. Structures may partially or completely span stream channels or be positioned along streambanks.

3. No conifers should be felled in the riparian area for in-channel large wood placement unless conifers are fully stocked and are consistent with project design criteria in vegetation treatment categories. Felled hazard trees can be used for in-channel wood placement.

4. Key boulders (footings) or LW may be buried into the streambank or channel but shall not constitute the dominant placement method of boulders and LW.

5. Anchoring Large Wood – Anchoring large wood with cable should only occur after first reviewing feasibility of the following, in preferential order, avoid cabling except as a last resort:

a. The size and weight of the wood sufficient for stability, no anchoring is required.

b. The wood is oriented in such a way that movement is unlikely (sharp bends in the stream, naturally narrow reaches, placed within a functional riparian zone.

c. Ballasting (gravel and/or rock) is used to increase the mass of the structure to resist movement (the height of the structure generally must be above design flow elevations) (this works well in systems with intact floodplains).

d. Large boulders are used as anchor points for the large wood.

e. Wood is pinned with rebar to large rock to increase its weight (the wood/rock combinations are still independent in the overall structure).

6. Gravel Augmentation – Gravel augmentation should only occur in areas where the natural supply has been eliminated or significantly reduced through anthropogenic means. Gravel to be placed in streams shall be a properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After gravel placement, allow the stream to naturally sort and distribute the material.

7. Boulder Weirs:

a. Full channel-spanning boulder weirs are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, etc.), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property.

b. Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).

c. Place boulder weirs diagonally across the channel or in more traditional upstream pointing "V" or “U” configurations with the apex oriented upstream. Structures installed perpendicular to the streamflow are not covered in this consultation.

d. Boulder weirs are to be constructed to allow upstream and downstream passage of all native listed fish species and life stages that occur in the stream. This can be accomplished by providing plunges no greater than 6” in height, allowing for juvenile fish passage at all flows.

e. The use of gabions, cable or other means to prevent the movement of individual boulders in a boulder weir is not allowed.

f. Rock for boulder weirs shall be durable and of suitable quality to ensure permanence in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading

g. The project designer or an inspector experienced in these structures should be present during installation.

h. Full spanning boulder weir placement should be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LW.

8. Tree Removal for LW Projects

a. Trees may be removed by cable, groundbased equipment, horses or helicopters, or felled directly into the stream. Felled trees may be stock-piled for later use in instream restoration projects.

b. Individual trees or small groups of trees (<5) should come from the periphery of permanent openings (roads etc) or from the periphery of non-permanent openings

(e.g. plantations, along recent clear-cuts etc).

c. Single trees may only be removed from the first two lines of trees.

d. Trees selected for LW restoration projects must be spaced at least one site potential tree height apart and at least one crown width from any trees with potential nesting structure for ESA-listed bird species.

9. If other aquatic restoration activities included in this consultation are used as complementary actions, follow the associated design criteria and conservation measures.

Design Criteria—Headcut Stabilization

In an emergency head-cut event, armor the head-cut with sufficient appropriately sized material to prevent continued up-stream movement. Materials can include both rock and organic materials which are native to the area. The Action Agencies will focus stabilization efforts in the plunge pool, the head cut, and a short distance above the head-cut. Minimize lateral migration of channel around the head cut ("flanking") by placing rocks and organic material at a lower elevation in the center of the channel cross section to direct flows to the middle of channel.

2. For non-emergency head cut stabilization actions, the following two grade control treatments are acceptable alternatives to stabilize a head cut and re-establish fish passage. These alternatives are also acceptable to complete channel stabilization and fish passage activities during the first in-water work period, for previously-treated emergency head-cut sites. These alternatives may also include complete or partial removal of all materials placed at head-cut during emergency stabilization efforts, and replacement with carefully designed, long-term, fish passage friendly, head-cut stabilization options. The choice of treatment should be based on site characteristics and limitations (i.e., channel slope, bed material type), but may also be based on material availability, economics, land use, design competence or familiarity, and/or regulatory restrictions (i.e., jump heights for fish). NMFS Level 1 Team members will assist the action agencies in choosing an appropriate treatment.

a. Large Roughness Elements: In many Pacific Northwest streams, large wood and boulders provide natural grade control in the form of channel spanning log jams or debris flow deposits. Hence, the designed rock and wood structure should mimic natural colluvial features, such as debris flow or landslide deposits, that provide this base level control or grade stabilization in areas where the risk of head-cut migration exists. This technique is applicable to a wide range of stream types, from low gradient meandering streams (less than 1%) to high gradient cascade channels (greater than 8%). The goal of using large roughness elements is not to completely halt the incision process, but rather to slow it down and spread the elevation change over a greater length of channel. Since log jams are porous structures, not all of the sediment will be held in place; however, sediment inputs will be spread out over time rather than introduced to the stream as one large pulse. A log jam is also self-maintaining as long as more large wood is available in the stream system. Rock and wood should be sized so that it is not mobile during the design flood. Buoyancy calculations to determine appropriate ballast requirements should be completed for structures that will be completely inundated.

b. Rock and Log Weirs: Rock and log weirs are very low channel spanning structures that are

often used to stabilize streambeds and halt channel incision. These weirs are used in low gradient (generally less than 2%) streams. The weirs are 'V' shaped, oriented with the apex upstream, and are lower in the center to direct flows to the middle of channel. A series of V weirs will help to stabilize stream gradient, dissipate energy, provide some level of bank protection, and will maintain fish passage. Weirs should be keyed into the stream bed by a minimum of 2.5 x their exposure height to minimize structure undermining due to scour. The weir should also be keyed into both banks a minimum of 8 feet. If several structures will be used in series, weir spacing should be no closer than the net drop divided by the channel slope (for example, a one-foot-high weir in a stream with a 2% gradient will have a minimum spacing of 50 feet. Weirs can fail if flow goes subsurface flow below weir material. If placed material is coarse and unconsolidated, it is possible that upstream flows will go subsurface and reemerge at the downstream end of the structure, effectively causing a complete passage barrier. Careful consideration of subsurface flow is therefore required before weir construction.

Design Criteria – Fish Passage Restoration and Culvert Replacement

1. Fish passage projects will be designed by an experienced engineer with design input from an experienced fish biologist and hydrologist. Such personnel shall oversee or review the project during construction to ensure that project designs and conservation measures are being properly implemented.

2. Forest Service Design Assistance Teams or the BLM and Coquille Tribe equivalent will provide design review for projects that exceed $100,000 or will result in structures that are greater than 20 feet wide.

3. Assess sites for a potential to head-cut below the natural stream gradient. Projects that lead to head-cutting below the natural stream gradient are excluded from this consultation.

4. Design Standards

a. Structure Type – Structure types include closed-bottomed culverts, open-bottomed arch culverts, and bridges. Structure material must be concrete or metal.

b. Structure Width – The structure width shall never be less than the bankfull channel width. (The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.) The minimum structure width and height for a closed bottom culvert shall be 6 feet to allow manual placement of stream simulation material. Structures must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches. To meet this requirement, unconfined channel types (Rosgen C, E, and B channel types (Rosgen 1996)) may require structures wider than bankfull and/or the addition of flood relief culverts or other comparable flood relief methods.

c. When possible, flood relief culverts will be designed to restore and maintain access to off-channel rearing and high flow areas for juvenile and adult fish. Therefore, existing floodplain channels should be the first priority for location of flood relief culverts which should be installed in a manner that matches floodplain gradient and does not lead to scour at the outlet.

d. Channel Slope – The structure slope shall approximate the average channel gradient of the natural stream up- and downstream of the structure. The maximum slope for closed-bottomed culverts shall not exceed 6% because of difficulties in retaining substrate in the culvert at higher gradients. Open-bottom arches can be placed in channel gradients that exceed 6%.

e. Embedded Culvert – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be designed to be stable at the

largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability.

f. Riprap – The use of riprap is permissible above bankfull height to protect the inlet or outlet of new culverts or open-bottomed arches. If the use of riprap is required for culvert stability, then an additional analysis may be required to ensure that the structure is not undersized. Riprap may only be placed below bankfull height when necessary for protection of abutments and pilings for bridges. However, the amount and placement of riprap around the abutments and/or pilings should not constrict the bankfull flow.

g. Grade Control Structures – Grade control structures are permitted to prevent head-cutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and are buried in the substrate.

h. Where applicable, incorporate road dips into crossing designs, to ensure catastrophic flood events will transport overflow back into the downstream channel instead of the road bed.

i. Structures containing concrete must be sufficiently cured or dried before they come into contact with stream flow.

j. In cases of structure removal or when removing an existing structure and replacing it with a bridge, consideration should be given to restoring the stream channel and reconnecting the floodplain at the site.

k. When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing.

l. Monitor structures after high flow events, which occur during the first fall/winter/spring after project completion. Assess the following parameters: head-cutting below natural stream gradient, substrate embeddedness in the culvert, scour at the culvert outlet, and erosion from sites associated with project construction. Apply remedial actions (using project design criteria and conservation measures) if projects do not meet the intended goals.

m. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures Along with the general conservation measures summarized at the end of this section, the following conservation measures would be used to minimize sediment and turbidity and the effects of fish handling/transport:

1. Isolate construction area and remove fish from project area. Fish shall be removed from project area (see fish capture guidelines below). Dewater Construction Site – Upstream of the isolated construction area, coffer dams (diversions) constructed with non-erosive materials are typically used to divert stream flow with pumps or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain are not permitted. Pumps must have fish screens and be operated in accordance with NMFS fish screen criteria. Dissipate flow energy at the bypass outflow to prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage, (i.e., is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. When necessary, pump seepage water from the dewatered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

3. Stream Re-Watering – Upon project completion, slowly re-water the construction site to

prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site

4. Fish Handling – If capture, removal, and relocation of fish are required, follow these steps:

a. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician.

b. Isolate capture area – Install block nets at upstream and downstream locations and leave in a secured position to preclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.

c. Fish Capture Options

i. Collect fish by hand or dip nets, as the area is slowly dewatered.

ii. Seining – Use seine with mesh of such a size to ensure capture of the residing ESA-listed fish.

iii. Minnow traps – Traps will be left in place overnight and in conjunction with seining

iv. Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective. The protocol for electrofishing includes the following:

If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds.

Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used.

Conductivity <100 use voltage ranges from 900 to 1100. Conductivity from 100 to 300 then use voltage ranges from 500 to 800. Conductivity greater than 300 then use voltage to 400.

Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized.

Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time.

5. Handling and Release –Fish must be handled with extreme care and kept in water for the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish. Place larger fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible (especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or other area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report.sediment mix and construction techniques that include washing material into place to seal the weir to the channel bed is highly recommended.

3. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

APPENDIX E. AQUATIC SPECIES; EFFECTS COMMON TO ALL ALTERNATIVES

The following analysis has been summarized from the USFS R6 Aquatic Restoration Biological Opinion as prepared by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) for aquatic restoration activities in R6.

Riparian Vegetation Treatment (non-commercial, mechanical): Many riparian areas throughout Oregon were logged aggressively in the past 100 years. Additionally, fire suppression in dry forests has resulted in unnaturally high tree densities along stream corridors. As a result, many riparian areas are dominated by dense, even-aged stands of small diameter conifers or hardwood species such as alder (*Alnus sp.*). Large-diameter conifers that provide shade and appropriately-sized large woody debris are typically missing from these areas. The Forest Service proposes to carry out non-commercial thinning, primarily with chainsaws, to restore plant species composition and structure that would occur under natural disturbance regimes. The most common application of this activity would be to reduce small tree density prior to conducting prescribed fire (the effects of prescribed fire in riparian areas are discussed later in this document).

Some studies (Lindh and Muir 2004, Drever 2005) have shown that thinning of conifer or hardwood stands in the Pacific Northwest results in accelerated growth of trees. The Forest Service proposes this activity to accelerate the development of mature stands of large trees along streams to provide large woody debris and wildlife habitat. Short-term adverse effects include minor reductions in stream shade, input of allochthonous materials, and small woody materials. Since the proposed activity does not involve ground-disturbing actions, inputs of fine sediment would not occur.

Riparian and Upland Juniper Treatment (non-commercial): The Forest Service proposes to non-commercially thin western junipers (*Juniperus occidentalis*) to restore montane plant communities to a structure that would occur under natural fire regimes. Western junipers have expanded rapidly into neighboring plant communities in the past 130 years primarily due to climatic influences, livestock grazing, and fire suppression (Miller *et al.* 2005). Some authors have concluded that the unnaturally large number of juniper trees currently present in some areas may cause decreased stream flow due to evapotranspiration and increased soil erosion (Miller *et al.* 2005). Other authors (Belsky 1996) conclude that these concerns are only based on anecdotal evidence and observations and potential effects of juniper expansion are generally overstated in their severity. Regardless of one's position on juniper expansion, the restoration of natural plant community structure to riparian areas would be beneficial to stream ecosystems. The goal of this activity is not to favor a particular species or life-history stage, but to provide habitat resembling that in which native species evolved so as to support complete assemblages of these species. For example, the restoration of a natural plant community structure would enhance the production of nutrients and food organisms appropriate for the juvenile life-history stages of native species.

Reductions in stream shade and compaction of soils would result from juniper thinning in riparian areas and associated uplands. Streams where juniper removal would take place are typically small (5 to 15 feet wide), as juniper expansion tends to occur in dry areas. Streams and riparian areas within this arid environment are typically dominated by willow communities, willow/herbaceous plant communities, herbaceous meadow plant communities, or sagebrush/herbaceous plant communities (Crowe and Clausnitzer 1997). Reductions in stream shade from juniper removal are likely to be short-lived (likely 1-5 years) as the removal of the juniper overstory should increase shrub vigor and stream shade provided by junipers would be replaced by native shrubs. Beneficial

effects from juniper treatment to salmonids and their habitat include increased allochthonous inputs from native shrub leaves and potentially, reduced evapotranspiration from junipers.

Riparian Vegetation Treatment (prescribed burning): In general, prescribed burning would be planned and implemented to result in low severity burns as defined in the National Fire Plan (2000). An exception is allowed for burns designed to invigorate aspen (Populus sp.) and willow (Salix sp.) stands. In aspen, profuse sprouting occurs after moderate- to high-intensity fires; less sprouting occurs following light burns (Fitzgerald 2010). Therefore, a burn of moderate intensity as defined in the National Fire Plan (2000) would be allowed. Moderate burns would be confined to the observable historic boundaries of the aspen or willow sites and would generally not encompass more than 20% of the riparian area being treated.

This activity may cause some short-term adverse effects on salmonids and their habitats. Generally, fires burn in a mosaic pattern of differing severities across the landscape, depending on topography, aspect, vegetation, weather, and other factors. Riparian areas frequently differ from adjacent uplands in vegetative composition and structure, geomorphology, hydrology, microclimate, and fuel characteristics (Dwire and Kaufmann 2003). Consequently, riparian areas typically react to wildfire and prescribed fire differently than adjacent uplands. Deciduous streamside vegetation immediately adjacent to the stream can recover rapidly (5 year; e.g., willows and alders), whereas forest trees (e.g., Douglas fir) recover over decades.

Wildfire can have a wide range of effects on aquatic ecosystems ranging from minor to severe (Reiman et al. 2003). However, this project proposes to carry out prescribed burns in the spring and fall when fuel moisture and relatively humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire. Effects from low to moderate intensity prescribed fire in riparian areas include minor reductions in stream shade, minor reductions in LW recruitment and inputs of fine sediment and nutrients to streams. In some cases, LW levels would increase due to prescribed fire (Chan 1998).

Although there is considerable research available on the effects of wildfire on streams and riparian areas, there is less information available on the effects of prescribed burning, and considerably less on prescribed burns within riparian areas. In an Atlantic coastal pine forest, Richter (1982) concluded that prescribed fire had limited effects on nutrient cycling, soils, and hydrologic systems. In the western United States fires have a notably larger effect of wildfire on water quality (Gresswell 1999; Neary et al. 2005. (revised 2008); Spencer et al. 2003; Stednick 2010).

In the Payette National Forest in Idaho, the Joint Fire Science Program (2009) found that a prescribed fire conducted in the spring when fuels were moist had negligible effects on stream communities. However, they concluded that even the lowest severity wildfires produced changes in stream communities. Streamside buffers are often difficult to exclude from a prescribed burn, but the soil and vegetation are usually moist and do not burn. Prescribed fire effects in these forests on stream communities are negligible, at least when the riparian forest is not burned. They reached the following key findings:

- Habitat changes varied based on interactions of annual stream flow patterns and burn severity of the streamside forest.
- Changes in habitat were correlated with instabilities in macroinvertebrate communities.
- Macroinvertebrate communities in burned areas did not become similar to communities in unburned areas within 4 years after fire.
- Springtime prescribed fire effects on stream ecosystems were negligible and even lower than the effects observed after low severity wildfire.

- Riparian forest burn severity and extent were lower after prescribed fire than after wildfire, which may explain observed patterns.

In a recent study conducted in the Sierra Nevada Mountains of California, Bêche et al. (2005) concluded that low to moderate intensity prescribed fire that was actively ignited in the riparian area had minimal effects on a small stream and its riparian zone during the first year post-fire. The fire was most severe in those areas with large accumulations of conifer litter and debris and usually self-extinguished when it came into contact with moist soil and characteristic riparian vegetation. The prescribed fire did result in a tenfold increase in bare ground and a significant decrease in understory vegetation, but did not result in a measurable decrease in riparian canopy cover. Mortality of trees in the riparian areas was low (4.4%). Fine sediment in pools did not increase as a result of the fire, but the authors note that relatively little precipitation occurred post-fire. Little to no response was observed in the macroinvertebrate community. In contrast, Chan (1998) observed a reduced diversity of stream macroinvertebrates due to increased fine sediments one year after a prescribed burn in Sequoia National Park.

Gresswell (1999) states that even in the event of extensive high severity wildfires, local extirpation of fishes is patchy and recolonization is rapid. He also warns however, that in situations where native populations of fish have declined, effects from severe wildfires can be longer-lasting. In contrast, Rinne (1996) found that a large wildfire and subsequent hydrologic events on the Tonto National Forest in Arizona effectively extirpated three populations of salmonids in headwater streams and drastically reduced macroinvertebrate densities. In this study, severe effects to streams and aquatic communities were not observed immediately after the fire, but rather after subsequent precipitation events washed exposed fine sediments into streams. The wildfire addressed by this study burned in an area with heavy fuel build-up due to years of fire suppression. The proposed action does not include prescribed burning in areas with heavy fuel build up.

Changes in macroinvertebrate communities are generally associated with more intense burns (crown fires with at least 50% of a stream’s catchment involved) (Minshall 2003). This is far above the expected fire severity that would result from implementation of this activity type. Minshall (2003) also concludes that in un-fragmented habitats supporting functional ecosystems in the Rocky Mountain region, recovery from fire appears to be relatively rapid, and that fire can contribute to aquatic productivity and biodiversity. In Boise River basin streams (Idaho), Rosenberger et al. (2011) compared the effects of wildfire on the invertebrate prey base for rainbow trout a decade after fires in watersheds unburned, burned, and burned followed by a debris flow. The quantity of macroinvertebrate drift (biomass density) was more variable within than among disturbance categories. Average body weight and taxonomic richness of drift were significantly related to water temperature and influenced by disturbance history. During the autumn sampling period, the amount of terrestrial insects in rainbow trout diets varied with disturbance history and the amount of overhead canopy along the stream banks. Responses were better correlated with specific characteristics of the stream (water temperature, canopy cover) than with broad disturbance classes. Therefore, fuels reduction treatments implemented in heavily degraded watershed or treatments proceeded by high intensity rain would be expected to be negatively impacted and recovery would be more protracted.

Although dead salmonids have been discovered after the 1998 Yellowstone National Park wildfires, the reason for this mortality was unknown (Minshall and Brock 1991). It is reasonably certain that no mortality would occur and individual fish behavior would not be affected directly by the patchy low-intensity fires and no debris flows would likely occur. Indirect effects such as reduced forage for juvenile salmonids would be minor. Recolonization would restore macroinvertebrate abundance in one to two years after burning. Over this time, juvenile

salmonids that receive less food have lower body condition and smaller size at smoltification. The primary beneficial effect of reducing fuel loads in riparian areas is reduced chance of severe wildfire. The short-term adverse effects caused by this activity are minor when compared to the potential adverse effects of severe wildfires.

Road and Trail Erosion Control and Decommissioning: Road and trail erosion control and decommissioning typically includes one or more of the following actions – culvert removal in perennial and intermittent streams; removing, installing or upgrading cross-drainage culverts; upgrading culverts on non-fish-bearing steams; constructing water bars and dips; reshaping road prisms; vegetating fill and cut slopes; removing and stabilizing of side-cast materials; grading or resurfacing roads that have been improved for aquatic restoration with gravel, bark chips, or other permeable materials; contour shaping of the road or trail base; removing road fill to native soils; soil stabilization and tilling compacted surfaces to reestablish native vegetation. A significant amount of information is available regarding the adverse effects of roads on aquatic habitats (Gucinski et al. 2001; Jones et al. 2000; Trombulak and Frissell 2000). Increased introduction of invasive species and delivery of fine sediment derived from roads has been linked with decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, increased predation of fishes, decreased benthic production, and increased algal production. Improper culvert placement can limit or eliminate fish passage. Moreover, roads can greatly increase the frequency of landslides, debris flows, and other mass movements.

Unfortunately, much less information is available on the specific effects of road and trail restoration or removal, and its effectiveness for reversing adverse habitat conditions attributed to the presence of road and trail systems. The short-term effects of these actions using the proposed project design features (PDC) would include the restoration construction effects and, in the case of culvert removal, fish passage restoration, discussed above. The long-term effects of road and trail restoration or removal appear to include mitigation of many of the negative effects to aquatic habitats that have been associated with roads (Madej 2001; McCaffery et al. 2007), but the large variance stream between substrate conditions and other stream habitat characteristics that are important to fish make it difficult to assign measurable effects to road decommissioning (Madej 2001; McCaffery et al. 2007). Thus, road and trail erosion control and decommissioning are likely to result in restoration of riparian and stream functions as a result of reduced sediment yield and improved fish passage.

Fish Passage Restoration*:* Fish passage includes a broad range of activities to restore or improve juvenile and adult fish passage as described in the proposed action. Such projects would take place where fish passage has been partially or completely eliminated through road construction, stream degradation, creation of small dams and step structures, and irrigation diversions. Equipment such as excavators, bull dozers, dump trucks, front-end loaders and similar equipment may be used to implement such projects.

These activities usually require isolation of the work area from flowing water, relocation of fish, and significant instream construction. The construction-related effects described in the above section on restoration construction effects would occur at all culvert and bridge project sites. The Forest Service proposes to replace culverts and bridges using the stream simulation method, in which natural stream substrates would be placed in the bottom of these structures. Under this activity, artificial obstructions that block fish passage would be removed or replaced with facilities that restore or improve fish passage. The beneficial effects of this activity category include improved fish passage and restoration of natural bedload movement in streams. Removal of these structures requires instream construction with effects as described earlier.

Culverts and Bridges: Long-term beneficial effects of culvert and bridge replacement or removal projects include restoration of fish passage and restoration of natural stream channel processes through removal of channel constricting structures. Removing fish-passage blockages would restore spatial and temporal connectivity of streams within and between watersheds where fish

movement is currently obstructed. This, in turn, would permit fish access to areas critical for fulfilling their life history requirements, especially foraging, spawning, and rearing. At a larger scale this would improve population spatial structure.

However, the removal of fish passage barriers could have short-term (typically lasting less than one week, depending on the duration of instream work) temporary effects to fish and their habitat. Heavy equipment might be used in the stream for unblocking, removing and replacing culverts and bridges activities. In-water equipment use could temporarily affect salmonids and critical habitat, including impacts on redds, smothered or crushed eggs and alevins, increased suspended sediment and deposition, blocked migration, and disrupted or disturbed overwintering behavior. However, because of the seasonal restrictions imposed by in-water work windows, these effects would be avoided. Salmon are particularly vulnerable during the fall and winter, when adult salmon are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. The activities could move juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. Fish passage impediments are common throughout Oregon and Washington and restoration planning efforts have highlighted the need to restore fish passage, particularly when the blockage occurs low in a watershed.

Head-cut and Grade Stabilization*:* The stabilization of active or potential head-cuts with LW, rock, or step structures primarily takes place in Rosgen (1994) C- and E-type channels. In these areas, historic land management such as heavy livestock grazing and road construction has destabilized stream channels and increased the chance of head-cut formation. Stabilization requires instream construction, so short-term construction related adverse effects as described below would occur.

The Forest Service proposes aggressive treatments to prevent further incision of stream channels including use of rock and log step structures. These aggressive restoration techniques are sometimes necessary to stop the ongoing damage caused by migrating head-cuts. The Forest Service also proposes temporary head-cut stabilization, in which case fish passage may be blocked. In these circumstances, the fish passage must be reestablished during the subsequent in-water work period. This may block fish passage for several months, but without this treatment, head-cut formation might also block fish passage.

The beneficial effects of this proposed activity result primarily from the action's prophylactic nature. Left unchecked, head-cuts lead to channel incision, deposition of fine sediments in downstream substrates, and disconnection of a stream from its floodplain. Stabilizing head-cuts would stop the progression of these adverse effects. An increase in habitat functions, improvements to functional parameters, and a reduction in the risk of effects to TES species is expected.

Large Wood, Boulder, Boulder Structures and Tree Removal for Large Wood Projects: Installation of wood and boulder instream structures is likely to require entry of equipment into the riparian area and channel would result in unavoidable short-term construction related effects as described below, but would increase stream habitat complexity, increase overhead cover, increase terrestrial insect drop, and help reestablish natural hydraulic processes in streams over time. LWD, in a stream, can accomplish multiple purposes by trapping gravel above the structure, creating pools and increasing the connection with the floodplain vegetation. Wood placement is likely to cause minor damage to riparian soil and vegetation, and minor disturbance of streambank or channel substrate.

However, the intensity and duration of disturbance is unlikely to increase total suspended sediment, or otherwise impair aquatic habitats or freshwater rearing and migration. Conversely, an increase in habitat functions and a reduction in the risk to sensitive species is expected long-

term. Numerous authors have highlighted the importance of LWD to river ecosystems (Bilby 1984; Keller et al. 1985; Lassettre and Harris 2001; Spence et al. 1996). LWD influences channel morphology, traps and retains spawning gravels, and provides food for aquatic invertebrates that in turn provide food for juvenile salmonids. LWD, boulders, and other structures provide hydraulic complexity and pool habitats that serve as resting and feeding stations for salmonids as they rear or migrate upstream to spawn (Spence et al. 1996).

Land management actions such as logging, road building, stream clearing, and splash damming carried out over the last 150 years have greatly reduced the amount of LWD and boulders in streams in Oregon and Washington (McIntosh et al. 1994; Murphy 1995). This project proposes these activities to return these important elements to stream ecosystems. Addition of LWD is a common and effective restoration technique used throughout the Pacific Northwest (Roni et al. 2002). Roni and Quinn (2001a) found that LWD placement can lead to higher densities of juvenile coho salmon during summer and winter and higher densities of steelhead and cutthroat trout in the winter. These authors also found that addition of LWD to streams with low levels of wood can lead to greater fish growth and less frequent and shorter fish movements (Roni and Quinn 2001b).

As with LW, the addition of boulders and properly designed rock structures can help restore natural stream processes and provide cover for rearing salmonids. Boulders can accomplish the retention of gravel by physically intercepting the bed load or slowing the water, increase the interaction with the floodplain habitat by increasing the bed elevation and providing pool habitat. Boulders are most effective in high velocity or bedrock dominated streams. Roni et al. (2006) found that placement of boulder step structures in highly disturbed streams of Western Oregon led to increased pool area and increased abundance of trout and coho salmon.

The proposed PDC and BMPs would ensure that the Forest Service would place LW, boulders, and gravel in a natural manner to avoid unintended negative consequences. This action would result in numerous long-term beneficial effects including increased cover and resting areas for rearing and migrating fish and restoration of natural stream processes.

Channel Reconstruction/Relocation*:* Forested areas that have a legacy of timber harvest and log drives may have simplified straightened channels with a scarcity of instream wood. In general, the level of intervention dictates the scale or magnitude of a stream restoration project. As the streams were channelized or naturally returned to their original bed elevation, stream bank heights increased so that greater water depth and discharge became required before the stream could spread onto the floodplain. The increase in bank heights and bankfull discharge, in turn, increased bank erosion and may responsible for a significant portion of modern sediment loads in streams. Along many streams, this may cause channel spreading and, over decades, the re-establishment of a new “meander belt” (Knox 2006). The resistance of bed materials to stream incision is one of the major factors that determine how this process manifests itself along each stream course.

Projects which involve significant channel reconfiguration over a considerable stream length or require extensive alteration of land management practices are likely to have more constraints, be more costly, and have a greater level of associated risk. For stream reaches that have evolved to a condition of greater instability, it may be necessary to adjust the channel’s geometry. This may involve minor adjustments such as narrowing the channel cross-section and stabilizing the eroding stream banks. At the opposite end of the intervention scale, extremely unstable conditions with poor potential for natural recovery may require complete reconstruction of the stream channel to provide a stable channel pattern, profile, and cross-section, utilization of bank stabilization techniques, and installation of flow diverting and grade control structures.

Therefore, the short-term negative and long-term beneficial effects of channel reconstruction would vary with the scale of the project. For some stream reaches, restoration may not be a

realistic goal without intervention at the watershed level first. In addition to the restoration construction effects discussed above, channel reconstruction/ relocation projects using the proposed PDF are likely to have significant local and landscape level effects to processes related to sediment transport, energy flow, stream flow, temperature, and biotic fragmentation. Although the Forest Service can predict the worse-case effects of this activity, with the proposed PDC and BMP it is believed that the stream ecological condition would be measurably improved. Typically stream channel reconstruction/relocation projects are conducted in phases that would end with the full return of river flows to the historic channel and the filling of the old shortened channel. Fish passage is typically blocked until the restored channel can be activated. Mechanical manipulation and grading of hundreds, and in some cases, thousands of cubic yards of bed material may be required to recover floodplain width and elevations.

Fish evacuation and relocation of juvenile fish from the old channel to the restored channel can be challenging because of the long transport distances required. Some fish mortality would also likely occur from predation, suffocation, or temperature stress, in the old channel when it is dewatered unless they are relocated upstream or downstream promptly. Fish that are not located would also likely be stranded. Indirect mortality of aquatic species would be possible from high turbidities in lower third of reach and some distance downstream during channel relocation. In-water work windows, work area isolation, fish capture and release PDF are intended to minimize handling and mortality. With in-water work timing during low water periods and isolation of the work area, the release of suspended sediment is expected to be a short-term event. Sediment is likely to be carried by surface runoff when the newly configured channel(s) are reactivated and erosion control structures are removed. Localized suspended sediment increases are likely to cause some juveniles and adults to seek alternative habitat, which could contain suboptimal cover and forage and cause increases in behavioral stress (e.g., avoidance, displacement), and sub-lethal responses (e.g., increased respiration, reduced feeding success, reduced growth rates). Excessive sediment clogs the gills of juvenile fish, reduces prey availability, and reduces juvenile success in catching prey. However, the Forest Service's implementation procedures and pollution and erosion control plans would be designed to minimize suspended sediment. If turbidity is observed in the outflow, turbidity levels should be measured in the outflow using a hand-held turbidimeter. If these measurements indicate violations of State water quality standards, the Forest Service would work with the contractor to take appropriate corrective actions.

Disturbances associated with restoration have the potential to increase non-native plant abundance in the project area through influx of non-native species on equipment and by providing bare soil conditions. However, PDF for revegetation of native species and active removal/treatment of invasive plants would help to establish native species and reduce the overall presence of non-natives plants. Effectiveness monitoring for channel reconstruction/relocation projects would be designed to measure progress toward achieving the project objectives, inform maintenance needs, and provide input into whether the restoration project is trending towards or away from achieving project goals. Based on the project goals and compliance with this programmatic opinion, physical and biological parameters would be monitored using standard field techniques that would produce data compatible with the various protocols required. Monitoring may include evaluation of stream length and channel complexity, riparian and floodplain vegetation, channel-floodplain connectivity, thermal regime, and fish passage. The Forest Service would complete an existing conditions survey on the existing channel to determine the pre-project conditions and an as-built survey, which follows the same parameters, immediately upon completion of the new channel construction.

Generally, post-project monitoring surveys would occur frequently enough to capture change that could result in a significant reduction in the desired habitat conditions. Surveys should occur during a similar timeframe each cycle, and should occur under similar flow conditions.

Effectiveness of mitigation techniques for the restoration activities would be reviewed at the end of each construction season with NMFS, and any improvements would be incorporated into plans for the next season. Post-project, hydrologic function of the stream channel would be restored to more natural conditions. Functional floodplains would promote riparian vegetation and stable banks. The restored corridor would provide an adequate riparian buffer zone. Aquatic habitat would be greatly improved in the short term and long term. Under this activity category streams that are made more self-sustaining and resilient to external perturbation would lead to improved aquatic habitat, which would help improve aquatic population abundance and productivity.

Effects of Near and Instream Restoration Construction*:* The direct physical and chemical effects of the construction associated with the proposed actions typically begin with surveying, minor vegetation clearing, placement of stakes and flagging, and minor movement of personnel and sometimes machines over the action area. The next stage, site preparation, is likely to require development of access roads or temporary access paths, construction staging areas, and materials storage areas that affect more of the action area. If additional earthwork is necessary to clear, excavate, fill, or shape the site, more vegetation and topsoil are be removed, deeper soil layers exposed, and operations may extend into the channel. The final stage of construction consists of any action necessary to undo the short-term disturbance, and includes replacement of LW, native vegetation, topsoil, and native channel material displaced by construction.

Fish passage would be provided for any adult or juvenile fish likely to be present in the action area during construction, unless passage did not exist before construction, stream isolation and dewatering is required during project implementation, or where the stream reach is dry at the time of construction. When isolation and fish relocation are required, juvenile salmonids are likely to receive mechanical injury during capture, holding, or release, and potential horizontal transmission of disease and pathogens and stress-related phenomena. All aspects of fish handling, such as dip netting, time out of water, and data collection (e.g., measuring fish length), are stressful and can lead to immediate or delayed mortality (Murphy and Wouldis 1996). Electrofishing causes physiological stress and can cause physical injury or death, including cardiac or respiratory failure (Snyder 2003). There is also potential that some fish would be missed or stranded in substrate interstices after a site is dewatered. Although some salmonids would die during dewatering and relocation, fish would only be exposed to the stress caused by these activities once and the procedure is only expected to last a few hours. If construction took place without work area isolation, more fish would be injured or killed.

Vegetation, soil and channel disturbance caused by construction can disrupt the vegetative and fluvial processes in the action area that create and maintain habitat function, such as delivery of wood, particulate organic matter, and shade to a riparian area and stream; development of root strength for slope and bank stability; and sediment filtering and nutrient absorption from runoff (Darnell 1976; Spence et al. 1996). Although the sizes of areas likely to be adversely affected by actions proposed to be funded or carried out under this opinion are small, and those effects are likely to be short lived (weeks or months), even small denuded areas would lose organic matter and dissolved minerals, such as nitrates and phosphates. The microclimate at each action site where vegetation is removed is likely to become drier and warmer, with a corresponding increase in wind speed, and soil and water temperature.

Water tables and spring flows (if present) in the immediate area are likely temporarily reduced. Loose soil would temporarily accumulate in the construction area. In dry weather, this soil is likely to be dispersed as dust and, in wet weather; loose soil would be transported to streams by erosion and runoff, particularly in steep areas. Erosion and runoff during precipitation and snowmelt would increase the supply of sediment streams and rivers, where they would increase total suspended solids and sedimentation and, in some cases, stream fertility. Increased runoff also increases the frequency and duration of high stream flows and wetland inundation in construction areas. Higher stream flows increase stream energy that can scour stream bottoms and

transport greater sediment loads farther downstream than would otherwise occur. Sediments in the water column reduce light penetration, and can increase water temperature and modify water chemistry. Redeposited sediments can fill pools, reduce the width to depth ratio of streams, and change the distribution of pools, riffles, and glides.

During dry weather, the physical effects of increased runoff would reduce ground water storage, lower stream flows, and lower wetland water levels. The combination of erosion and mineral loss can reduce soil quality and site fertility in upland and riparian areas. Concurrent in-water work can compact or dislodge channel sediments, thus increasing total suspended solids and allowing currents to transport sediment downstream where it would eventually be redeposited. Continued operations when the construction site is inundated can significantly increase the likelihood of severe erosion and contamination.

Using heavy equipment for vegetation removal and earthwork would compact soils, reducing soil permeability and infiltration. The use of heavy equipment also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants are likely to occur. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonid fish and other aquatic organisms at high levels of exposure and can cause sublethal adverse effects to aquatic organisms at lower concentrations (Heintz et al. 1999; Incardona et al. 2005; Incardona et al. 2004; Incardona et al. 2006). The discharge of construction water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes can carry sediments and a variety of contaminants to riparian areas and streams. Some of these adverse effects would abate almost immediately, such as increased total suspended solids caused by boulder or LW placement. Others would create long-term conditions that decline quickly but persist at some level for weeks, months, or years, until riparian and floodplain vegetation are fully reestablished. Failure to complete site restoration, or to prevent disturbance of newly-restored areas by livestock or unauthorized persons, would delay or prevent recovery of processes that form and maintain productive fish habitats.

For actions that include a construction phase, the direct physical and chemical effects of site clean-up after construction is complete are essentially the reverse of the construction activities that go before it. Bare earth would be protected by various methods, including seeding, planting woody shrubs and trees, and mulching. This would dissipate erosive energy associated with precipitation and increase soil infiltration. It also would accelerate vegetative succession necessary to restore root strength necessary for slope and bank stability, delivery of leaf and other particulate organic matter to riparian areas and streams, shade, and sediment filtering and nutrient absorption from runoff. Microclimate would become cooler and moister, and wind speed would decrease. Whether recovery occurs over weeks, months or years, the disturbance frequency (i.e., the number of restoration actions per unit of time, at any given site) is likely to be extremely low, as is the intensity of the disturbance as a function of the quantity and quality of overall habitat conditions present within an action area.

Restoration of aquatic habitats is fundamentally about allowing stream systems to express their capacities, i.e., the relief of human influences that have suppressed the development of desired habitat mosaics (Ebersole et al. 1997). The time necessary for recovery of functional habitat attributes sufficient to support species recovery following any disturbance, including construction necessary to complete a restoration action, would vary by the potential capacity of each habitat attribute. Recovery mechanisms such as soil stability, sediment filtering and nutrient absorption, and vegetation succession generally recover quickly (i.e., months to years) after completion of the proposed actions. Recovery of functions related to wood recruitment and microclimate require

decades or longer. Functions related to shading of the riparian area and stream, root strength for bank stabilization, and organic matter input generally require intermediate lengths of time.

Additionally, this project proposes a suite of conservation measures intended to reduce the short-term effects caused by near and instream construction. Limiting instream construction to low flow periods and using sediment control measures greatly reduces the amount of suspended sediment created by the restoration actions. Refueling and servicing equipment outside the riparian area reduces the chance of spilling toxic fuels and lubricants. Development and implementation of a pollution and erosion control plan limit any potential adverse effects of a toxic material spill by ensuring that spill response materials are on site during all construction activities. Ensuring that all heavy equipment that would operate instream is cleaned and free of leaks would also reduce the introduction of contaminants into the aquatic environment. Project implementation would include several conservation measures to limit stress and mortality during work area isolation and fish relocation. Limiting in-water work activities to in-water work periods would greatly reduce the chance of affecting adult fish, as these periods are designated to avoid times when adult salmonids are present.

Temporary Site Access and Site Restoration*:* The direct adverse effects of temporary site access would include minor restoration construction effects (i.e., soil compaction, erosion, loss of upland vegetation) caused by the movement of personnel over the action area. Site Restoration would be implemented to reverse these direct effects. However, the effects of temporary site access would be minimized by following PDC that would prohibit new roads and sets limits and conditions for heavy equipment access would minimize adverse effects. Additionally, PDC are in place to minimize impacts from temporary travel ways and access trails within riparian areas. Site restoration would include treating exposed soils that may deliver sediment to streams with grass seed (preferably native grass seed if available), slash, water bars or other appropriate methods to minimize or eliminate sediment delivery.

Riparian Vegetative Planting*:* This alternative proposes to plant riparian vegetation that would naturally occur in the treatment area. Many authors have discussed the importance of riparian vegetation to stream ecosystems (Dosskey et al. 2010; Hicks et al. 1991; Murphy and Meehan 1991; Spence et al. 1996; Swanston 1991). Streambanks covered with well-rooted woody vegetation have an average critical sheer stress three times that of streambanks weakly vegetated or covered with grass (Millar and Quick 1998). Riparian vegetation also plays an important role in protecting streams from nonpoint source pollutants and in improving the quality of degraded stream water (Dosskey et al. 2010).

Planting in riparian areas may result in very minor fine sediment delivery to streams. It could also temporarily flush fish from hiding cover. In the long term, planting of riparian vegetation would increase shade, hiding cover, LW, and streambank stability. This would improve the survival of yearling and other juvenile salmonids by providing appropriate substrate for fry and an increase in cover from predators and high flows. Beneficial effects to fish also include enhanced fitness through improved conditions for forage species and improved reproductive success for adult salmonids as a result of increased deep water cover and holding areas. As plantings mature, width-to-depth ratios of disturbed channels and fine sediment delivery would decrease.

Weed Treatments (Non-native Invasive Plant Control)*:* The proposed action includes manual, mechanical, biological and herbicidal treatments of invasive and non-native plants and are analyzed under the DES/OCH Invasive Plant EIS. The types of plant control actions analyzed here are a conservative (i.e., less aggressive) subset of the types of actions considered in those analyses, and the effects presented here are summarized from those analyses. Each type of treatment is likely to affect fish and aquatic macrophytes through a combination of pathways, including disturbance, chemical toxicity, dissolve oxygen and nutrients, water temperature, sediment, instream habitat structure, forage, and riparian and emergent vegetation.

Short-term displacement or disturbance of TES fish are likely to occur from activities in the area that disturb or displace fish that are feeding, resting or moving through the area. Due to the proposed PDC, mechanical and herbicidal treatments of invasive plant species in riparian areas are not likely to substantially decrease shading of streams in most cases. Significant shade loss is likely to be rare, occurring primarily from treating streamside knotweed and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, etc.). Most invasive plants are understory species of streamside vegetation that do not provide the majority of streamside shade and furthermore and would be replaced by planted native vegetation or vegetation. The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated. However, short-term shade reduction is likely to occur due to removal of riparian weeds, which could slightly affect stream temperatures or dissolved oxygen levels, which could cause short-term stress to fish adults, juveniles and eggs.

Manual and mechanical treatments are likely to result in mild restoration construction effects (discussed above). Hand pulling of emergent vegetation is likely to result in a localized mobilization of suspended sediments. Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) or heavy machinery is likely to result in short-term releases of suspended sediment when treatment of locally extensive streamside monocultures occurs. Thus, these treatments are likely to affect a definite, broad area, and to produce at least minor damage to riparian soil and vegetation. In some cases, this would decrease stream shade, increase suspended sediment and temperature in the water column, reduce organic inputs (e.g., insects, leaves, woody material), and alter streambanks and the composition of stream substrates. However, these circumstances are likely to occur only in rare circumstances, such as treatment of an invasive plant monoculture that encompasses a small stream channel. This effect would vary depending on site aspect, elevation, and amount of topographic shading, but is likely to decrease over time at all sites as shade from native vegetation is reestablished.

Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities*:* The direct effects of constructing a livestock crossing or off-channel watering facility using the proposed PDC would be similar, though less intense, to the restoration construction effects discussed above. Although the net benefits of fencing streams to exclude livestock or humans are clear, some minor adverse effects can occur at watering or crossing sites. Concentration of livestock or human traffic at these areas can result in streambank damage and add fine sediment to stream substrates. Redds created by salmon or steelhead could be trampled if they are located in crossings. The Action Agencies propose several conservation measures to reduce the potential for these types of adverse effects from occurring. Crossings would be located in areas where streambanks are naturally low, crossing widths are limited to 15 feet, and areas of sensitive soils and vegetation would be avoided. Although these measures would reduce the potential for adverse effects, some minor streambank damage is likely to occur in these small areas and redds could occasionally be trampled.

Indirect effects are likely to be beneficial, including reducing the likelihood that livestock, particularly cattle, would have unrestricted access to a riparian area or stream channel for shade, forage, drinking water, or to cross the stream. This, in turn, is likely to reduce the likelihood that livestock would disturb streambeds, spawning areas or redds, or erode streambanks, and would improve water quality by increasing riparian vegetation and reducing sediment and nutrient loading to streams.

APPENDIX F. JOINT AQUATIC AND TERRESTRIAL PROGRAMMATIC BIOLOGICAL ASSESSMENT PDC

Table F-1 2010 – 2013 Joint Aquatic and Terrestrial Programmatic Biological Assessment PDC.

Project Design Criteria Compliance Checklist (attach to BE/BA)	Applies to project (Yes/No)	Project Complies (Yes/No)
Oregon and Columbia Spotted Frogs		
A. Do not fragment or convert wetland habitat to upland habitat through management activities	No	X
B.1. Do not allow in channel, lake, or shoreline digging except as needed for restoration	No	X
B.2. Comply with Fish PDC: (c) Sediment and Substrate 1,2,3,6,7,8,9,10, (d) Bank Stability 1,2, and (g) Livestock Grazing 3,4,5	Yes	Yes
C. No changes in stream, spring, lake, or wetland hydrology except as needed for restoration	Yes	Yes
C.1. In reservoir habitats, maintain or develop shallow water habitat with emergent veg through July	No	X
C.2. Do not allow removal of fish passage if it causes introduction of non-native species	No	X
D. Activities within the channel migration zone or 100-year floodplain are restricted 3/1 thru 5/31	Yes	Yes
E. Maintain connectivity through properly functioning streams, marsh, in stream, and floodplain vegetation. Restore native sedges, rushes, and willows where possible and appropriate	Yes	Yes
F. Use of pesticides, herbicides, and similar potential contaminants are prohibited in and immediately adjacent to wetland habitat. Be conservative when estimating drift to avoid any contamination	No	X

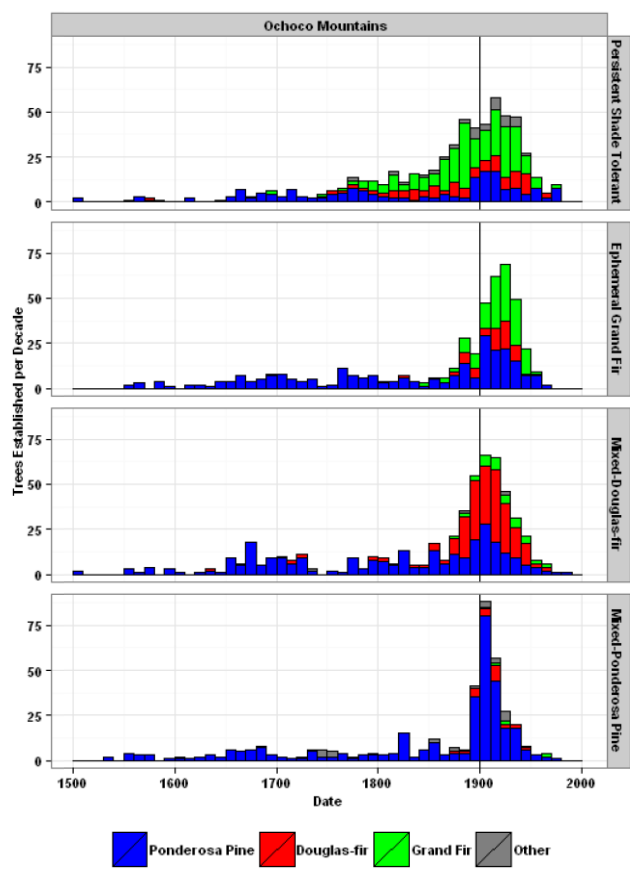
APPENDIX G. CRITERIA TO GUIDE DECISION-MAKING ON THE REMOVAL/RETENTION OF GRAND FIR AND DOUGLAS-FIR IN 384 ACRES WITHIN THE WOLF PROJECT

The following draft criteria were developed by an OFRC sub-committee which met via conference call in advance of the November 19th, 2013 full collaborative meeting. The intent of these draft criteria is to provide a starting point for further discussion with the full OFRC membership and does not yet represent the full collaborative's input or agreement. Participants on the call included: Glen Ardt, Pete Caligiuri, Phil Chang, Tim Lillebo, Marilyn Miller, Jack Southworth, and George Wuerthner. Steve Fitzgerald also provided written input on the criteria although he was not able to join the call.

These criteria were further amended following the November 19th meeting to reflect discussion by OFRC members, then were presented to the OFRC again on January 14th. While specific member disagreement with specific criteria is documented below, all members of the OFRC present on January 14th supported the use of these criteria in the 384 acres of selective removal of over 21" trees in Alternative 3 of the Wolf project.

1. *Consider the stand in relation to neighboring stands and landscape context, taking into account topographic position and landscape features that would likely affect forest development/succession over time with characteristic disturbance regime*
    - Examples include barriers or impediments to fire that would limit fire flow and affect forest succession over time (e.g., fire refugia) **–OR–** the converse, lack of impediments between frequent, low-severity forest types/sites and moderate or mixed-severity forest stands contributing to manifestation of more fire tolerant species composition and structure
2. *Incorporate best appropriate science for mixed conifer forests in the Ochoco Mountains regarding mixed conifer structure/composition types, current conditions, and historically resilient conditions*
    - In addition to the potential vegetation type, utilize evidence of historical species composition and structure gathered on site (e.g., living old trees, old snags and stumps) to classify the mixed conifer structure/composition type to guide restoration prescriptions
    - Base post-treatment desired conditions and stand characteristics (e.g., species composition mix, tree density, size class distribution, and basal area by species) on best applicable science for Ochoco mixed conifer forest types (e.g., see graph/descriptions below)

    1. **Persistent shade tolerant type (PIPO/PSME/ABGR):** The persistent shade tolerant type is characterized by



Source: Andrew Merschel

predominance of grand fir, Douglas-fir, western larch, and ponderosa pine among overstory trees.

2. **Encroaching grand fir type (PIPO/ABGR):** The encroaching grand fir type is characterized by ponderosa pine as the predominant overstory trees with grand fir common among small overstory trees at many sites.
3. **Encroaching Douglas-fir type (PIPO/PSME):** The encroaching Douglas-fir type is characterized by ponderosa pine as the predominant overstory trees and Douglas-fir as a minor overstory component.
4. **Ponderosa pine type (PIPO/PIPO):** The ponderosa pine type is characterized by the predominance of ponderosa pine in all canopy layers. Grand fir and Douglas-fir are rare among overstory trees.

3. *Retain all greater than 21" shade intolerant/early seral species in the stand (e.g., ponderosa pine & western larch) regardless of age in order to restore the early seral species overstory component most impacted by past harvesting (see Merschel et al. 2013 – in press)*
   - Interfor does not agree with this criteria

   3a. Below 21", retain and promote the healthiest shade-intolerant tree species, while providing for leaving trees for future snag recruitment

4. *Retain all old (>150 years of age) trees, regardless of size or species*
   - Utilize morphologically-based old growth identification guides like "Identifying Old Trees and Forests" by Robert Van Pelt and "Ageing grand fir on the Malhuer National Forest" by James Johnston
   - Interfor and Woodward do not support use of the Van Pelt or other morphologically-based tree age guides when used in addition to the Eastside Screens

5. *When evaluating possible large (including trees >21" dbh) but young shade tolerant tree species (i.e., grand fir & Douglas fir) for **removal**, prioritize those trees that are in direct competition (see bullets below) with old ponderosa pine, western larch, and Douglas-fir*
   - Consider below-ground competition for soil moisture using the tree drip line as a general proxy for the zone of below-ground competition. Trees prioritized for removal that are over 21" inches will be within one dripline not to exceed 20 feet.
   - Consider options to leave large Grand fir with low commercial value as standing and downed dead wood for wildlife

6. *When evaluating possible trees for **removal**, consider young shade tolerant species (e.g. grand fir & Douglas fir) regardless of size that are encroaching in riparian/hardwood, aspen systems, or other unique habitat types*

7. *When evaluating possible trees for **retention**, consider the following:*
   - If a large ponderosa pine or western larch is dead or dying and there are no other early seral replacement trees nearby, consider retaining large Douglas-fir or grand fir to maintain large tree structure
   - If a large grand fir or Douglas-fir has characteristics that made it especially valuable for wildlife habitat (e.g. forked top, obvious cavities, large branch structure, etc.), consider retaining the tree when thinning out other Grand or Douglas fir below 21 inches in the vicinity of the habitat tree

8. *Incorporate opportunities for pre- (sample marking) and post-implementation collaborative monitoring trips in order to increase transparency and trust on these important acres of the Wolf Watershed project*

- Consider qualitative monitoring techniques like multi-party monitoring field reviews to evaluate pre-treatment sample marking and post-treatment implementation
- Consider quantitative monitoring techniques like effectiveness monitoring on legacy tree vigor over time following treatments

APPENDIX H – PROJECT MAPS

Map 1: Vicinity Map

Map 2: Ochoco National Forest Plan Management Areas

Map 3: RHCAs and Redband Trout Distribution

Map 4: Proposed Action (Alternative 2) Commercial Harvest and Road Proposals

Map 5: Proposed Action (Alternative 2) Noncommercial Thinning and Juniper Removal

Map 6: Proposed Action (Alternative 2) Fuels Treatments

Map 7: Alternative 3 Commercial Harvest and Road Proposals

Map 8: Alternative 3 Noncommercial Thinning and Juniper Removal

Map 9: Alternative 3 Fuels Treatments

Map 10: Alternative 4 Commercial Harvest and Road Proposals

Map 11: Alternative 4 Noncommercial Thinning and Juniper Removal’

Map 12: Alternative 4 Fuels Treatments

Map 13: Key Wildlife Areas

Map 14: Recreation Areas