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Draft Environmental Impact Statement

McKay Fuels and Vegetation Management Project

Lookout Mountain Ranger District, Ochoco National Forest
Crook County, Oregon

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McKay Fuels and Vegetation Management Project
Draft
Environmental Impact Statement
Crook County, Oregon

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Abstract: This Environmental Impact Statement (EIS) describes the effects of implementing vegetation management strategies and fuel reduction in the McKay project area. The McKay project area is located on the Lookout Mountain Ranger District of the Ochoco National Forest near 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. The Responsible Official has identified Alternative 3 as her 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 decisionmaking 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: **Slater Turner, District Ranger**
3160 NE 3rd Street
Prineville, OR

Date Comments Must Be Received: **45 Days following 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, pre-commercial thinning, grapple piling, hand piling, and prescribed fire in the McKay Creek watershed 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 McKay project area is located on the Lookout Mountain Ranger District of the Ochoco National Forest, about 11 miles northeast of Prineville, Oregon. The approximately 25,526 -acre project area falls within McKay Creek watershed.

Why is the action being proposed?

Based upon direction from the Ochoco Forest Plan and opportunities identified in the McKay WA, the Lookout Mountain Ranger District has determined that within the McKay project area:

1. There is a need to strategically 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.

2. There is a need to increase or maintain large tree structure and hardwood abundance and diversity in RHCAs while meeting the need identified in point #1.

3. 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?

The following activities are included in the proposed action for the McKay project area.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning)	
Commercial Thin	3,032 ac
Modified Commercial Thin (in units 28 – 33)	532 ac
Mistletoe Reduction Harvest	205 ac
TOTAL COMMERCIAL THIN	**3,769 ac**
Precommercial thinning (would be followed by prescribed burning)	1,943 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction	
Small-diameter thin, limb, hand-pile and burn	210 ac
Prescribed burn	1,222 ac
Thin with fire	853 ac
Restoration of Riparian Special Plant Communities	12 sites

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile
Temporary road on existing disturbance	6 miles
Road reconstruction	11 miles
Expansion of Highland Material Source	up to 5.2 acres

What would it mean not to meet the need?

Forest Vegetation

Stands in the project area would continue growing. The amount of 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.

Upland shrub 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. Mountain mahogany and other shrubs would continue to decline in abundance.

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 low fire intensity as a result of being thinned and burned in the 1980s and 1990s would not be maintained, and would transition into mixed fire intensity over time. The amount of forested acres within the mixed and high-intensity fire regimes is 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?

One other alternative was identified that would meet the need for the project.

Alternative 3 was developed to respond to key issues 1, 2, 3, and 4 discussed in Chapter 1, while also meeting the stated purpose and need.

The following activities are included in Alternative 3.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning)	
Commercial Thin	3,263 ac
Modified Commercial Thin (in units 28 – 33)	532 ac
Mistletoe Reduction Harvest	205 ac
TOTAL COMMERCIAL THIN	**4,000 ac**
Precommercial thinning (would be followed by prescribed burning)	1,989 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction	
Small-diameter thin, limb, hand-pile and burn	210 ac
Prescribed burn	1,190 ac
Thin with fire	853 ac

Restoration of Riparian Special Plant Communities	12 sites
Riparian treatment (outside of harvest and/or precommercial thin units)	519 ac

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile
Temporary road on existing disturbance	4.5 miles
Road reconstruction	12 miles
New Specified Road	1 mile
Expansion of Highland Material Source	up to 5.2 acres
Floodplain connection	2 sites

Alternative 4 was developed to respond to issues 4, 5, and 6 as discussed in Chapter 1 of the EIS.

The following activities are included in the Alternative 4 for the McKay project area.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning) **TOTAL COMMERCIAL THIN**	 **2,985 ac**
Precommercial thinning (would be followed by prescribed burning)	1,943 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction Small-diameter thin, limb, hand-pile and burn Prescribed burn Thin with fire	 210 ac 1,222 ac 853 ac
Restoration of Riparian Special Plant Communities	12 sites

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile
Temporary road on existing disturbance	3.6 miles
Road reconstruction	8.5 miles
Expansion of Highland Material Source	up to 5.2 acres

What are the effects of the alternatives?

Forest Vegetation

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

Under all 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 pre-commercial 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.

Broadleaf and Shrub Communities

Harvest and noncommercial thinning in and around aspen stands would improve aspen 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 will 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 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 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, precommercial thinning, aspen treatments, and fuels reduction activities in the Canyon 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.

What monitoring is necessary?

Implementation monitoring is necessary to assure 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.

Which alternative is preferred?

Alternative 3 has been selected by the Responsible Official as the preferred alternative.

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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 [X].

Background

The McKay project area is within the 45,700-acre McKay Watershed; about 25,526 acres of this watershed are managed by the Ochoco National Forest, 1,360 acres are managed by the Bureau of Land Management, and 18,814 acres are private land. The McKay Fuels and Vegetation Management project area is northeast of the city of Prineville; the Forest Boundary (and project area boundary) is about 11 miles from town (see Map 1).

There are many high-value areas within and adjacent to the 25,526 acres of National Forest System land within the McKay Watershed. The area is home to a variety of fish and wildlife species, including northern goshawk, pileated woodpeckers, redband trout, deer and elk, as well as a reintroduced population of steelhead. McKay Watershed is on the western edge of the habitat range for Peck's Mariposa Lily; there are populations of this sensitive plant in the project area. The area is popular for recreation, and although it does not contain any developed campgrounds, the watershed supports at least 50 dispersed camping areas. Other recreational use includes

hiking, hunting, horseback riding, mountain biking, driving for pleasure, rock hounding, geocaching, snowmobiling, cross-country skiing, sledding, and off-highway vehicle (OHV) use on the Green Mountain trail, which winds in and out of the project area. The project area also includes the Green Mountain Roadless Area, as well as notable heritage resources including Divide Cabin, Summit Historic Trail, and Hash Rock Lookout. The Crook County Community Wildfire Protection Plan (2005) identified 7,549 acres of wildland urban interface (WUI) within the McKay Watershed, including the area along the Forest Boundary and surrounding a 40-acre parcel of private property along McKay Creek. High fuel loads and the presence of ladder fuels create a risk of large-scale wildfire in the McKay Watershed; such a fire could impact any of these species, habitats, and activities.

The range of tree species within the McKay Watershed 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. Even though speculations of significant global climate change exist, the current climate limits what management activities can be applied to forest trees at this 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 on this project area. Some of the species in the project area, such as the pines, are well adapted to warm dry growing seasons, while other species do well in cool wet conditions. Hence, regardless of the climatic changes, a full suite of species remaining on the project area ensures adaptability for a wide range of climatic conditions.

The existing condition of the McKay Watershed was evaluated in 2006 and documented in the McKay Watershed Analysis. The Watershed Analysis (WA) determined that vegetation conditions in the watershed have departed from the historic condition in several ways:

- Changes in tree species compositions.
- A reduction in late and old structured forest.
- A reduction in open-canopy 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.
- Areas where dwarf mistletoe in overstory trees is affecting the growth and sustainability of the next generation of trees.
- A reduction in upland shrub habitat.
- A decline in the condition of riparian vegetation.

The project area contains McKay and Little McKay creeks, both of which are on the Oregon Department of Environmental Quality's 303(d) list of water quality limited waters; both streams are listed due to high summer water temperatures. Stream temperature can be affected by stream shade, which may be provided by riparian vegetation. Riparian vegetation, especially deep-rooted hardwoods, contributes to bank stability and stream structure and also provides important habitat for many bird species. Large conifers near streams eventually fall and contribute to instream wood, which is an important component of fish habitat and contributor to stream form and function. Streams in the McKay Watershed are often deficient in streamside vegetation. Large conifers along streams are at risk of loss due to understory competition and fuels accumulation.

Purpose and Need for Action

Based upon direction from the Ochoco Forest Plan and opportunities identified in the McKay WA, the Lookout Mountain Ranger District has determined that within the McKay project area:

1. There is a need to strategically 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.

2. There is a need to increase or maintain large tree structure and hardwood abundance and diversity in RHCAs while meeting the need identified in point #1.

3. 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.

Proposed Action

The following activities are included in the proposed action for the McKay project area.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning)	
Commercial Thin	3,032 ac
Modified Commercial Thin (in units 28 – 33)	532 ac
Mistletoe Reduction Harvest	205 ac
TOTAL COMMERCIAL THIN	**3,769 ac**
Precommercial thinning (would be followed by prescribed burning)	1,943 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction	
Small-diameter thin, limb, hand-pile and burn	210 ac
Prescribed burn	1,222 ac
Thin with fire	853 ac
Restoration of Riparian Special Plant Communities	12 sites

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile
Temporary road on existing disturbance	6 miles
Road reconstruction	11 miles
Expansion of Highland Material Source	up to 5.2 acres

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, precommercial thinning, aspen treatments, and fuels reduction activities in the Canyon 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.

Public and Intergovernmental Involvement

The McKay Fuels and Vegetation Management project was first announced in the Ochoco National Forest's Schedule of Proposed Action on October 1, 2011. Letters announcing the proposed action and inviting comment were mailed to Lookout Mountain Ranger District's mailing list on January 25, 2012. The Notice of Intent (NOI) was published in the Federal Register on January 31, 2012. The NOI asked for public comment on the proposal from February 1, 2012 to March 1, 2012.

Letters announcing the proposed action and inviting comment were mailed to the Burns Paiute Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Klamath Tribes, and the Confederated Tribes of the Warms Springs Reservation of Oregon, as part of government-to-government consultation. The Lookout Mountain Ranger District received eight comments from individuals, organizations and agencies.

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 Lookout Mountain Ranger District office, Prineville, Oregon, in the project record.

As for significant issues, the Forest Service identified the following issues during scoping:

1. The proposed action does not maximize commercial value of the project area.
2. The proposed action does not do enough to improve native (desirable) vegetation in RHCAs.
3. Proposed re-use of roads in the vicinity of the McKay Material Source restoration risks compromising the restoration work that recently took place in that area (this issue was raised internally).
4. Vegetation management in moist mixed conifer may affect species that rely on that habitat.
5. Forest Plan Amendments should not be used because they can lead to impacts that Forest Plan Standards and Guidelines are in place to avoid.
6. Cutting of large trees is inconsistent with Purpose & Need because it removes LOS instead of increasing it.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes and compares the alternatives considered for the McKay Fuels and Vegetation Management 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 (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion caused by helicopter logging versus skidding).

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

The following activities are included in the proposed action for the McKay project area. Please refer to Maps for locations of activities.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning)	
Commercial Thin	3,032 ac
Modified Commercial Thin (in units 28 – 33)	532 ac
Mistletoe Reduction Harvest	205 ac
TOTAL COMMERCIAL THIN	**3,769 ac**
Precommercial thinning (would be followed by prescribed burning)	1,943 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction	
Small-diameter thin, limb, hand-pile and burn	210 ac
Prescribed burn	1,222 ac
Thin with fire	853 ac
Restoration of Riparian Special Plant Communities	12 sites

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile

Temporary road on existing disturbance	6 miles
Road reconstruction	11 miles
Expansion of Highland Material Source	up to 5.2 acres

Explanation of Proposed Activities and Connected Actions:

Commercial Thin: This prescription would be used in overstocked stands with a surplus of merchantable-sized trees; trees selected for thinning would be removed from the stand and sold. The emphasis of this activity would be to maintain existing large-structure trees (21 inches diameter at breast height [dbh] and larger), accelerate the development of additional large trees, improve the resiliency of retained trees, move species compositions closer to what occurred historically, and increase the amount of acres in single-strata stand structure.

Moidified Commercial Thin: Commercial thinning in Units 28 – 33 would be interspersed with areas of group selection, which would entail removing groups of trees in stands with a substantial disease component. The objective would be to retain and improve the health and resiliency of remnant large-diameter ponderosa pine and larch. This prescription may require removing trees that are greater than 21inches dbh; the estimate is that the group selection component of this activity would be applied on about 27 acres within the 532-acre block in Alternatives 2 and 3.

Mistletoe Reduction Harvest: In selected areas where mistletoe-infected overstory trees are spreading mistletoe to the next generation of trees, overstory removal would be utilized to improve the health and resiliency of understory trees. Overstory trees of all sizes may be removed. Trees selected for removal would be sold.

Precommercial Thinning: The objective of this treatment is to reduce the amount of small, nonmerchantable trees (generally smaller than 9 inches dbh). The number of small trees to be left would vary by stand depending on the overall stocking objectives.

Juniper Removal: Generally most, if not all, small-diameter (up to 16 inches dbh) juniper would be removed, with the objective of benefitting upland shrub habitats.

Restoration of Riparian Special Plant Communities: Generally intended to benefit riparian hardwood species such as quaking aspen, cottonwood, and willow, this activity also may be used to improve habitat for other riparian species, including Peck's Mariposa Lily. Activities would extend up to 50 feet to either side of the active desired plant community. All juniper and most pine would be removed; there would be no removal of trees that are contributing to bank stability, and large pine would be retained.

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 10%); 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 McKay project activities, all temporary roads would be barricaded to prevent motorized access and subsoiled (depending on soil type) to return them to vegetative productivity.

Road Reconstruction: The purpose of the proposed road reconstruction would be to improve, restore, or realign a road to protect subgrade, reduce risk of erosion, protect resources, and reduce long-term maintenance costs. The majority of the proposed road reconstruction may include placing additional crushed aggregate on major haul roads, installation of surface drainage features, and placing spot rock; reconstruction would be recommended on some proposed haul routes (see section titled "Transportation" in Chapter 3 of this document).

Expansion of Highland Material Source: Highland Material Source is located in the General Forest Management Area in T12S, R17E, Section 15, just north of FS Road 2710 and west of FS Road 2715, in McKay Creek watershed. Existing mineral reserves at Highland Material Source

will not meet needs associated with the McKay Fuels and Vegetation management project. The purpose for expanding the material source is to provide pit-run rock for implementation of projects under the McKay decision, which may include road maintenance, reconstruction or closure. The Highland Material Source would be expanded from its current size of about 6.8 acres to no greater than 12 acres. Expansion of Highland Mineral Material Source would require removal of timber over the expansion area. The resulting slash would be machine piled and burned.

Vegetation Management Strategy within RCHAs

Under PACFISH and INFISH, timber harvest (including fuel wood cutting) is prohibited within RHCAs except to acquire desired vegetation characteristics where needed to attain RMOs (INFISH, A-7). The treatments described in Table 1 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). Units and treatments not listed in Table 1 would be subject to the Project Design Criteria for all action alternatives described in Chapter 2 of this document.

Table 1. Unit-specific RHCA treatments for Alternative 2.

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
Thin with Fire	All thin with fire units	No specific treatment recommendations beyond the Project Design Criteria
Juniper Treatment	All Juniper Treatment units besides 151	Class 2, 3, 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	151	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
Pre-commercial Thin	All pre-commercial thin units except those listed below	Class 1: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 2, 3, 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	80	Class 1: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	81b	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	81c	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30'
	82a	Wetland: No cut within 30' of edge
	83	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125'
	84	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Wetland: No cut within 30' of edge
	85	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Wetland: No cut within 30' of edge
	86	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125'
	91	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	92	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	93	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	94	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	95	Class 2: No cut within 5' of stream; cut and leave between 5' and 30' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream

	142	Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125'
Mistletoe Treatment	All mistletoe treatment units	Class 2: No cut north of FS Road 3300-170 Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 30' of stream Wetland: No cut within 30' of edge
Commercial Thin	All commercial thin units except those listed below	Class 1 and 2: No cut south of FS Road 33 Class 3 and 4: No cut within 30' of stream
	15	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125'
	18	Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125'
	25	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 30' of stream
	26	Class 2: No cut within 50' of stream; 10% density reduction between 50' and 125'
	34	Class 2: No cut south of FS Road 33 Class 3: No cut west of FS Road 33
	35	Class 2: No cut south of FS Road 33 Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 30' of stream
	36	Class 2: No cut south of FS Road 33 Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 30' of stream
	37	Class 2: No cut within 100' of stream Class 3 and 4: No cut within 30' of stream
	41	Class 2: No cut within 100' of stream
	42	Class 2: No cut within 125' of stream
	43	Class 2 (McKay Creek): No cut south of FS Road 33 Class 2 (Little McKay Creek): No cut within 30' of stream; 10% density reduction between 30' and 125'
	44	Class 2 (McKay Creek): No cut south of FS Road 33 Class 2 (Little McKay Creek): No cut within 30' of stream; 10% density reduction between 30' and 125'
	50	Class 1: No cut within 125' of stream
	51	Class 2 and 3: No cut within 100' of stream Class 4: No cut within 30' of stream
	88	Wetland: No cut within 30' of edge
Special Plan Community Treatments	A1	Class 1, north side: No cut within 5' of stream; cut and leave between 5' and 125' Class 1, south side: No cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A2	Class 2: No cut within 20' of stream; 10% density reduction, cut and leave between 20' and 125'
	A3	Class 3: No cut within 5' of stream; cut and leave between 5' and 50'
	A4	Class 2, north side: No cut within 5' of stream; cut and leave between 5' and 125' Class 2, south side: No cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A6	Class 3: no cut within 30' of stream; 10% density reduction between 30' and 125'; cut and leave between 30' and 50'
	A7	Class 2, north side: no cut within 5' of stream; cut and leave between 5' and 125' Class 1, south side: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A8	Class 2 (McKay Creek), north side: no cut within 5' of stream; cut and leave between 5' and 125' Class 2 (McKay Creek), south side: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125' Class 2 (unnamed): no cut within 30' of stream, 10% density reduction, cut and leave between 30' and 125'
	A9	Class 3: no cut within 5' of stream; cut and leave between 5' and 50'
	A11	Class 3: no cut within 50' of stream; 10% density reduction between 50' and 125'
	A13	Class 2: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'

Forest Plan Amendments

About 31 acres of fuels treatments are proposed within an Old Growth Management Area (OGMA) near the Green Mountain Trail; the intent is to reduce fuels within 300' of the trail. A Forest Plan amendment may be required to either allow for management activities within the OGMA or to move the OGMA boundary to encompass more suitable Old Growth habitat.

A Forest Plan amendment may be required to conduct commercial thinning in Late and Old Successional stands (LOS) if, based on analysis of the Historic Range of Variability (HRV), this activity is inconsistent with the Ochoco Forest Plan, as amended.

A Forest Plan amendment may be required to allow harvest of overstory trees (over 21 inches dbh) in areas where mistletoe reduction harvest is proposed.

Alternative 3

Alternative 3 was developed to respond to Issues 1, 2, 3 and 4. Issues 1 and 2 indicated a concern on the part of the commenter that the Proposed Action did 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 McKay 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 additional acres on which commercial thinning would contribute to meeting project objectives. In addition, the ID team identified areas along McKay and Little McKay creeks where riparian restoration activities could be implemented to meet the purpose and need of the project.

Issue 3 was developed internally, and reflected a concern about compromising recently-completed restoration work at McKay Material Source (see Issues). To address this concern, Alternative 3 includes construction of a new specified road to eliminate the need to re-use two roads that were previously closed due to sedimentation concerns. The new road would be placed in a more hydrologically sound location, and would be closed (but not decommissioned) following implementation of McKay project activities.

To respond to Issue 4 (the concern about vegetation management in moist mixed conifer), the portion of Unit 27 that contains a contiguous block of moist grand fir was dropped. Moist mixed conifer is mapped in other locations in the project area; based on field reconnaissance, moist mixed conifer actually exists in small patches interspersed with other plant associations in proposed units. Areas of moist mixed conifer would be avoided in unit layout.

The following activities are included in Alternative 3. Please refer to Maps for locations of activities.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning)	
Commercial Thin	3,263 ac
Modified Commercial Thin (in units 28 – 33)	532 ac
Mistletoe Reduction Harvest	205 ac
TOTAL COMMERCIAL THIN	**4,000 ac**
Precommercial thinning (would be followed by prescribed burning)	1,989 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction	
Small-diameter thin, limb, hand-pile and burn	210 ac
Prescribed burn	1,190 ac
Thin with fire	853 ac
Restoration of Riparian Special Plant Communities	12 sites
Riparian treatment (outside of harvest and/or precommercial thin units)	519 ac

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile

Temporary road on existing disturbance	4.5 miles
Road reconstruction	12 miles
New Specified Road	1 mile
Expansion of Highland Material Source	up to 5.2 acres
Floodplain connection	2 sites

Explanation of Proposed Activities and Connected Actions:

The explanations of the activities common to the other action alternatives are explained under Alternative 2.

New Road Construction (new specified road): New road construction would be subject to Forest Plan standard design criteria. The proposed new segment of road would be capped with aggregate material. It would be constructed for a single user and would be managed for long-term intermittent use under Maintenance Level 1 (see section titled "Transportation" in Chapter 3 of this document). The road would be closed by the timber purchaser after implementation of project activities.

Floodplain Connection: Historically, McKay Creek was straightened and has since incised, disconnecting it from accessing its floodplain for most of its length. Two sites located along the mainstem of McKay Creek were identified as priority floodplain sites. Reconnecting McKay Creek to its floodplain would create a shallower water table, resulting in a larger area for riparian vegetation to establish. This would assist with increasing riparian vegetation density and diversity.

The floodplain connection portion of the McKay Fuels and Vegetation Management Project would involve either reactivating relic channels or creating new channels on the floodplain and aggrading the existing channel in phases. By partially aggrading the channel prior to moving to the floodplain connected channel, there would be an opportunity to establish riparian vegetation on the new channel before it takes all of the flow. One of the sites, referred to as Site 2, appears to have relic channels to reactivate. The other, an old mill site (Site 4), was highly modified and the channel would need to be constructed for much of the site. Site 4 would also include reconnecting Miner's Gulch to its floodplain, the location of which appears to have been moved multiple times likely as a result of old mill/logging activities. One possibility would be to move Miner's Gulch back to its historic location. Ground-disturbing activities may include tree tipping, planting, aggrading the existing channel in phases, new channel construction, grade control structure installation, fencing, and boulder barrier placement.

Vegetation Management Strategy within RCHAs

Under PACFISH and INFISH, timber harvest (including fuel wood cutting) is prohibited within RHCAs except to acquire desired vegetation characteristics where needed to attain RMOs (INFISH, A-7). The treatments described in Table 2 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). Units and treatments not listed in Table 2 would be subject to the Project Design Criteria for all action alternatives described in Chapter 2 of this document.

Table 2. Unit-specific RHCA treatments for Alternative 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
Thin with Fire	All thin with fire units	No specific treatment recommendations beyond the Project Design Criteria
Juniper	All Juniper	Class 2, 3, 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream

Treatment	Treatment units besides 151	
	151	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
Pre-commercial Thin	All pre-commercial thin units except those listed below	Class 1: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 2, 3, 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	80	Class 1: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	81b	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	81c	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30'
	82a	Wetland: No cut within 30' of edge
	83	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125'
	84	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Wetland: No cut within 30' of edge
	85	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Wetland: No cut within 30' of edge
	86	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125'
	91	Class 2: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	92	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	93	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	94	Class 2: No cut within 10' of stream; 10% density reduction between 10' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	95	Class 2: No cut within 5' of stream; cut and leave between 5' and 30' Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; cut and leave between 5' and 30' from stream
	142	Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125'
Mistletoe Treatment	81	Class 2: No cut north of FS Road 3300-170 Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met Wetland: No cut within 30' of edge
	82	Class 2: No cut north of FS Road 3300-170 Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met Wetland: No cut within 30' of edge
Commercial Thin	All commercial thin units except those listed below	Class 1 and 2: No cut south of FS Road 33 Class 3 and 4: No cut within 30' of stream
	9	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	15	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125'
	17	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	18	Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125'
	22	Class 3: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	24	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	25	Class 3: No cut within 50' of stream; 10% density reduction between 50' and 125' Class 4: No cut within 30' of stream
	26	Class 2: No cut within 50' of stream; 10% density reduction between 50' and 125'
	30	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	31	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	34	Class 2: No cut south of FS Road 33

		Class 3: No cut west of FS Road 33
	35	Class 2: No cut south of FS Road 33 Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	36	Class 2: No cut south of FS Road 33 Class 3: No cut within 30' of stream; 10% density reduction between 30' and 125' Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	37	Class 2: No cut within 5' of stream; between 5' and 100', cut and leave until large wood RMO is met Class 3 and 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	38	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	39	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	40	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	41	Class 2: No cut within 5' of stream; between 5' and 100', cut and leave until large wood RMO is met
	42	Class 2: No cut within 5' of stream; between 5' and 125', cut and leave until large wood RMO is met
	43	Class 2 (McKay Creek): No cut south of FS Road 33 Class 2 (Little McKay Creek): No cut within 30' of stream; 10% density reduction between 30' and 125'
	44	Class 2 (McKay Creek): No cut south of FS Road 33 Class 2 (Little McKay Creek): No cut within 30' of stream; 10% density reduction between 30' and 125'
	45	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	46	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	47	Class 3: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	50	Class 1: No cut within 10' of stream; between 10' and 125' 10% density reduction, cut and leave until large wood RMO is met
	51	Class 2: No cut within 10' of stream; between 10' and 125' 10% density reduction, cut and leave until large wood RMO is met Class 3: No cut within 5' of stream; between 5' and 100' cut and leave until large wood RMO is met Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	88	Wetland: No cut within 30' of edge
	116a	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	117	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	118	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	152	Class 3: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
	153	Class 4: No cut within 20' of stream; between 20' and 50', cut and leave until large wood RMO is met
	156	Class 2: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met; between 20' and 125', 10% density reduction
	158	Class 4: No cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met
Special Plan Community Treatments	A1	Class 1, north side: No cut within 5' of stream; cut and leave between 5' and 125' Class 1, south side: No cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A2	Class 2: No cut within 20' of stream; 10% density reduction, cut and leave between 20' and 125'
	A3	Class 3: No cut within 5' of stream; cut and leave between 5' and 50'
	A4	Class 2, north side: No cut within 5' of stream; cut and leave between 5' and 125' Class 2, south side: No cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A6	Class 3: no cut within 30' of stream; 10% density reduction between 30' and 125'; cut and leave between 30' and 50'
	A7	Class 2, north side: no cut within 5' of stream; cut and leave between 5' and 125'

		Class 1, south side: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
	A8	Class 2 (McKay Creek), north side: no cut within 5' of stream; cut and leave between 5' and 125' Class 2 (McKay Creek), south side: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125' Class 2 (unnamed): no cut within 30' of stream, 10% density reduction, cut and leave between 30' and 125'
	A9	Class 3: no cut within 5' of stream; cut and leave between 5' and 50'
	A11	Class 3: no cut within 50' of stream; 10% density reduction between 50' and 125'
	A13	Class 2: no cut within 10' of stream; 10% density reduction, cut and leave between 10' and 125'
Riparian Treatments	162	Class 1: no cut within 10' of stream; between 10' and 125', 10% density reduction; between 10' and 30', cut and leave until large wood RMO is met
	163	Class 2 (McKay Creek), north side: no cut within 5' of stream; between 5' and 30', cut and leave until large wood RMO is met Class 2 (McKay Creek), south side: no cut within 10' of stream; between 10' and 125', 10% density reduction; between 10' and 30', cut and leave until large wood RMO is met Class 2 (Little McKay Creek), mouth to 3500' upstream: no cut within 30' of stream, between 30' and 125', 10% density reduction Class 2 (Little McKay Creek), 3500' upstream of mouth to end of unit: no cut within 10' of stream, between 10' and 125', 10% density reduction, between 10' and 30', cut and leave until large wood RMO is met
	164	Class 2 (Little McKay Creek), Rd 2710 to 1500' downstream: no cut within 30', between 30' and 125', 10% density reduction, between 20' and 30', cut and leave until large wood RMO is met

Forest Plan Amendments

About 31 acres of fuels treatments are proposed within an Old Growth Management Area (OGMA) near the Green Mountain Trail; the intent is to reduce fuels within 300' of the trail. A Forest Plan amendment may be required to either allow for management activities within the OGMA or to move the OGMA boundary to encompass more suitable Old Growth habitat.

A Forest Plan amendment may be required to conduct commercial thinning in Late and Old Successional stands (LOS) if, based on analysis of the Historic Range of Variability (HRV), this activity is inconsistent with the Ochoco Forest Plan, as amended.

A Forest Plan amendment may be required to allow harvest of overstory trees (over 21 inches dbh) in areas where mistletoe reduction harvest is proposed.

Alternative 4

Alternative 4 was developed to respond to Issues 4, 5, and 6. Activities would be similar to those proposed in Alternative 2, with the following exceptions:

- To respond to Issue 4 (the concern about vegetation management in moist mixed conifer), the portion of Unit 27 that contains a contiguous block of moist grand fir was dropped.
- Moist mixed conifer is mapped in other locations in the project area; based on field reconnaissance, moist mixed conifer actually exists in small patches interspersed with other plant associations in proposed units. These small inclusions are most prevalent in Units 28 – 33; therefore these units were dropped from Alternative 4.
- To respond to Issues 5 and 6, mistletoe treatments (units 81, 82 and 153) were dropped from Alternative 4.
- Removal of mistletoe treatments and group selection would eliminate the need to cut trees over 21 inches dbh, would eliminate commercial treatments in LOS, and would eliminate the need for related Forest Plan amendments.

The following activities are included in the Alternative 4 for the McKay project area. Please refer to Maps for locations of activities.

Activity	Quantity (approximate)
Commercial Activities (would be followed by precommercial thinning and prescribed burning) **TOTAL COMMERCIAL THIN**	**2,985 ac**
Precommercial thinning (would be followed by prescribed burning)	1,943 ac
Juniper removal (would be followed by jackpot and prescribed burning)	2,951 ac
Fuels reduction Small-diameter thin, limb, hand-pile and burn Prescribed burn Thin with fire	 210 ac 1,222 ac 853 ac
Restoration of Riparian Special Plant Communities	12 sites

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

Connected Action	Quantity
Streambank stabilization at proposed stream crossing	1 location
Temporary road	1 mile
Temporary road on existing disturbance	3.6 miles
Road reconstruction	8.5 miles
Expansion of Highland Material Source	up to 5.2 acres

Explanation of Proposed Activities and Connected Actions:

These would be the same as in Alternative 2.

Vegetation Management Strategy within RCHAs

The RCHA strategy would be the same as in Alternative 2 (see Table 1) except that Units 28-33, 81, 82 and 153 would no longer be included.

Project Design Criteria Common to All Alternatives

Commercial Harvest Activities

- To protect sensitive resources, harvest activities in Unit 33a would take place over snow.

Prescribed Fire Activities (General)

- Prescribed burning operations would be coordinated with the Department of Environmental Quality through the State of Oregon smoke management program.
- Private landowners within the project area will be notified approximately 5 days in advance of any burning activities adjacent to their lands.
- Enclosures, exposed water lines, and other improvements would be protected during implementation.

Prescribed Fire Activities in RHCAs

- Burn plans and unit-specific prescriptions would be developed as an on-the-ground, interdisciplinary process; team should include (at a minimum) a fuels specialist, a fisheries biologist, a hydrologist, and a wildlife biologist.
- Generally in RHCAs, there would be no intentional ignition within 100’ of stream channels. Fire would be allowed to back 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 100' 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 100' of the stream channel would be desirable.
    - EXAMPLE: Excessive amounts of understory conifers 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: Excess fuels accumulations within 100' of the stream channel exist and fire is determined to be the tool of choice to reduce them.
- Where necessary, fireline would be constructed within RHCAs with the following guidelines:
  - Fireline would be a fuel break to mineral soil, 12-14 inches wide.
  - Fireline in RHCAs would not be constructed within 25' of streambanks.
  - Fireline in RHCAs would be dug by hand or with a garden plow pulled by a four-wheeler or a small rubber-tired farm tractor.
  - 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 fireline, soil would be pulled back, 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; site-specific plan would be developed to ensure retention of that piece of wood.
  - EXAMPLE: A given stream might be so deficient in down wood that the retention of all in-channel down wood in a unit might be necessary.
- Do not place slash piles in the bottom of ephemeral draws and swales.
- Post-activity effectiveness monitoring would be conducted whenever site-specific plans are implemented.

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 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 it 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 historic stock driveway signs, General Land Office bearing trees, or physical remains of other historic features are found within treatment units, their location would be made known to the project archaeologist for recording. After recording, project activities would continue.
- Historic sites would be protected from fuel reduction activities by surrounding them with fire lines to avoid damage from flames or pulling fuels away from the sites to avoid impacts due to heat and flames.
- Establishment of staging areas for motorized vehicles and equipment of any kind would not be permitted within known ground-based cultural resource sites.

Divide Cabin

- Mitigation for this historic/prehistoric site complex would be a protective/avoidance buffer zone
- Within a tree-length from the cabin trees would be directionally felled away from the cabin.
- Skidding through or mechanical equipment, log landings or the parking of trucks would not be allowed within the buffered site area.
- No woody debris piles would be built within the site.
- Pre-commercial thinning and light, fast burning flames are encouraged to keep the area open and discourage damage by wildfire to the historic structure.

Historic Summit Trail (Forest Road 2700-300) Units 28-33 & 36

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).

- Coordination with the project archaeologist would occur on a unit-by-unit basis for all proposed treatments within the Summit Trail corridor.
- Light, fast burning flames are permitted across the length of the road.
- Log-hauling over the historic road will, to the greatest extent possible, stay within the existing lens of the historic trail.
- No new vehicle staging areas will be permitted along the historic road; vehicles may park within existing landings or existing pull-offs or spur roads; exceptions may be considered on a case-by-case basis in coordination with the project archaeologist.
- The re-use of established log landings within foreground areas would be permitted. The establishment of new log landings adjacent to the road may be considered on a case-by-case basis in coordination with the project archaeologist.
- Stumps would not exceed eight inches in foreground areas.
- Slash generated in foreground areas from logging activities will be hand piled and will be no larger than eight feet in diameter; piles will be burned or otherwise removed so that they do not remain in the visual corridor longer than one season.
- Trees with historic blazes, signs or telephone insulators would be left standing. If a blaze is on a hazard tree, the tree would be cut above the blaze.

- Logs will not be skidded across the Summit Trail.
- Blading, widening, installing culverts or modifying the road in any way will 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 is permitted.

Sensitive Plants and Scablands

- No slash piling or ground-based equipment would be used within 50 feet of areas identified as Peck's lily (*Calochortus longebarbatus* var. *peckii*) populations or habitat. Exceptions would be reviewed by the botanist and hydrologist or fisheries biologist. Exceptions include:
    - Pulling cable (winch lining) from an existing road;
    - Using existing roads as landings;
    - Hardwood treatments.
- No new roads would be constructed within 100 feet of population boundaries.
- Vehicles, including off-highway or all-terrain vehicles, would not be operated within areas identified as Peck's lily populations or habitat, except on existing roads.
- Layout of harvest treatment or pre-commercial thinning units near Peck's lily populations or potential habitat would be coordinated with the district botanist. Associated units are #6, 7, 7a, 7b, 8, 25, 25a, 120, 137, 138, 139, 140, and 141.
- Implementation of activities including pre-commercial thinning and layout of new road construction near other documented populations of sensitive plants will be coordinated with the botanist.
- Any new sensitive plant sites or habitat found during implementation would be protected similarly to known populations.
- Avoid ground-disturbing activities, including piling of slash, on scablands to reduce impacts to unique scabland habitat (lithosol soils), and associated sensitive needlegrass (*Archnatherum hendersonii* and *A. wallowaensis*) habitat. Exceptions can occur on existing roads, or other areas that have been reviewed by the botanist. Scabland habitat is identified by rigid sagebrush (*Artemisia rigida*), low sage (*A. arbuscula*), or Sandberg's bluegrass (*Poa secunda*) and occurs within or near units #17, 31, 32, 33, 76, and 129.
- Road construction on scablands will be limited to long-term collector, arterial and local roads. Temporary or short-term roads or trails will not be constructed across scablands unless there is no other feasible alternative. Any disturbance of scabland habitats would be reviewed by the district botanist. The area affected by construction of a temporary road would be erosion proofed through the use of crushed rock or other appropriate methods.
- Manage skid trails and mechanical logging operations with a 50 foot infiltration buffer along the scabland/forest interface. Where possible, place skid trails on the contour along the scabland/interface buffer; however, do not cross a creek or swale.
- 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.

Non-native Invasive Plants (Noxious Weeds)

- Conduct a non-native invasive plant identification workshop for Forest Service personnel who would be preparing, implementing, and/or administering the proposed activities.
- Re-use of landings infested with non-native invasive plants would not occur, shade would be retained, and ignition during burning would be avoided within 100 feet of infestations. Avoid these areas for camps, staging, and parking areas. Exceptions may be made through coordination with the district weed coordinator. In addition, any new invasive plant infestations found during implementation would be managed similarly. Treatment units in or near non-native invasive plants include units #1, 12, 17, 26, 44, 45, 46, 47, 58, 80, 91, 92, 98, 106, and 135.
- 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 gravel over the weed site prior to use by vehicles.
- To reduce the potential for transport or spread of non-native invasive plants by road construction or logging equipment, the timber sale contract would require provision BT6.35: (1) certification that equipment be clean of all plant or soil material that may result in the establishment or spread of non-native invasive plants; and (2) notification of location where equipment was most recently used. The Forest Service Timber Sale Administrator would certify that equipment is clean of plant and soil material before the equipment enters the project area. Cleaning shall occur off of Federal lands. Project-related activities that are implemented under a stewardship contract or other agreements would include an equivalent contract provision.
- Where McKay treatment units overlay grazing allotments, design elements include a post-burning evaluation. This is described under the design elements for range.
- Document all non-native invasive plant infestations identified during implementation by notifying the district noxious weed coordinator.
- To reduce the potential for non-native invasive plant 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 inspected by the Forest Service and determined to be weed free.
- All equipment and vehicles used at mineral material sites would be cleaned and certified free of all plant or soil material that could contain invasive plant seed or plant parts prior to entrance onto the National Forest. Cleaning means removing all dirt, grease, debris, and materials that may harbor invasive plants and their seeds. This may require the use of a pressure hose. Cleaning would occur off of Federal lands.
- 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.
- To reduce erosion potential and reduce risk of non-native invasive plants, apply seed to roads that will be closed or decommissioned, primary skid trails, and log landing areas as part of the final sale contract work. Seed would be certified as “All States Noxious Weed Free” by an approved testing laboratory, such as the Oregon State University Seed Lab. Local native grasses such as Sandberg’s bluegrass (*Poa secunda*), blue wildrye (*Elymus glaucus*), red fescue (*Festuca rubra*), and bottlebrush squirreltail (*Elymus elymoides*)

would be in the seed mix. Native forbs, such as yarrow (*Achillea millefolium*) would also be included in the mix if available. The seeding rate would be approximately 5-10 lbs/acre, depending on availability of species.

- Where feasible, retain desirable vegetation on road shoulders, cuts, fills, ditches, and drainages.
- A non-native invasive plant locator map would be included in the sale area map and project file to assist in avoidance and monitoring.
- Stream channel work identified by the hydrologist would be reviewed by the botanist prior to implementation.

Water Quality and Aquatic Habitats (Riparian Habitat Conservation Areas)

The following Project Design Criteria (PDC) were developed to minimize environmental effects of the proposed activities to streams, wetlands, and RHCAs and would be used in all of the action alternatives. These PDCs comply with the standards and guides outlined in the Ochoco National Forest Plan, INFISH, and PACFISH, as well as requirements for protection of water quality in the State of Oregon in accordance with the Clean Water Act.

Table X. RHCA boundaries by stream class, as defined in PACFISH.

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
PACFISH uses the term *stream category*. These categories have been converted to *stream class*, which is a more commonly used term. More complete definitions are given in Appendix X. These are only RHCA boundaries and do not indicate vegetation treatments within them.		

Thinning (Commercial and Non-commercial)

- Follow unit-specific treatments within RHCAs for each alternative (Table x). If a stream is encountered that is not accounted for in Table x, follow these treatments:
    - Perennial streams: 0-50’ no cut; 50-125’ <10% reduction in canopy closure
    - Intermittent streams: 0-5’ no cut; 5-30’ cut-and-leave

  Exceptions may be possible after review by fisheries biologist or hydrologist.
- Thinning around hardwoods within RHCAs will be coordinated with the fisheries biologist or hydrologist and silviculturist.
- Trees cut for cut-and-leave treatments within RHCAs would be felled toward stream channels where possible to increase large woody material and to reduce livestock access.
- 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.
- Where possible, slash would be arranged to protect hardwood sprouts in RHCAs.

Skid Trails, Landings, and Roads

- All specified roads used for this project determined to have high sediment delivery potential, as determined by the Hydrologist, would either be reconstructed prior to project use or would be inspected by the Hydrologist and Road Manager to determine whether sediment delivery is a concern prior to use. If field inspection determines that sediment delivery is occurring as a result of poor drainage or road surfacing, then the road would be reconstructed accordingly.
- New skid trails, landings, and temporary roads within RHCAs (including wetlands and springs) and ephemeral draws would not be developed except after review by the fisheries biologist and the hydrologist.
- 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 would not be used except after review by the fisheries biologist or hydrologist.
- New and existing skid trails would not cross streams; exceptions may be possible after review by the fisheries biologist or hydrologist.
- Skid trails and temporary roads would be designed to reduce the concentration of flows and to encourage the flow of water off of them.
- Landings and main skid trails within 300 feet of landings would be scarified and seeded to increase infiltration and prevent surface erosion. Landings that are located on a gravel road or at turnouts that will remain open to traffic use would be exempt from the scarification and seeding requirements.
- 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. Stream crossings structures (culverts and fords) on Class IV streams would be installed when the channel is dry. Temporary and reconstructed roads would be coordinated with the fisheries biologist or hydrologist. A stable fill would be constructed across all streams when crossed by new temporary roads.
- Native riparian-associated vegetation would be planted or seeded at new and reconstructed stream crossings.
- Temporary roads would be removed after completion of logging operations. Removal of temporary roads would include: berming the entrance, removal of culverts and associated fill, out-sloping the road surface, installation of water bars, removal of placed rock, re-vegetation of the road prism with native species, and scarification of compacted surfaces when necessary.
- Suspension of use would occur when road use is contributing to sediment detachment and transport (i.e. rutting 2 inches or deeper) or muddy ditch water to prevent siltation outside of the roadway.
- When consistent with other management actions, thinning slash would be placed on landings, skid trails, temporary roads, and roads to be closed.
- Dust abatement on haul roads within RHCAs would occur to reduce sediment (i.e. dust) entering streams. Water used for dust abatement would be obtained from sources identified in the May 1996 Ochoco National Forest Water Conservation Plan. Stream flow requirements are specified in the Plan.

- Construction, reconstruction, or maintenance of roads would not be done when soils are saturated or run-off occurs, to minimize erosion and sedimentation.
- Native surfaced roads would be restricted from hauling when soils are saturated or run-off occurs, to minimize erosion and sedimentation.
- Ground-based equipment used for yarding, processing, fuel treatment, or other project activities would operate only when soils are relatively dry following the rainy season in the spring through the summer, or during the winter months when there is a continuous snow pack or when soils are frozen to a depth of six inches or greater. Operations would be suspended before rainfall or precipitation results in off-site movement of muddy water into drainage courses.

Other Activities

- In-channel work such as culvert replacements on perennial streams would be accomplished in accordance with "Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources, 2008." For the project area, the timing for in-water work is July 1 to October 31.
- Industrial camps would not be located in RHCAs.
- Water sources used by project operations would be reconstructed or maintained as necessary to protect stream bank stability, riparian vegetation, and water quality.
- Water intakes must meet the following fish screen criteria (NMFS):
    - Perforated plate: screen openings shall not exceed 3/32 inches (2.38 mm), measured in diameter.
    - Profile bar: screen openings shall not exceed 0.0689 inches (1.75 mm) in width.
    - Woven wire: screen openings shall not exceed 3/32 inches (2.38 mm), measured diagonally (e.g.: 6-14 mesh).
- To reduce ground-disturbance within RHCAs during thinning and burning operations, use of off-highway vehicles would be restricted within RHCAs or on closed roads within RHCAs. Exceptions would be coordinated with the hydrologist or fisheries biologist.

Special Plant Communities

- The term "special plant community" may refer to aspen, riparian hardwoods, or populations of sensitive species.
- Treatment would remove understory conifers within 50 feet of any special plant community, including sprouting aspen or other hardwoods, except on south or west sides of 303(d) listed streams that are shade-limited.
- All juniper would be removed.
- Most understory conifers would be removed.
- No tree of any species would be removed if it is contributing to bank stability

Soils and Geology

- 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. Winch lining will be required on slopes greater than 35 percent 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 ephemeral draws. Crossings would be perpendicular to ephemeral draws.
- After harvest and grapple piling activities are completed, soil monitoring will evaluate the need for soil rehabilitation, such as tilling.
- In units where detrimental soil conditions occur on less than 20 percent of the area, design 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.
- Grapple piling equipment would remain on existing disturbed area to limit the amount of detrimental soil conditions. In undisturbed areas, grapple pile equipment would be allowed to make 1 or 2 passes to move between skid trails and other disturbed areas. Equipment would be limited to slopes less than 35 percent.
- Waterbars (waterdrains) on skid trails will be installed at regular intervals (varies by slope class), preferably with a crawler type tractor with an angled blade. Reference Appendix C for waterdrain construction requirements.
- On slopes where erosion in fire lines could occur, waterbars would be dug into the fireline. On slopes from 0 to 30 percent, waterbars would be placed every 60 feet. On slopes over 30 percent, waterbars would be placed every 25 feet.
- Any evidence of recent landslide slope movement requires consultation with the geologist.

Wildlife

Goshawk

- A 400-acre post fledging area has 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 of the prescription window.
- There would be a seasonal restriction (March 1 to August 31) on commercial harvest, precommercial 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 new road construction and road reconstruction.
- Seasonal restrictions (March 1 to August 31) on hauling would be applied within 0.25 mile of known nests. Haul restrictions would not apply to arterial or collector roads.
- These seasonal restrictions may be waived on an annual basis as determined by a site-specific review by a wildlife biologist.

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 mile of nest sites from February 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 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. Operations would be seasonally restricted within 660 feet of a nest site between March 1 and August 1. Exceptions would be evaluated on a case by case basis by the wildlife biologist.

Lewis' and White-headed Woodpeckers

- Active nest trees (or snags) located during layout or project implementation would be designated with a wildlife tree marker and protected. If the nest tree is determined to be a safety hazard coordination with the wildlife biologist would occur to determine if the hazard can be mitigated. Safety hazards would be identified by a qualified person, as defined by, and using the procedures provided in the interagency Field Guide for Danger Tree Identification and Response (Toupin et. al., 2005).
- If the hazard cannot be mitigated, felling of the tree would occur outside of the nesting season after the young have fledged. No felling would occur from April 1 to August 15.

Deer and Elk

- Seasonal restriction on harvest, thinning, fuels and related activities would be implemented between December 1 and May 1 in General Forest Winter Range. Within winter range, road construction, reconstruction and inactivation would be restricted between December 1 and May 1 of each year. Within General Forest, road work would not be restricted except on roads that are accessed through winter range on roads that are not designated open during the seasonal closure.
- Activities within elk calving areas will be seasonally restricted from May 15 to June 30.
- Activities within 0.25 mile of known elk wallows will be seasonally restricted from September 1 to October 15. This restriction would not apply to log haul on arterial or collector roads.

Snags/Down Logs

- Snags that pose a safety hazard which cannot be mitigated would be felled. Safety hazards would be identified by a qualified person, as defined by, and using the procedures provided in the interagency Field Guide for Danger Tree Identification and Response (Toupin et. al., 2005)

- 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 impacts to 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/Minerals

- Mining claim markers, livestock fences, cattle guards, and other structural range improvements would be protected and/or returned to their pre-activity condition if damaged during activities.
- Logging, burning, and road closure activities would be coordinated with permittees/mining claimants as needed. Efforts will be made to minimize conflicts between livestock use/sheep camps/mining activities and logging, thinning, and burning activities.
- To improve the rate of vegetation recovery following fuels treatments, and reduce potential for introduction and spread of non-native invasive plants, the following design elements would apply where McKay activity units occur within cattle or sheep grazing allotments:
    - To facilitate implementation of these design elements, prescribed burning would be planned based on pastures as implementation units.
    - Pastures that are overlaid by units planned for fall prescribed burning would be grazed first in that year.
    - To ensure recovery of native vegetation, encourage expansion of native vegetation into areas where vegetation and/or organic layer has been removed, and reduce the risk of introduction or spread of invasive plant species, pastures would be evaluated after burning to determine if rest is required or other adjustments to livestock grazing need to be made in order to meet resource objectives.
    - At a minimum, evaluation team would include range management specialist, weed coordinator, fuels specialist, and hydrologist or soils scientist.
    - Road construction, timber harvest, and other proposed activities, such as prescribed burning, can expose soils, cause compaction, or otherwise alter sites that can impact some sensitive plant populations and their habitat (Kagan 1996, Croft et al 1997, Halvorson 2000, 2003). These practices can damage soils and alter plant communities in both upland and riparian communities, and can increase potential for stream downcutting, bank erosion, and altered hydrological patterns, affecting sensitive plant species associated with riparian habitats. Ground disturbance and reasonably foreseeable activities (cumulative effects) such as vehicle use and livestock grazing can also facilitate the introduction and spread of non-native invasive plants (noxious weeds) that can degrade environmental quality and potentially impact sensitive plant species on a variety of habitats (USDA/USDI 1997).
    - Specific unit concerns are listed in the Botany Notes Table (Appendix A). Measures to address concerns were incorporated in action alternatives as either site-specific recommendations noted in the Botany Notes Table or as project

design elements. Additional information is in the McKay botany file at the Lookout Mt Ranger District.

  - If it is deemed appropriate to resume grazing in the year following prescribed burn, burned pastures would be deferred for last use that year.
  - Coordination would occur annually with the fuels specialist, the range management specialist, and the affected permittee to plan and schedule burning activities with consideration of understory vegetation and grazing; coordination would take place at the Annual Operating Instructions meeting.

- Range readiness is monitored annually prior to turn-out of livestock and criteria are as follows:
  - Overall vegetation 4-5" tall including new growth and previous year's growth to sustain livestock.
  - Soil firm enough to support livestock without creating compaction or breaking sod, postholes will be no more than 3" deep.

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 Camping Sites

- Forest Plan designated dispersed recreation sites located on existing landings may be reused for log decks, piling slash, or storing road rock. Each site will be rehabilitated after use.
- Activities adjacent to dispersed recreation sites identified in the Forest Plan will be designed to retain visual screening within 50 feet.
- If a Forest Plan-identified dispersed recreation site is utilized as a landing, haul back or chipping of slash will be required of logging debris to ensure site returns back to its natural appearance.
- Hand piling of non-commercial generated slash will be required within 50 feet of Forest Plan-designaged dispersed campsites.

Trails

- Landings shall not be located on (but could be adjacent to) system trails.
- Forest System trails (Pot Lid and Green Mountain) will not be used for yarding or skidding.
- Yarding across trails is permitted on a case-by-case basis, with locations identified as needed to limit disturbance.
- Grapple piling is prohibited within 50 feet of trails; hand piling is allowed.
- After project-related activities are complete, disturbed sections of system trails will be reconstructed to the existing (pre-activity) condition within 2 months of activity or funds will be collected for reconstruction. This includes replacing any trail markers that are removed as a result of activities.

- Along system trails, if trees containing diamond or other trail markers are designated for removal, the trail markers will be moved to a nearby tree that is not designated for removal.
- Boundary tags, markers, and flagging along trails will be removed after completion of treatment activities.
- Informative signs will be posted at Pot Lid and Green Mountain trailhead kiosks prior to activities occurring in these areas.
- Trail segments adjacent to commercial harvest units will be posted as closed to the public during commercial tree felling operations for public safety; posting will occur at trailheads and other points of access.
- Activity-generated slash will be cleared from the trail for a minimum of four feet on each side.

Visual/Scenic Resources

- When marking trees to be left, mark side of tree facing away from road within 75 feet of roads 27 and 33. This applies to commercial harvest Units 24-28, 34-37, 39-43, 81.
- Boundary tags, flagging, and markers would be removed from visual foreground areas in treatment units after completion of activities. Foreground occurs along Forest Service Roads 27, and 33.
- In Foreground areas or within 75 feet of the travel corridor, stumps would not exceed 8 inches in height. This applies to commercial units 24-28, 34-37, 39-43, 81, and additional non-commercial units 25a, 81a, 81b, 162-166.
- 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.
- Do not burn large slash piles (greater than 8 foot in diameter) within the visual foreground areas.
- Landings in visual foreground areas will be reseeded or replanted.

Roads

- Temporary road construction will be limited to sustained grades of 20% or less, allowing short lengths of not more than 100 feet to not exceed 30%. New construction of a cut and fill template will not be permitted. Temporary culvert installation will be allowed at non-complex stream crossings. Temporary roads will be decommissioned at the completion of commercial harvest activities.
- Roads across scablands would not be through-cut or trenched to prevent concentrating overland water flows. Drainage structures and leadoff ditches would be located to allow surface water to disperse on rocky areas, natural or constructed.
- All roads located on dormant landslide terrain would be reviewed by the geologist to check for stability. If unstable areas are identified, stabilization designs such as spot rock, geo-textile, realignment, or other engineered structures would be required.

- Haul roads which serve a multi-use purpose as winter recreation (snowmobile or nordic) trails will be restricted for commercial use from December 1 to March 30. This restriction may be waived by the timber sale administrator if there is no snow suitable for snowmobiling or skiing.
- Dry season/frozen haul conditions would be required on native surface roads to reduce road damage.
- Closures and barriers on Road 33 would be protected; if they need to be moved during project implementation, they would be replaced following implementation.
- The following road rules would apply:

Road Number	TERMINI		Road Restrictions
	From	To	
27	Forest Boundary (McKay Crk)	Rd. 2745	Commercial use is prohibited on weekends from the end of rifle deer hunting season to April 1. A parking area shall be snowplowed at the junction with Rd. 2730 and 2720, as designated on the ground, each time the road is plowed.
33	Rd. 27	Forest Bdry (Mill Crk)	Commercial use is prohibited on weekends from the end of rifle deer hunting season to April 1. A parking area shall be snowplowed at the junction with Rd. 27, Rd. 3320 (Harvey Gap) and Rd. 3300300 (Wildcat Campground), as designated on the ground each time plowed.
3370	Rd. 33	3370200	Use restricted Dec 1 - May 1. Gated rd for wildlife, Winter Range Closure.

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.

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 McKay Project Area. Background information can be found in the Upper McKay 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 McKay Planning 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 sites. These groups contain plant associations of similar biophysical environments, productivity, and disturbance regimes. Six of the eight PAGs occur within the McKay planning area, with subalpine fir and Western Juniper Steppe being the groups that are not present (see Table 3 and Figure 1).

Table 3. Acres by Forest Plant Association Group for the McKay Project Area.

Plant Association Group	Map Code (see Figure 1)	Total Acres
Moist Grand fir	MA	2,555
Dry Grand fir	DA	10,128
Douglas-fir	DF	7,350
Mesic Ponderosa Pine	MP	958
Xeric Ponderosa Pine	DP	911
Western Juniper Woodland	JW	1,360
Total		23,262

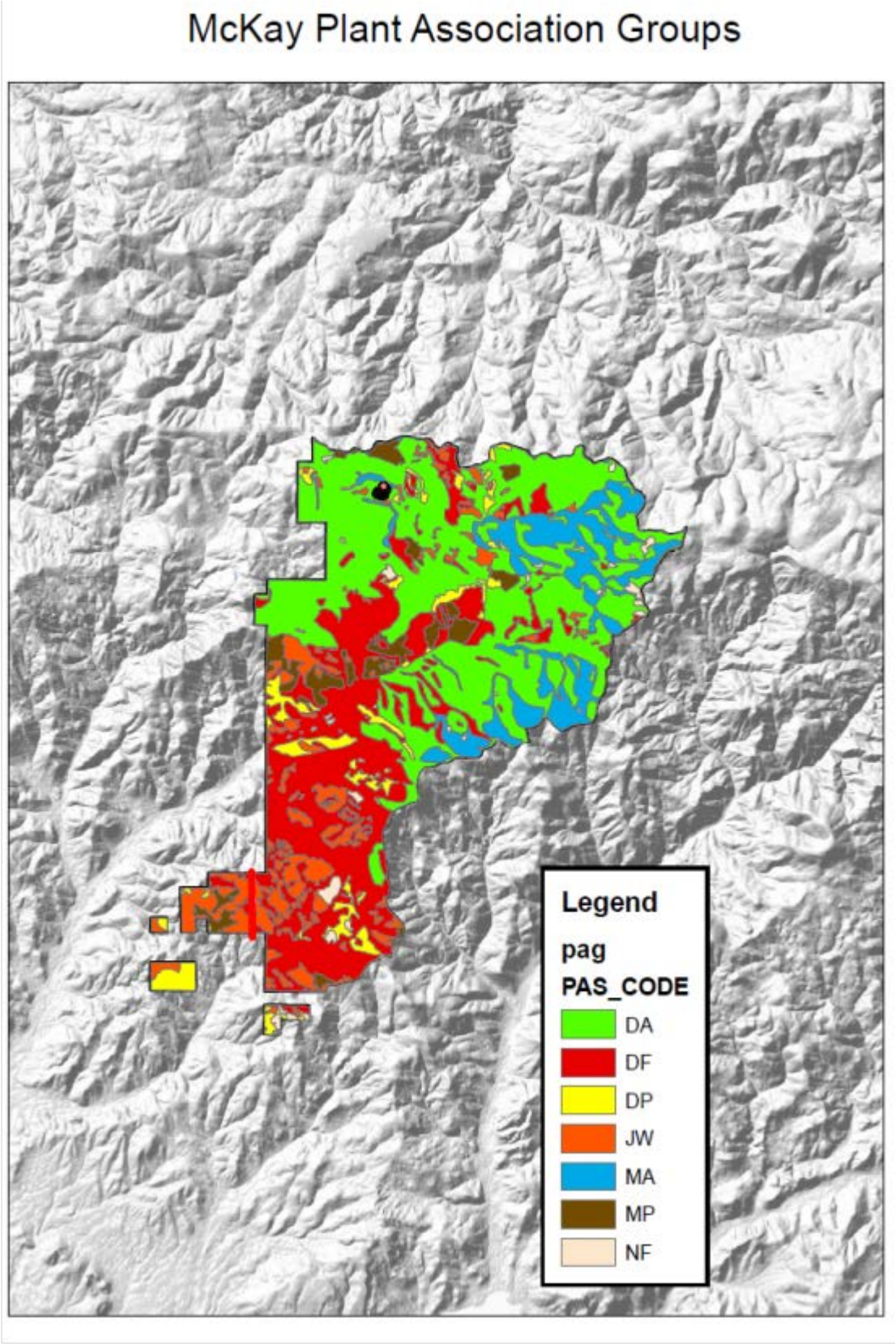


Figure 1. Plant Association Groups in the McKay project area.

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 4.

Table 4. 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.

Gradient imputation (Gradient Nearest Neighbor, or GNN; Ohmann and Gregory 2002) is used to map detailed vegetation composition and structure for areas of forest and woodland. GNN uses multivariate gradient modeling to integrate data from FIA field plots with satellite imagery and mapped environmental data. A suite of fine-scale plot variables is imputed to each pixel in a digital map, and regional maps can be constructed for many of the same vegetation attributes available for FIA plots. All GNN map products are grid-based at 30-m spatial resolution. These data along with field reconnaissance and Viable Ecosystem Modeling was used to determine existing and predicted future conditions within the analysis area.

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions. Records from the Lookout Mountain Ranger District indicate the following amount of past harvest treatments on Forest Service lands since 1971:

- Regeneration Harvest Total – 1,312 acres
- Clearcut/Clearcut with Reserve Trees – 1,297 acres
- Shelterwood/Seedtree– 15 acres
- Overstory Removal – 621 acres.
- Partial Removal Cutting (thinning, selection cutting) – 1,439 acres

Past timber sales in the area are: Windmill, Rye, Lightening Bust, Saddle, Graygap, Colt, Ochillee, Foley, Catfish and Beetle. Additional harvest is known to have occurred in the area but has not been recorded in the District GIS records. In general, prior to 1970 the harvest was primarily focused on harvesting individual trees, often removing the high value trees which were deemed at risk of insect mortality. The Keen's Tree Classification system was used for this risk rating and ground based logging was most commonly used. In the 1970s and 1980s overstory

removal harvest became common. Regeneration harvests began in the late 1970s and were common in the 1980s. This was especially true following the mountain pine beetle outbreak of the late 1970s and 1980s. Some skyline logging occurred in the 1970s/1980s on the steeper ground in the planning area.

The effects of past harvest, fire, and mortality have been incorporated into the analysis. Changes occurring since 2004 are so small in scale or effect that they would not meaningfully change this analysis.

Existing versus Historic Vegetative Conditions

The Viable Ecosystem model has been used to characterize the existing landscape and to provide a means of comparison to historical conditions. Five of the six PAGs have been fully analyzed for the McKay planning area. A range of acres for each stage is given to compare the current conditions to conditions found in the area historically. The existing condition of the Western Juniper PAG is displayed but effects on the alternatives on this PAG was not analyzed as the amount of area is small (~6% of the forested area).

Some of the more important departures from the historic condition are listed below:

- The exclusion of fire as a disturbance agent, along with past harvest practices, has fostered 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.
- 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 within or above their historic levels of abundance. 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 class 3 and 4) are the dominant feature.
- 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 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 outbreaks which rarely occurred before. 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. The fundamental capability of the system is still largely intact, however, and with careful management can support most historic vegetative conditions.

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

Table 5. Moist Grand Fir PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	**446**	128	307
E2a	**6**	0	0
E2b	**41**	128	307
E3a	**14**	26	77
E3b	**76**	102	307
E4a	**1**	10	51
E4b	**207**	41	204
E5a	**0**	10	26
E5b	**15**	41	102
M2a	0	0	0
M2b	166	77	256
M3a	32	26	102
M3b	**81**	102	409
M4a	**91**	307	818
M4b	**581**	77	204
M5a	**24**	204	409
M5b	27	51	102
L2a	0	0	51
L2b	**53**	0	0
L3a	**14**	26	128
L3b	**31**	0	0
L4a	173	102	204
L4b	**391**	0	0
L5a	**63**	102	204
L5b	**22**	0	0

Table 6. Dry Grand Fir PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	**856**	202	708
E2a	**11**	0	0
E2b	**228**	303	809
E3a	136	101	303
E3b	**99**	404	1,213
E4a	**538**	243	404
E4b	1356	970	1,617
E5a	**107**	243	404
E5b	**166**	970	1,617
M2a	5	0	101
M2b	**169**	303	809
M3a	95	0	202
M3b	**99**	303	809
M4a	**1585**	303	566
M4b	1570	1,213	2,264
M5a	382	202	505
M5b	**258**	809	2,022
L2a	2	0	202
L2b	**81**	0	0
L3a	**214**	0	202
L3b	**40**	0	0
L4a	**1188**	162	404
L4b	**691**	40	101
L5a	**224**	323	647
L5b	**28**	81	162

Table 7. Douglas-fir PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	**198**	360	1,440
E2a	**1**	0	0
E2b	55	0	720
E3a	**178**	0	144
E3b	102	0	576
E4a	**783**	288	576
E4b	1402	1,152	2,304
E5a	**83**	504	2,880
E5b	**92**	2,016	9,236
M2a	**2**	0	0
M2b	18	0	720
M3a	**75**	0	0
M3b	20	0	360
M4a	**885**	72	288
M4b	**1170**	288	1,152
M5a	148	72	216

Table 8. Moist Ponderosa Pine PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	**25**	48	239
E2a	0	0	0
E2b	0	0	48
E3a	3	0	10
E3b	7	0	38
E4a	1	0	19
E4b	29	0	76
E5a	4	0	19
E5b	0	0	0
M2a	**2**	0	0
M2b	1	0	48
M3a	**12**	0	10
M3b	0	0	38
M4a	**137**	0	19
M4b	36	0	76
M5a	2	0	29

M5b	359	288	864
L2a	1	0	72
L2b	5	0	288
L3a	43	0	288
L3b	**192**	0	72
L4a	**1006**	230	461
L4b	**237**	58	115
L5a	**69**	230	461
L5b	**39**	58	115

M5b	2	0	115
L2a	**6**	0	0
L2b	6	0	96
L3a	**55**	10	29
L3b	**2**	38	115
L4a	**437**	0	38
L4b	**102**	191	344
L5a	**80**	0	38
L5b	**6**	478	630

Table 9. Dry Ponderosa Pine PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	50	46	228
E2a	**1**	0	0
E2b	0	0	46
E3a	3	0	5
E3b	18	0	41
E4a	**37**	0	9
E4b	69	46	82
E5a	**15**	0	9
E5b	**3**	46	82
M2a	**1**	0	0
M2b	0	0	165
M3a	**8**	0	5
M3b	0	0	41
M4a	**133**	0	18
M4b	62	46	164
M5a	2	0	14
M5b	**6**	46	123
L2a	**3**	0	0
L2b	**11**	46	19
L3a	**62**	0	18
L3b	**0**	46	164
L4a	**268**	0	32
L4b	**91**	136	296
L5a	**57**	0	36
L5b	**10**	136	328

Table 10. Western Juniper Woodland PAG.

S/S Stage	Existing (Acres)	Low (Acres)	High (Acres)
E1	**124**	7	952
L2a	**17**	0	0
L2b	**0**	68	136
L3a	**185**	0	0
L3b	**0**	68	136
L4a	**929**	0	0
L4b	**0**	204	408
L5a	**105**	0	0
L5b	**0**	68	163

The total acre departure from HRV has been determined for the existing landscape and each proposed alternative by calculating the acres outside HRV for each seral/structural stage. For example: the HRV for a particular stage is 20 to 100 acres. There are currently 8 acres existing. The acreage outside HRV is equal to 12 (20 minus 8). Conversely, if there were 185 acres existing, the departure from HRV would be 85 acres (185 – 100). Summing the acres outside HRV for all stages yields the total acre departure for the landscape. Currently, there are approximately 12,637 acres of departure from the HRV ranges.

The Forest Vegetation Simulator (FVS) (Wykoff et. al. 1984), a stand growth and yield model, has been used to simulate changes in structure and density for the proposed treatment units. The

model allows for comparison of the no action alternative to simulated treatments proposed in the action alternatives.

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.

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.

Effects Common to all Action Alternatives

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 will more quickly restore historic seral/structural stage conditions and improve growing conditions for larger trees than either no action or prescribed fire alone. 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).

Live trees 21 inches DBH or larger would only be cut in select units within Alternatives 2 and 3. Within these units removal of larger trees is prescribed to reduce the spread of dwarf mistletoe (Sanitation units Alt. 2 and 3) as well as increase retention of large ponderosa pine and western larch (Group selection Alt. 3). In addition, live trees 21 inches DBH and larger would be cut when necessary to provide safe working conditions. Hazardous trees that are cut down in Riparian Habitat Conservation Areas would be left on site. See Appendix A for detailed descriptions of proposed activities.

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). 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).

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. Many of these conditions are already within

or above HRV. The rate at which many stands would develop large tree character would be hampered by overstocked conditions. 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. The overall departure from historic condition is currently about 14,705 acres and continues to increase through the projection period. In 50 years this alternative has the greatest departure of all the alternatives. Table 13 and Figure 2 summarize the effect on departure from HRV for all alternatives.

Dense structural stages, already above the historic abundance, 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 14, 15 and 16 and Figures 3, 4, and 5 display the effects of the alternatives on species composition and dense conditions. This alternative was not modeled using FVS to show expected changes over time. It is expected that stand densities would increase and acres dominated by grand fir and Douglas-fir would be higher than those displayed in the following tables.

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 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 (most trees >21” dbh) as well as in the understory but at lesser amounts.

Modified commercial thin treatments are proposed in multi-strata stands where disease is present within the fir component and scattered western larch and ponderosa pine are also present. Removing groups of fir from 7 inches dbh to greater than 21 inches dbh, where larch and pine are present, would reduce disease within these stands while creating conditions more conducive to the establishment of early seral species. Targeting fir trees up to and over 21 inches dbh for removal would aid in reduction of mistletoe infection, Indian paint fungus and Armillaria/laminated root rot from within these stands. Where fir is not common and/or western larch is not present, the stand would be treated with a traditional commercial thin. Modified commercial thin is expected to be applied on approximately 27 acres within the larger 532 acre block, the remainder of which would be thinned from below to retain all trees 21” dbh and greater.

A sanitation prescription would be applied on stands where overstory ponderosa pine trees are infected with mistletoe and a healthy understory of pine, Douglas-fir, grand fir and larch is present. Removal of most of the infected overstory pine, of all sizes, would move the stand towards a single strata condition, reduce the risk of mistletoe spread to the future stand and encourage the development of large tree structure at an accelerated rate. This treatment is proposed on 205 acres within the planning area.

Commercial thinning treatments are also proposed in single-strata and multi-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 where they occur. In stands which are currently in a multi-strata condition, parts of or the entire stand will be moved towards a more single-strata state. 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 overall departure from historic condition would decrease by about 951 acres directly due to treatment. Departure decreases over time as stand development continues without additional disturbance. In 50 years this alternative has the largest overall departure of all the alternatives and is about 148 acres less than Alternative 1.

The amount of dense structural stage, at 50 years post treatment, is the lowest of all the alternatives. Acres dominated by grand and Douglas-fir will remain the lowest of all the action alternatives through at least the first three decades, post treatment and will remain within the historic range. Over time the amount of acres dominated by ponderosa pine and western larch increases in this alternative, and is the highest overall at year 50 but will remain below HRV.

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 both in the overstory (most trees >21” dbh) as well as in the understory but at lesser amounts.

Modified commercial thin treatments are proposed in multi-strata stands where disease is present within the fir component and scattered western larch and ponderosa pine are also present. Removing groups of fir from 7 inches dbh to greater than 21 inches dbh, where larch and pine are present, would reduce disease within these stands while creating conditions more conducive to the establishment of early seral species. Targeting fir trees up to and over 21 inches dbh for removal would aid in reduction of mistletoe infection, Indian paint fungus and Armillaria/laminated root rot from within these stands. Where fir is not common and/or western larch is not present, the stand would be treated with a traditional commercial thin. Modified commercial thin is expected to be applied on approximately 27 acres within the larger 532 acre block, the remainder of which would be thinned from below to retain all trees 21” dbh and greater.

A sanitation prescription will be applied on stands where overstory ponderosa pine trees are infected with mistletoe and a healthy understory of pine, Douglas fir, grand fir and larch is present. Removal of most of the infected overstory pine, of all sizes, would move the stand towards a single strata condition, reduce the risk of mistletoe spread to the future stand and encourage the development of large tree structure at an accelerated rate. This treatment is proposed on 205 acres within the planning area.

Commercial thinning treatments are also proposed in single-strata and multi-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 where they occur. In stands which are currently in a multi-strata condition, parts of or the entire stand will be moved towards a more single-strata state. 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 overall departure from historic condition would decrease by about 1,228 acres directly due to treatment. This departure continues to increase overtime and shows the largest departure of the action alternatives at 50 years, post treatment.

The amount of dense structural stages would be reduced by about 1,172 acres and continue to be above 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. Acres dominated by grand and Douglas-fir would continue to be the highest of the action alternatives for the first 3 decades but, by 50 years post treatment, it will have the fewest acres dominated by fir. It remains within the historic range throughout the analysis period. The amount of area dominated by ponderosa pine and western larch would increase the most during the first 30 years, post treatment, but would remain below the historic range.

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.

Commercial thinning treatments are also proposed in single-strata and multi-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 where they occur. In stands which are currently in a multi-strata condition, parts of or the entire stand would be moved towards a more single-strata state. 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 overall departure from historic condition would decrease by about 1,117 acres directly due to treatment. Similar to the other alternatives, departure then begins to increase in the absence of disturbance. By the end of the 50 year period the departure of this alternative is the second largest of all the action alternatives.

The amount of dense structural stages is not reduced to within the historic range, using these treatments and dense conditions will continue to increase as succession and growth continue in the absence of additional disturbance. Acres dominated by grand and Douglas-fir remains with the historic range but are the highest of all the alternatives by year 50, post treatment. The amount of area dominated by ponderosa pine and western larch would increase over time but would not reach the historic range and remains the lowest at year 50, post treatment.

Table 11. Acres departure from historic range.

	0 years	20 years	30 years	50 years
Alt 1	12,768	12,999	13,964	15,857
Alt 2	11,817	12,863	13,600	15,709
Alt 3	11,540	12,729	13,001	16,547
Alt 4	11,651	13,458	14,446	16,434

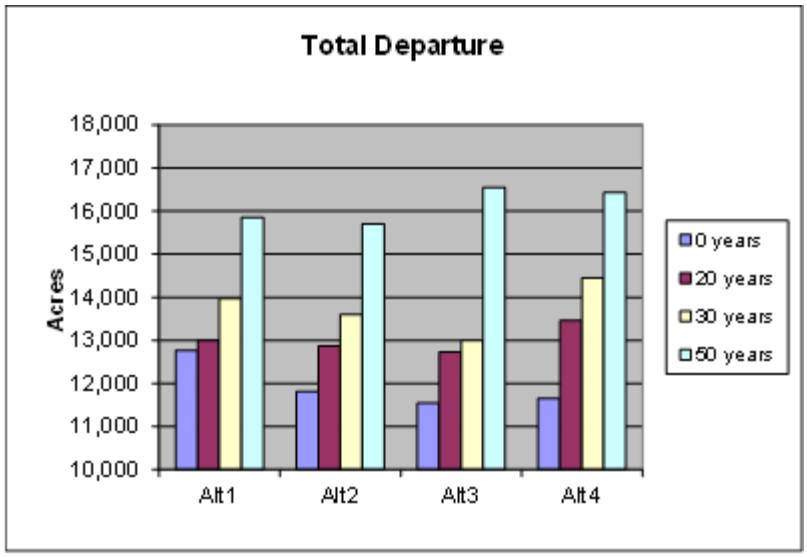


Figure 2. Departure from historic range by alternative.

Table 12. Acres of dense structural stages.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	8,790	11,886	13,064	14,834	3765	8248
Alt 2	9,276	12,091	13,158	14,790		
Alt 3	9,962	12,639	13,652	15,192		
Alt 4	10,025	12,642	13,630	15,135		

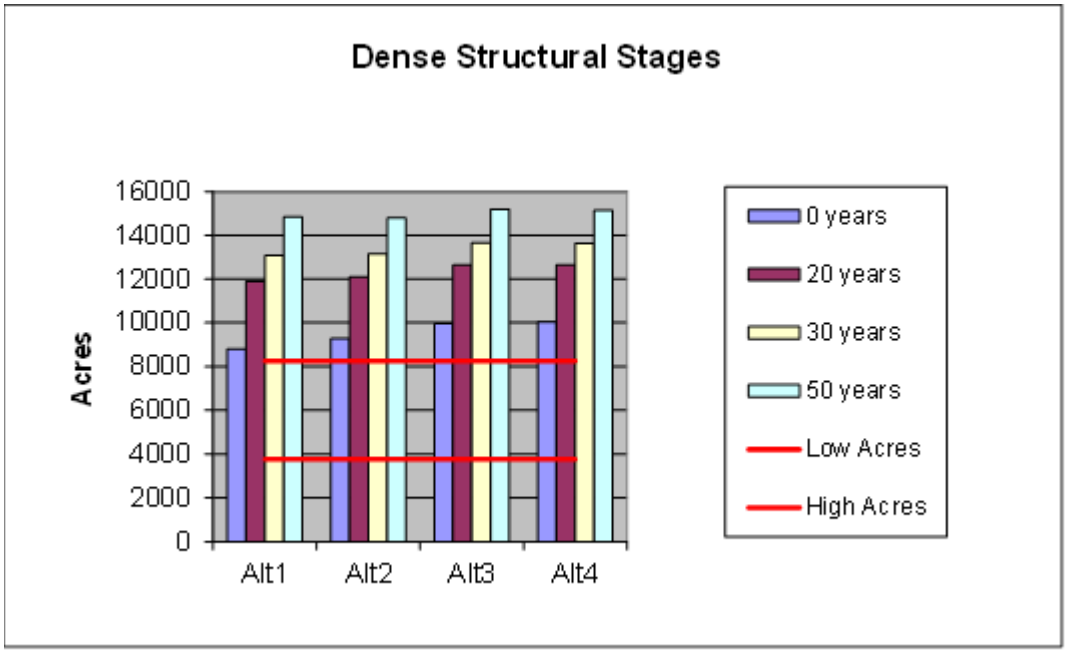


Figure 3. Dense stages by alternative and historic range.

Table 13. Acres dominated by grand and Douglas-fir.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	4,807	5,367	5,619	6,151	4,752	10,104
Alt 2	5,084	5,494	5,709	6,178		
Alt 3	5,125	5,594	5,831	5,975		
Alt 3	5,096	5,561	5,803	6,316		

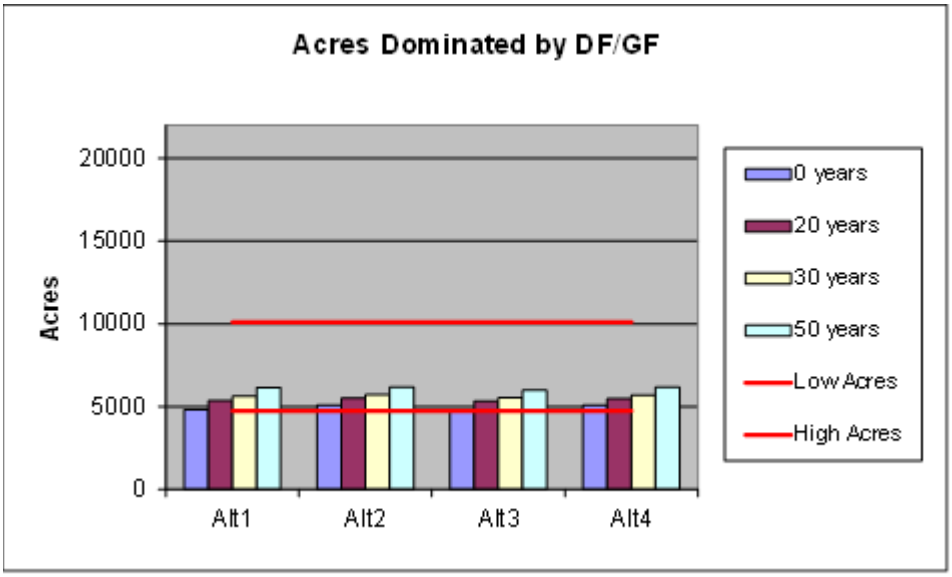


Figure 4. Grand and Douglas-fir dominated stages by alternative and historic range.

Table 14. Acres dominated by ponderosa pine and western larch.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	6,702	7,437	7,411	7,202	8,730	18,748
Alt 2	6,703	7,648	7,560	7,391		
Alt 3	6,703	7,721	7,634	7,362		
Alt 4	6,702	7,476	7,389	7,129		

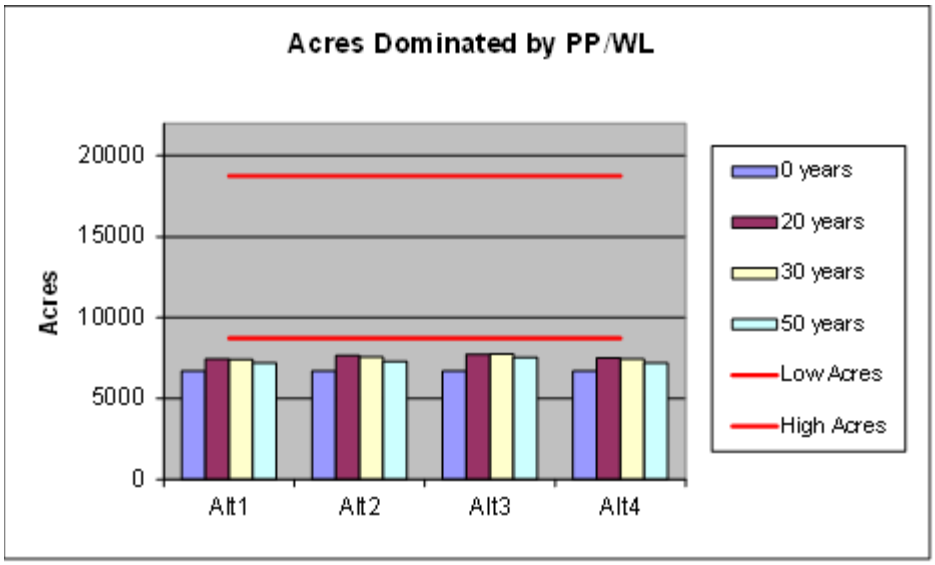


Figure 5. Ponderosa pine/western larch dominated stages by alternative and historic range.

Cumulative Effects – Departure from Historic Conditions

The effects of past harvest and have been included in the analysis of the existing condition as described previously.

The amount of E1 stage in the moist and dry grand fir PAGs currently exceeds the historic range by about 286, acres, primarily due to the regeneration harvest in the project area that occurred in the 1990s. This harvest created about 1,312 acres of young plantations in the project area which are now fully stocked with young trees have grown or are rapidly growing out of the grass/forb/shrub stage. It is estimated that within 10 years the amount of dry grand fir E1 stage will drop from about 856 acres now to less than 250 acres and be near the low end of the historic range.

There are no other vegetation projects currently ongoing or planned within the area which would have a meaningful effect on upland forest vegetation.

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 and Douglas-fir. They would have been more open and single storied 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. The major natural disturbance agents of concern are listed below.

Bark Beetles: Aerial insect and disease surveys for years 2004 through 2009 show scattered active mortality centers due to bark beetle feeding. Field reconnaissance also identified bark beetle activity and susceptible stand conditions.

Mountain pine beetle (Dendroctonus ponderosae) and western pine beetle (Dendroctonus brevicomis) occur in the project area. Ponderosa pine is a susceptible host in overstocked stands. Bark beetle mortality is symptomatic of over-stocked stand conditions that create competition

stress and reduce tree vigor (Schmid 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).

Also occurring in the project area are Douglas-fir beetle (Dentroctonus 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).

Foliage Insects: A group of insects called defoliators are also present in the area. The western spruce budworm is the most notable. Also present are the Douglas-fir tussock moth and the larch case bearer. From approximately the mid 1980's to the early 1990's the western spruce budworm was at an outbreak in the planning area, along with the rest of the Ochoco, which caused large amounts of tree 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.

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 trees of the upper canopies spread readily to trees in the lower canopies. Ponderosa pine dwarf-mistletoe is present in the planning area, specifically on the slopes south of McKay Creek. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) causes growth loss, reduced wood quality, top kill and eventually mortality. When present in Douglas-fir, the Douglas-fir dwarf-mistletoe can also be severe and lead to mortality.

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 edge of later seral species. Dwarf mistletoes cause branch structure to broom 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 faster. 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 wild fire 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. This treatment is proposed in Alternatives 2 and 3. Harvest or precommercial 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: Stem decay is common in late seral stands in the Dry and Moist Grand Fir PAGs in this 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 easily infected with Indian Paint Fungus as minor wounding of a branch can serve as an entry point for infection. In stands where grand fir is abundant today, this disease is most likely present. Reducing the level of grand fir in a stand, especially from the understory is effective at reducing the presence of this stem decay.

Root disease: Armillaria root disease and laminated root rot are two diseases of concern within the area. They are most evident within stands of high density and those with a major component of later 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).

The grand fir PAGs are where most of the 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 and disease 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. The tendency, without disturbance, 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 15 indicates the stages that are considered to be at high risk to insects and disease.

Table 15. 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 9,206 acres within the project area that are in stages rated as high risk. This is currently above the amount of this condition that existed historically by about 1,448 acres. Under this alternative, no actions are proposed which would reduce susceptibility. Vegetative development would continue dependent on the conditions and successional trends which currently exist. Many of the stages, which become more abundant 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 by an about 2,900 acres under this alternative.

Table 16 and Figure 6 display the amount of high risk area associated with each alternative.

Effects Common to Action Alternatives

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 unsustainable situation for many forest stands in the McKay project area, which can be expected to continue under Alternative 1. Under Alternatives 2, 3, and 4, if drought

conditions were to continue, the proposed treatments would decrease stand density and help to improve sustainability of the managed forests when in drought conditions.

Alternative 2

The actions proposed in this alternative comes the closest of all action alternative to being within the range at which it historically occurred. 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 most of all the action alternatives. This trend continues through the 50 year projection period. Not reflected in the totals in Table 16 is the immediate reduction of mistletoe infected overstory trees on 205 acres, as proposed in the sanitation treatments. This improvement is not reflected because these stands do not fall into what is classified typically as "high risk"; meaning they are not dense in structure and high in a component of fir. This treatment will move these stands from a condition where all existing and future understory ponderosa pine will become infected, leaving no options for improved stand health to a condition where mistletoe infection, if not eliminated, can be kept a low and manageable levels. Additionally, on 532 acres, where a modified commercial thinning treatment is proposed, small group openings will target fir trees currently infected with mistletoe and/or Indian paint fungus for removal. Pockets of root rot will be treated, removing the susceptible grand and Douglas-fir, in both overstory and understory, and promoting conditions favorable to existing and/or future ponderosa pine and western larch. Again, these improvements are of such a fine scale they do not show up in the large scale modeling. By targeting fir trees from 7" dbh to 20.9" dbh for removal on approximately 26 acres, of the total 532 acres, this alternative will have the second highest reduction of high risk conditions within these stands.

Alternative 3

The proposed treatments in this alternative would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents. Not reflected in the totals in Table 16 is the immediate reduction of mistletoe infected overstory trees on 205 acres, as proposed in the sanitation treatments. This improvement is not reflected because these stands do not fall into what is classified typically as "high risk"; meaning they are dense in structure and high in a component of fir. This treatment will move these stands from a condition where all existing and future understory ponderosa pine will become infected, leaving no options for improved stand health to a condition where mistletoe infection, if not eliminated, can be kept a low and manageable levels. Additionally, on 532 acres, where a modified commercial thinning treatment is proposed, small group openings will target fir trees currently infected with mistletoe and/or Indian paint fungus for removal. Pockets of root rot will be treated, removing the susceptible grand and Douglas-fir, in both overstory and understory, and promoting conditions favorable to existing and/or future ponderosa pine and western larch. Again, these improvements are of such a fine scale they do not show up in the large scale modeling. By targeting fir trees from 7" dbh to >21" dbh for removal on approximately 26 acres, of the total 532 block, this alternative will do the most to remove diseased trees and reduce high risk conditions in these stands.

Alternative 4

The actions proposed in this alternative reduce the high-risk stages, but does not bring the amount of area to within the range at which it historically occurred. The proposed treatments would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents.

Table 16. 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	9,206	12,106	13,221	14,929	3,375	7,758

Alt 2	9,668	12,324	13,332	14,892		
Alt 3	10,312	12,837	12,800	15,287		
Alt 4	10,387	12,840	13,773	15,220		

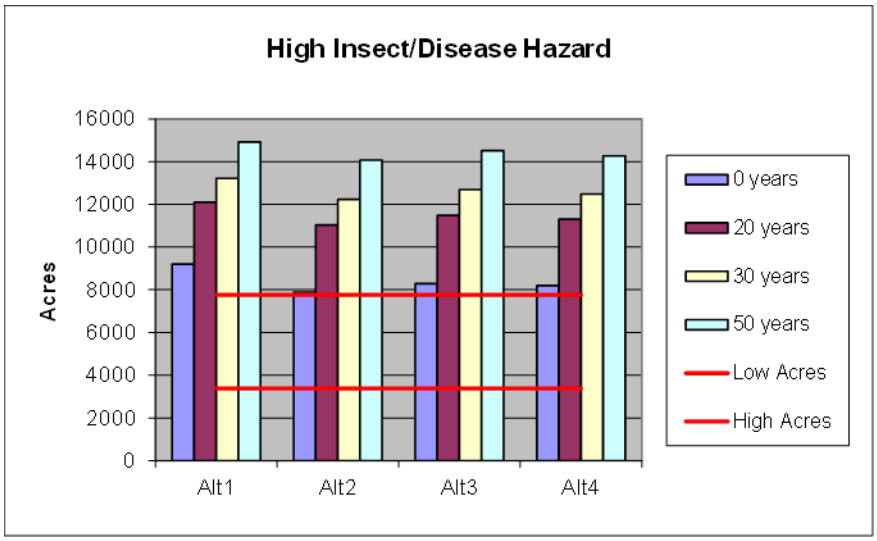


Figure 6. High risk to insects and disease and historic range.

The 20, 30 and 50-year projections include only the proposed actions associated with each alternative. They do not include any future management such as continued underburning, thinning, or other stand tending activities, which could occur. Thus, the acres of high risk increase with time as succession and stand growth continue uninterrupted.

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 and, depending on its abundance in relation to historic condition, sets different scenarios for interim management.

GNN and lidar imagery is used as the landscape analysis tool to estimate the existing amount of LOS. The Viable Ecosystem's size/structure class 5 (21"+ dbh) is used to identify existing LOS. Differentiation between multi- and single-strata LOS is based on the "a" and "b" density classifications. 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 McKay project.

Existing LOS Condition

There are currently an estimated 2,301 acres of LOS within the grand fir, Doulas-fir, and ponderosa pine PAGs. About half (1,262 acres) of the LOS is in a multi-strata condition. Historically, the overall amount of LOS would have ranged between 6,980 and 13,000 acres, with the bulk of it in a single strata condition due to the frequent low-intensity fires which were the dominant disturbance regime in the area. Examination of each PAG reveals that all PAGs except mesic and xeric pine are below the historic range for the multi-strata condition. All PAGs are below the historic range for the single strata condition.

Table 17. Existing LOS and historic ranges by PAG.

PAG	LOS Type	Existing Acres	Historic Low Acres	Historic High Acres	HRV Status
MGF	multi	87	316	639	Below
	single	64	92	204	Below
	Total	151	408	843	Below
DGF	multi	713	770	1,559	Below
	single	452	1,863	3,808	Below
	Total	1,165	2,633	5,367	Below
DF	multi	303	822	1,426	Below
	single	496	2,411	3,940	Below
	Total	798	3,233	5,366	Below
M Pine	multi	86	0	85	Above
	single	8	479	747	Below
	Total	94	479	832	Below
X Pine	multi	74	0	59	Above
	single	19	227	533	Below
	Total	93	227	592	Below
Total	multi	1,262	1,908	3,768	Below
	single	1,039	5,072	9,232	Below
	Total	2,301	6,980	13,000	Below

Table 18. Summary of existing LOS status by PAG.

Plant Assoc. Group	Multi-strata LOS	Single-strata LOS	RF Amend. #2
Moist Grand Fir	Below Historic	Below Historic	Scenario A
Dry Grand Fir	Below 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

The information displayed above includes all LOS, regardless of patch size. This ranges from individual 30 meter acre pixels to groups of several pixels. Often there are numerous individual pixels in close proximity to one another but not connected. The Ochoco National Forest has also identified a minimum patch size of 5 acres that must be met in order to qualify as an LOS "stand" as described in the Regional Forester's Amendment. To identify LOS stands, pixel maps, on-the-ground field checking, and aerial photo interpretation was conducted. Using these techniques 5,007 acres of LOS stands have been identified. The amount of LOS stand acreage is larger than discussed previously because the stands contain some non-LOS conditions within them as well as small inclusions of non-forest land. All stands are classified as multi-strata LOS.

Up to 1996, most timber sales within this project area concentrated on harvest of large trees. However, many 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.

Under Scenario A of the RF Amendment #2, the Interim Wildlife Standard directs that no harvest activities will occur within late and old stands and that no trees larger than 21 inches DBH will be cut. Silvicultural treatments outside late and old structural stands should maintain or enhance late and old structure. Ponderosa pine stands will be maintained in an open, park-like condition. A memo from the Regional Forester dated June 11, 2003 encourages site-specific Forest plan amendments treating LOS stands to help meet LOS objectives.

Due to the current multi-strata, dense conditions within 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. For this reason Alternatives 2, 3 and 4 propose harvest and non-harvest treatments within mapped LOS stands to help maintain the existing large tree structure, enhance the development of additional large trees, and lessen the risk of loss; however, ground-truthing has indicated that some stands that are mapped as LOS really include only small (less than 5 acre) patches of true LOS. Implementation of Alternatives 2 or 3 would require a Forest Plan Amendment as they propose commercial harvest within mapped LOS stands; design criteria applied in Alternative 4 would avoid harvest in all LOS (including small patches) and therefore would not require a Forest Plan amendment. In addition, Alternatives 2 and 3 propose the removal of trees > 21" dbh on approximately 26 acres within Units 28 – 33. The trees targeted for removal would be grand fir or Douglas-fir, which is currently infected with mistletoe and/or Indian Paint fungus and, which is within 50 feet of a ponderosa pine or western larch.

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 (precommercial thinning, slash piling, and prescribed fire) within LOS stands. Alternative 1 does not propose any treatment in LOS stands. The following tables show the amount of mapped LOS stands treated by alternative and harvest in LOS stands by plant association group.

Table 19. Acres of mapped LOS treatment by alternative.

	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4
Acres LOS stands treated	0	935	962	808
Commercial thinning with precommercial thinning and/or fuel treatment	0	613	597	489
Precommercial thinning and fuel treatment	0	79	125	79
Juniper treatment	0	50	50	50
Prescribed burning only*	0	190	190	190
*Includes acres which may have prescribed fire allowed to creep in under certain conditions. No direct ignition.				

Table 20. 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
1	0	0	0	0	0
2	177	324	103	4	1
3	146	340	103	3	1
4	67	311	103	3	1

Alternative 1

No treatments would occur. LOS stands that are currently stocked would remain dense with high risk of competition-related mortality, especially of the large tree component. LOS stands would remain at high risk of severe wildfire due to high canopy closure and existing ladder and ground fuels.

Alternatives 2, 3 and 4

Commercial harvest and precommercial thinning would help maintain large trees overall by reducing stand density, thus reducing competition stress in the older, larger overstory and removing ladder fuels which would lessen the risk of crown fire. Prescribed fire would reduce

existing and activity fuels and also reduce risk from wildfire. These treatments reduce the risk of losing LOS stands to wildfire or insects/disease.

Large trees in treated LOS are expected to persist longer than in untreated LOS. Due to the number of large trees and existing stand densities, most treated LOS stands would still retain basal areas above the recommended stocking which means that the effects of treatment will not last as long or produce as much growth as stands with lower densities.

In Alternatives 2 and 3, the proposal is to harvest a limited number of trees > 21" DBH using a modified group select treatment. Within these pockets of ½-acre or less, large diameter grand fir and Douglas-fir would be removed, leaving all large pine and western larch intact. In some pockets this would reduce stocking from a basal area that qualifies as LOS to a basal area below that threshold. Increased growth rates in residual trees would bring these pockets up to and above the prior stocking levels.

Direct and Indirect Effects – Total LOS

Predictions have been made for each alternative, which 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. It is recognized that the decision tree used to move stands through the Forest Vegetation Simulation model is artificially pushing more stand acres into a LOS condition, immediately post treatment, than would be expected to occur naturally.

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 mid or late-seral species composition and multi-strata characteristics. 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 would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk of loss due to insects, disease, and wildfire. In 50 years this alternative is projected to generate the least amount of total LOS for the project areaDue to landscape level modeling limitations, it is likely that large scale insect, disease, and wildfire will measurably reduce the amount of LOS predicted and shown for Alternative 1 in 50 years.

Alternatives 2, 3 and 4

Treatments would remove understory trees to reduce stand density, maintain existing large trees, and enhance the development of additional large trees. Within LOS stands, no live trees 21 inches dbh or larger, except those trees considered hazardous to the logging/hauling operation or those trees proposed in Alternative 3, modified commercial thinning, 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 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 sustainable over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. By year 50, multi-

strata LOS is expected to reach the lower end of HRV in all of the action alternatives. The abundance of early-seral species would be maintained and enhanced in the long term.

Post treatment in all alternatives, the total amount of LOS acres is expected to increase. In addition, all action alternatives maintain a higher ratio of single story LOS to multi-story LOS throughout the projection period than the no treatment alternative.

Post Treatment LOS Conditions (acres)

Overall, the planning area is currently below HRV for both multi-strata LOS and for single-strata LOS. These tables display the immediate effect of each action alternative on the total amount of LOS and the resultant status for the entire planning area. Single-strata and multi-strata LOS would continue to be below HRV for most PAGs. The exception would be single strata LOS in the moist grand fir PAG and multi-strata LOS in the mesic and xeric pine PAGs.

Table 21. Existing and post-treatment LOS by PAG (acres).

PAG	LOS Type	Existing	Alt 2	Alt 3	Alt 4	Historic Low Acres	Historic High Acres
MGF	multi	87	63	80	67	316	639
	single	64	**276**	**322**	**194**	92	204
DGF	multi	713	543	601	585	770	1,559
	single	452	1118	1001	1283	1863	3808
DF	multi	302	321	321	324	822	1426
	single	496	496	460	526	2411	3940
M Pine	multi	**86**	84	**100**	**99**	0	85
	single	8	8	8	8	479	747
X Pine	multi	**74**	**72**	**92**	**97**	0	59
	single	19	54	61	49	227	533
Total	multi	1,262	1083	1194	1172	1908	3768
	single	1,039	1952	1852	2010	5072	9232
	Total	2,301	3035	3046	3182	6980	13000

Table 22. Projected acres of LOS in years 20, 30, and 50 by alternative.

		Year 20	Year 30	Year 50
Alternative 1	multi	3108	3884	5212
	single	1360	1452	1543
	Total	4469	5336	6755
Alternative 2	multi	3847	4578	5832
	single	2176	2179	2125
	Total	6023	6757	7958
Alternative 3	multi	3843	4547	5758
	single	2045	2044	1992
	Total	5888	6591	7750
Alternative 4	multi	3880	4687	5830
	single	2201	2195	2136
	Total	6081	6882	7966

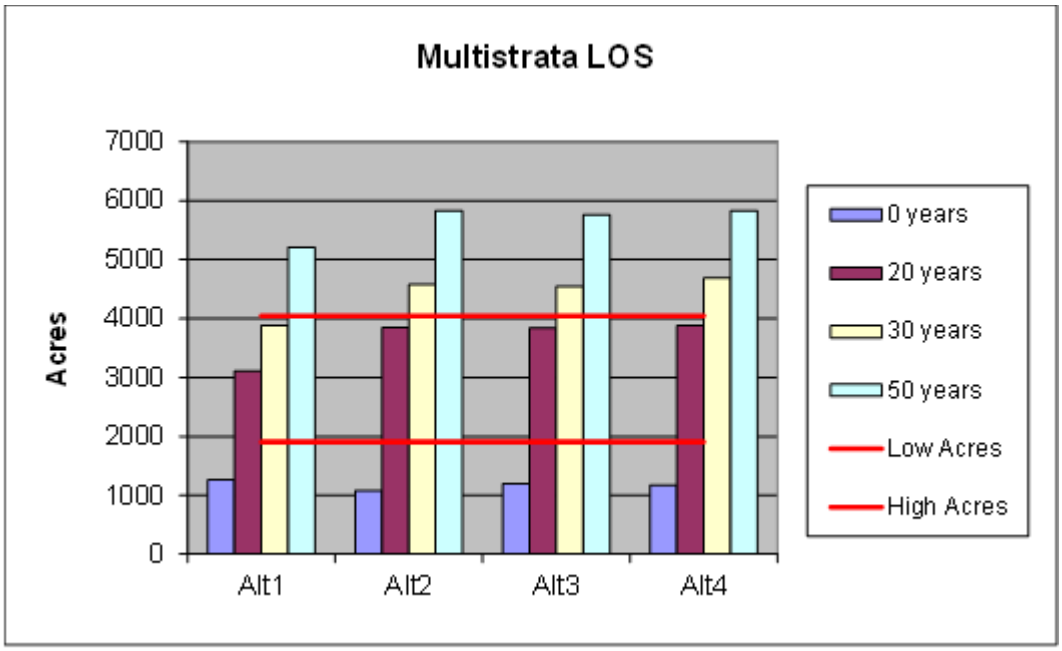


Figure 7. Projected acres of multi-strata LOS by alternative.

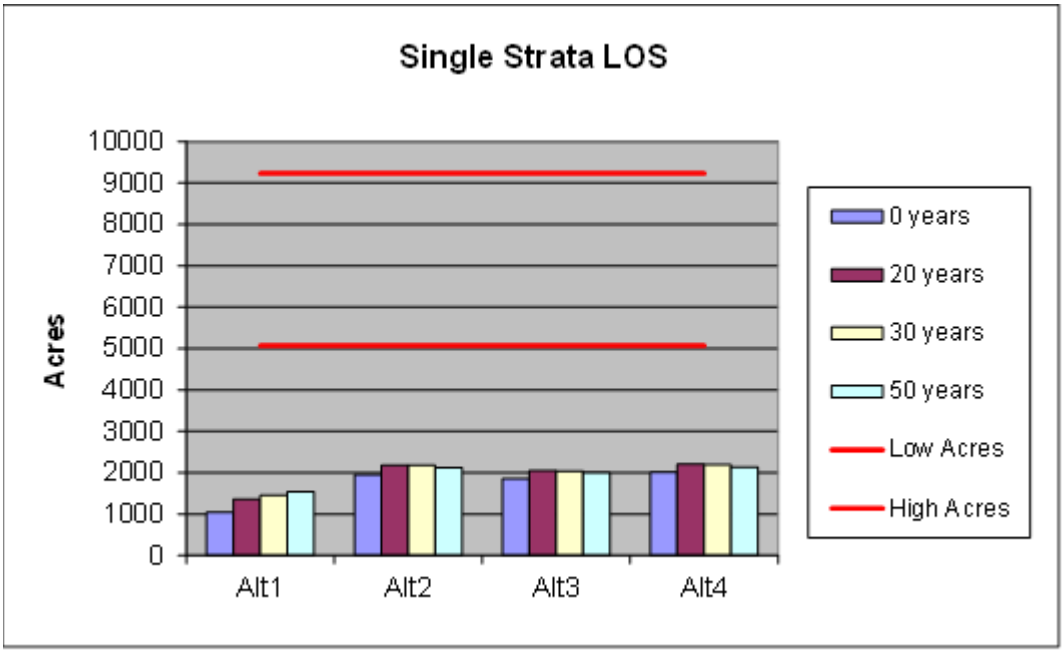


Figure 8. Projected acres of single strata LOS by alternative.

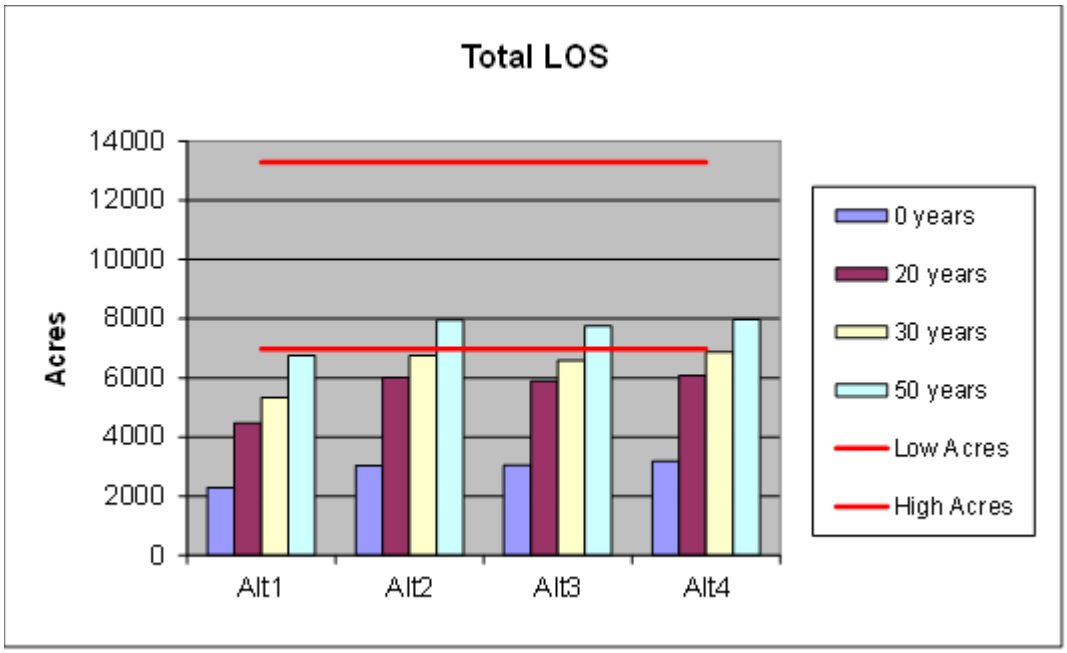


Figure 9. Projected total acres of LOS by alternative.

Cumulative Effects

There are no active or planned timber sales within the planning area. The effects of past harvest and other activities have been included in the description of the existing condition as described previously.

The privately owned forestland within the watershed currently contains little if any stands of LOS. It is foreseeable that land management practices on these lands would neither favor the development of additional LOS nor remove existing LOS.

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 692 acres within the project area are within connective corridors (see Table 23).

Table 23. Proposed activities within connective habitat by alternative (acres).

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Commercial Harvest/ modified commercial harvest with precommercial thinning and/or fuels treatment	0	41	41	0
Precommercial thinning and fuels treatment (no harvest)	0	17	17	0
Underburning only*	0	38	38	0
*Includes acres which may have prescribed fire allowed to creep in under certain conditions. No direct ignition.				

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 precommercial 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 maintain 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 occurs) be left in patches or scattered to assist in supporting stand density and 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 precommercial thinning will add to the amount of canopy closure retained. These understory trees may be retained in clumps or scattered as mentioned previously. Table 24displays 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 24. 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
Moist Grand fir (Grand fir/twinflower)	75	56	49

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 precommercial 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 would retain canopy closure in the top third of site potential and not require a Forest Plan amendment. In Alternatives 2 and 3 the harvest that is proposed within connective corridors occurs primarily within the grand fir plant association groups (approximately 85%).

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 will 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.

Effects Common to Action Alternatives

Alternatives 2 and 3 propose other treatments in addition to the harvest units discussed. 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. Noncommercial 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.

Alternatives 2 and 3

The commercial harvest proposed within Alternatives 2 and 3 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). Two action alternatives include portions of harvest units within connective corridors, encompassing approximately 41 acres. Prescriptions in the connective corridors would be modified to retain density in the upper half of the management zone. 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 enhance the large tree component.

Cumulative Effects to Connective Corridors

There are no other known past or proposed treatments within the planning area that would affect mapped connectivity corridors.

Moist Mixed Conifer

Mapping in the project area indicates that there are approximately 2,555 acres of the moist grand fir plant association group. This PAG occurs primarily at the highest elevation in the planning area. Most of it occurs in smaller fragmented blocks and/or as moist pockets within drier plant association groups.

The moist grand fir PAG includes the most productive sites on the Ochoco National Forest. Site productivity varies from the Grand fir/queens cup beadlilly plant association to the somewhat drier Grand fir/Columbia brome association (Johnson and Clausnitzer, 1992). Historically, fire regimes in this PAG were variable, ranging from infrequent stand replacing severity fires to frequent non-lethal fires (Simpson, 1994). Due to its juxtaposition with drier forest types and fragmented nature most of the moist grand fir PAG in the project area historically experienced a more frequent fire return interval than if it was in large contiguous blocks.

Typical insect and disease concerns within this PAG include western spruce budworm, Douglas-fir tussock moth, laminated root rot, Armillaria root disease, and Indian paint fungus. All of these organisms are favored by high concentrations of host species (grand fir and Douglas-fir) and by complex multi-strata conditions. During the western spruce budworm outbreak of the late 1980s and early 1990s this forest type was severely affected. Ground reconnaissance of the moist grand fir stands as well as aerial detection surveys has verified that many of them currently exhibit high levels of insect and disease susceptibility and ongoing mortality especially from root disease and fir engraver beetle.

District records indicate that the most recent harvest within this PAG was primarily regeneration cutting that occurred in the 1980s and 1990s in response to the damage occurring from western spruce budworm. Older harvest prior to 1980 is known to have occurred but is not reflected in the District database. This older harvest was mostly focused on selective removal of individual high value trees that were deemed at risk to insects and disease.

Alternative 1

No treatments would occur. Stands that are currently overstocked would remain dense with high risk of competition-related mortality, especially of the large tree component. Stands would remain at high risk of severe wildfire due to high canopy closure and existing ladder and ground fuels.

Alternatives 2, 3 and 4

Commercial harvest and precommercial thinning would help maintain large trees and early seral species by reducing stand density, thus reducing competition stress in the older, larger overstory and removing ladder fuels which would lessen the risk of crown fire. Remnant ponderosa pine and western larch would be favored for retention and remain as a stand component. Prescribed fire would reduce existing and activity fuels and also reduce risk from wildfire. These treatments reduce the risk of losing stands to wildfire or insects/disease. Stands selected for commercial harvest, which include the moist grand fir plant association, are generally within larger blocks of dry grand fir. In addition, they are stands which have a manageable component of ponderosa pine and western larch which can be favored by density reduction.

Large trees in treated stands are expected to persist longer than in untreated stands. Due to the number of large trees and existing stand densities, some treated stands would still retain basal areas above the recommended stocking level which means that the effects of treatment will not last as long or produce as much growth as stands with lower densities.

Cumulative Effects

There are no other active or planned timber sales within the planning area. The effects of past harvest have been included in the description of the existing condition.

The privately owned forestland within the watershed currently contains little if any moist grand fir PAG. It is foreseeable that land management practices on these lands would have no effect on this forest type.

Table 25. Proposed activities in the Moist Grand Fir PAG (acres).

	Alternative 2	**Alternative 3**	**Alternative 4**
Commercial Harvest with precommercial thinning and/or fuels treatment	349	327	129
Precommercial thinning and fuels treatment (no harvest)	830	861	829
Underburning only*	112	107	112
*Includes acres which may have prescribed fire allowed to creep in under certain conditions. No direct ignition.			

Fuels and Fire

Affected Environment

Fire has been the dominant natural disturbance on the Ochoco since the dawn of time.[1] 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 forest – more than half of that being low-intensity fire in forests dominated by ponderosa pine.[2]

During the last century, extensive livestock grazing (which reduces the fine fuels that carry fire) and fire suppression caused a significant decrease in the number of acres burned historically.

A fire history analysis was recently conducted in three areas on 93 plots across the Ochocos.[3] 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 (removing small, partial cross sections - average 8% of tree's cross-sectional area - from live ponderosa pine trees does not substantially increase their likelihood of tree death).[4] All samples were dated (i.e., crossdated) using existing master ring-width chronologies that are already publicly available for the region.[5] See Figure 10.

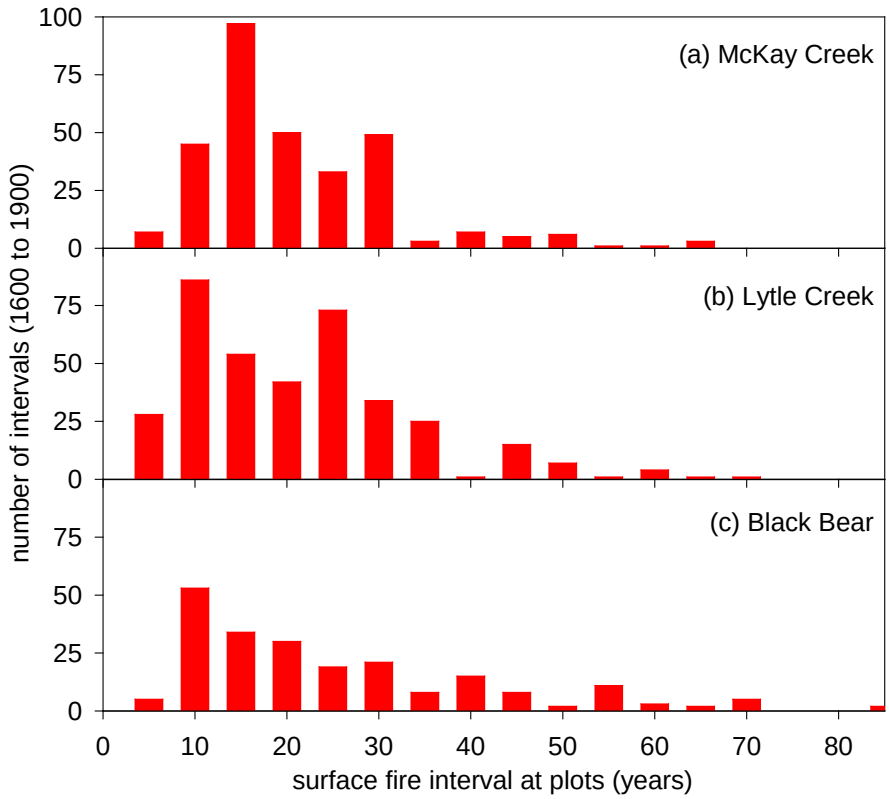
[1] Komarek 1973, Cope and Chaloner 1985
[2] Barrett, Arno, and Menakis 1997
[3] Heyerdahl, Falk and Loehman 2012
[4] Heyerdahl 2001, 2008
[5] http://www.ncdc.noaa.gov/ paleo/treering.html

Figure 10. Cross-section of a fire-scarred tree from the McKay watershed.

In Lytle Creek, on a 1925-acre area between 5054 and 5798 feet in elevation, 1115 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.

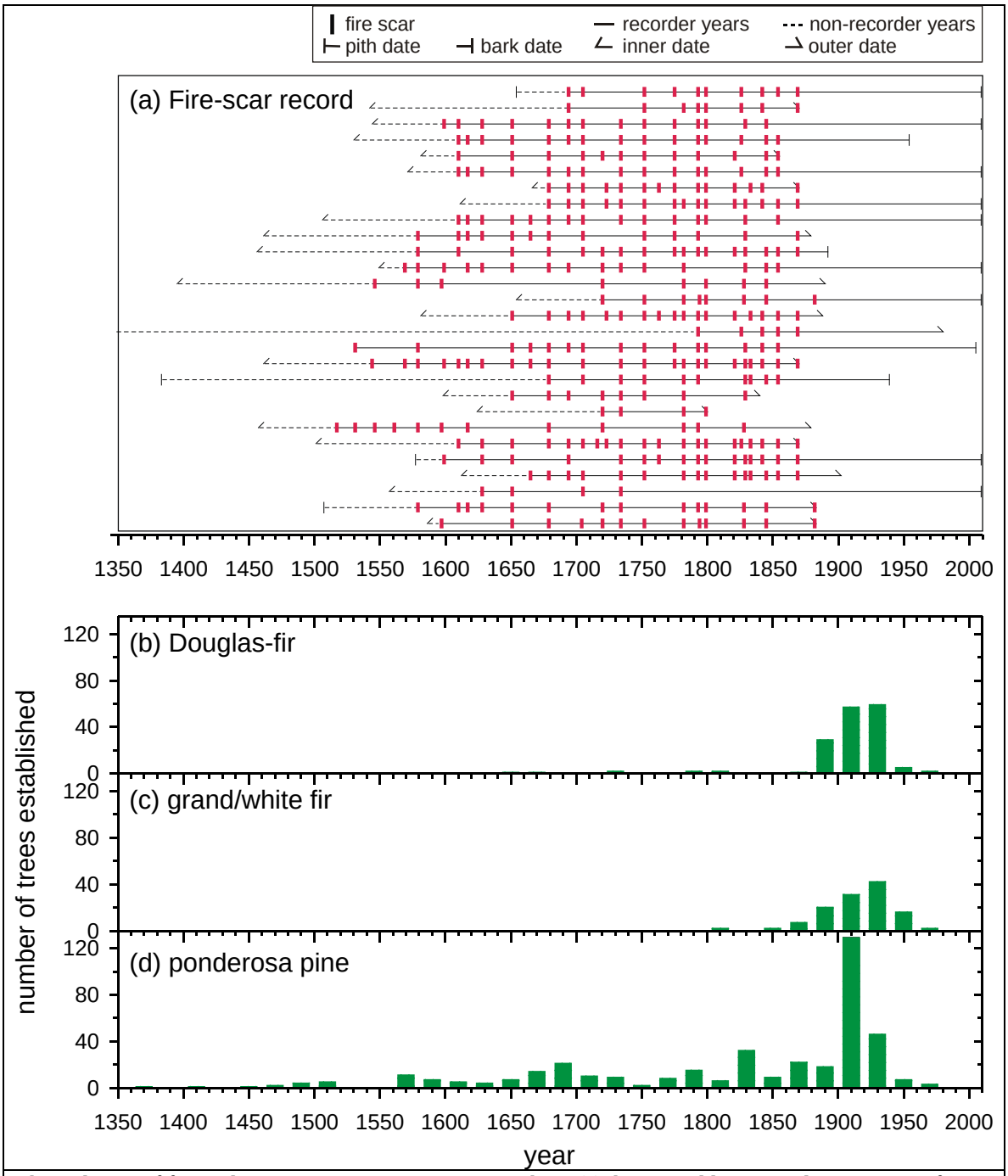
In Cottonwood Creek, on a 1963-acre area between 4972 and 5993 feet in elevation, 624 fire scars were identified, dating from 1599 to 1908, showing an average fire return interval of 23 years on dry mixed conifer sites, and 33 years in wet mixed conifer sites.

As part of the same analysis, in the Mckay watershed west of Hash Rock, on a 1933-acre site between 4265 and 5488 feet in elevation, 822 fire scars were identified on 27 plots in dry mixed conifer, dating from 1518 to 1883, showing an average fire return interval of 17 years. See Figure 11.



The plots average 0.4 acres in area (range 0.2 to 1.0 acres). The box (top panels) encloses the 25th to 75th percentiles and the whiskers enclose the 10th to 90th percentiles of the distribution of intervals. The vertical line indicates the median fire interval, and all values falling outside the 10th to 90th percentiles are shown as circles. In the histogram (bottom panel), the same intervals are plotted in 10-year bins.

Figure 11. Plot-composite intervals between low-severity fires that occurred in the sampling sites between 1600 and 1900 at three sites on the Ochoco National Forest.



Chronologies of fire and tree recruitment at McKay Creek. In (a), horizontal lines are plot-composite fire-scar dates. Non-recorder years precede the first scar, whereas recorder years generally follow it, but non-recorder years can also occur when the catface margin is consumed by subsequent fires or rot. In (b) through (d), recruitment dates are given for species comprising ≥10 percent of trees with pith dates. The latter part of the distribution is incomplete because only trees ≥8 inches DBH were cored.

Figure 12. Chronologies of fire and tree recruitment at McKay Creek.

Average wildfire acres burned annually, based on a 17-year fire return interval on the 23,065 forested acres in the watershed, is 1357 acres a year. In the McKay watershed, from 1986 through 2007, there were 89 wildfires, all under 5 acres. (In December 2011, a human-caused wildfire burned 106 acres in two days on Little McKay in an open pine stand previously burned in the 1990s. The wildfire consumed mostly the top of the litter layer, dried grass and rotten downed

wood.) From 1983-2007, prescribed fire was used on 3616 acres, an average of 150 acres per year.

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, adjacent to the McKay watershed. 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 intensity mapping of the Hash Rock Fire was completed in October 2000. The fire intensity 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. [6]

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." [7]

Measuring the Current Condition and Alternatives

Forest fuels are considered hazardous when they cause high severity wildfire, with high flame lengths, fast rates of spread and fire in the crowns of the trees, and cause the loss of old growth trees, wildlife habitat, soils and fisheries, and generate heavy long-term smoke production. Reducing the hazard – the amount of fuel in a stand – lowers the risk of high severity fire in that stand.

Condition Class describes the changes in stand conditions caused by fire exclusion, and the potential for high-severity fire, and nicely defines fuels hazard. When low-intensity fire is excluded from a stand, 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 fire. Characteristics of the condition classes are summarized in

[6] Fontaine and Seymour, forest survey 2002, Ochoco NF
[7] Effects of Climatic Variability and Change on Forest Ecosystems, Vose et al, Dec 2012

Table 26. Fire effects in each condition class are summarized in Table 27.

Table 26. Characteristics of Condition Classes.

Low Hazard/CC 1	Mixed Hazard/CC 2	High Hazard/CC 3
• Low intensity fire has occured within 0-15 years • Flame lengths 2-4 feet • non-lethal fire effects • ladder fuels scattered, clumpy • crown base heights > 6ft • low crown fire potential • light smoke, short duration • canopy closure <55%	• No fire has occurred for 15-35 years • Flame lengths 4 to 8 ft • mixed fire effects (between 20% and 80% mortality to overstory) • ladder fuels filling in understory • mixed to high crown fire potential • canopy closure >55%	• No fire has occurred for 35+ years • Flame lengths over 8 ft • lethal fire effects • ladder fuels abundant • crown fire potential is high • heavy long term smoke from complete combustion • tree growth is reduced • tree mortality increases

Table 27. Anticipated fire effects by condition class[8].

	Surface Fire **Low Hazard/CC 1**	Mixed Severity Fire **Med Hazard/CC2**	Crown Fire **High Hazard/CC3**
Fire Severity	90% of the canopy remains intact	Fire creates a mosaic of conditions.	Less than 10% of the canopy remains intact.
Litter	Scorched, charred, consumed	Consumed	Consumed
Duff	Intact, surface charred	Deep charred	Consumed
Woody debris – small, < 3 in. diam	Partly consumed - charred	Consumed	Consumed
Woody Debris – large, > 3 in. diam	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

Changes in fire hazard result from reductions in surface fuels, ladder fuels and stand density. The Proposed Action would reduce the potential for high intensity 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.

See Table 28 for descriptions of some typical activities used to manage fuels. Most of the stands in which prescribed fire alone would be used to reduce surface fuels and seedlings and saplings are low hazard. Stands in which noncommercial thinning of trees under 9” dbh is prescribed are generally classified as mixed hazard. Stands in which commercial thinning of trees between 9” and 21” dbh is prescribed are in either mixed or high hazard, depending on stand density and the amount of surface fuels present.

Table 28. Description of typical treatments in various condition classes.

Objective	Typical Treatment Prescription	Expected Effects of Treatment
Move High Hazard/CC3 to Low Hazard/CC1	Commercial Thinning Noncommercial Thinning Underburn	Opens canopy Reduces ladder fuels Reduces surface fuels
Move High Hazard/CC3 to Mixed	Noncommercial Thinning Underburn	Reduces ladder fuels Reduces surface fuels

[8] Hungerford 1996 and DeBano and others 1998, cited in Robichaud and others 2000, and from Tarrant 1956, cited in Wells and others 1979

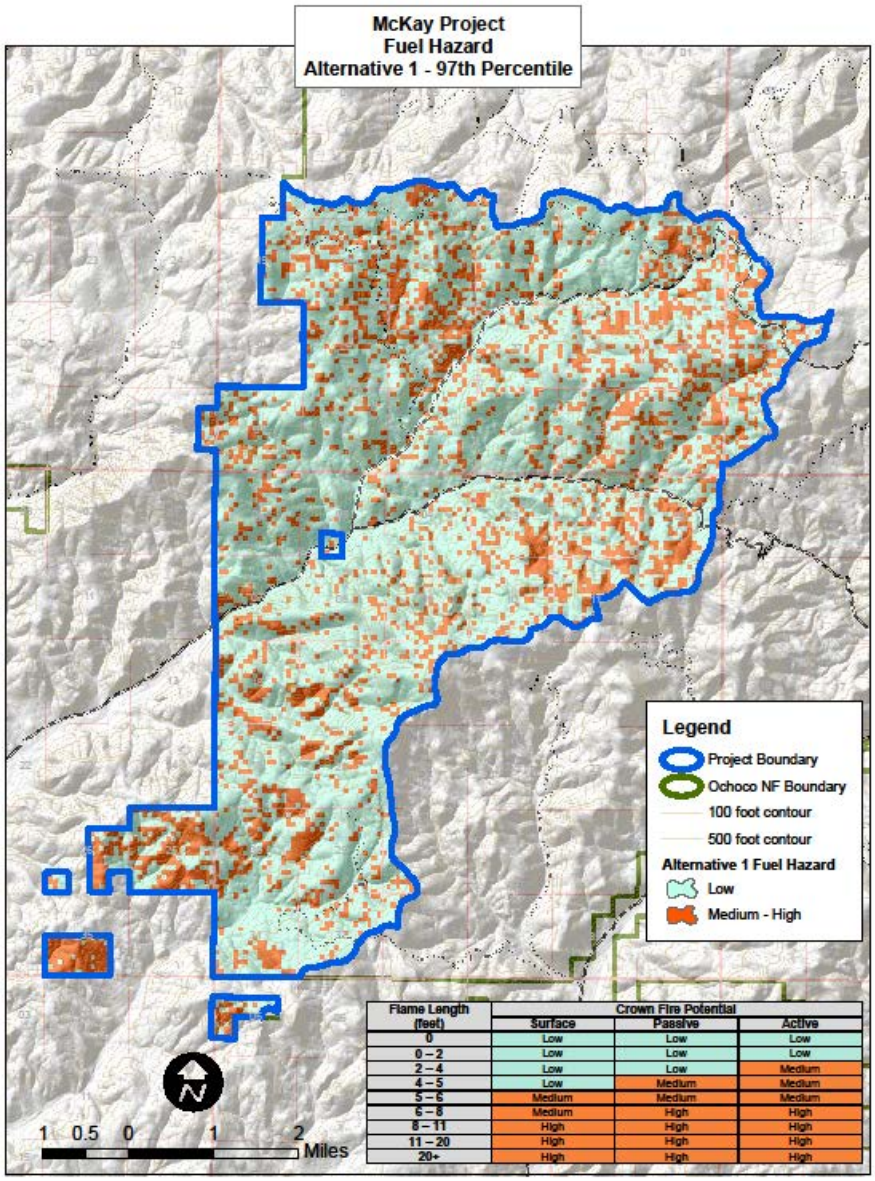
Move Mixed Hazard/CC2 to Low Hazard/CC1	Commercial Thinning Noncommercial Thinning Underburn	Opens canopy Reduces ladder fuels Reduces surface fuels
Move Mixed Hazard/CC2 to Low Hazard/CC1	Noncommercial Thinning Underburn	Reduces ladder fuels Reduces surface fuels
Maintain Low Hazard/CC1	Underburn	Reduces ladder fuels (seedlings and saplings) and surface fuels

Figure 13. Representative photograph of a ponderosa pine stand in Condition Class 3.

Environmental Effects

Alternative 1

Under the No Action alternative, low hazard/Condition Class 1 stands would not be maintained in that condition, and will transition into mixed 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 will tend to be more severe. Figure 14 displays the current fuel hazard in the project area.



Flame Length (feet)	Crown Fire Potential		
	Surface	Passive	Active
0	Low	Low	Low
0 – 2	Low	Low	Low
2 – 4	Low	Low	Medium
4 – 5	Low	Medium	Medium
5 – 6	Medium	Medium	Medium
6 – 8	Medium	High	High
8 – 11	High	High	High
11 – 20	High	High	High
20+	High	High	High

Figure 14. Existing fuel hazard in the McKay Fuels and Vegetation project area.

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.

Alternatives 2-4

The three action alternatives would reduce the potential for high intensity wildfire (high and mixed hazard/Condition Class 2 & 3) by opening the forest canopy, and reducing surface and ladder fuels, and maintain conditions that support low intensity wildfire (low hazard/Condition Class 1) by reducing surface and ladder fuels.

A hazard level/condition class was assigned to every stand in the McKay watershed, based on stand exams, aerial photos, site visits and local knowledge.[9] According to that analysis, 14,000 acres of the 25,000 acre watershed are in high hazard/CC3. Table 29 summarizes the expected results of vegetation treatments in the McKay project; based on the conditions of the stands and the changes from treatment, the three action alternatives would move the following acres from one hazard level to another as described in the table.

Table 29. Expected results of the proposed alternatives on fuels condition class in the McKay project area.

	High/CC 3 to Low/CC1	Mixed/CC2 to Low/CC1	Maintenance of Low/CC1
Alternative 2	7252 acres	2796 acres	1222 acres
Alternative 3	7483 acres	2842 acres	1190 acres
Alternative 4	6515 acres	2796 acres	1222 acres

Alternative 3 would move the most acres of Condition Class 2 and 3 (mixed and high intensity fire conditions) into Condition Class 1 (low intensity fire conditions).

McKay treatment unit 88, two miles east of Green Mountain, has high hazard fuel conditions characteristic of Condition Class 3; closed canopy, heavy surface fuels, and heavy ladder fuels. Low hazard/Condition Class 1 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. Table 30 compares fire effects with and without treatment, from a wildfire under the extreme conditions when large fires typically occur.[10]

Table 30. Comparison of expected fire behavior effects in a McKay project unit before and after proposed management activities.

Fire Effects from a Wildfire in 2020	**Mckay Unit 88** Current Condition High Hazard/CC 3	**Mckay Unit 88** After treatment Low Hazard/CC 1
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

The following maps are intended for comparison with Figure 14; they display how fuel hazard (crown fire potential) would change with treatment (Figure 15 shows changes under Alternative 2, Figure 16 shows Alternative 3 and Figure 17 shows Alternative 4). 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).[11]

[9] Fontaine and Scholz 2006 McKay Watershed Analysis
[10] Forest Veg Simulator, Fire & Fuels Extension
[11] Finney 2006

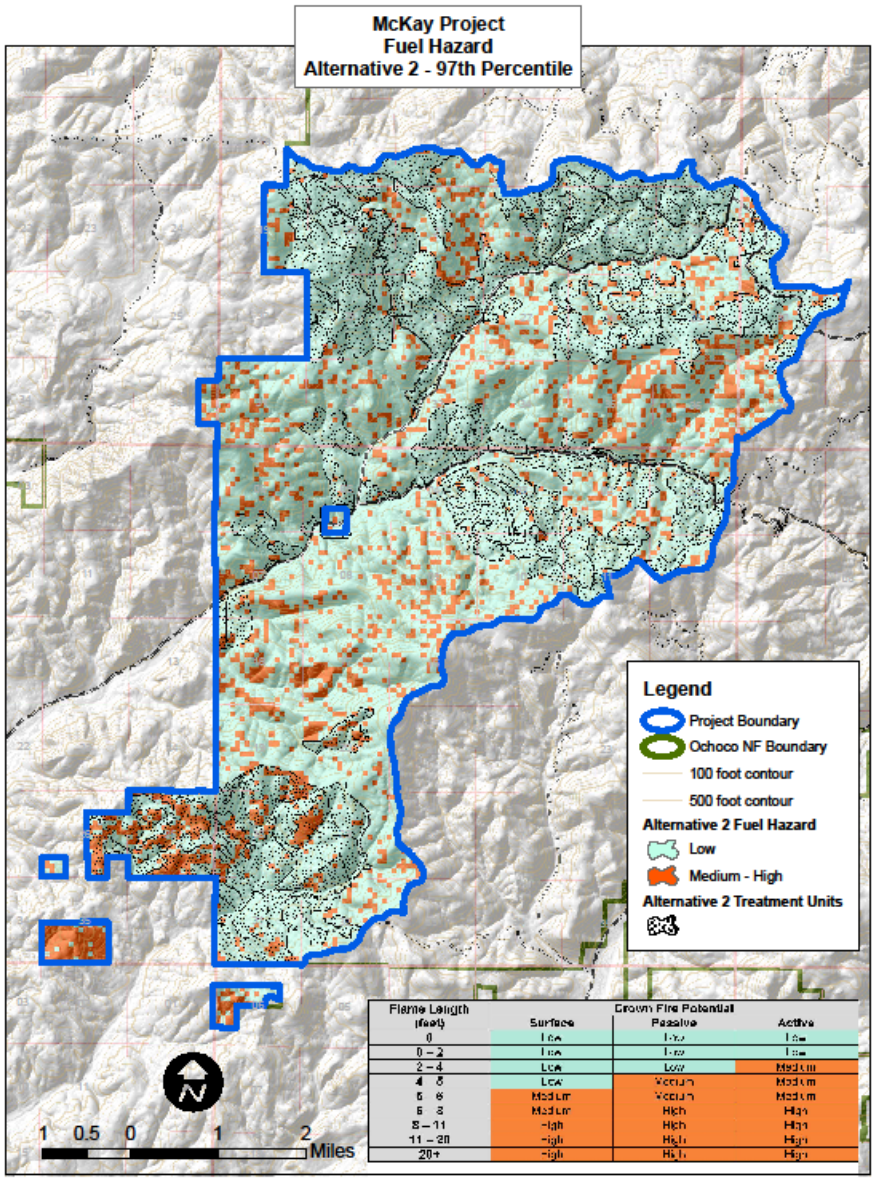


Figure 15. Anticipated fuel hazard under Alternative 2.

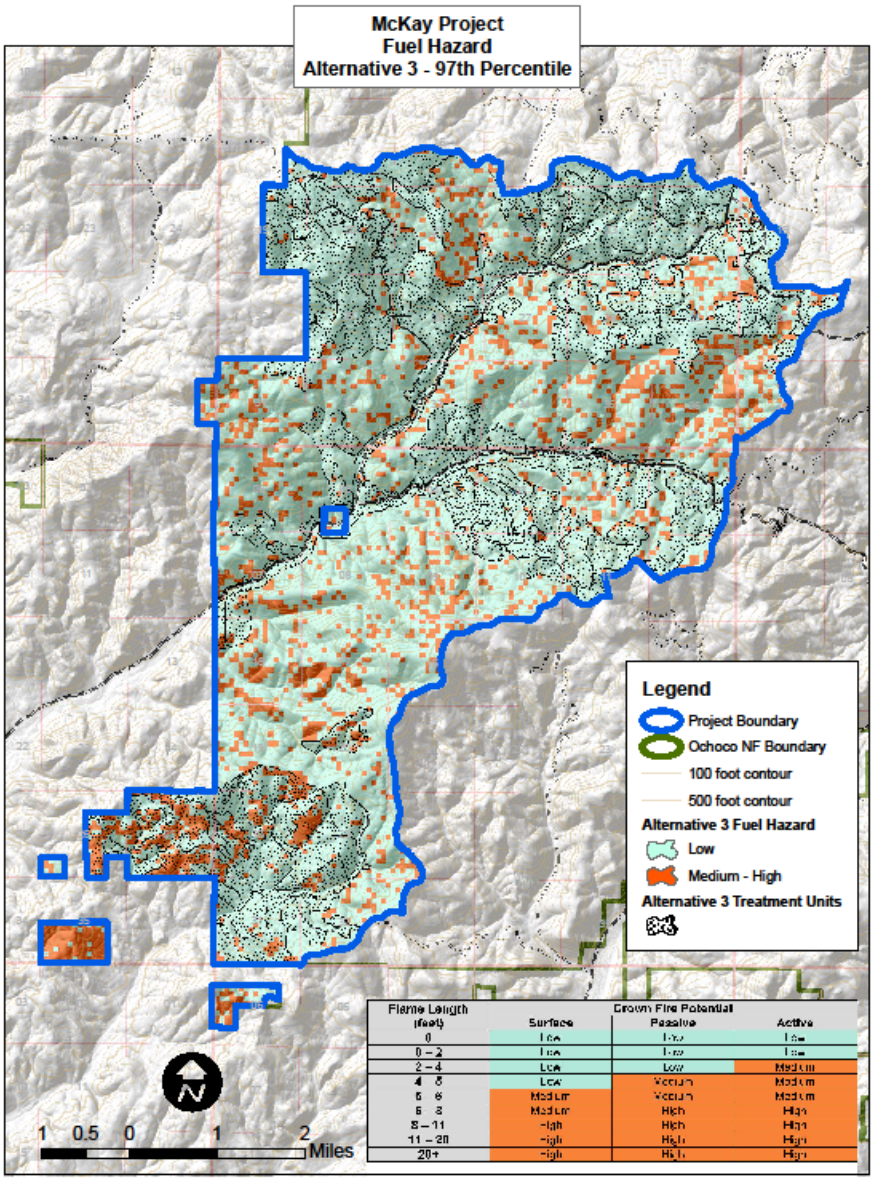


Figure 16. Anticipated fuel hazard under Alternative 3.

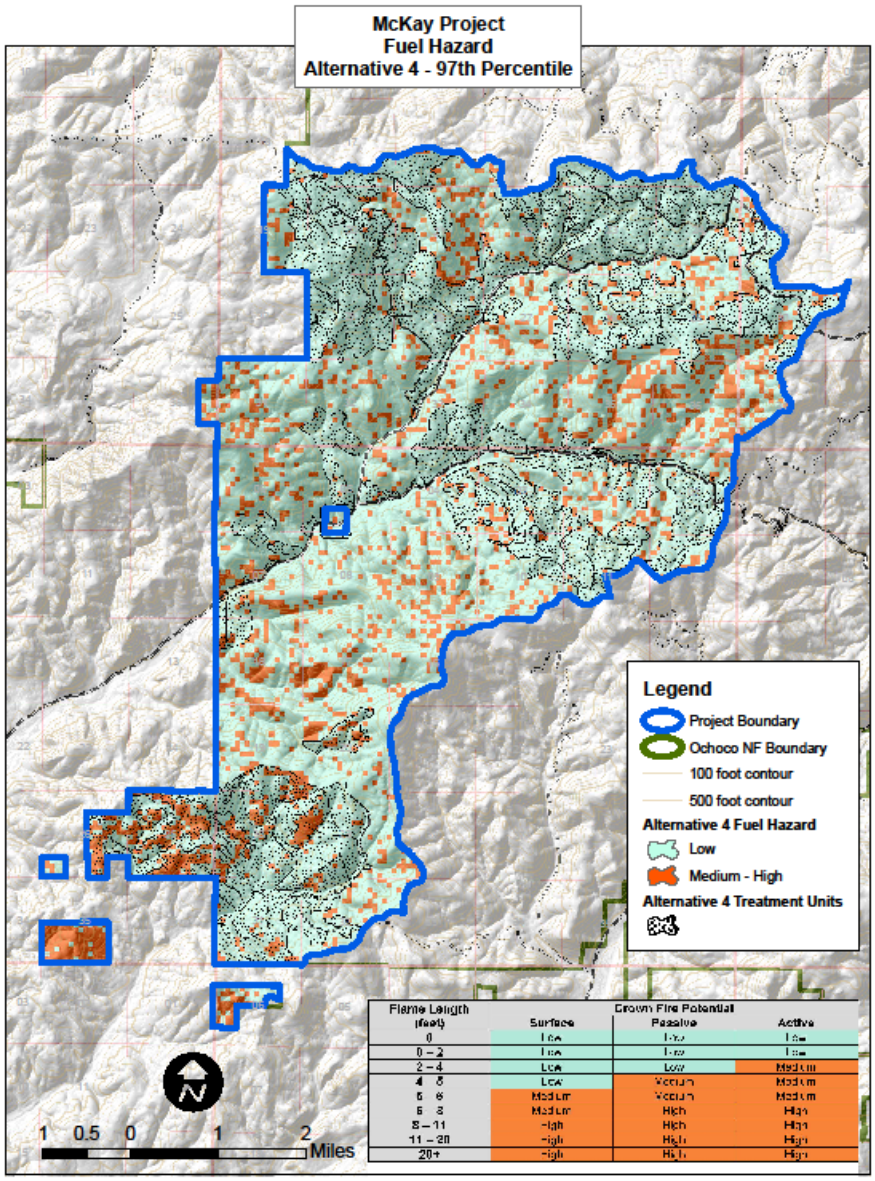


Figure 17. Anticipated fuel hazard under Alternative 4.

Other Effects Common to Action Alternatives

Wildland-Urban Interface

The Crook County Community Wildfire Protection Plan (2005) identified 7,549 acres of wildland urban interface in the McKay Watershed, along the forest boundary on the west end of the watershed. In that area is a 40-acre plot of private property surrounded by National Forest, on McKay Creek, 1.5 miles east of the forest boundary on the 27 road. This plot has several buildings on it. A small diameter thinning and hand piling of a 300 foot buffer around this property is planned. Reducing surface fuels, ladder fuels and stand density in the forest around this area would reduce the risk to the homes and other developments in the event of a wildfire.

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 windspeed 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.[12]

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 increase fire hazard because it does not increase surface fuels.

However, the <u>non</u>commercial thinning of trees under 7” 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 under 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 et al 1999).

Mortality in Large Old Pine after Prescribed Fire

While both 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 class 2, 3). Mortality from prescribed fire is less than 5% (Ochoco NF prescribed fires, personal observation, 1986-2010). By contrast, 48% of the 18,000 acre Hash Rock fire in the Mill Creek Wilderness in 2000 had 100% mortality from a high intensity 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

[12] 1992 Fire Behavior Field Reference guide PMS 436-4, pgs 32, 33.

- 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-intensity 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.

Mountain Mahogany

Curlleaf mountain-mahogany (*Cercocarpus ledifolius*) is usually killed by high-intensity fire, but the thick bark on mature trees allows some plants to survive low-intensity fires in stands with low litter levels and a grass understory.

“Curlleaf mountain-mahogany recolonizes burned sites predominantly through seedling establishment. Seeds in the soil may survive low- or mixed-severity fires. Curlleaf mountain-mahogany is typically absent from areas with frequent fire. Many researchers indicate that curlleaf mountain-mahogany abundance has increased in the absence of fire since the early 1900s” (FEIS).

Underburning to rejuvenate mountain mahogany in the East Maurys south of Arrowwood Point in 1999 was hot enough to kill some old (over 10 feet tall) mahogany, and did result in seedling establishment. New plants are now 1-4 feet tall (Robinhood unit 3).

A project to promote new mahogany by cutting juniper and using prescribed fire to remove old mahogany in the upper Hammer Creek drainage in the West Maurys in 1996 was successful.

Fire in 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 thru 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 (Arno 1976, McCune 1983, Olson 2000). Fires thinned the conifers, leaving a mixedly 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 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.[13]

Post-fire monitoring of Large Woody Debris in Dick Creek

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 EA (USDA Forest Service, 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 31).

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, and 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 31. 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

[13] Personal observations of prescribed fire projects on the Ochoco National Forest, 1986-2009

Table 32 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 32. 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 (A. Dean, Fire Effects Monitor 08/17/2009).

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 (see Figure 18). 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 2002). High severity fires followed by heavy runoff flows can harm streams and their aquatic food chains (Biswell 1989, Minshall and 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, and Tewksbury 1997). However, with continuing protection from lightning fires and restrictions on prescribed burning, many riparian forests are now dominated by conifer thickets” (Arno 2002).

Figure 19 is a photograph 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 were reduced, and most large downed logs were retained. The duff collar surrounding the old growth pine was reduced, increasing its chance of survival during the next fire event.

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

Figure 18. East Fork Mill Creek after the Hash Rock fire of 2000.

Figure 19. Results of mixed-severity fire in a riparian area in the Hash Rock fire perimeter.

Fire Effects on Riparian Plants[14]

Alnus incana subsp.*Tenuifoli*a Thinleaf Alder

Severe fires can completely remove organic soil layers, leaving alder roots exposed and charred, eliminating basal sprouting. Low severity fires kill only aboveground plant parts. Thinleaf alder often sprouts from its root crown following fire. Several new sprouts may arise from each burned plant.

Off-site plants are important in revegetating burned areas through the dispersal of numerous wind- and water-transported seeds. Since thinleaf alder disperses its seeds in the fall, favorable seedbeds created by late summer fires are immediately colonized.

Betula occidentalis Water Birch

Aboveground plant parts of water birch are easily destroyed by fire. Plants will normally resprout from uninjured basal buds. Fires may expose mineral soils, which are favorable seedbeds for this species' light, wind-dispersed seed.

Cornus nuttallii Dogwood

[14] Fire Effects Information System

Low-consumption, early-spring fires in mature mixed conifer ecosystems produce temperatures hot enough to kill Pacific dogwood foliage but not hot enough to kill buds protected by bark. After being burned, Pacific dogwood typically sprouts from the root crown.

Salix exigua Willow

When top-killed by low- to mixed-severity fire, narrowleaf willow resprouts vigorously from roots, root crowns, and basal stems. More sprouts are produced after quick, intense fires than after slower fires, which are potentially more damaging to narrowleaf willow and result in few, if any, sprouts.

Salix scouleriana Scoulers Willow

Willows sprout quickly after fire if depth of the burn in the soil is low to mixed. When fire is intense enough to kill live foliage but does not kill the vascular cambium, Scouler willow experiences vigorous epicormic sprouting from the root. Root crowns of Scouler willow are often so large that some buds always survive, except when disturbance is really severe. Scouler willow has a high postfire response rating; the species population will regain its preburn frequency and cover in 5 years or less.

Populus balsamifera subsp.*Trichocarpa* Black Cottonwood

Black cottonwood sprouts from the lateral roots, root crown, and bole after top-kill by fire.

Populus tremuloides Quaking Aspen

Quaking aspen is highly competitive on burned sites. Even where quaking aspen was a barely detectable component of the prefire vegetation, it often dominates a site after fire. Aspen's thin bark has little heat resistance, and it is easily top-killed by fire, but the root systems of top-killed stems send up a profusion of sprouts for several years after fire. Sprouts grow rapidly by extracting water, nutrients, and photosynthate from an extant root system, and may outcompete other woody vegetation. Following a fire, a new, even-aged quaking aspen stand can develop within a decade (see West Maurys units 36/43, east fork of Pine creek).

Spiraea douglasii Douglas' Spirea

Douglas' spirea is mixedly resistant to fire and sprouts readily from the stem base and rhizomes after fire. In presettlement times, wildfires were "probably common" in Douglas' spirea communities of riparian areas in Oregon; soils were usually dry by mid-summer, allowing fires from adjacent uplands to encroach upon the stand.

Rosa woodsii Wood's Rose

Wood's rose establishes after fire primarily by sprouting from the root crown. While less frequent, Wood's rose may establish after fire by root sprouting or seed establishment. Wood's rose is strongly fire tolerant, except for smoldering fires with heavy volumes of surface fuel which may kill the root crown. In interior ponderosa pine communities, fire may occur as often as every 2 years.

Prunus virginiana Chokecherry

Chokecherry is well adapted to disturbance by fire. Although susceptible to top-kill by fire, it resprouts rapidly and prolifically from surviving root crowns and rhizomes. Seed germination improves with heat, suggesting scarification by fire is an important adaptation.

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. Costs shown in Table 33 are for a 10-100 acre fire, which has the highest suppression cost per acre.[15]

Table 33. Suppression cost per acre by fuel model.

NFDRS Fuel Model	Fire Behavior Fuel Model	2007 Suppression Cost-per-acre
C (open pine with grass, condition class 1)	9	$3906
H (short needle conifers, closed canopy, condition class 3)	8	$6086

The cost-per-acre of precommercial 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.

Cumulative Effects

The Mill Creek Allotment Management Plan FEIS and Record of Decision (Ochoco NF 2010) included about 5,950 acres of underburning to improve upland range conditions in the McKay watershed on the north side of Green Mountain. The effects would be the same as those described above, reducing the risk of high intensity fire by reducing surface fuels and ladder fuels.

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 affect fire intensity in closed canopy, multi-storied stands with heavy surface fuel loading.

Geology and Soils

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

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

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 34.

Table 34. 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

The analysis area is within the Blue Mountain ecological region (Level IV) (Appendix A). Through further refining of the eco-regions (Level V), almost the entire watershed is encompassed within the South Slope Ochoco Level 5 Eco-region (Table 35) which 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 South Slope concerns. The 1% remaining is in the North Slope Ochoco, which is characterized by more effective moisture, deeper ash depth and dissected montane terrain.

Table 35. Level V Eco-region for McKay project area.

Level V Eco-	Lower	McKay	Mill Creek	Upper Trout	Grand Total

region	Ochoco Creek WA (acres)	Creek WA (acres)	WA (acres)	Creek WA (acres)	(acres)
North Slope Ochoco		44		5	49 (1%)
South Slope Ochoco	3	25,028	11	2	25,044 (99%)
Grand Total (acres)	**3**	**25,072**	**11**	**7**	**25,092(100%)**

The McKay Creek Planning Area is primarily underlain by clay-rich volcanic mudflows of the Clarno Formation (FM) (Swanson, 1969 and Walker & MacLeod, 1991) with minor amounts of Tertiary John Day FM welded tuff, rhyolite flows and landslides (Table 2). These highly weathered andesites, basalts, rhyolites and ashflow tuffs form the dissected ridges with moderately steep side slopes present in the watershed. 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.

The climate 60 million years ago to the present has evolved from a warm moist tropical regime to the temperate four distinct seasons of today. The tectonic movement, uplift of the Blue Mountain anticline and mass wasting processes combined to create the moderately dissected and hummocky terrain which is the predominant landform.

Physical Environment

The 8 sub-watersheds are 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 Upper McKay and Lower McKay Creek sub-watersheds are underlain by four distinct geologic formations (see Table 36).

Table 36. Lithology (acres) in the McKay Creek project area.

Subwatershed	Quaternary Landslide Debris - Acres	Tertiary Clarno FM (Tca) - Acres	Tertiary John Day FM (Tr) - Acres	Tertiary John Day FM (Twt?) - Acres	Total Acres
Allen Creek	0	455			**455**
Foley Creek	0	2			**2**
Headwaters Trout Creek	2	1	**2**		**5**

Lower McKay Creek	0	5,526	**0**	**42**	**5,568**
Lower Mill Creek	0	5	**1**	**1**	**7**
Ochoco Reservoir-Ochoco Creek	0	3	**0**	**0**	**3**
Upper McKay Creek	122	17,212	**1,557**	**159**	**19,050**
Upper Mill Creek	0	1	**2**	**0**	**3**
Total Acres	**124 (1%)**	**23,203 (92%)**	**1,563 (6%)**	**203 (1%)**	**25,092**

The oldest is the Clarno Formation (FM) (Tca) (Eocene to lower Oligocene, 41-34 Ma) composed of lava flows, mudflows, and small amounts of tuffaceous rocks (Swanson, 1969 and Walker & MacLeod, 1991). The Clarno Formation (Tca), is mapped on the majority of the watershed and covers 92 percent of the analysis area (Table 2). The formation is rated as intermediate for susceptibility to mechanical and chemical weathering processes. The most of the landslides are underlain by the Clarno FM, occur on the upper slopes, on slopes greater than 40 percent, are rotational slides and are associated with ridge tops. Springs and seeps are associated with these hummocky areas.

An erosional surface exists between the deposition of the John Day Formation and the underlying Clarno Formation, representing the continuing uplift. A saprolite (thoroughly decomposed rock) has been mapped in places along the boundary between the formations.

Between the deposition of the Clarno and the John Day Formations, the style of volcanism changed from local to regional in nature (Walker,1990; Swanson,1969 and Swinney,1968). The John Day Formation (Tr, Twt) (middle Oligocene to lower Miocene -- 32-25 Ma) is compositionally heterogeneous, erupting from vents in the Crooked River Caldera (McClaughry and Ferns, 2006). The two John Day age units underlie approximately 7 percent of the watershed (see Table 2). The John Day Formation generally consists of air fall and ash-flow tuff (Twt), tuffaceous sedimentary rocks, lava flows and domes (Swanson, 1969 and Swinney, 1968) and is poorly stratified. The flows and intrusive bodies (Tr, Twt) are rated resistant for susceptibility to mechanical and chemical weathering processes. Most of the landslides that occur on the John Day Formation are on the upper slopes, on slopes greater than 40 percent, are rotational slides and are associated with ridge tops.

Rhyolite and dacite domes and flows and small hypabyssal intrusive bodies (Tr) (Miocene to Upper Eocene) are represented by light-gray to red, dense, flow-banded, non-porphyritic rhyolite and dacite in nested domes, small intrusive bodies and related flows. These bodies are commonly associated with mercury mineralization. They may represent vents for lava flows and tuff. These units may also include near-vent breccias, pumice-lapilli tuffs and coarse pumicites. They are located in the upper reaches of the McKay Creek watershed.

The youngest major geologic unit in the McKay Creek watershed is the landslide and debris flow deposits (Qls) (Pleistocene and Holocene -- 2 Ma to Present) composed of chaotic masses of angular blocks, chiefly mixtures of basalt and tuffaceous sedimentary rocks (Swanson, 1969). The unit includes debris flows and large talus piles.

Landslide debris (Qls) underlies 1 percent of the watershed (Table 36). The majority of the debris is mapped on the upper reaches of the watershed. The unconsolidated material is highly susceptible to mechanical and chemical weathering. The difference between published mapped landslide debris acres and the dormant landslide terrain discussed later in this report is due to how geologic maps are compiled, additional air photo interpretation and analysis of LiDAR images to identify landforms.

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

This area contains a wide variety of soils and landtypes. Parent materials are largely the Clarno Formation, 95 percent, which is comprised of andesitic lava flows, domes, breccia, interlayered saprolite, bedded volcaniclastic and epiclastic mudstone, claystone, siltstone, sandstone, conglomerate and mudflow (lahar) deposits (Walker 1990). This includes the weathered tuffaceous sediments. Landslide debris occurs over 26 percent of the area. (C.Gordon, ONF). Alluvial deposits in the drainage bottoms comprise another 1.5 percent (Orr 1992).

Volcanic ash from Mt. Mazama blanketed the area about 6600 years ago and has been subsequently reworked by water and air. Newberry Crater ash has also been deposited over much of the area also but with much less depth. Ash soils such as the R2, R6, T2, T6, B8, and B9 occur over approximately 52 percent of the area or 13,188 acres on NFS lands. The balance of the watershed is largely residual soil which is clay-loam or clay texture. Much of the lower elevation area is non-commercial ground and is scabland, sage, juniper, rock outcrop, low site ponderosa, or meadow.

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 et al. 1977). The major landtypes for the NFS owned portions of the McKay Creek Watershed are the T (47%) and B (40%) and R (12%) landtypes. Additional minor landtypes are the A (1%) and M (0.2 %) landtypes. An acreage summary by major landtype within the project area is provided in Table 37; summaries of acreage by major textural class and by general soil groupings are provided in Table 38 and Table 39, respectively.

Table 37. Acreage by landtype group with acreage and percent of NFS land.

Landtype Group	Acreage	% of USFS ground only.
T Landtypes	11,953	47
B Landtypes	10,110	40
R Landtypes	2,944	12
A Landtypes	231	1
M Landtypes	56	0.2

Table 38. Acreage by major textural class.

Textural Class	Landtypes Included	Acres
Alluvium	A12	231
Ash	R1,R2,R3,R6,T2,T26,T6, T8	8,285
Ash, very cobbly	B8, B9,	1,263
Ash, very stony	T2B	3,145
Ash ½, w rocky areas	B79,B84,R14	989
Clay	B6, T5	895
Clay, rocky (skeletal)	B4, B45, B47, B49, B5, B56, B7, B74	8,001
Mixed Souths	T3, T3B	2,206

Shallow	B1, R4, R5	231
Meadow alluvium	M8	56

Table 39. Acreage by ash, clay, and landslide debris (these are broader groupings of soils).

General Groupings 0f Soil	Acres	Percent Of Forest Service Land In Watershed
Ash Capped Soils W >7 In Of Ash	13,188	52
Clay	8,896	35
Soils Formed In Landslide Debris	6579	26 (Both Ash And Clay Soils)
Alluvium / Meadows	287	1.1

Existing Condition

The existing condition of soils in the McKay 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 McKay and Little McKay 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 40 summarizes the effects of current livestock management on soils in and around the McKay project area. See the section titled “Range” in Chapter 3 of this document for summaries of actually allotment/pasture acreage that falls within the McKay project area. All allotments and pastures identified in Table 40 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 40. Summary of livestock grazing effects as they related to current soil condition in the McKay project area.

Allotment/ Pasture	Acres Grazed	Class 1-4 Stream miles/ac Grazed- 10% detrimental	Structures with acres	Fence Miles/Ac	Salting/ Mineral supplement sites; Stock driveways	Logging and Roading Impacts Acres (Rds are 1% of acres on average)	Total acres/% of detrimental soil conditions by allmt
Big Table Allotment	Total= 793	3.2 mi= 7.7 ac. 10%= 0.8 ac	0	3 mi x 1.2ac/mi= 3.6 ac	1 salting site = 0.0023 ac	32	36.4 ac
A-Y Pasture (Mill Creek Altmt)	4,679	20.1 mi= 49 ac; 10%= 5 det. ac	3 troughs,1 pond = 4 ac	7.6 mi x 1.2 ac/mi = 9.1 ac	5 salting sites = 0.012 ac 2.25 mi stock driveways @ 6 ft wide = 2.25 mi x 0.727 ac/mi= 1.6 ac	281 ac	301 ac = 6.4 % Meets S/Gs

Lemon Pasture	15,073 (4,963 ac in Mill PA)	65.3 mi= 158 ac; 10%= 15.8 ac	16 troughs, 1 pond= 17 ac	25.3 mi x 1.2 ac/mi= 30 ac	17 salting sites = 0.04 ac	603	665 ac= 4.4% Meets S/Gs
McKay Pasture	9,757	39.7 mi= 96 ac; 10%= 9.6 ac. det	14 troughs, 1 pond = 4 ac	17.4 mi x 1.2 ac/mi= 20.9 ac; plus 27-100 Corral= 0.02 ac	11 salting sites = 0.025 ac 3.5 mi stock driveways @ 0.727 ac/mi = 2.5 ac	585	623 ac = 6.4 % Meets S/Gs
Trout Ck Pasture	5,682 ac	18.2 mi= 44 ac 10%= 4.4 ac	1	8.25 x 1.2 ac/mi= 9.9 ac	6 sites= 0.01 ac	341	356 ac = 6 % 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 this project area it is estimated that 6,245 acres have been harvested since 1975. Another 10,529 acres are estimated to have been harvested from the 1950s to 1975. Given this assumption, it is estimated that 10 to 30% of the tractor harvested acres (depending on the type of treatment) or approximately 1,884 acres have been detrimentally compacted and/or displaced (see Table 41). These 1,884 acres comprise 7 percent of the total FS project area acreage of 25,301. With another 1 percent for roads, the project area is at the 8 percent compaction level which is several percentage points below that which produces significant changes in runoff and timing of peak flows.

Table 41. Summary of the effects of past vegetation management on current soil condition in the McKay project area.

Approximate Timeframe of Activity	Management Prescription	Acres and Logging System	Detrimental disturbance Estimates
1975 - Present	HCC/HSH, HCR, HSD	1,555 skyline	1,555 acres of skyline @10% detrimental disturbance = 156 ac
	HCC/HSH, HCR, HSD	500 tractor	500 acres of tractor regeneration @ 30% = 150 ac
	HOR, HFR	4,191 tractor	25%= 1,048 ac
Between 1950s and 1975	HSL/HPR, HIM, HTH	10,529 tractor	10% = 419 ac
			Grand Total= 1,884

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 99.6 miles. Road acreage (1.82 acres/mile for ave. 15 ft wide rd) is approximately 181.3 acres or 1 % percent of the total USFS watershed acres.

In the McKay 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.B8, B9, L6, R1, R2, R3, R6, T2, T6 and T8) 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 problem. No reduction in the estimate for existing damage was made, although it is predicted that some of the older compaction (from the 1950s and 1960s) 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.

The road system consists of 184.3 miles of road within the watershed. Approximately 99.6 miles are on NFS lands. Table 42 displays total miles of road in the watershed, by jurisdiction. All roads, other than Forest Service roads, are assumed to be open for purposes of this assessment. Unknown roads have been derived from the Ochoco National Forest GIS (geographic information system). The status of these roads is unknown, because they are private, BLM, or county roads.

Table 42. Total miles of road in the McKay project area.

Jurisdiction	Open Roads	Closed Roads	Total
Forest Service	70.3	29.3	99.6
County	23.1	0	23.1
State	0.3	0	0.3
Private	18.0	0	18.0
Unknown	43.3	0	43.3
Total	155.0	29.3	184.3

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 reach 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 on the Howard, Elliot, Johnson (HEJ) timber sales and in the 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

Pre-commercial thinning (PCT) activities will 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 precommercial 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 precommercial 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 McKay Project, only small (<12”) diameter material will be piled, and the piles will 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. What this does is to 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 tree (WTY) 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 McKay project area), the clay is left exposed and puddled. This has the potential to direct runoff at an accelerated rate. The required waterbarring will 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 McKay project are such that less than 5 percent damage is projected. Prescriptions will be tailored to further reduce intensities so that detrimental effects are minimized.

JACKPOT BURNING (JKP): 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 Special Plant Communities

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. Commercial harvest would occur on 12 acres of these stands. In general, conifers up to 15 inches dbh would be cut. Most, if not all, conifers within 25 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 will also help maintain cover levels. Since these areas are often along streambanks there will be more protection along banks which will reduce erosion. These treatments will comply with the soils standards.

Juniper Thinning

This treatment is proposed on 2,951 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 will 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 will help reduce potential sheet and rill erosion. These treatments will 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. There would be a 5 to 125 foot no cut buffer or a cut and leave zone which would reduce probability of sediment delivery. 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. Mitigations such as leaving and/or back hauling slash on to skid trails, installation of water bars and re-using old skid trails and roads will 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.

McKay Floodplain Reconnection (Alternative 3 only)

Site 2, the site located near the dispersed camp site at the confluence of Little McKay and McKay totals approximately 11 acres of floodplain. Current stream length is approximately 2700 feet. Ground disturbance will be limited to approximatey 10 to 15% of the floodplain acres (1.2 to 2.3 acres) at the grade control, sill, side vane, j-hook and other structures to help to raise the water tables. Higher banks will be laid back and flood plain benching will be constructed as well as plug and fill operations to reconnect the channel with older relict channels with better sinuousity. Temporary access trails for the truck delivery of stream rock and wood will need to be constructed at various locations. Excavator type equipment will be used to construct the stream structures. This may result in potential short term (2 to 5) delivered sediment increases during high flow events. Mitigation measures such as seeding, planting of hardwoods and increasing floodplain roughness will help reduce delivered sediment. Long term erosion (6 to 25 years) will be reduced by reducing high flow stream velocities (reducing bank and bed erosion) and increasing access to the floodplain.

Site 4, the site located at and downstream of the old mill and the confluence with Miner's Gulch, covers approximately 24 acres and approximately 4000 feet of stream channel. Temporary access trails for the truck delivery of stream rock and wood will need to be constructed. Excavator type equipment will be used to construct the cross channel grade controls structures such as upstream

Vs and Ws along with sills, side vanes, j-hooks and plug and fill operations. Approximately 10 to 15 percent of the floodplain acreage (2.4 to 3.6 acres) would be disturbed in the short term (2 to 5 years) potentially resulting in short term delivered sediment increases during high flow events. Mitigation measures such as seeding, planting of hardwoods and increasing floodplain roughness will help reduce delivered sediment. Long term erosion (6 to 25 years) will be reduced by reducing high flow stream velocities (reducing bank and bed erosion) and increasing access to the floodplain.

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 reburned (Shank 2004).

Alternative 2

This alternative proposes 3,564 acres of commercial thinning harvest, 532 acres of group selection; 205 acres of sanitation harvest for a total of 4,301 acres of ground based harvest. This alternative also proposes 2,951 acres of juniper thinning (JUT) and 1,943 acres of pre-commercial thinning (PCT) to be accomplished with hand felling via chainsaws. Harvest in RHCAs would consist of 10.6 acres of mistletoe sanitation harvest, 135.8 acres of commercial thinning (HTH) and 1 acre of commercial thinning with group selection (overall disturbance levels in RHCAs would be at a reduced 10 to 15 percent level due to site specific restrictions- see unit-specific project design criteria in Aquatics Report). What this means is that harvest treatments would occur only on approximately 10 to 15 percent of the listed RHCA acres. Fire treatments proposed are 210 acres of hand piling (HP); 2,753 acres of jackpot burning (JKP); 5,547 acres of prescribed burning (RXF) and 853 acres of thin with fire (TWF).

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 mitigations and practices identified which will ensure that all activity units meet the soil standards (see Appendix B). Temporary road construction on existing disturbance would entail approximately 5.7 miles (1.82 acres/mile, 15 feet wide) = 10.4 acres of road impacts. New temporary road construction would entail approximately 1 miles (1.82 acres/mile, 15 feet wide) = 1.82 acres of road impacts. Reconstruction of existing road system would occur on 22.1 miles (40.2 acres). The total road disturbance proposed in this alternative is 28.8 miles (52.4 acres). Implementation of this alternative would result in approximately 142 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 51 of the units listed in Appendix B.

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

Alternative 3

This alternative proposes 3,795 acres of commercial thinning harvest,532 acres of group selection commercial thinning and 205 acres of sanitation harvest for a total of 4,532 acres of ground based

harvest. This alternative also proposes 2,951 acres of juniper thinning (JUT) and 5,990 acres of pre-commercial thinning (PCT) to be accomplished with hand felling via chainsaws. Harvest in RHCAs would consist of 10.6 acres of mistletoe sanitation harvest, 145.7 acres of commercial thinning (HTH) and 1 acre of commercial thinning group selection (overall disturbance levels in RHCAs would be at a reduced 10 to 15 percent level due to site specific restrictions- see unit-specific project design criteria in Aquatics Report). What this means is that harvest treatments would occur only on approximately 10 to 15 percent of the listed RHCA acres. Fuels treatments proposed are 210 acres of hand piling (HP); 2,753 acres of jackpot burning (JKP); 5,794 acres of prescribed burning (RXF) and 853 acres of thin with fire (TWF).

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 mitigations and practices identified which will ensure that all activity units meet the soil standards (see Appendix C). This alternative also creates approximately 69.2 additional acres of detrimental soil impact due to construction of 5 miles of new temporary roads (9.1acres);19 miles of temporary roads on existing disturbance (43.7 acres); road reconstruction on 13 miles (23.7 acres) and 1 mile of new spec road construction (1.82 miles). Implementation of this alternative would result in approximately 142 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 51 of the units listed in Appendix B.

McKay Creek floodplain reconnection would occur on sites 2 and 4 along McKay Creek. This would consist of stream realignment and connection with the floodplain on 1.2 to 2.3 acres for Site 2 (along ca 2,700 feet of stream) and 2.4 to 3.6 acres of Site 4 along 4000 feet of stream. Stream activities would consist of construction of grade control structures, side vanes, j-hooks, flood plain benches 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 to 15 percent of the floodplain. Mitigation 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 3,564 acres of commercial thinning harvest, 0 acres of sanitation harvest for a total of 3,564 acres of ground based harvest. This alternative also proposes 2,951 acres of juniper thinning (JUT) and 5,507 acres of pre-commercial thinning (PCT) to be accomplished with hand felling via chainsaws. Harvest in RHCAs would consist of 136.8 acres of commercial thinning (HTH) (overall disturbance levels in RHCAs would be at a reduced 10 to 15 percent level due to site specific restrictions- see unit-specific project design criteria in Aquatics Report) What this means is that harvest treatments would occur only on approximately 10 to 15 percent of the listed RHCA acres. Fuels treatments proposed are 210 acres of hand piling (HP); 2,753 acres of jackpot burning (JKP); 5,342 acres of prescribed burning (RXF) and 853 acres of thin with fire (TWF).

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 mitigations and practices identified which will ensure that all activity units meet the soil standards (see Appendix B). Temporary road construction on existing disturbance would entail approximately 4.9 miles (1.82 acres/mile, 15 feet wide) = 8.9 acres of road impacts . New temporary road construction would entail approximately 0.8 miles (1.82 acres/mile, 15 feet wide) = 1.5 acres of road impacts. Reconstruction of existing road system would occur on 22.1 miles (40.2 acres). The total road disturbance proposed in this alternative is 27.9 miles (50.6 acres).

Implementation of this alternative would result in approximately 124 acres of tillage to alleviate detrimental soil compaction dependent on post-harvest monitoring. Tentative tillage is proposed in 55 of the units listed in Appendix B.

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

Mass Wasting

Portions of headwaters of Little McKay Creek and McKay 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

In all Action alternatives, the proposed treatments of precommercial thinning and prescribed burning would have no direct effects on increasing slope instability. Indirectly, the treatments would encourage increased growth of the vegetation, which will increase the evapotranspiration, thereby increasing the stability of the dormant landslide terrain.

For all the action alternatives, the primary concern from a mass wasting standpoint is for those units on dormant landslide terrain. Mapped landslide debris underlies 49 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 management prescriptions do not generally alter groundwater movement measurably, except in the vicinity of seeps and springs. The management activities 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 43).

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

	Alternative 2	**Alternative 3**	**Alternative 4**
Total Treated Acres within Dormant Landslide Terrain (tractor logging system)	1314	1274	1109
Total Treated Commercial Acres	*3776*	*4007*	*3571*
Percent of Treated Acres in Dormant	35%	32%	31%

Landslide Terrain			

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 44. Through the design elements and mitigation, the units identified will 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 44. Units with dormant landslide terrain by alternative.

Prescription	Unit	Alternative 2 (PA)	Alternative 3	Alternative 4
		Dormant Landslide Terrain acres	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres
HSA				
	81	**67.57**	**67.57**	**0**
	82	137.86	137.86	0
HTH				
	1	**38.92**	**38.92**	**38.92**
	11	21.26	21.26	21.26
	12	10.74	10.74	10.74
	13	**13.62**	**13.62**	**13.62**
	14	14.96	14.96	14.96
	152	17.16	17.16	17.16
	153	2.61	2.61	2.61
	154	44.81	44.81	44.91
	155	44.87	44.87	44.87
	157		5.34	
	16	3.38	3.38	3.38
	17	0.78		0.78
	19		0.78	
	2	**17.17**	**17.18**	**17.17**
	20	0.35	0.35	0.35
	21	55.95	55.95	55.95
	22	51.36	51.36	51.36
	23	19.08	19.08	19.08
	25	0.72	0.72	0.72
	26	71.93	71.93	71.93
	27	**86.17**	**41.17**	**86.17**
	28	13.83	13.83	0
	3	0.07	0.07	0.07
	30	44.67	44.67	0
	31	17.96	17.96	0
	32	20.57	20.57	0
	33	73.84	73.84	0
	34	27.54	57.54	27.54

	36	26.30	26.30	26.3
	37	5.58	5.58	5.58
	38	3.76	3.76	3.76
	39	0.42	0.42	0.42
	4	0.28	0.28	0.28
	41	0.29	0.29	0.29
	42	0.94	0.94	0.94
	45	**16.66**	**16.66**	**16.66**
	46	**75.85**	**75.85**	**75.85**
	47	27.56	27.56	27.56
	48	**6.16**	**6.06**	**6.16**
	49	**3.00**	**3.00**	**3.00**
	50	3.69	3.69	3.69
	51	**99.08**	**99.08**	**99.08**
	52	4.78	4.78	4.78
	6	33.98	33.98	33.98
	7	79.13	79.13	79.13
	88	7.01	7.01	7.01
Total Acres of Dormant Landslide Terrain		**1,314**	**1,274**	**938**

There are 10 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 1, 2, 13, 27, 45, 46, 48, 49 and 51. Unit 81 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 43), with the fewest 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 5,142 acres of dormant landslide terrain within the planning unit boundary. Alternative 2 proposes to commercially treat 26 percent (1,314 acres), Alternative 3 proposes treatment of 25 percent (1,274 acres) and Alternative 4 proposes treatment of 18 percent (938 acres). Alternatives 2 and 3 propose treating slightly more acres of dormant landslide terrain; the actual acres at risk are fewest in Alternative 4.

If seeps or springs are found in an activity unit, design criteria would result in an adequate buffer around the wet area to protect from additional compaction and reduce the risk of changes to the groundwater hydrology and initiation of slope movement.

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 will 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 areas less than 1 acre would be protected by a slope distance of 50 feet (INFISH, 1995). Unstable terrain and springs greater than 1 acre

would be protected by a buffer of 150 feet (INFISH, 1995). If there were 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 and for the reconstruction for the action alternatives (Table 45). 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 45. Proposed road miles on dormant landslide terrain for each alternative.

Road Type	Alt. 2 (PA) – Road Length on Dormant Landslide Terrain (Total) (Miles)	Alt. 3 – Road Length on Dormant Landslide Terrain (Miles)	Alt. 4 – Road Length on Dormant Landslide Terrain (Miles)
Existing Temporary Roads	2.64 (5.67)	2.6 (4.50)	1.91 (4.94)
New Temporary Roads	0.30 (1.05)	0.30 (1.05)	0.01 (0.76)
New Specified Road	0	0 (0.78)	0
Reconstruction of Specified Roads	9.14 (22.15)	9.14 (26.40)	11.06 (22.15)
Total Miles	**12.08 (28.87) = 42%**	**12.04 (32.73) = 37%**	**12.98 (27.85) = 47%**

Hydrology and Aquatic Species

Management Direction and Regulatory Framework

Direction for managing water quality and quantity, fisheries, aquatic habitat, and riparian areas on the Ochoco National Forest are found in:

- Ochoco National Forest Land Resource and Management Plan (USDA 1989)
- Forest Service Manual Title 2500 - Watershed and Air Management (FSM 1984),
- Forest Service Manual Title 2600 - Wildlife, Fish, and Sensitive Plant Habitat Management (FSM 1994)
- Decision Notice for the Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (INFISH, USDA 1995)
- Decision Notice for the Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH, USDA 1995)
- Endangered Species Act of 1973 (as amended),50 CFR § 402.12
- Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267)
- Code of Federal Regulations (36 CFR 219)
- General Water Quality Best Management Practices (BMP 1988)
- National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1 (USDA 2012)
- Clean Water Act (CWA 1972)
- Water Conservation Plan for the Ochoco National Forest (1996)

- 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
- Executive Orders 11988, 11990, 12088, and 12962
- Organic Administration Act of 1897

Goals, objectives, standards and guidelines, and best management practices from these documents have been incorporated into the project design. The following further discusses important guiding documents applicable to the project.

PACFISH and INFISH

In 1995 the Forest Service signed Decision Notices for the Inland Native Fish Strategy for the Intermountain, Northern, and Pacific Northwest Regions (USDA 1995; referred to as INFISH) and Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (USDA 1995; referred to as PACFISH). PACFISH and INFISH provide interim management direction to protect habitat and populations of native anadromous and resident fish. Direction in INFISH applies only in watersheds without anadroumous fish. Because the project area is within an anadromous fish-producing watershed, direction in PACFISH will apply.

Riparian Management Objectives

PACFISH established landscape-scale interim Riparian Management Objectives (RMO) that would be applied to watersheds with anadromous native fish. PACFISH also states that interim RMO may be modified to better reflect conditions that are attainable in a specific watershed or stream reach based on local geology, topography, climate, and potential vegetation. Modifications to RMO are to be made during a watershed analysis or site-specific analysis to provide the ecological basis for the change. The rationale supporting those changes and the effects of those changes should be documented. A McKay Creek Watershed Analysis was conducted in 2006 and an updated list of resource objectives, or "desired conditions," was developed. Some of the objectives listed in the watershed analysis were used to modify RMO for the project area. In some cases, RMO were modified based on scientific literature that was more relevant to the project area than the literature used to develop PACFISH interim objectives. The site-specific modifications to interim RMO, the rationale for the modifications, and effects of the modifications are listed in Table 46.

Table 46. Riparian Management Objectives applicable to the McKay Fuels and Vegetation Management Project. Site-specific objectives modify interim objectives.

Habitat Feature	Interim Objective from PACFISH	Modified Site-specific Objective	Rationale for Modification	Effects of Modification
water temperature	no measurable increase in maximum water temperature; maximum water temperatures below 64 degrees F within migration and rearing habitats and below 60 degrees F within spawning habitats	N/A	N/A	N/A
large woody material	>20 pieces per mile; >12 inch diameter; >35 foot length	>69 pieces/mile (Class I, II, III) >12 inches diameter >35 foot length[1]	modified using data from undisturbed reference streams in the Oregon Blue Mountain Range (Cordova 1995)	project will manage for greater amounts of large woody material in streams than the interim objective
		>48 pieces/mile (Class IV) >12 inches diameter >35 foot length[1]		

Habitat Feature	Interim Objective from PACFISH	Modified Site-specific Objective	Rationale for Modification	Effects of Modification
pool frequency	varies by channel width; Table 47	N/A	N/A	N/A
bank stability (non-forested systems)	>80 percent stable	interim objective used, even though project area is a forested system	this is a Forest Plan standard and should also be applicable to forested systems	modifying the RMO to include forested systems will now make the bank stability RMO applicable to the project area
lower bank angle (non-forested systems)	N/A (project area is a forested system)	N/A	N/A	N/A
width/depth ratio	<10, mean wetted width divided by mean depth	varies by channel type; see Table 48	modified using channel type as a better indicator of natural width to depth ratio (Rosgen 1996)	desired width to depth ratio by channel type will be more site-specific and applicable to the project area than the interim objective
native riparian vegetation	no interim objective	increase density of hardwood, shrub, and herbaceous vegetation based on site potential and plant association group; increase density of understory vegetation associated with sensitive plants along meadow and riparian edges	modified using site-specific objectives from the McKay Creek Watershed Analysis (2006)	project will manage for desired understory vegetation characteristics; where RMO conflict, interim RMO are given priority over added RMO
fine sediment	no interim objective	allow no more than a 10% cumulative increase in stream turbidity	this is a Forest Plan standard and an important objective	adding RMO won't change how we manage, but emphasizes the importance of limiting fine sediment

[1]Cordova (1995) doesn't show results for large wood frequencies with the same size class as the interim objective (>12 inch diameter; >35 foot length). Instead, Cordova includes all pieces over 1 meter in length in a wood frequency by diameter table (Cordova, Table 16). For moderately constrained channel types (most similar to Class I, II, and III streams in the project area), there was a frequency of 69 pieces per mile for pieces greater than 12" diameter. For constrained channel types (most similar to Class IV streams in the project area), there was a frequency of 48 pieces per mile for pieces greater than 12" diameter. Separate length and diameter frequency distributions (Cordova, Figure 7) indicate that roughly 50% of all wood pieces were over 35 feet in length and 37% of all wood pieces were over 12" diameter. Based on personal communications with Cordova, diameter was tightly correlated to length (i.e. the larger diameter pieces were more likely to be greater in length). Therefore, we are making the assumption that *most* of the pieces over 12" diameter were over 35 feet in length. Although 69 and 48 pieces per mile aren't an exact representation of the data, we feel it is a much better depiction of natural conditions than the interim objective of 20 pieces per mile.

Table 47. Interim objectives for pool frequency (PACFISH, USDA 1995).

Wetted width (feet)	10	20	25	50	75	100	125	150	200
Pools per mile	96	56	47	26	23	18	14	12	9

Table 48. Width to depth ratio by channel type (Rosgen 1996).

Channel Type	A	B	C	D	DA	E	F	G
Width/Depth Ratio	<12	>12	>12	>40	<40	<12	>12	<12

Riparian Habitat Conservation Areas

In addition to interim RMO, PACFISH also requires the delineation of interim Riparian Habitat Conservation Areas (RHCA), portions of watersheds 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. RHCA are defined as follows:

- Category 1 – Fish-bearing streams: Interim RHCA 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 slope distance, whichever is greatest.
- Category 2 – Permanently flowing non-fish-bearing streams: Interim RHCA 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, whichever is greatest.
- Category 3 – Ponds, lakes, reservoirs, and wetlands greater than 1 acre: Interim RHCA 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 to 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 edge of the maximum pool elevation of constructed ponds and reservoirs or 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 of the inner gorge, (c) the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation, (d) the area from the edges of the stream channel, wetland, landslide, or landslide-prone area slope distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

RHCA boundaries for the project area are defined in Table 49. *Stream category* has been converted to *stream class*, which is a more commonly used term. More complete definitions are given in Appendix B.

Table 49. RHCA boundaries by stream class, as defined in PACFISH.

Stream Class	Description	Width Each Side (feet)
I and II	Fish-bearing streams	300
III	Perennial (and select intermittent), non-fish bearing streams Ponds, lakes, reservoirs, and wetlands greater than 1 acre Unstable areas near water bodies	150
IV	Intermittent streams Wetlands less than 1 acre Landslides and landslide-prone areas	50

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.

Endangered Species Act

The Endangered Species Act (ESA) of 1973 requires federal agencies to consult with the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS) for activities that may affect an ESA-listed species or their habitat. Due to the proximity of the project area (greater than 39 miles) to bull trout, bull trout Critical Habitat, and Chinook salmon EFH, this project will have No Effect and consultation is not required. Because the Middle Columbia River steelhead above the Pelton Round Butte Hydroelectric Project on the Deschutes River were recently designated by NMFS as a Nonessential Experimental Population (NEP) under Section10(j) of the ESA (NOAA 50 CFR Part 223), consultation is not required. NEP are to be treated as a Proposed population, but because by definition a NEP is not essential to the continued existence of the species, no proposed action impacting a population so designated could lead to a jeopardy determination. Regardless of their status, effects to Middle Columbia steelhead and their habitat will be analyzed in this document because they are a Forest Management Indicator Species.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the

Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with the National Marine Fisheries Service on activities that may adversely affect Essential Fish Habitat (EFH). EFH for the Pacific coast salmon fishery means those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. The final rule of "Fisheries Off West Coast States; West Coast Salmon Fisheries; Amendment 14; Essential Fish Habitat Descriptions for Pacific Salmon" was published in the Federal Register, Vol. 73, No. 200, Wednesday, October 15, 2008. This rule designated EFH for Chinook salmon in the lower Crooked River up to Opal Springs Dam where there is currently no upstream fish passage. Chinook salmon EFH is over 50 miles from the project area and therefore the project will have “No Adverse Effects” on EFH. There will be no further analysis of EFH in this document.

Affected Environment

The entire project area is within the McKay Creek Watershed. Most of the project area is within the Upper McKay Creek Subwatershed, but some project activities are proposed in a portion of Lower McKay Creek Subwatershed and the Allen Creek Subwatershed. Hydrologic Unit Codes (HUC), which break drainage systems into progressively smaller areas, and subwatershed names within the project area are listed in Table 50.

The watershed terminates at the confluence of McKay Creek with the Crooked River about a mile and a half northwest of Prineville on US Highway 26. The Upper McKay Creek, Lower McKay Creek, and Allen Creek Subwatersheds consist of approximately 93, 24, and 4 percent of National Forest Lands, respectively. The McKay Creek watershed lies within Crook County.

Table 50. Hydrologic Unit Codes for the McKay Fuels and Vegetation project area.

Field	Area	Name	Hydrologic Unit Code
1st	Region	Pacific Northwest	17
2nd	Sub-Region	Middle Columbia River	1707

3rd	River Basin	Deschutes River	170703
4th	Subbasin	Lower Crooked River	17070305
5th	Watershed	McKay Creek	1707030505
6th	Subwatershed	Upper McKay Creek	170703050501
6th	Subwatershed	Allen Creek	170703050502
6th	Subwatershed	Lower McKay Creek	170703050503

Streams

Streams in the McKay Creek Watershed and within the project area have a dendritic drainage pattern with approximately 100 miles of mapped streams with defined channels (Class I-IV). For the purposes of this analysis, only Class I-IV streams are considered functional streams. Class V (or IX) streams do not have established beds and banks, are often covered with vegetation, and do not routinely transport sediment similar to the other classes of streams.

Table 51 lists named streams within the McKay Creek Watershed; stream names listed in bold are completely or partially located within the project boundary. There are approximately 27 miles of fish bearing streams (Class I and II) within the project boundary. Table 52 lists the lengths of streams by stream class within the project area summarized by subwatershed.

Table 51. List of named streams in the McKay Creek watershed by subwatershed. Stream names listed in bold are those that are completely or partially located within the project boundary.

Allen Creek Subwatershed	Lower McKay Creek Subwatershed	Upper McKay Creek Subwatershed
Allen Cr.	McKay Creek	**McKay Creek**
Rail Hollow	**Old Dry Creek**	**Little McKay Cr.**
Lofton Creek	Sawtail Canyon	**Miner's Gulch**
Kuiman Cr.	Sealy Creek	**Poppy Creek**
Turner Cr.	**Lincoln Canyon**	**Deer Creek**
Bogue Cr.	**Burn Creek**	
Fall Cr.	**Water Trough Canyon**	

The only Class I stream within the project area is McKay Creek and consists of approximately 1.7 miles of stream near the Forest boundary. The Upper McKay Creek Subwatershed encompasses a majority of the streams within the project boundary equating to approximately 72% of all streams.

Table 52. Stream class miles by subwatershed within the McKay Fuels and Vegetation Project boundary.

Subwatershed	Class I	Class II	Class III	Class IV	Total
Allen Creek	-	-	-	0.7	0.7
Lower McKay Creek	-	8.2	1.4	17.3	26.9
Upper McKay Creek	1.7	19.3	14.7	36.3	72.0
Total Stream Miles	**1.7**	**27.5**	**16.1**	**54.3**	**99.6**

The perennial streams equate to Forest Service Class I, II, and III streams. Class I and II streams may, however, be intermittent if they are used by fish part of the year. In addition, some intermittent streams are designated as Class III streams based on their contribution of flow to a higher class stream (Class I or II). Flow regime (i.e. perennial or intermittent) characteristics for the subwatersheds in the project area are summarized in

Table 53. Overall, streams in the project area are dominated by intermittent streams. Numerous streams are springfed streams including Deer Creek, Old Dry Creek, Miner's Gulch and numerous unnamed tributaries to Little McKay Creek and McKay Creek.

Table 53. Miles of perennial and intermittent streams in the project area.

Subwatershed	Stream	Perennial	Intermittent	Total
Allen Creek	No Name	-	0.7	0.7
Lower McKay Creek	Burn Creek	-	1.8	1.8
	Lincoln Canyon	-	2.2	2.2
	No Name	-	16.7	16.7
	Old Dry Creek	-	3.1	3.1
	Water Trough Canyon	-	3.0	3.0
Upper McKay Creek	Deer Creek	2.6	0.1	2.6
	Little McKay Cr.	6.3	0.5	6.8
	McKay Creek	5.0	1.9	6.9
	Miner's Gulch	2.0	-	2.0
	No Name	5.9	45.2	51.1
	Poppy Creek	-	2.5	2.5
Total		21.8	77.8	99.6

Aquatic Species

Management Indicator Species

Within the Wildlife and Fish Standards and Guidelines, the Forest Plan lists rainbow trout (*Oncorhynchus mykiss*) – both resident (redband trout) and anadromous (steelhead trout) – and brook trout (*Salvelinus fontinalis*) as aquatic Management Indicator Species (MIS). Direction in the Forest Plan for MIS is as follows:

- Determine if the species' use of the area is incidental or if it is essential habitat. If it is determined to be essential habitat protect it from adverse modifications through curtailment of conflicting activities, modification of activities, seasonal restrictions of activities, or avoiding the area.
- Provide habitat by managing as per Riparian Management Area (MA-F15) Prescriptions

Redband trout and steelhead trout are present in the McKay Creek watershed.

Brook trout, historically stocked by Oregon Department of Fish and Wildlife (ODFW) on the Ochoco National Forest, are non-native to the Deschutes River Basin. Brook trout are not currently stocked or managed for by ODFW, and are not part of ODFW's overall native fish policy. Brook trout are not present in the McKay Creek Watershed and will not be further discussed.

Threatened, Endangered, and Sensitive Species

Within the Wildlife and Fish Standards and Guidelines, the Forest Plan provides the following direction applicable to the project area for TES species:

- During environmental analysis of each project activity, available habitat, location records, and other information should be reviewed to determine whether known or suspected locations of sensitive species or their habitat occur.

- When suitable habitats or reported locations are suspected to occur in the area of influence of the project, a field reconnaissance will be performed to more precisely verify the presence, abundance, and distribution of the sensitive species.
- Identified safeguards will be clearly spelled out in the environmental analysis and project plan and project personnel will be fully responsible for being aware of and implementing them. Supervision of the activity must assure that the actions which jeopardize the species do not occur.

On December 9, 2011 an updated Region 6 Regional Forester Special Status Species list was released. Table 54 shows all of the species with documented or suspected occurrence on the Ochoco National Forest. There are other species categorized as "wildlife" and addressed in the wildlife report.

There are no aquatic species listed as endangered under the Endangered Species Act (ESA) on the Ochoco National Forest or in the Crooked River subbasin.

Bull trout

Bull trout (*Salvelinus confluentus*) are listed as threatened under the ESA. The closest population of bull trout are known to occur in the lower Crooked River up to Opal Springs Dam where there is currently no upstream fish passage. Bull trout Critical Habitat, however, extends upstream of Opal Springs Dam about 11 miles where Highway 97 crosses the Crooked River. Because the closest population is over 27 miles from the confluence of McKay Creek with the Crooked River and an additional 12 miles up McKay Creek to the project boundary, the project will have No Effect on bull trout or Critical Habitat and will not be further analyzed in this report.

Steelhead

The Deschutes River Basin once supported thriving steelhead runs. In 1964, the completion of Round Butte Dam—the most upstream dam of the three-dam Pelton Round Butte Hydroelectric Project—prevented significant numbers of juvenile steelhead from reaching the Pacific Ocean. With dwindling adult returns, fish passage was abandoned by 1968. This, among other challenges, prevented fish from accessing their historical spawning and rearing habitat and contributed to the decline of Middle Columbia River steelhead. In 1999, NMFS listed Middle Columbia River steelhead as threatened under the Endangered Species Act.

Table 54. Aquatic species on the 2011 USFS Region 6 Regional Forester Special Status Species list that may occur on the Ochoco National Forest.

Species	Evolutionarily Significant Unit or Distinct Population Segment	Listing Category	Type of Occurrence on Ochoco NF	Potentially Present in Project Area and Analyzed in this Report
Bull trout (*Salvelinus confluentus*)	All	Federally Threatened	Documented	No
Steelhead (*Oncorhynchus mykiss)*	Middle Columbia River	Nonessential Experimental Population[1] (Proposed); Ochoco NF Management Indicator Species	Documented	Yes
Redband trout (*Oncorhynchus mykiss* ssp.)	Malheur Lakes	Sensitive in Oregon; Ochoco NF Management Indicator Species	Documented	Yes
Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*)	All	Sensitive in Oregon	Documented	No
Columbia spotted frog (*Rana luteiventris*)	Outside Great Basin	Sensitive in Oregon	Documented	Yes

Species	Evolutionarily Significant Unit or Distinct Population Segment	Listing Category	Type of Occurrence on Ochoco NF	Potentially Present in Project Area and Analyzed in this Report
Crater Lake tightcoil (*Pristiloma arcticum crateris*)	N/A	Sensitive in Oregon	Documented	No
Western ridged mussel (*Gonidea angulate*)	N/A	Sensitive in Oregon and Washington	Suspected	No
Harney basin duskysnail (*Colligyrus depressus*)	N/A	Sensitive in Oregon	Suspected	No
Shortface lanx (*Fisherola nuttalli*)	N/A	Sensitive in Oregon	Suspected	No
Indian Ford juga (*Juga hemphilli* ssp. nov.)	N/A	Sensitive in Oregon	Suspected	No
Columbia clubtail (*Gomphus lynnae*)	N/A	Sensitive in Oregon	Suspected	Yes
A caddisfly (*Namamyia plutonis*)	N/A	Sensitive in Oregon	Suspected	No
[1]Listing status of Middle Columbia River steelhead above Round Butte Dam has changed since the 2011 list was released; this table reflects that change.				

Today, efforts are underway to reintroduce steelhead to the upper basin. Reintroduction efforts are part of a new operating license for the Pelton Round Butte Hydroelectric Project, which included a fish passage requirement and a plan to reintroduce Middle Columbia River steelhead above the project. Portland General Electric and the Confederated Tribes of Warm Springs are co-owners of the project, and together they developed solutions to facilitate fish passage. With safe upstream and downstream passage available, reintroducing steelhead will help re-establish a self-sustaining population and contribute to the species' recovery. Since 2008, steelhead fry from the Round Butte Hatchery have been released annually into the Crooked River, Ochoco Creek, and McKay Creek. In 2012, the first adult steelhead returned to the Crooked River to spawn and were subsequently passed over Opal Springs Dam with a temporary trap and haul system.

In January 2013, Middle Columbia River steelhead (*Oncorhynchus mykiss*) above the Pelton Round Butte Hydroelectric Project on the Deschutes River were designated by the National Marine Fisheries Service (NMFS) as a Nonessential Experimental Population (NEP) under Section10(j) of the ESA (Federal Register, 2013). They were given this designation as part of an ongoing reintroduction effort in the upper Deschutes River basin. The geographic boundaries of the NEP extend upstream from Round Butte Dam to the Crooked River from its confluence with the Deschutes River upstream to Bowman Dam and all accessible tributaries between these points, including McKay Creek. Under Section 10(j), a NEP is to be treated as a proposed species. The McKay watershed is identified as one of the headwater tributaries to the Crooked River that is important for steelhead recovery. Effects to Middle Columbia River steelhead will be analyzed in this report as an ESA-proposed species and as a Management Indicator Species (MIS).

Redband trout

Redband trout (*Oncorhynchus mykiss* ssp.) of the Malheur Lakes Species Management Unit (SMU) are listed as Sensitive in Oregon. This SMU is documented on the Ochoco National Forest in the Silver Creek and Silvies River drainages in the far southeast corner of the Forest. This SMU is not located in the project area. However, because little is known about the population of redband trout in the project area, we are still considering them as Sensitive. Within the project

area, redband trout are present in Class I and II streams (Appendix A, Figure 2). Effects to redband trout will be analyzed in this report as a Sensitive species and as a MIS.

Westslope cutthroat trout

Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) are listed as Sensitive in Oregon and are documented to occur on the Ochoco National Forest. All westslope cutthroat trout in Oregon exist only in the John Day River Basin. These populations are disjunct from the greater contiguous distribution in the Upper Missouri and Columbia basins of Montana and Idaho (ODFW 2005). Because they are not present in or near the project area, there will be No Impact to westslope cutthroat trout and will not be further analyzed in this report.

Columbia spotted frog

There are currently four recognized Distinct Population Segments (DPS) of Columbia spotted frogs (*Rana luteiventris*): Northern, Great Basin, Wasatch, and West Desert. Columbia spotted frogs within the Northern DPS are considered to be abundant; however, the other three DPS (Great Basin, Wasatch, and West Desert) are either declining or almost extirpated. Currently, only the Great Basin DPS that occurs in Oregon (Malheur, Lake, Harney and possibly Grant Counties) are considered a candidate species by the US Fish and Wildlife Service (USFWS 2009). The DPS found on the Ochoco National Forest are part of the Northern DPS and not listed as a candidate species under the ESA. They are, however, listed as Sensitive in Oregon. Effects to Columbia spotted frog will be analyzed in this report.

Crater Lake tightcoil

The Crate Lake tightcoil (*Pristiloma arcticum crateris*) is a small snail known to occur throughout the Oregon Cascades Range from Mt. Hood National Forest in the north to the Umpqua and Winema National Forests in the south (Gowan and Burke 1999). They are listed as Sensitive in Oregon. There is no data stating known or suspected locations of tightcoil on the Ochoco National Forest (NatureServe Explorer). Because they are not present in or near the project area, there will be No Impact to Crater Lake tightcoil and will not be further analyzed in this report.

Western ridged mussel

The western ridged mussel (*Gonidea angulate*), listed as Sensitive in Oregon and Washington, is known to occur in the Crooked River about 30 miles downstream from the project area (Freshwater Mollusk Conservation Society). Extensive streams surveys have been conducted on McKay Creek and its tributaries and no mussels were identified. Because the closest known population is likely 30 miles downstream from the project area, the project will have No Impact on the western ridged mussel and will not be further analyzed in this report.

Harney basin duskysnail

The Harney basin duskysnail (*Colligyrus depressus*), listed as Sensitive in Oregon, is only known to occur in the Silvies River drainage in Harney County, Oregon (NatureServe Explorer). Because they are not present in or near the project area, there will be No Impact to Harney basin duskysnail and will not be further analyzed in this report.

Shortface lanx

The shortface lanx (*Fisherola nuttalli*) is a freshwater snail found in cold, unpolluted, well-oxygenated, permanent medium-sized streams to large rivers, at least 30 to 100 meters wide. They occur on diatom covered rocks in main channels or fast-flowing streams (Neitzel and Frest 1989). The nearest potential habitat would be the Crooked River over 12 miles downstream of the project boundary. Because they are not present in or near the project area, there will be No Impact to shortface lanx and will not be further analyzed in this report.

Indian Ford juga

The Indian ford juga (*Juga hemphilli* ssp. nov.), listed as Sensitive in Oregon, is a medium-sized snail found from a single site in Indian Ford Creek on the Deschutes National Forest (NatureServe Explorer). Because this is the only known site and is not near the project area, there will be No Impact to Indian Ford juga and will not be further analyzed in this report.

Columbia clubtail

The Columbia clubtail (*Gomphus lynnae*) is a medium-sized dragonfly listed as Sensitive in Oregon. Only five populations are known, one on the Yakima River in Washington, one on the Owyhee River in Oregon, and three on the John Day River system in Oregon. This dragonfly can be found in a variety of river habitats, which can range from sandy or muddy to rocky, shallow rivers with occasional gravelly rapids, but water flow tends to be slow-moving (Paulson 1999). Although Columbia clubtail have not been documented in the project area, there is potential habitat in the project area. Therefore, effects to Columbia clubtail will be analyzed in this report.

A caddisfly

A caddisfly (*Namamyia plutonis*) has been documented in the Coastal and Cascade Ranges of Oregon and California on the Rogue River-Siskiyou, Siuslaw, and Willamette National Forests (Anderson 1976). Currently, fewer than 30 locations are known to contain this caddisfly, which occurs in low numbers. N. plutonis tend to be found associated with small streams in densely forested old growth or mature forest watersheds (Scheuering 2006). Because dense forested old growth or mature forest habitat does not exist in the project area, there will be No Impact to N. plutonis and will not be further analyzed in this report.

Analysis Design - Watershed, Water Quality, and Aquatic Habitat

Table 55 lists all of the habitat indicators that will be analyzed and gives specific criteria that will determine how well each indicator is functioning at the watershed-scale. Some criteria were defined by the National Marine Fisheries Service in the Matrix of Pathways and Indicators (NMFS 1996), some criteria were established by the interim Riparian Management Objectives in PACFISH, and some were modified based on site-specific conditions (Table 46).

Table 55. Criteria for habitat indicator condition rating.

Pathway	Habitat Indicator	Properly Functioning (PF)	Functioning At Risk (FAR)	Not Properly Functioning (NPF)
Water Quality	**water temperature (RMO[1])**	50-57°F	57-64°F	>64°
	fine sediment/turbidity (RMO)	<12% fines at surface (silts/organics)	12-20% fines at surface (silts/organics)	>20% fines at surface (silts/organics)
	chemical contamination/ nutrients	low levels of chemical contamination, no excess nutrients, no CWA 303d designated reaches	moderate levels of chemical contamination, some excess nutrients, one CWA 303d designated reach	high levels of chemical contamination, high levels of excess nutrients, more than one CWA 303d designated reach
Habitat Access	**physical barriers**	any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements	**substrate**	dominant substrate is gravel	gravel is subdominant	bedrock, sand, silt or small gravel dominant

Pathway	Habitat Indicator	Properly Functioning (PF)	Functioning At Risk (FAR)	Not Properly Functioning (NPF)
	large woody material (RMO)	>69 pieces/mile (Class I, II, III) >12 inches diameter >35 foot length >48 pieces/mile (Class IV) >12 inches diameter >35 foot length	currently meets standards for properly functioning, but lacks potential sources from riparian areas of large wood recruitment to maintain that standard	does not meet standards for properly functioning and lacks potential large wood recruitment
	pool frequency (RMO)	meets pool frequency standards	meets pool frequency standards but large wood recruitment inadequate to maintain pools over time	does not meet pool frequency standards
	pool quality	pools >1 meter deep with good cover and cool water; minor reduction of pool volume by fine sediment	few deep pool >1 meter present or inadequate cover/temperature; moderate reduction of pool volume by fine sediment	no deep pool >1 meter present and inadequate cover/temperature; major reduction of pool volume by fine sediment
	off-channel habitat	backwaters with cover and low energy off-channel areas	some backwaters and high energy side channels	few or no backwaters or off-channel ponds
	refugia	habitat refugia exist and are adequately protected by intact riparian areas; existing refugia are sufficient in size, number, and connectivity to maintain viable populations	habitat refugia exists but are not adequately protected by intact riparian areas; existing refugia are insufficient in size, number, and connectivity to maintain viable populations	adequate habitat refugia do not exist
Vegetation Conditions in Riparian Habitat Conservation Areas	**native riparian vegetation (RMO)**	riparian vegetation provides adequate large wood recruitment, habitat protection, and connectivity in all subwatersheds; percent similarity of riparian vegetation to the potential natural community/composition >50%	moderate loss of large wood recruitment, habitat protection, and connectivity; percent similarity of riparian vegetation to the potential natural community/composition 25-50%	riparian vegetation is fragmented, poorly connected, or provides inadequate protection of habitat; percent similarity of riparian vegetation to the potential natural community/composition <25%
	shade	>80% stream shade	70-80% stream shade	<70% stream shade
Channel Condition & Dynamics	**width/depth ratio (RMO)**	varies by channel type	within 1 number of width/depth ratio for channel type	greater than 1 number outside of width/depth ratio for channel type
	bank stability (RMO)	>90% stable	80-90% stable	<80% stable
	floodplain connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas;

Pathway	Habitat Indicator	Properly Functioning (PF)	Functioning At Risk (FAR)	Not Properly Functioning (NPF)
		functions, riparian vegetation and succession	relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	wetland extent drastically reduced and riparian vegetation/succession altered significantly
Hydrology	**change in peak/base flows**	peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed
	increase in drainage network	zero or minimum increases in drainage network density due to roads	moderate increases in drainage network density due to roads	significant increases in drainage network density due to roads
Watershed Condition	**road density/location**	<2 mi/mi², no valley bottom roads	2-3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads
	disturbance history	<25% EHA (National Forest portion of the watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area	<25% EHA (National Forest portion of the watershed) but some disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area	>25% EHA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area

Some criteria were defined by the National Marine Fisheries Service in the Matrix of Pathways and Indicators (NMFS 1996), some criteria were established by the interim Riparian Management Objectives in PACFISH, and some were modified based on site-specific conditions (Table 46).

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified (see Table 46).

Water Quality

Stream Temperature

Aquatic species viability within the project area is limited by habitat quantity and quality, particularly water temperature. Temperatures have increased due to channelization and incision of stream channels, loss of riparian vegetation providing shade, removal of large woody material, and removal of beavers. Redband trout have been found to typically be present in small- to medium- sized streams between 50°F (10°C) and 61°F (16°C), outside of this range they are less likely to be present (Meyer et al. 2010).

The Oregon Department of Environmental Quality (ODEQ) has designated streams in the McKay Creek Watershed for salmon and trout rearing and migration (ODEQ, Oregon Water Quality Standards Fish Use Maps, Figure130A). No streams in the project area were designated for salmon and steelhead spawning (ODEQ, Oregon Water Quality Standards Fish Use Maps, Figure130B). The state standards (340-041-0028, approved by EPA Mar 2004) say the seven-day-average maximum temperature of streams identified as having salmon and trout rearing and migration should not exceed 18.0ºC (64.4ºF). The state of Oregon assumes that waters meeting this standard will provide water temperatures suitable for redband trout spawning. In addition, treatments have been designed to not measurably increase the 7-day moving average daily maximum water temperature on any adult holding habitat or spawning or rearing habitat in the project area.

Within the project area there are several streams with assessed water quality impairments related to summer water temperature. These include McKay Creek (RM 0.0 to 19.5) and Little McKay Creek (RM 0.0 to 6.7). These streams are on Oregon's 2010 Section 303(d) List of "Water Quality Limited Waterbodies." The Oregon State Water Quality Standards states that the seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use including the streams within the planning area, may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit). No measurable increase in water temperature from management practices is allowed in these streams based on the Forest Plan.

In order to compare the proposed alternatives relative to stream temperatures in the McKay Fuels and Vegetation Management Project area, monitored summer stream temperatures within and directly adjacent to the project boundary were compiled and 7-day-average maximum temperatures were determined for all sites. When all or most 7-day-average maximum temperatures fell between 50 and 57 degrees Fahrenheit, it was given a condition rating of Properly Functioning. If most sites 7-day average maximum temperatures ranged between 57 and 64 degrees Fahrenheit the condition was determined to be Functioning at Risk. Finally, if 7-day-average maximum temperatures consistently exceeded 64 degree Fahrenheit, then the existing condition was determined to be Not Properly Functioning.

Fine Sediment/Turbidity

Turbidity is the degree to which suspended material in the water impedes light penetration. Turbidity is expressed in Nephrometric Turbidity Units (NTUs). There can be a close correlation between turbidity and suspended sediment in a given stream, but the correlation can change as organic material increases over the summer or if the percent of sediment from different sources in the drainage changes. The correlation is poor in sediment-limited systems. Turbidity is not a good indicator of the amount of sediment being transported as bedload. Generally, turbidity levels between 25 to 50 NTU can result in reduced growth or emigration of salmonids (Sweka and Hartman 2001). Most measurable effects to aquatic life result from sediment instead of turbidity.

Current State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. There is no quantitative standard for sediment in the current Oregon DEQ water quality rules. The Narrative Criteria section (340-041-0007-12); however, states that activities can not result in the formation of appreciable organic or inorganic deposits deleterious to fish or other aquatic life but this is more of an objective than a standard. The state appears to be using turbidity as a surrogate for sediment. Sources of suspended sediment in small forest streams include both internal and external sources (Gomi et al. 2005). Internal sources that frequently occur include channel substrate, sediment wedge, bank deposits, headward channel extension, soil subsurface erosion. Potential effects from timber harvest activities to internal sources include changes in flow response, channel roughness as a result of slash entrainment, substrate and sediment wedge. External sources of suspended sediment in small streams that frequently occur include slope surface erosion and bank erosion. Potential effects from timber harvest activities to external sources include road fill failures (mass movement), road surface, cut slope, fill, and ditch, slash burning, wind throw in riparian buffer, tree/wood death and decay, soil compaction and soil clearing by yarding (Gomi et al. 2005). Many studies have identified roads as the dominant source of erosion relative to other timber harvest activities (Gomi et al. 2005, Surfleet et al. 2011, Belt et al. 1992). Luce and Black found that little sediment was eroded from most road segments, but just a few road segments produce a large amount of the sediment (1999).

The amount of sediment actually delivered to the stream is the component of surface erosion that affects the aquatic species habitat. Magnitudes of sediment delivery are primarily controlled by overland flow characteristics and vegetative filtering (Croke and Hairsine, 2006). Sediment delivery to the stream channel is of a particular concern in semi-arid climates. Semi-arid climates, such as the climate found in Central Oregon, are expected to be elevated relative to

other climates as a results of these climates having sufficient precipitation to drive erosion, but limited amounts of vegetation that stabilize hillslopes from erosion (Goode et al. 2012). Generally, vegetated filter strips between 200 to 300 feet from the stream are considered to be effective in controlling sediment that is not channelized depending upon the riparian buffer slope (Belt et al. 1992).

The numerous organisms forming the base of the aquatic food chain find shelter and habitat in the open spaces within stream gravel and cobble. Filling these spaces with sediment reduces the habitable volume of the stream. As sediment sources and delivery exceeds 20 percent of the total area on the substrate, deposits within the larger cobble material of the streambed produce an embedded channel, with consequent loss of aquatic habitat. Gravel embeddedness of less than 20 percent is essential to maintain a healthy salmonid population, particularly in those areas identified as potential or existing spawning areas (Bjorn and Reiser, 1991). If fine sediment exceeds 20 percent, the spaces between the rocks in the substrate are filled and oxygenation of eggs is reduced. Reduced oxygenation results in reduced success of fish and frog eggs surviving.

Estimates of the percent of surface substrate which is composed of silt and organics were compiled from the ODFW aquatic inventory data (2005 and 2007). These data were then weighted by reach length and averaged by subwatershed. These weighted average fine sediment percentages were then compared to the criteria in Table 55 to determine whether the water quality in the streams in each subwatershed appear to be Properly Functioning, Functioning at Risk or Not Properly Functioning relative to fine sediment in streams.

Chemical Contamination/Nutrients

Oregon water quality standards are benchmarks established to assess whether the quality of rivers and lakes is adequate for fish and other aquatic life, recreation, drinking, agriculture, industry and other uses (i.e. beneficial uses). When chemicals or nutrients are released into streams at levels that are impede the stream's beneficial uses, those chemicals or nutrients become a pollutant to the stream. Water quality standards are also regulatory tools used by ODEQ and the Federal Environmental Protection Agency (EPA) to prevent pollution of Oregon waters.

ODEQ assessed water quality in Oregon to meet the federal Clean Water Act Section 305(b) and Section 303(d) requirements to provide an Integrated Report on Oregon's surface waters. ODEQ prepared Oregon's 2010 Integrated Report in phases and submitted a final 2010 Integrated Report to EPA in May 2011. EPA approved the submitted 303(d) listings and de-listings on March 15, 2012 but also disapproved DEQ's submittal for not including other waters. EPA proposed additions to Oregon's 2010 303(d) list and completed its process and took final action on Oregon's 2010 303(d) list on December 14, 2012 by adding 870 listed segments.

With EPA's action, the listings/de-listings approved in March 2012 and listings added in December 2012 complete Oregon's 303(d) list and the list can be used for Clean Water Act purposes.

Included in the listings added to Oregon's 303(d) list in December 2012 were McKay Creek for Escherichia Coli (E. Coli) from its mouth to river mile 14.7 and for pH from its mouth to river mile 19.5 based on field monitoring and water sampling from July and August of 2005.

The presence of E. Coli, a type of bacteria that makes up one genus of fecal coliform, strongly indicates recent sewage or animal waste contamination. Potential sources of E. Coli in McKay Creek include cattle, wildlife, and humans. In order to help identify the dominant source for E. Coli in the streams, a better understanding of the grazing patterns, the wildlife migration habits, and the human activity patterns would be required.

Various journal articles relate elevated bacteria concentrations in surface water to significant hydrologic events or other substrate disturbing event (Solo-Gabriele et al., 2000; Stephenson and Rychert, 1982; Sherer et al., 1992; McDonald and Kay, 1981; Craig et al., 2004). Substrate

disturbing events, other than due to a significant hydrologic event, include disturbance by cattle or wildlife in the stream or possibly human activity in the stream. The most significant hydrologic/substrate disturbing event is the 'first flush' or the first major runoff event that flushes the fecal material into the stream. After the 'first flush', this relationship of elevated bacteria concentrations to substrate disturbing events is predominately based on the difference in survival of bacteria within the water column as compared to the bacteria that is adsorbed to the sediment in the stream bottom. The rate at which bacteria die-off in the water column is much greater than the rate at which bacteria adsorbed to sediment die-off (Sherer et al., 1992). This difference in die-off rates results in a higher concentration of bacteria remaining in the substrate material while the bacteria concentrations in the water declines, only to increase when the sediments are disturbed or during a runoff event when new inputs of bacteria are added to the stream. Sherer et al. also conclude that this adsorption of bacteria to sediment allows the bacteria to survive for months in these streams as opposed to days as previously thought (1992). Small sediment particle size (i.e. fine sediment) increases E. Coli survival (Howell et al. 1996). Another factor affecting the survival of the bacteria in the stream is water temperature, according to Craig et al. (2004), the survival of E. Coli in freshwater has been identified to be greater at lower temperatures. In addition to lower temperatures, Howell et al.(1996) found that fecal coliform mortality rates declined as sediment particle-size shrank.

The reason that the EPA and ODEQ consider pH levels and their effect on water quality is based on the understanding that the largest variety of aquatic organisms prefer a pH range of 6.5-8.0. pH values outside of this range result in stresses on most organisms, potentially resulting in reduced reproduction (EPA 2013).

Habitat Access

Physical Barriers

Aquatic organism passage through artificial barriers in streams is critical to maintaining connectivity among habitat. Culverts and other barriers can also degrade habitat by altering or limiting the downstream movement of sediment, large woody material, and other organic material. Connectivity is important because anadromous salmonids migrate upstream and downstream during their lifecycle; in addition, many resident salmonids and other aquatic species move extensively upstream and downstream to seek food, shelter, better water quality, and spawning areas. Where these barriers occur, fish can no longer reach suitable habitat. By reducing the amount of accessible habitat in a watershed, fish populations may be limited.

Based on the Matrix of Pathways and Indictors developed by NMFS (1996), habitat access is considered Properly Functioning if any man-made barriers present in a watershed allow upstream and downstream fish passage at all flows; it is considered Functioning at Risk if any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows; and it is considered Not Properly Functioning if any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows.

Habitat Elements

Large Woody Material

Large woody material (LWM) is widely recognized as a major element in the physical and biological structure of forested stream ecosystems (McDade et al, 1990). LWM also affects the routing of other watershed products, particularly sediment, and their influence on ecosystems. By concentrating and dispersing hydraulic forces, LWM can greatly diversify physical conditions in streams and provide habitat for various species and age classes in aquatic communities (Lisle 2002). Native salmonids and other aquatic organisms have evolved in steam systems where LWM and fluvial processes develop and maintain suitable channel morphology for all or part of their life stages. LWM helps retain organic and inorganic particulate matter that is important for

channel stability, biological diversity, and productivity. It also plays an important role in pool formation. Within the watershed, the majority of pools are formed and maintained by LWM.

For LWM frequency, PACFISH gives an interim objective of at least 20 pieces per mile. The natural amount of LWM reflects differences in physical processes that shape valley floors and the subsequent successional stages of terrestrial plant communities on these geomorphic surfaces. These processes vary across broad spatial scales. Reference conditions for LWM have been documented in streams of unmanaged, mix conifer forests in the Oregon Blue Mountains (Cordova 1995), a physiographic province more similar to the McKay Creek Watershed. We will use LWM frequencies from this study, instead of the PACFISH interim objective, as the standard for the McKay Creek Watershed.

On page 93 of Cordova (1995), Table 16 shows wood frequency by wood diameter for all pieces over 1 meter in length. The PACFISH interim objective for wood frequency is based on wood over 12 inches diameter and over 35 feet long. Because Cordova doesn't give results for wood frequency with the same size class as the PACFISH interim objective, the following assumptions were made:

- Cordova shows separate length and diameter frequency distributions (1995, Figure 7) that indicate roughly 50% of all wood pieces were over 35 feet in length and 37% of all wood pieces were over 12" diameter.
- Based on personal communications with Cordova, diameter was tightly correlated to length (i.e. the larger diameter pieces were more likely to be greater in length).
- Therefore, we are making the assumption that *most* of the pieces over 12" diameter were over 35 feet in length.

Based on these assumptions, we will use the wood frequencies given in Table 16 (Cordova 1995) as our Riparian Management Objective and the measure for Properly Functioning. In moderately constrained channel types (typical of Class I, II, and III streams in the project area) LWM frequencies greater than 69 pieces per mile is considered Properly Functioning; in constrained channel types (typical of Class IV streams in the project area) LWM frequencies greater than 48 pieces per mile are considered Properly Functioning. Streams that currently meet LWM frequency standards for Properly Functioning, but lack potential sources of LWM recruitment to maintain that standard are considered Functioning at Risk. Streams that do not meet standards for Properly Functioning and lack potential LWM recruitment are considered Not Properly Functioning.

Pool Frequency and Quality

Pools can be either freely formed by the interaction of flow and sediment transport or forced by local obstructions, such as boulders and LWM, which cause flow convergence and turbulent velocity fluctuations that scour the channel bed. Extensive literature documents the influence of LWM on channel morphology in forested mountain streams. In small channels, individual pieces of LWM trap sediment, cause local bed and bank scour, and create step pools. In larger channels, LWM accumulations locally influence bed and bank scour, side channel development, bar stability, and island formation (Montgomery et al 1995). Channels without LWM can quickly evolve to very simple forms. Moderately sized channels with gradients of about 1 to 4 percent are particularly prone to simplify, because they have a weak tendency to form bars and pools without exogenous structure (Montgomery and Buffington 1997). These conditions typify the fish-bearing streams in the project area. Pool depth and complexity are also a function of sediment routing. Large pulses of sediment moving through a stream system can restrict pool depth and ultimately limit habitat capability.

Pools provide critical habitat for salmonids and other aquatic species. Salmonid production is typically greatest in streams with a pool-to-riffle ratio of approximately 1: 1. Pools are inhabited throughout the year by adult and juvenile salmonids and are important as refuge from high flow

or frozen conditions during the winter (Raleigh et al 1984). Pools differ in their ability to provide resting areas and cover; Lewis (1969) found that streams with deep, low velocity pools containing extensive cover had the most stable trout populations.

The frequency and volume of pools is dependent on stream gradient and drainage area, generally as stream size (order) increases, pools become larger but more infrequent. PACFISH gives interim objectives for pool frequency based on channel width (Table 47). These values are used as Riparian Management Objectives for the project and as condition criteria. Streams that meet pool frequency standards outlined in Table 47 are considered Properly Functioning. Streams that meet pool frequency standards but large wood recruitment is inadequate to maintain pools over time are considered Functioning at Risk. Streams that do not meet pool frequency standards are considered Not Properly Functioning.

Based on the Matrix of Pathways and Indictors developed by NMFS (1996), pool quality is considered Properly Functioning if there are numerous pools greater than1 meter deep with good cover and cool water and only minor reduction of pool volume by fine sediment. Streams with only a few pools greater than1 meter deep or inadequate cover or cool temperatures, and a moderate reduction of pool volume by fine sediment are considered Functioning at Risk. Streams with no pools greater than 1 meter deep and inadequate cover or cool temperatures, and a major reduction of pool volume by fine sediment are considered Not Properly Functioning.

Substrate

Substrate plays an important role relative to salmonid spawning and nourishment. For a stream channel to be properly functioning relative to salmonid spawning, adequate spawning gravels are needed. Typically redband trout redds are located at pool tailouts, where well sorted gravels typically occur (Muhlfeld 2002). According to Muhfeld, size classes for gravels selected by redband trout ranged between 2-6 mm (i.e. very fine to fine gravel). In addition to particular substrates needed for spawning, substrates conducive to hyporheic flow are also needed to sustain macroinvertebrates, a major component of nourishment for fish (Richards and Bacon 1994). Studies indicate that macroinvertebrate biodiversity is the highest in pebbles (i.e. gravels) relative to other substrate, particularly finer substrates (Duan et al. 2008). Gravels provide the appropriate porosity and interstice dimensions ideal for macroinvertebrate taxa richness and density. Very fine sediment in the form of silts, clays, and organics can deposit in the interstices of gravels resulting in spawning gravel embeddedness, poor egg survival, and reduced macroinvertebrate habitat (Young et al. 1991; Richards and Bacon 1994).

Channel material sizes and distributions depend upon many factors in a stream channel. Substrate sizes depend on quantities of erosion, the geology of the watershed, the streamflow hydrology, as well as the amount of wood roughness. Fine sediment, as well as some courser material, can be eroded from streambanks, roads, hillslopes, and the streambed. Varying sizes of material are carried by the streamflow depending upon the magnitude of flow and whether it’s on the rising or falling limb of the hydrograph. Generally, lower flows tend to only carry very fine sediments; whereas, bankfull flows and higher tend to move larger particle sizes. In addition, incised channels have more stream power and therefore tend to carry larger channel materials compared to unimpaired reference channels. Stream velocities and channel morphology play a key role in where the gravels are deposited spatially. Generally, suitable spawning gravels in steeper, upper-mainstem have been found to be controlled by wood roughness in the form of LWM (Buffington et al. 2004).

Dominant substrate sizes were derived from ODFW aquatic inventory data for all three subwatersheds in the McKay Watershed and compared to the criteria in Table 55. Dominant substrate types for each reach surveyed were identified as the surface channel material size that made up the highest percentage of the overall surface channel material. The dominant substrate size that most of the reaches within the subwatershed exhibited was selected as the overall

dominant substrate size for that subwatershed. The relative dominance of gravel substrates were then evaluated to determine whether the streams within each subwatershed are Properly Functioning, Functioning at Risk or Not Properly Functioning (Table 55).

Off-Channel Habitat

Off-channel habitat such as freshwater sloughs, alcoves, side channels, ponds, wetlands, and other permanently or seasonally flooded areas are important habitat for salmonids, amphibians, and other aquatic organisms. However, off-channel habitat normally associated with floodplains have been routinely isolated or altered by floodplain and hillslope activities such as logging, agriculture, urbanization, grazing, flood control, and transportation (Roni et al 2002).

Extensive literature documents the influence of LWM on channel morphology in forested mountain streams, including the formation of off-channel habitat. In small channels, individual pieces of LWM trap sediment, cause local bed and bank scour, and create step pools with areas of low energy. In larger channels, LWM accumulations locally influence bed and bank scour, side channel development, bar stability, and island formation (Montgomery et al 1995). Channels without LWM can quickly evolve to very simple forms.

Based on the Matrix of Pathways and Indictors developed by NMFS (1996), off-channel habitat is considered Properly Functioning if streams have backwaters with cover and low energy off-channel areas. Streams that have some backwaters and high energy side channels are considered Functioning at Risk. Streams with few or no backwaters or off-channel ponds are considered Not Properly Functioning.

Refugia

According to Sedell et al (1990) habitat or environmental factors that convey spatial and temporal resistance and/or resilience to biotic communities that have been impacted by biophysical disturbances may be called refugia. There are various kinds of refugia at different spatial scales that function differently for different types and magnitudes of disturbance. At the channel unit and reach scale, important refugia include deep pools, backwater areas, side channels, and woody material. These habitat features provide areas of protection from disturbance events. In general, more complex channels are more likely to serve as refugia than less complex ones. LWM plays a large role in the formation of refugia.

Thermal refugia for cold-water dependent species like salmonids can be very important, particularly in arid landscapes. Periods of high stream temperatures during midsummer can elevate metabolic demands and induce mortality in fish, particularly if these temperatures persist for several days. High water temperatures can effectively limit the longitudinal distribution of fish within streams, restrict seasonal migration patterns, and fragment populations within a watershed by isolating suitable thermal habitats (Ebersole et al, 2001).

Based on the Matrix of Pathways and Indictors developed by NMFS (1996), streams in which habitat refugia exist and are adequately protected by intact riparian areas and sufficient in size, number, and connectivity to maintain viable populations are considered Properly Functioning. Streams in which habitat refugia exist but are not adequately protected by intact riparian areas and insufficient in size, number, and connectivity to maintain viable populations are considered Functioning at Risk. Streams in which adequate habitat refugia do not exist are considered Not Properly Functioning.

Vegetation Conditions in Riparian Habitat Conservation Areas

Native Riparian Vegetation

Interactions between riparian forests and streams influence the biological community and physical conditions found in each system. Streams influence forest conditions that create riparian forest communities different from upland forests in species composition and structure, and

conversely, riparian forests influence stream conditions (Meleason et al 2003). Interactions between terrestrial and aquatic ecosystems include modification of microclimate, alteration of nutrient inputs from uplands, contribution of organic material to steams and floodplains, and retention of those inputs (Gregory et al 1991). Allochthonous inputs (organic matter from outside the channel – i.e. litterfall, LWM, etc.) are critical to stream ecosystem function. Coniferous, deciduous, shrub, and herbaceous litterfall are important drivers of stream productivity. Hardwoods are considered the most productive food source (quickly decompose, rich in nitrogen) while conifer needles are considered less desirable (slower decomposition, lower nutrients) (Benda et al 2011). Also, terrestrial insects, which are an important component in the diet of salmonids, occur in higher abundance in deciduous forests. In small, fish-bearing streams, terrestrial invertebrates can account for about half of the diet of salmonids during the summer and fall. Openings in the canopy may increase primary productivity, biomass, and diversity of aquatic invertebrates, and thus biomass of fish. However, excess light and temperature may lead to blooms of filamentous green algae, which can depress invertebrate stocks.

This organic material must also be retained within a stream to serve as either nutritional resources or habitat for most aquatic organisms. LWM along with smaller branches trap organic material in transport, making it available for consumption by the biological community.

Riparian plant communities reflect complex disturbance histories – floods, wildfires, wind, and insect and disease outbreaks – and therefore exhibit a high degree of structural and compositional diversity (Gregory et al 1991). Thus, allochthonous inputs to streams are also highly variable and governed by different recruitment processes – mortality, bank erosion and landsliding. Depending on which process is dominant, the source distance of LWM and other allochthonous inputs to the stream varies greatly (Benda and Bigelow 2011).

Protection of riparian source areas that deliver allochthonous material to streams has been a major component of National Forest Plans, including the Ochoco National Forest Land and Resource Management Plan. During the last couple of decades, riparian protection in the form of prescriptive uniform no-treatment (or minimal treatment) buffers has been the prevailing paradigm in watershed management The uniform buffer concept is widely used because of its simplicity in regulation and compliance, but uniform buffers are generally not designed to account for riparian functions that are naturally variable including wood loading, thermal loading, biological productivity, aquatic habitat quality, wildlife use and wildfire risk. Uniform buffers, therefore, may not effectively provide protection based on ecological processes, and may not address other restoration needs such as accelerated recovery of young, dense forest stands to ones with old forest structure or increased susceptibility of riparian forests to wildfire, insects and disease outbreaks that may occur due to altered fire regimes or changing climate. Uniform buffers may also limit management activities that could improve riparian and aquatic habitat (Benda et al 2011).

Because of high physiographic variation along riparian areas, tailoring riparian management to site-specific conditions may more effectively protect ecological processes. For example, larger protective buffers could be targeted in areas that are currently well-functioning riparian and stream systems, and smaller protective buffers could be targeted in areas that are poorly-functioning and could benefit from restorative management activities. This may include management activities that create fire breaks within riparian zones to reduce the risk of fire transmission into other sensitive riparian areas, and manipulate forest density, forest age, or species composition to increase food availability to aquatic organisms (Benda et al 2011).

Besed on the Matrix of Pathways and Indictors developed by NMFS (1996), riparian vegetation that provides adequate large wood recruitment, habitat protection, and connectivity in all subwatersheds, and percent similarity of riparian vegetation to the potential natural community/composition is greater than 50% is considered Properly Functioning. A moderate loss of large wood recruitment, habitat protection, and connectivity, and percent similarity of riparian

vegetation to the potential natural community/composition is 25-50% is considered Functioning at Risk. Riparian vegetation that is fragmented, poorly connected, or provides inadequate protection of habitat and percent similarity of riparian vegetation to the potential natural community/composition is less than 25% is considered Not Properly Functioning.

Stream Shade

Stream shading is one of the top environmental conditions related to redband trout densities based on a study by Meyer et al. (2010). Stream shade not only contributes to lower stream temperatures, but it also affects the habitat quality of the stream by providing improved cover for trout or increased invertebrate food supply.

Reductions in solar input resulting from shading are a primary factor affecting stream temperature. The term "stream shade" often refers to all shade on any part of the stream that blocks solar input to the stream channel. Shade functions (Beschta, et al., 1987) generally occur within 100-200 feet of the channel. Stream shade is primarily a function of stream orientation, channel width, tree heights adjacent to the stream, and ground slope above the bankfull channel. Very little if any shade is provided to the stream from trees located on the north side of east-west trending streams (Zwieniecki and Newton 1999; Ice 2001).

Shade is measured with a Solar Pathfinder 2 above water surface at mid-channel. Shade is recorded for hardwoods (include alder, aspen, sage brush, current, snowberry, etc.) as well as overall shade that includes tree species and steep valleys. Shade values for a channel reach are determined by placing this instrument above the channel midpoint, reading areas across the curve that display a reflection of trees or other shading features, and summing the values for those shaded areas.

On the Ochoco National Forest, the Forest Plan standards and guidelines direct that at least 80 percent of stream surfaces should be shaded, or that 100 percent of potential shade levels should be present when 80 percent shade cannot be attained (e.g. open wet meadow areas). Stream shade comes from adjacent conifer forests, topographic shading in steep drainages, or riparian vegetation near the stream. Open meadow areas are common in the watershed and have a low potential for meeting the 80 percent shade criteria due to the absence of bordering forest and hillsides. Sources of shade in open meadows generally include; sedges, rushes and other riparian vegetation that tends to flourish where the water table is high most of the year.

Existing condition of stream shade in McKay Creek Fuels and Vegetation Project Streams were compiled from stream surveys and rated as poor, fair, or good. A Properly Functioning rating indicates that stream shade is meeting Forest Plan Standards (i.e. > 80 percent), a Functioning at Risk rating indicates stream shade estimates between 70 and 80 percent, and a Not Properly Functioning rating is associated with stream shade of less than 70 percent.

Channel Condition and Dynamics

Width/Depth Ratio

Width/Depth ratio is the ratio of the bankfull surface width to the mean bankfull depth of the channel. This ratio is important to the understanding of the distribution of flows within the channel and their ability to move sediment (Rosgen 1996). This is one of the most sensitive indicators to changes in channel stability as a result of disturbance to channels or watersheds. As width/depth ratios increase, the channel becomes wider and shallower, resulting in higher bank erosion. Increased sediment supply from increased bank erosion then results in a loss in the capability of the channel to transport the same amount of sediment, further accelerating bank erosion.

Ideally, to determine whether a stream channel is properly functioning relative to its width/depth ratio, reference reaches within the same channel types and hydro-physiographic regions should be

surveyed to determine appropriate ranges. Identifying these reference reach sites and collecting the reference reach data is an intensive process; therefore, this data is unavailable for the McKay Creek Watershed. In absence of this reference reach data, width/depth ratios used by Rosgen for classification of primary stream types were used to assess whether the surveyed stream channels within the McKay Watershed were Properly Functioning, Functioning at Risk, or Not Properly Functioning (Table 48).

Bank Stability

Soil disturbance on ridges or side slopes may never affect water quality, but disturbance of a channel bed or bank is immediately reflected in downstream sediment levels. Unstable stream banks associated with mechanical disturbance (including trampling), loss of vegetative root strength, decreases in roughness associated with large woody material (LWM) and vegetation removal, or stream banks of incised streams are highly susceptible to changes in flow or sediment load. These stream banks can account for most of the sediment load in a drainage system. If the discharge and/or the sediment load are substantially increased, the flow may erode the streambanks or deposit sediment to reach a new equilibrium. A high incidence of raw banks (i.e. cutbanks), headcuts, and/or braided channels (Rosgen channel type D) are indicative of unstable stream banks.

Environmental effects of unstable streambanks include increased turbidity and sediment yield, development of cutbanks, and changes in channel morphology. The result of these changes may result in water quality conditions that are lethal to aquatic organisms. Changes in channel morphology would primarily be seen with changes in entrenchment and width to depth ratios (Marcuson 1977, Duff 1979). Streams with unstable banks typically erode laterally (i.e. become wider and shallower), which increases the width to depth ratio. See soils report (2005) for additional descriptive information on soil erosion, channel erosion, bank erosion, and overland flow from compaction and/or displacement.

The percent of stable bank was derived from a combination of data sources of actively eroding banks (ODFW 2005 and 2007) and measurements of cutbank (BLS and Level II over multiple years). Percent of stable banks was weighted by length and averaged by subwatershed to assess existing condition of each subwatershed relative to bank stability using Table 55. The effects analysis was based on anticipated changes to habitat elements, channel condition and dynamics, and hydrology relative to the existing condition.

Floodplain Connectivity

Historically, it was a common practice to straighten stream channels with the intention of flood control. As a result; however, by straightening the stream channels, channel lengths decrease and stream slopes increase, effectively increasing flow velocities and shear stress. Higher shear stress cause channel incision and lowering of the stream base level, effectively disconnecting the stream channel from its floodplain. Once the floodplain is inactivated, all flood flows must be contained within the channel, resulting in even higher shear stress and bank erosion, as well as lowering of the shallow water table. By deepening the water table and disconnecting the floodplain from the stream channel, riparian vegetation density and diversity results (Stromber et al. 2007).

A combination of professional judgment, field observations, aerial photography interpretation, and the use of LiDAR elevation data were used to qualitatively assess conditions relative to channel straightening and floodplain connectivity. To assess priority floodplain reconnection project activities (Alternative 3), estimates of anticipated disturbance as well as anticipated long-term impacts to channel condition, hydrology, habitat elements, and riparian vegetation were evaluated.

Hydrology

Change in Peak/Base Flows

Even with the variable nature of weather and precipitation events, undisturbed stream hydrographs exhibit a repeatable pattern relative to their peak flow and base flow recession characteristics and magnitudes unique to their watershed based on geology and geography. These hydrograph characteristics can be altered through anthropogenic changes to the watershed including introduction of impervious surfaces, road building, irrigation withdrawals, impoundments, and changes to floodplain and wetland environments (Arrigoni et al. 2010; Croke and Hairsine 2006).

Hydrographs were not available for most of the McKay Watershed; however, information form the McKay Watershed Assessment Hydrology Report and local knowledge of the area was used to determine the existing condition of the watershed relative to Table 55. Anticipated changes to the hydrograph from the McKay Fuels and Vegetation Project Alternatives were evaluated relative to anticipated changes in disturbance relative to the anthropogenic changes listed above.

Increase in Drainage Network

Roads have the potential to increase the drainage density of a stream network by intercepting runoff at stream crossings or by channelizing flow that would otherwise be sheet flow or groundwater flow (Wemple at al. 1996; Jones et al. 2000; Takken et al. 2008). By increasing the drainage density and providing a more direct route to stream channels, roads in effect can decrease the time it takes for the precipitation, in the form of runoff, to enter the stream channel and potentially resulting in increased peak flows (La March and Lettenmaier 2001; Storck et al. 1998; Woldie et al. 2009). Areas with high road densities, high drainage densities, and a high density of stream crossings typically result in higher connectivity of the road and stream network. The effects of roads (or trails) on increased peak flows is expected to be greatest downstream of areas with a high density of stream crossings (Jones et al., 2000).

In order to address potential effects of increased drainage densities within the McKay Fuels and Vegetation Project Area, the existing condition and alternative conditions of road densities, drainage densities, and intermittent and perennial stream crossing densities were estimated and rated relative to one another for each analysis subwatershed.

Road Density

Road densities were determined for the existing condition by estimating the total miles of Operational Maintenance Level 1-5 Roads within the analysis subwatershed and dividing this length my the total drainage area of the subwatershed in square miles. These values for road densities were then given a rating of low, moderate, or high. Low for road densities <2 miles per square mile, moderate for 2-3 miles per square mile), and high for > 3 miles per square mile. Closed roads (Level I) were included in the analysis, since road closures typically consist of installing a blockage of some sort at the road entrance to prevent use rather than stabilized hydrologically (i.e. obliterated). Closed roads, therefore, can still have the potential to increase the drainage network. For alternative analysis, temporary and new network road miles were added to existing condition road miles, to determine the overall road densities. These values were then rated using the same values as for the road density existing condition.

Drainage Density

Drainage densities were determined for the existing condition by estimating the total miles of intermittent and perennial streams within the analysis subwatershed and dividing this length by the total drainage area of the subwatershed in square miles. Based on the overall ranges from other subwatersheds within the Ochoco National Forest (Ochoco Summit OHV Draft EIS), these values for drainage densities were then given a rating of low, moderate, or high. Low for

drainage densities <2.2 miles per square mile, moderate for 2.2-2.5 miles per square mile, and high for drainage densities > 2.5 miles per square mile.

Stream Crossing Density

The existing condition relative to stream crossing density was determined by dividing the total number of intermittent and perennial stream crossings by the drainage area in square miles. Each of these factors was given a low, moderate, or high rating based on the number of crossings per subwatershed drainage area. Based on the overall ranges from other subwatersheds within the Ochoco National Forest (Ochoco Summit OHV Draft EIS), subwatersheds with more than 3.5 crossings per square mile of drainage area were considered high, between 2.5 and 3.5 crossings per square mile were considered moderate, and less than 2.5 crossings per square miles were considered low. To analyze the McKay Fuels and Vegetation Proposed Action and the alternatives, the number of new stream crossings and the number of existing road/stream crossings per subwatershed drainage area were assessed relative to the stream channel's existing condition.

The subwatershed road density, drainage density and the stream crossing density ratings were combined to estimate an overall condition for the subwatershed relative to potential increases in the drainage network from roads. Generally, the ratings for road density and stream crossing density were averaged and considered against the existing drainage density. Higher drainage densities have the potential to exacerbate moderate and high road densities and stream crossing densities. However, if road and stream crossing densities are low, then a high drainage density did not affect the overall rating. Ratings for the alternative analysis were based on the same values as for existing condition. Departure from existing condition could then be evaluated.

Watershed Condition

Road Density and Location

Roads are a major source of erosion and stream sedimentation on forested lands. Roads can increase erosion rates and turbidity three orders of magnitude greater than the undisturbed forest condition (Grace, 2003). Sediment eroded from the road prism can be delivered to a forest stream, resulting in increased turbidity, sediment loads, and degraded habitat for fish. Research has shown that roads have the greatest effect on erosion relative to other forest management practices (Megahan and King, 2004; Surfleet et al., 2011).

Location to the stream can make a large difference in whether sediment eroded from a road surface is actually delivered to a stream.

Road Density

Road densities were determined as described in the Increase in Drainage Network section of the Analysis Design above. Closed roads (Level I) were included in the analysis, since road closures typically consist of installing a blockage of some sort at the road entrance to prevent use rather than stabilized hydrologically. Closed roads, therefore, can still contribute sediment to stream channels (Elliot 2000). For alternative analysis, temporary, new network, and reconstructed decommissioned road miles were added to existing condition road miles, to determine the overall road/trail densities. These values were then rated using the same values as for the road density existing condition. Departure from existing condition could then be evaluated.

Location

The location of the road relative to the stream channel is also an important factor that effects whether sediment is actually delivered to the stream. Roads further from the stream typically have longer hillslopes and therefore longer overland flowpaths between the road and the stream (Croke and Hairsine 2006). Long hillslopes typically mean a higher likelihood that the vegetated

hillslope will induce infiltration or dissipate overland flow resulting in sediment deposition on the hillslope and less sediment delivery to the stream.

In order to incorporate road location in the existing condition and effects analysis, mapped road locations relative to the stream channel were considered along with road densities to assess watershed condition relative to roads.

Disturbance History

The Ochoco National Forest developed a formula to rapidly depict how much of the area in a watershed could be in a "Equivalent Harvest" condition and not cause a cumulative increase in water yield that would adversely affect channel condition in average or above average runoff years. The Forest Plan Standards and Guidelines indicate a threshold of 30% for the McKay Watershed; however, the hydrology report for the McKay Watershed Analysis recommended a reduced threshold of 25%. EHA condition exceeding 25% would indicate that the watershed is not properly functioning relative to water yield and conditions less than 25% would indicate either a functioning at risk or a properly functioning condition relative to water yield. If some of the disturbances are concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area, then the watershed is considered to be functioning at risk. Availability of historic timber harvest activity is limited to within the Ochoco National Forest, so only those portions of the McKay Watershed were used to calculate EHA.

Disturbance history is also a factor of the amount of historic disturbance was concentrated in potentially unstable areas and/or refugia and/or riparian areas. In order to address this, the percentage of area in landslide terrain and overlapping RHCAs were considered. For the effects analysis of the McKay Fuels and Vegetation Project alternatives, percentages of units overlapping landslide terrain or RHCAs was considered in order to determine the functioning condition of the McKay Watershed.

Analysis Design – Aquatic Species

Project activities have the potential to impact aquatic species through modification of habitat that may affect a species' population size and distribution, growth and survival, life history diversity and isolation, and persistence and genetic integrity. The analysis design for evaluating modification of habitat has previously been explained. Once effects to habitat have been analyzed, the potential effects to each species will be discussed and an effects determination will be made. The species that are present in the project area or have potential habitat in the project area are listed in Table 56.

Table 56. Aquatic species on the 2011 USFS Region 6 Regional Forester Special Status Species list that occur or have potential habitat in the project area.

Species	Evolutionarily Significant Unit or Distinct Population Segment	Listing Category
Steelhead (*Oncorhynchus mykiss)*	Middle Columbia River	Nonessential Experimental Population (Proposed); Ochoco NF Management Indicator Species
Redband trout (*Oncorhynchus mykiss* ssp.)	Malheur Lakes	Sensitive in Oregon; Ochoco NF Management Indicator Species
Columbia spotted frog (*Rana luteiventris*)	Outside Great Basin	Sensitive in Oregon
Columbia clubtail (*Gomphus lynnae*)	N/A	Sensitive in Oregon

Existing Condition – Watershed, Water Quality, and Aquatic Habitat

This section provides a summary (Table 57) and description of the existing watershed, water quality and habitat conditions of the McKay Creek Watershed. The habitat indicators used are key components of healthy, properly functioning, stream ecosystems. The criteria for condition ratings (Table 55) were defined by the National Marine Fisheries Service in the Matrix of Pathways and Indicators (NMFS 1996), and modified slightly by Riparian Management Objectives (Table 46).

Table 57. Summary of existing condition ratings at the watershed scale.

Pathway	Habitat Indicator	Existing Condition
Water Quality	**water temperature (RMO[1])**	NPF
	fine sediment/turbidity (RMO)	PF
	chemical contamination/ nutrients	FAR
Habitat Access	**physical barriers**	NPF
Habitat Elements	**substrate**	Allen Creek and Upper McKay Creek Subwatersheds: FAR Lower McKay Creek Subwatershed: PF
	large woody material (RMO)	NPF
	pool frequency (RMO)	Allen Creek and Upper McKay Creek Subwatersheds: NPF Lower McKay Creek Subwatershed: FAR
	pool quality	Lower McKay Creek Subwatershed: PF Allen Creek Subwatershed: FAR Upper McKay Creek Subwatershed: NPF
	off-channel habitat	FAR
	refugia	NPF
Vegetation Conditions in Riparian Habitat Conservation Areas	**native riparian vegetation (RMO)**	NPF
	shade	NPF
Channel Condition & Dynamics	**width/depth ratio (RMO)**	PF
	bank stability (RMO)	Allen Creek and Lower McKay Creek

Pathway	Habitat Indicator	Existing Condition
		Subwatersheds: NPF Upper McKay Subwatershed: FAR
	floodplain connectivity	NPF
Hydrology	**change in peak/base flows**	FAR
	increase in drainage network	Allen Creek Subwatershed: NPF Lower McKay Subwatershed: PF Upper McKay Subwatershed: FAR
Watershed Conditions	**road density/location**	Allen Creek and Upper McKay Creek Subwatersheds: FAR Lower McKay Creek Subwatershed: PF
	disturbance history	PF

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified (see Table 46).

Condition ratings, Properly Functioning (PF), Functioning at Risk (FAR), and Not Properly Functioning (NPF), are defined by criteria from the Matrix of Pathways and Indicators (NMFS 1996), and modified slightly by RMO (Table 46).

Bottom Line Surveys (BLS) were conducted between 1991 and 2001 on the Ochoco National Forest perennial and intermittent streams to determine if a streamside management unit was in compliance with the riparian zone standards and guidelines. These surveys included measurements of shade, large woody material, cutbanks, and pools.

USFS Region 6 Level II Stream Inventory surveys were conducted between 1989 and 2011 on the Ochoco National Forest perennial streams to quantify existing riparian and aquatic ecosystem conditions on a basin-wide scale.

Oregon Department of Fish and Wildlife (ODFW) have also conducted stream inventory surveys since 1990. Data collection focuses on channel and valley morphology, riparian characteristics and condition, and in-stream habitat. Data for the McKay Watershed were collected in Allen Creek, Little McKay Creek, and McKay Creek and select tributaries in 2005 and 2007. Since BLS and Level II Stream Inventory data are only collected on National Forest land, the ODFW data were used to evaluate many of the indicators relative to the criteria discussed in Table 55 in order to include an understanding of the baseline conditions of the Allen Creek and Lower McKay Creek Subwatersheds.

Existing condition of subwatersheds was also determined as part of the Watershed Condition Framework (WCF) process. Numerous attributes were rated and combined to determine an overall rating for the following indicators on the National Forest Land: aquatic biota condition, riparian/wetland vegetation condition, water quality condition, water quantity condition, aquatic habitat condition, road and trail condition, soil condition, forest cover condition, forest health condition, terrestrial invasive species condition, and rangeland vegetation condition. These indicator ratings were then combined to determine an overall watershed condition on Forest Lands within each subwatershed on the Ochoco National Forest. Overall, the Upper McKay Creek Subwatershed was determined to be Functioning at Risk as a result of poor water quality conditions and road and trail conditions and fair conditions relative to riparian/wetland vegetation condition, aquatic habitat condition, and rangeland vegetation condition. Lower McKay, within the 24 percent of the subwatershed within the forest boundary, was determined functioning properly; however, road and trail conditions were also poor and riparian/wetland vegetation condition, aquatic habitat condition and rangeland vegetation condition are fair. Allen Creek

Subwatershed was not assessed since only a very minor portion of the subwatershed is located within the Ochoco National Forest.

Water Quality

Water Temperature

Table 58 summarizes the Seven-Day-Average Maximum Water Temperatures measured between 1994 and 2009 using thermistors at multiple locations in streams within the Upper McKay Subwatershed and within McKay Creek Fuels and Vegetation Project Area. No thermistor data is available from streams within the Lower McKay or Allen Creek Subwatersheds. Temperatures exceeded the state stream temperature threshold of 64.0°F at all sites. Stream temperature thresholds were only exceeded two of the six maximum summer temperatures at the highest elevation site on McKay Creek (MK 4428). In addition, the Oregon's 303(d) list indicates that McKay Creek from its mouth to river mile 19.5 and Little McKay Creek from its mouth to river mile 6.7 are impaired relative to stream temperatures. These consistent instances of stream temperature thresholds and the 303(d) listing of McKay Creek and Little McKay, indicate that streams in the Upper McKay Subwatershed and Lower McKay Creek Subwatershed are not properly functioning relative to stream temperature. Stream temperature information and data were not available for streams in the Allen Creek Subwatershed.

Impaired stream temperatures are likely a result of a combination of factors. These factors include grazing in riparian areas, impaired wetland and meadow conditions, and incised channels disconnected from their floodplains.

Table 58. Seven-Day Average Maximum Water Temperatures in Degrees Fahrenheit* (1994-2009).

Stream	Site ID	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Deer	DM3693						75.9										
Little McKay	LM3672		70.7	72.86	73.22	73.22	73.6[D]	73.8	74.3	76.3	74.7[D]	73.9	72.7 [D]	75.7	75.4	71.6	72.9[D]
Little McKay	LM3777												72.0	74.1	76.5	73.2	77.7 [D]
Little McKay	LM3977		65.1	66.38	60.8												
Little McKay	LM4093												76.5		75.9	69.3	73.8
Little McKay	LM4177		75.6	72.86													
Little McKay	LM4256												67.5	69.4	66.0	65.3	67.6
McKay	MK3454	78.4	72.1	73.94	72.14	73.22	72.7	75.4	70.0	77.7	88.0[D]	73.6	73.4	75.2	76.8	70.5[D]	73.4 [D]
McKay	MK3679	75.2	73.0	73.04	73.04	73.94	72.0	70.7	69.1	71.2	70.9	69.6		72.1	69.3	66.6	66.7 [D]
McKay	MK3851												68.0	69.6	67.6	65.7	67.5
McKay	MK3909		72.6	73.22													
McKay	MK4100			67.46													
McKay	MK4428												59.2	69.1	61.0	58.5	59.4

* Temperatures exceeding state standards are bolded.

[D] = Stream went dry at thermistor location or thermistor out of water at time of retrieval

Fine Sediment/Turbidity

Fine sediment consisting of silts and organics are relatively low in the Allen Creek and Upper McKay Subwatersheds based on 2007 Oregon Department of Fish and Wildlife (ODFW) aquatic survey substrate data. Surface substrate material in Allen Creek consisted of approximately 2.5% fines (silt/organics) and in Lower McKay Creek of approximately 1.5% fines. All of the ODFW stream reaches monitored were Properly Functioning relative to fine sediment deposition, likely resulting from stream types that are generally less sensitive to disturbance and the watershed geology.

A large percentage of the existing road networks within the Allen Creek and Upper McKay Creek Subwatersheds are located within 300 feet of perennial or intermittent streams, while identified roads in Lower McKay are less concentrated near streams. Allen Creek Subwatershed has approximately 29 miles of road located within 300 feet of streams, Lower McKay Creek has approximately 18 miles of road located within 300 feet of streams, and Upper McKay Creek has approximately 23 miles of road located within 300 feet of streams; equating to approximately 70%, 34%, and 88% of the road network, respectively.

Chemical Contamination/Nutrients

In the summer of 1997 and 1998, the Oregon DEQ collected water samples in the Deschutes Basin above Lake Billy Chinook for chemical analysis, as part of the EPA sponsored Regional Environmental Monitoring and Assessment Program (REMAP). Samples were collected on NFS lands in Little McKay Creek and McKay Creek. Numerous parameters were considered. Results showed that the Biological Oxygen Demand (BOD), which measures organic pollution, exceeded desirable conditions on McKay Creek at RM 14.3. As part of this effort, a water quality index (WQI) was developed and water quality for a site was then categorized as 0-59 = very poor, 60-79 = poor, 80-84 = fair, 85-89 = good, and 90-100 = excellent. McKay Creek had a water quality index of 77 and Little McKay had an index of 87. A more detailed description of procedures, results, and conclusions can be found in the chemistry summary of the “Upper Deschutes River Basin REMAP” (Oregon DEQ 1999).

In addition, the EPA added listings to the Oregon’s 303(d) list in December 2012 that included McKay Creek *for E. coli* from its mouth to river mile 14.7 and for pH from its mouth to river mile 19.5 based on field monitoring and water sampling from July and August of 2005.

Since *E. coli* is an organic pollutant, it is possible that *E. coli* in McKay Creek is resulting in poor water quality relative to Biological Oxygen Demand. The source of *E. coli* concentrations in streams is typically from sewage or animal waste. Possible sources in McKay Creek could be from improper waste disposal at dispersed camp sites, cattle grazing near the stream, or wildlife in the stream. The specific source of the *E. coli* concentrations in McKay is currently unknown.

The cause for pH levels in McKay Creek that do not fall within the Oregon water quality criteria is unclear. Without historic background levels of pH, it is difficult to say what the departure of current pH levels are from natural. The pH of natural water depends on several factors, including geology, soil type, bicarbonate buffering, as well as pollutants.

Currently, only the mainstem of McKay Creek is on the 303(d) list for the pollutant of *E. coli* and for pH levels that do not fit within the water quality criteria. Based on this and that there is no indication that excess nutrients are a concern within the McKay Creek Watershed, the existing condition of the McKay Watershed is considered to be Functioning At Risk based on the criteria provided in Table 55.

Habitat Access

Physical Barriers

Numerous in-stream barriers associated with irrigation withdrawals were created between the 1850s and 1983 in the McKay Creek Watershed, preventing fish from moving freely, year-round between upper and lower McKay Creek and its tributaries. Over allocation of water rights in McKay and Allen Creeks generally results in complete withdrawal of all stream flow on private land below the NF boundary during late summer and early fall. Many diversion points are presently unscreened and result in fish kills in irrigation ditches each year. On private land in-holdings, approximately 1.25 miles above the NF boundary, a reservoir impoundment on lower Deer Creek isolates a subpopulation of redband trout. This subpopulation is no longer able to interbreed with redband trout in McKay Creek.

Some culverts in the watershed are also physical barriers to fish movements (i.e., they create velocity barriers, are subject to subsurface flow, are subject to plugging, were placed in a manner that prevents fish passage, or are causing channel incision due to gradient).

Headcuts impede fish passage to headwater habitat. One active headcut moving up Miner's Gulch is approximately 5 feet high. Other known headcuts occur on two McKay Creek tributaries, three Little McKay Creek tributaries, and in Poppy Creek.

Due to the numerous human-caused barriers at a range of flows, this indicator is considered Not Properly Functioning.

Habitat Elements

Substrate

Substrate composition directly affects the productivity of fish, particularly in spawning sites where gravels free of fine sediment are necessary for egg survival. Substrate data collected in the McKay Watershed indicate that dominant substrates range from gravels to cobbles and that fine sediments are relatively low. Gravel channel material dominates in Lower McKay Creek, indicating that it is Properly Functioning relative to substrate. Allen Creek and Upper McKay Creek, however, are dominated by cobble substrates and gravel is subdominant, indicating that they are Functioning at Risk based on the criteria listed in Table 55.

Large Woody Material

Table 59 provides large woody material (LWM) frequencies for surveyed streams in the McKay Creek watershed. Because the standard is greater than 48 pieces per mile on Class IV streams and 69 pieces per mile on Class I, II, and III streams, this indicator is considered Not Properly Functioning for all streams surveyed.

Table 59. Large woody material frequency in surveyed streams (ODFW, 2007).

Stream	LWM pieces/mile	Condition Rating
Lower McKay Creek	<1	Not Properly Functioning
Upper McKay Creek	3	Not Properly Functioning
Upper McKay Creek Tributaries	19	Not Properly Functioning
Little McKay Creek	11	Not Properly Functioning
Little McKay Creek Tributaries	44	Not Properly Functioning
Allen Creek	<1	Not Properly Functioning
Deer Creek	2	Not Properly Functioning

Pool Frequency and Quality

Pools are lacking in the McKay Creek Watershed due to a loss of stream features that would normally contribute to scouring of the stream bed to form pools. Removal of large wood near streams for timber harvest and removal of debris jams directly interacting with stream flows, combined with removal or relocation of large boulders from stream channels after the 1964 flood event, greatly reduced pool habitat. The loss of beaver in the McKay Creek Watershed also contributed to a reduction in pools.

Stream inventory surveys have been conducted on a large portion of streams in the McKay Creek Watershed. Survey data on bankfull width and pools per mile are shown in Table 60, and given a condition rating accordingly. Pool frequency for streams in the Lower McKay Creek Subwatershed is Functioning at Risk and Not Properly Functioning in Upper McKay and Allen Creek Subwatersheds.

Table 60. Average pool frequency and bankfull width for streams in the McKay Creek Watershed and associated condition rating.

Stream	Average Bankfull Width (feet)	Average Pools/Mile	Condition Rating
Lower McKay Creek	27	44	Functioning At Risk
Upper McKay Creek	17	38	Not Properly Functioning
Upper McKay Creek Tributaries	6	27	Not Properly Functioning
Little McKay Creek	9	11	Not Properly Functioning
Little McKay Creek Tributaries	8	16	Not Properly Functioning
Allen Creek	13	21	Not Properly Functioning
Deer Creek	7	10	Not Properly Functioning

Pool quality is a function of depth; deeper pools tend to have colder temperatures and better rearing habitat for fry and juveniles. The standard for pool quality is numerous pools greater than 1 meter deep with good cover and cool water.

Table 61 shows the number of pools greater than 1 meter deep on major streams within the McKay Creek Watershed. Lower McKay Creek has 35 pools greater than 1 meter deep, not due to LWM frequency (<1 piece per mile), but because of a much lower gradient and a channel type more conducive to deeper scour pools (C-type channel); therefore pool quality is considered Properly Functioning. Streams within Upper McKay Creek Watershed – Upper McKay, Little McKay, and Deer Creeks – have only 1 combined deep pool and is therefore considered Not Properly Functioning. Allen Creek has 3 deep pools and is therefore considered Functioning at Risk.

Table 61. Number of pools greater than 1meter deep.

Stream	Pools >1 meter deep	Condition Rating
Lower McKay Creek	35	Properly Functioning
Upper McKay Creek	0	Not Properly Functioning
Little McKay Creek	1	Functioning At Risk
Allen Creek	3	Functioning At Risk
Deer Creek	0	Not Properly Functioning

Off-Channel Habitat

Off-channel features such as alcoves and side channels can have important ecological functions in streams. Some species and age classes of fish may select these features instead of the main

channel to feed, avoid predation by other fish, escape fast water, or seek out cool water in the summer. Other organisms such as amphibians, mussels, and birds may also be attracted to alcoves and side channels because of unique physical and water quality characteristics.

All streams surveyed in the McKay Creek Watershed were considered constrained channels, so potential for off-channel habitat is somewhat limited. Table 62 gives the proportion of total length surveyed that was side channel habitat. The standard for off-channel habitat is the presence of backwater areas with cover and low energy off-channel areas. Because there was 5-11% side channel habitat in surveyed streams that were typically high energy, this indicator is considered functioning At Risk.

Table 62. Side channel habitat as a proportion of total length surveyed.

Stream	Side channel habitat (percent of total length)	Condition Rating
Lower McKay Creek	7%	Functioning At Risk
Upper McKay Creek	11%	Functioning At Risk
Little McKay Creek	5%	Functioning At Risk
Allen Creek	8%	Functioning At Risk
Deer Creek	6%	Functioning At Risk

Refugia

As mentioned in the Analysis Design section, important refugia include deep pools with cold water, backwater areas, side channels, and LWM. Pool frequency and quality was already found, in general across the watershed, to be Not Properly Functioning, as was LWM.

Landslide terrain in headwater areas of the watershed creates numerous springs and seeps, which contribute clean, cold water to streams. Where these spring-fed streams flow into larger streams (Little McKay Creek and McKay Creek) there is the greatest potential for refugia for salmonids. Thermal refugia are likely not adequately protected as maximum stream temperatures throughout the watershed are Not Properly Functioning.

Refugia also refers to reaches of the stream channel that maintain flow throughout the year. This is particularly important in McKay Creek where the over allocation of water rights lower in the watershed often leads to low flows and dry reaches that reduce habitat availability and restrict migration of salmonids and aquatic organisms.

Because there are not adequate refugia, this indicator is considered Not Properly Functioning.

Vegetation Conditions in Riparian Habitat Conservation Areas

Native Riparian Vegetation

The McKay Creek Watershed includes a transition from irrigated low elevation agricultural lands that occur on private lands to moderately high elevation mixed coniferous forests within the public forest lands. The watershed primarily drains to the southwest which generally results in drier sites. The lower elevations on the forest are dominated by the Douglas-fir plant associations with juniper and ponderosa pine plant associations scattered on ridges and south slopes with shallow soils that occur throughout the watershed. Moist grand fir plant associations occur on north facing slopes created by the McKay Creek and Little McKay Creek drainages. Dry, rocky areas support scattered patches of mountain mahogany throughout the project area. Shrub fields are scarce within the watershed except for a few isolated areas southeast of Ray spring where ceanothus still dominates the understory from past wildfires. Bitterbrush is scattered across the watershed, although it does not cover large areas or occurs in high densities. The low numbers of upland shrubs that occur in the watershed are likely the result of a lack of fire and stands that are dominated by high stem densities.

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 and densities of riparian

vegetation lack the same capacity as historic vegetation to control bank stability, maintain channel stability, filter contaminants and nutrients out of the water and soil, supply woody material to streams, and provide shade. Historically, streams in this area were once populated with aspen, willow, black cottonwood, and red osier 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). McKay Creek, Little McKay Creek and tributaries support alder, willow, and dogwood. Aspen and cottonwood do occur in the watershed although they are scattered and primarily occur in small numbers. Other shrub species, such as snowberry and serviceberry can be found. However, most shrubs show signs of heavy pressure from browsing animals. Meadow systems are dominated by grasses and forbs, with some areas having sedges and rushes along their wetted edge.

With the advent of effective organized fire suppression, natural fire return intervals have been greatly increased, resulting in higher vegetation densities (see Fuels report). Most 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.

The Viable Ecosystems model is used on the Ochoco National Forest to ensure that all land management practices are based on the maintenance of a functioning and viable ecosystem across the landscape. LANDSAT imagery and field-mapped plant association data is used to give resource specialists indications of vegetation seral and structural stages that are out of balance with the historical range of variability (HRV). The Viable Ecosystem model is applied at the landscape scale where the model can encompass local disturbance processes. The Viable Ecosystems model was used to describe forested vegetation in the McKay Watershed. There are six upland forest/woodland Plant Associate Groups (PAG) in the watershed. Satellite imagery from 2004 was used to determine the current distribution of seral structural stages. The model looks at the current distribution of seral structural stages and compares them to the HRV. In all PAG in the watershed, stands dominated by large trees are deficient. The model indicates that there should be between 9,500 and 20,600 acres of stands with an open canopy and low conifer density. Currently, there are about 1,700 acres with an open canopy and low conifer density. The grass, forb, shrub stage is also deficient in the Douglas-fir, Ponderosa Pine, and Juniper Woodland PAG. Excess stages in all PAG include pole and small trees (stands with average diameters of 9 to 20.9 inches). Most large trees within the watershed are at risk due to understory stocking levels and the resultant competition stress. These trees are frequently susceptible to insects and disease and uncharacteristically severe fire behavior due to dense understories and accumulations of dead and down woody fuel. These dense forests block sunlight and have reduced the amount of grasses, forbs, and shrubs. Conifers are encroaching in meadows and reducing the size of meadows. On drier sites, juniper is encroaching in areas that historically were more shrub-dominated. Transpiration and evapotranspiration rates are likely higher than they were historically due to high tree densities, resulting in less water being made available for the understory, ground water, and streamflow (Swank).

Historic grazing and logging practices in the watershed has led to poor riparian vegetation conditions and channel incision, resulting in a lowering of local water tables in the riparian zone. Riparian woody species (long rooted species) bind the soil together and create a stable streambank. The woody species also creates a shaded climate for a variety of aquatic organisms. Woody species provide hiding cover from predators for steelhead, redband trout, and Columbia spotted frog.

Most of the project area is in the Dry Grand Fir PAG (Appendix A: Figure 3), in which the desired condition for tree density for trees approximately 12” dbh (typical tree diameter for project) is about 65 trees per acre. Riparian vegetation data was collected during stream surveys

in the project area (Table 63) and the conifer density ranged from 201 to 610 trees per acre These stand densities indicate overstocked conditions.

Table 63. Summary riparian zone data collected out to 30 meters from both sides of stream channel.

Stream	Total Hardwoods per Acre	Total Conifers per Acre	Conifers per Acre >20" DBH	Condition Rating
Upper McKay Creek[1]	286	416	1	Not Properly Functioning
Little McKay Creek[2]	140	272	12	Not Properly Functioning
Allen Creek[3]	170	201	7	Not Properly Functioning
Deer Creek[4]	9	610	53	Not Properly Functioning

[1] Average based on 19 transects; [2] Average based on 15 transects; [3] Average based on 14 transects; [4] Average based on 3 transects.

The rating criteria for Properly Functioning is a riparian system that provides adequate large wood recruitment, habitat protection, and connectivity in all subwatersheds and percent similarity of riparian vegetation to the potential natural community/composition is greater than 50%. Because trees over 21" diameter are lacking, conifer stands are overstocked, hardwoods stands are depressed, and the composition is greatly outside the historic range of natural variability for both riparian and upland forests, this indicator is considered Not Properly Functioning.

Stream Shade

Overall, stream shade did not meet or exceed 80% on any of the stream reaches surveyed stream reaches in the McKay Watershed, except for an approximately one mile long reach in the middle portion of McKay Creek within the Upper McKay Subwatershed surveyed using BLS in 2001. The Forest Plan standard is 80% or potential shade. Potential shade is unknown for streams in the Project Area. Stream surface shading was below the 70 percent shade level on approximately 66 percent, 100 percent and 41 percent of stream reaches surveyed in the Allen Creek, Lower McKay and Upper McKay Subwatersheds, respectively. Shade is particularly lacking along the entire Lower McKay Creek, the entire length of Allen Creek except the headwaters, and within the Upper McKay Creek Subwatershed on the tributaries to Little McKay and McKay Creeks, as well as the most upstream reach of McKay Creek.

Average stream shade within all three subwatersheds in the McKay Watershed met the criteria for Not Properly Functioning from Table 55. Length weighted average estimates for stream shade are 53 percent for Allen Creek Subwatershed, 23 percent for Lower McKay Creek Subwatershed, and 69 percent for Upper McKay Creek Subwatershed. Upper McKay Creek Subwatershed is relatively close to being considered Functioning at Risk.

Channel Condition and Dynamics

Width to Depth Ratio

Table 64 gives width/ratios for streams in the McKay Creek watershed based on stream surveys. Condition ratings are based on Rosgen (1996) instead of the criteria developed by NMFS. Most of the streams have average width/depth ratios that are Properly Functioning.

Table 64. Average width/depth ratio for streams in the McKay Creek Watershed and associated condition rating.

Stream	Dominant Channel Type	Average Width/Depth Ratio	Condition Rating
Lower McKay Creek	C	20	Properly Functioning
Upper McKay Creek	B	15	Properly Functioning

Upper McKay Creek Tributaries	A	11	Properly Functioning
Little McKay Creek	B	13	Properly Functioning
Little McKay Creek Tributaries	A	10	Properly Functioning
Allen Creek	B	12	Functioning at Risk
Deer Creek	B	19	Properly Functioning

Bank Stability

Accelerated erosion that has caused sediment input into streams within the McKay Creek watershed has also negatively affected the success of redband trout populations. Spawning habitat is adversely affected by the introduction of fine sediment from erosion. Sedimentation degrades spawning gravels and spawning success. Channel stability and the ability of the channel to transport the flows and sediment load of its watershed effectively is another important component of quality salmonid habitat.

Overall, streambanks were estimated by stream surveys to be much less stable in the Allen Creek and Lower McKay Creek Subwatersheds relative to the Upper McKay Creek Subwatershed. Weighted average by length of percent stable bank for the Allen Creek, Lower McKay, and Upper McKay Subwatersheds were estimated to be approximately 77, 78, and 85. Relative to the criteria established in Table 55, data indicate that Allen Creek and Lower McKay Creek Subwatersheds are not properly functioning and Upper McKay Creek Subwatershed is Functioning at Risk relative to bank stability.

Of the total length of stream surveyed in the McKay Fuels and Vegetation Project Area, approximately 78 percent of the surveyed stream reach lengths meet the Forest Plan Standards for bank stability (<20 percent cutbank). Overall, most of the streams have relatively stable bank stability conditions likely resulting from stream types that are generally less sensitive to disturbance. Stream reaches that are Not Properly Functioning include Reach 2 of Tributary 5 to Little McKay Creek, the middle reach of Miner's Gulch, the most upstream reach of Deer Creek, Tributary 4 to Little McKay Creek, reach 1 of Tributary 5 to Little McKay Creek, Tributary 30 to McKay Creek, and the upper and lower reaches of Miner's Gulch.

Floodplain Connectivity

Properly functioning wetlands and meadows are important for maintaining cooler stream temperatures and stream base flows within many watersheds across the Ochoco National Forest. Floodplains, wetlands and wet meadows store water throughout the year and slowly release it over the warmer summer months, resulting in cooler stream temperatures. Approximately 69 acres of wetland and/or meadows were identified based on Potential Natural Vegetation and field observations within the McKay Fuels and Vegetation Project Area, all of which are located within the Upper McKay Subwatershed. In addition, the National Wetland Inventory identifies approximately 106 acres of floodplain wetlands (i.e. riverine wetlands) within the project area and the Upper McKay Subwatershed. The National Wetland Inventory identifies approximately 28 acres of floodplain wetlands (i.e. riverine wetlands) within the project area and the Lower McKay Creek Subwatershed. The National Wetland Inventory identifies approximately 1.2 acres of floodplain wetlands (i.e. riverine wetlands) within the project area and the Allen Creek Subwatershed. Many of these wetlands and meadows exhibit impacts from either cattle grazing or off-highway vehicle cross-country use.

Much of McKay Creek and its tributaries were channelized using bulldozers following the 1964/1965 floods as an attempt to control flooding, resulting in poor floodplain connectivity and less water storage in floodplain wetlands. This disconnection of floodplains from the streams in the McKay Watershed has resulted in less available area with shallow water levels as needed for riparian vegetation establishment, in effect resulting in decreased riparian vegetation abundance.

As a result of the historic channelization of streams within the McKay Watershed, the existing condition is considered to be Not Properly Functioning.

Hydrology

Change in Peak/Base Flows

Hydrographs were not available for most of the McKay Watershed; however, the Hydrology Report prepared for the McKay Watershed Analysis indicates that hydrographs are expected to be altered due to substantial irrigation diversions on McKay Creek and Allen Creek. Over allocation of water rights in McKay and Allen Creeks generally results in complete withdrawal of all stream flow on private land below the NF boundary during late summer and early fall. This along with moderate road densities within the McKay Watershed indicate that the existing condition of the McKay Watershed is Functioning at Risk relative to changes in peak and base flows relative to an undisturbed watershed.

Increase in Drainage Network

The Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds vary relative to their overall drainage network existing condition (

Table 65). Based on estimated road densities, drainage densities, and stream crossing densities the Allen Creek Subwatershed was found to be Not Properly Functioning, the Lower McKay Creek Subwatershed was found to be Properly Functioning, and the Upper McKay Creek Subwatershed was found to be Functioning at Risk. The higher road densities and stream crossing densities in Allen Creek and Upper McKay Creek likely reflect that degree of land managed in part for timber harvest and the associated road network. These road densities; however, do not account for historic roads not identified in the GIS layer or user-created trails. The Watershed Condition Framework process determined that watershed condition within the forest boundary relative to roads in both the Upper McKay Creek and Lower McKay Creek Subwatersheds are poor.

Table 65. Summary of Road Density, Drainage Density, Stream Crossing Density and Overall Drainage Network Conditions by Subwatershed.

Subwatershed	Road Density	Drainage Density	Stream Crossing Density	Overall Condition
Allen Creek	Moderate (2.5 mi/mi^2)	High (2.6 mi/mi^2)	High (3.9 #/mi^2)	Not Properly Functioning
Lower McKay Creek	Low (0.9 mi/mi^2)	High (2.7 mi/mi^2)	Low (1.6 #/mi^2)	Properly Functioning
Upper McKay Creek	Moderate (2.8 mi/mi^2)	Moderate (2.4 mi/mi^2)	Moderate (2.5 #/mi^2)	Functioning At Risk

Watershed Condition

Road Density/Location

Based on a combination of Ochoco National Forest and State of Oregon GIS road layers, currently within the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds there are a total of approximately 70, 34, and 88 miles of road, respectively. Of these total road miles, 70 percent of the road miles in Allen Creek are located within 300 feet of intermittent or perennial stream channels; these are predominately located on private land. Approximately, 34 percent of the roads within the Lower McKay Subwatershed and approximately 88 percent of roads within the Upper McKay Subwatershed are located within 300 feet of streams. The Upper McKay Subwatershed consists almost entirely of National Forest Land (93%). These road miles

do not include unauthorized off-highway vehicle (OHV) trails, some historic logging roads, and some private farm roads, the sum of which could increase both road miles and road densities above these estimates.

Road densities were estimated for the Allen Creek, Lower McKay, and Upper McKay Subwatersheds to be approximately 2.5, 0.9, and 2.8 miles per square mile, respectively. Lower McKay Subwatershed has much lower road densities compared with the other two subwatersheds in the McKay Watershed. Overall road densities of open road and closed roads indicate that the Allen Creek and Upper McKay Creek Subwatersheds are Functioning at Risk and that the Lower McKay Creek Subwatershed is Properly Functioning; however, it should be noted that road miles do not likely include all private roads or historic logging roads.

As discussed in the Increase in Drainage Density section of the Existing Condition portion of this report, these road densities do not account for historic roads not identified in the GIS layer or user-created trails. The Watershed Condition Framework process determined that watershed condition within the forest boundary relative to roads in both the Upper McKay Creek and Lower McKay Creek Subwatersheds are poor. However, since these ratings only account for condition on the forest and do not assess the Allen Creek Subwatershed, in order to assess the overall condition of the subwatersheds the known road densities were used to determine the overall existing condition of the subwatersheds.

Disturbance History

As outlined in the Forest Plan, Equivalent Harvest Acres (EHA) should be estimated at the watershed scale to determine whether harvest activities could increase water yields to a point that exceeds an allowable threshold. Overall, the McKay Watershed within the Project Area is meeting the Forest Plan standards; however, since approximately 35% of the watershed is underlain by unstable dormant landslide terrain, the existing condition is considered to be Functioning at Risk relative to disturbance history. Limited commercial and pre-commercial thinning has maintained the EHA well below the Forest Plan threshold of 30% and the reduced threshold of 25% recommended by the McKay Watershed Analysis (Table 66).

Table 66 Projection of Existing Condition EHA for McKay Watershed based on historic activities.

Calendar Year	Existing Condition EHA (%)
2013	3.64%
2014	3.57%
2015	3.51%
2016	3.44%
2017	3.39%
2018	3.33%
2019	3.28%
2020	3.22%
2021	3.17%
2022	3.11%
2023	3.05%

Existing Condition – Aquatic Species

The species discussed below from the updated Region 6 Regional Forester Special Status Species list are either known to occur or have potential habitat in the project area (Table 54).

Columbia spotted frog (*Rana luteiventris*)

Columbia spotted frog occur from Alaska and most of British Columbia to Washington east of the Cascade Mountains, Idaho, the Bighorn Mountains in Wyoming, the Mary's, Reese, and Owyhee River systems in Nevada, the Wasatch Mountains, and the western desert of Utah. There

are currently four recognized populations of Columbia spotted frogs: Northern, Great Basin, Wasatch, and West Desert. The Northern population is found in the project area.

Columbia spotted frogs are highly aquatic and found closely associated with clear, slow-moving or ponded surface waters (lakes, ponds, slow streams and wetlands) with little shade, and relatively constant water temperatures (USFWS 2011). Reproducing populations have been found in habitat characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters). In colder portions of their range, Columbia spotted frogs will use areas where water does not freeze, such as spring heads and undercut streambanks with overhanging vegetation; however, they can overwinter underneath ice-covered ponds. Springs provide a stable, permanent source of water for frog breeding, feeding, shelter, and winter refugia (USFWS 2011). Movements of spotted frogs are limited to wet riparian corridors.

Spotted frogs breed during a short, two-week breeding window anywhere from early April to early June in shallow water areas such as stream margins or pond edges, flooded meadows, or in pools of water formed by snow melt. Females usually lay egg masses in the warmest areas of a pond, typically in shallow water (USFWS 2011). Successful egg production and the viability and metamorphosis of Columbia spotted frogs are dependent on habitat variables such as temperature, depth, pH of water, cover, and the presence or absence of predators. Tadpoles usually metamorphose by mid to late summer; however, they have been observed in the tadpole stage as late as October (USFWS 2011). The lifespan of spotted frogs can be seven to nine years (Engle 2001). Spotted frog diets can vary widely. Adults eat insects, mollusks, crustaceans, and arachnids; larvae eat algae and organic debris. Predators of spotted frog adults include herons and garter snakes, and the recently introduced bullfrogs. In addition, larvae may be consumed by the larvae of dragon flies, predacious diving beetles, fish, and garter snakes.

The causes of decline are not fully understood, but like most amphibians a major threat is the destruction, fragmentation and degradation of streams and wetlands. Land use activities have initiated or accelerated the channel incision process which has changed the hydrologic function of meadow systems (USFWS 2011). These changes in the hydrology of meadows, mainly the lowering of the water table, can cause the vegetation communities to shift from wet meadow communities to dry upland plant communities. The loss of meadow complexes reduces the available habitat for Columbia spotted frogs. Natural fluctuations in environmental conditions (e.g., drought) tend to exacerbate the adverse effects of land use activities (USFWS 2011). Improvements in stream and wetland hydrology and riparian plant communities would improve Columbia spotted frog habitat.

Formal Columbia spotted frog surveys have not be completed, but frog sightings have occurred in the project area. Vegetation preferred by frogs such as sedges, willows, and alders is limited, but available along some of the streams in the project area. There are numerous springs and a few wetlands that could also provide habitat for Columbia spotted frogs. There is no information about their population size, distribution, growth, survival, life history diversity and isolation, or persistence and genetic integrity in the McKay Creek Watershed.

Columbia clubtail (*Gomphus lynnae*)

The Columbia clubtail is known to occur in three populations: from a stretch of the Yakima River and in Benton Co., WA; in Oregon, over a somewhat short stretch (about 15 mi.) of the John Day River, Wheeler and Grant counties, from Twickenham to Monument; and at a single locality on the Owyhee River near Rome in Malheur Co. According to Valley (2010), *G. lynnae* is found over a much longer stretch of the John Day River from Monument to J.S. Burres State Park. Although this dragonfly is fairly common in the areas where it is found, it has one of the most restricted ranges of any North American odonate (Scheuering 2006). Documented occurrences are known from BLM land on the Prineville District.

Columbia clubtail is medium-sized dragonfly, whose eggs are laid in water. After hatching, larvae burrow in the mud and overwinter. After emerging from the water as adults, *G. lynnae* forage among shrubs from mid-June to mid-August; they are non-migratory. This dragonfly can be found in a variety of stream habitat, which can range from sandy or muddy to rocky, shallow rivers with occasional gravelly rapids, but water tends to be slow-moving. Larval habitat in streams is the most crucial (Paulson 1999).

Heavy amounts of siltation or agricultural runoff may be harmful to these dragonflies (Scheuering 2006). Introduced predatory fish may also pose a threat. Although existing populations of *G. lynnae* are common in the locations where they are found and populations appear stable, their range is very restricted. Therefore, any damage to existing habitat could be very detrimental to these few populations. It is essential to protect existing habitat and limit agricultural runoff and siltation where it could harm larval habitat.

Environmental Consequences – Watershed, Water Quality, and Aquatic Habitat

This section analyzes the effects of each alternative to each habitat indicator. **Table 67** summarizes overall the short-term and long-term effects as beneficial, adverse, or neutral for each alternative.

Table 67. Summary of existing condition ratings and potential impacts of the project to habitat indicators at the watershed scale.

Habitat Indicator	Existing Condition	Potential Impact of Project on Habitat Indicator (+/–/N)[2]			
		Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
water temperature (RMO[1])	NPF	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: +/++	ST: N LT: N/+
fine sediment/turbidity (RMO)	PF	ST: N LT: N/–	ST: N/+ LT: N/+	ST: N/– LT: –/N/++[3]	ST: N/+ LT: N/+
chemical contamination/ nutrients	FAR	ST: N LT: N/-	ST: N/+ LT:N/+	ST: N LT: +/++	ST: N/+ LT:N/+
physical barriers	NPF	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: N/+	ST: N LT: N/+
substrate	Lower McKay: PF Allen and Upper McKay: FAR	ST: N LT: N	ST: + LT: N	ST: +/++ LT: N/+	ST: + LT: N
large woody material (RMO)	NPF	ST: N LT: N	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N
pool frequency (RMO)	Allen and Upper McKay: NPF Lower McKay: FAR	ST: N LT: N	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N
pool quality	Lower McKay: PF Allen: FAR Upper McKay: NPF	ST: N LT: N	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N

Habitat Indicator	Existing Condition	Potential Impact of Project on Habitat Indicator (+/–/N)[2]			
		Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
off-channel habitat	FAR	ST: N LT: N/-	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N
refugia	NPF	ST: N LT: N/-	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N
native riparian vegetation (RMO)	NPF	ST: N LT: -	ST: + LT: +	ST: +/++ LT: +/++	ST: + LT: +
shade	NPF	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: +/++	ST: N LT: N/+
width/depth ratio (RMO)	PF	ST: N LT: N/-	ST: N LT: N	ST: N LT: +	ST: N LT: N
bank stability (RMO)	Allen & Lower McKay: NPF Upper McKay: FAR	ST: N LT: N/-	ST: N LT: N	ST: N/- LT: +	ST: N LT: N
floodplain connectivity	NPF	ST: N LT: N/-	ST: N/+ LT: N	ST: +/++ LT: N/+	ST: N/+ LT: N
change in peak/base flows	FAR	ST: N LT: N/-	ST: N/+ LT: N/+	ST: + LT: +	ST: N/+ LT: N/+
increase in drainage network	Allen: NPF Lower McKay: PF Upper McKay: FAR	ST: N LT: N/-	ST: N LT: N/+	ST: N/- LT: -/N/+[3]	ST: N LT: N/+
road density/location	Allen and Upper McKay: FAR Lower McKay: PF	ST: N LT: N	ST: N/- LT: N	ST: N/- LT: N/-	ST: N/- LT: N
disturbance history	PF	ST: N LT: N/+	ST: N/- LT: N	ST: N/- LT: N	ST: N/- LT: N

Short-term (ST) – within 5 years following implementation – and long-term (LT) impacts that are beneficial (+), adverse (-), or neutral (N)
[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified (see Table 1).
[2] + stands for beneficial, - stands for adverse, and N stands for neutral.
[3]Conditions vary substantially by subwatershed.

Alternative 1 (No Action)Table 68 summarizes the potential effects of Alternative 1 on habitat indicators for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds. Effects do not vary by subwatershed in Alternative 1.

Water Quality

Water Temperature

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to stream temperatures in the McKay Creek Watershed. Existing conditions contributing to impaired water temperatures would continue.

Under this alternative, cattle distribution would remain as it currently is, with cattle concentrating in some riparian areas, effectively maintaining reduced levels of stream shade resulting in elevated solar radiation on streams and elevated stream temperatures.

In addition, impaired wetlands, meadows, and floodplains would remain in their existing condition or become more impaired in the long-term with further incision or upstream headcut migration, effectively maintaining elevated stream temperatures as a result of diminished water storage and cooler temperature shallow groundwater releases to the stream through the hottest periods of the summer.

Alternative 1 would be a continuation of existing conditions and would not include fuel reductions in riparian or upland areas, potentially resulting in increased risk of wildfire in some riparian and upland areas in the Project Area due to high densities of fuels resulting from a history of fire suppression (Messier et al. 2012). Increased risk of wildfire would mean an increased risk of riparian vegetation shading reductions along the streams, resulting in increased solar radiation and potentially increased stream temperatures.

Table 68. Summary of Existing Condition and Effects of Alternative 1 by Subwatershed in both the short-term (< 5 years) and the long-term (> 5 years).

Habitat Indicator	Existing Condition	Potential Impacts of Alternative 1 on Habitat Indicator by Subwatershed (+/–/N)[2]		
		Allen Creek	Lower McKay	Upper McKay
water temperature (RMO[1])	NPF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
fine sediment/turbidity (RMO)	PF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
chemical contamination/ nutrients	FAR	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
physical barriers	NPF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
substrate	Lower McKay: PF Allen and Upper McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: N
large woody material (RMO)	NPF	ST: N LT: N	ST: N LT: N	ST: N LT: N
pool frequency (RMO)	Allen and Upper McKay: NPF Lower McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: N
pool quality	Lower McKay: PF Allen: FAR Upper McKay: NPF	ST: N LT: N	ST: N LT: N	ST: N LT: N
off-channel habitat	FAR	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
refugia	NPF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
native riparian vegetation (RMO)	NPF	ST: N LT: -	ST: N LT: -	ST: N LT: -
shade	NPF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
width/depth ratio (RMO)	PF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
bank stability (RMO)	Allen & Lower McKay: NPF Upper McKay: FAR	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-

Habitat Indicator	Existing Condition	Potential Impacts of Alternative 1 on Habitat Indicator by Subwatershed (+/–/N)[2]		
		Allen Creek	Lower McKay	Upper McKay
floodplain connectivity	NPF	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
change in peak/base flows	FAR	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
increase in drainage network	Allen: NPF Lower McKay: PF Upper McKay: FAR	ST: N LT: N/-	ST: N LT: N/-	ST: N LT: N/-
road density/location	Allen and Upper McKay: FAR Lower McKay: PF	ST: N LT: N	ST: N LT: N	ST: N LT: N
disturbance history	PF	ST: N LT: N/+	ST: N LT: N/+	ST: N LT: N/+

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified.
[2] + stands for beneficial, - stands for adverse, and N stands for neutral.

Fine Sediment/Turbidity

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to fine sediment or turbidity in the streams in the McKay Creek Watershed. Fine sediment generated from existing eroding banks, sediment delivery from roads, and sediment delivery from hillslope erosion would continue at the same locations as the existing condition. No road reconstruction would occur with the implementation of Alternative 1, the no action alternative, so existing roads delivering fine sediment to streams as a result of poor drainage and surfacing would continue contributing sediment to streams in the McKay Watershed. Fine sediment would continue to be transported through high energy, incised stream reaches downstream to lower energy reaches resulting in higher concentrations of fine sediment deposition in the downstream direction.

Alternative 1 would be a continuation of existing conditions and would not include fuel reductions in riparian or upland areas, potentially resulting in increased risk of wildfire in some riparian and upland areas in the Project Area due to high densities of fuels resulting from a history of fire suppression (Messier et al. 2012). Increased risk of wildfire would mean an increased risk of post-fire suspended sediment in streams of approximately 1-1459 times unburned suspended sediment exports during the first year post-fire (Smith et al. 2011).

Chemical Contamination/Nutrients

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to chemical contaminant or nutrients in the streams in the McKay Creek Watershed. Existing conditions contributing to impaired water temperatures would continue. Under this alternative, cattle and wildlife distribution would remain as it currently is, with cattle and some wildlife concentrating in some riparian areas, potentially maintaining existing levels of *E. coli* in McKay Creek.

Alternative 1 would be a continuation of existing conditions and would not include fuel reductions in riparian or upland areas, potentially resulting in increased risk of wildfire in some riparian and upland areas in the Project Area due to high densities of fuels resulting from a history of fire suppression (Messier et al. 2012). Increased risk of wildfire would mean an increased risk of post-fire nutrients and other water quality constituents in streams. First year exports of nutrients in the form of total N and total P of approximately 0.3-431 times unburned

nutrient exports (Smith et al. 2011). High levels of certain trace elements, including Fe, Mn, As, Cr, Al, Ba and Pb associated with elevated levels of highly elevated sediment concentrations have also been found in addition to elevated short-term levels of cyanide (Smith et al. 2011).

Habitat Access

Physical Barriers

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to physical barriers in the McKay Creek Watershed. Conditions that are Not Properly Functioning would continue. Under currently impaired stream conditions, new headcuts could form that may create additional passage barriers to fish and other organisms.

Habitat Elements

Large Woody Material

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to LWM frequency in the McKay Creek Watershed. Current rates of wood recruitment and growth rates of standing trees would continue at a relatively slow pace. Because the majority of riparian trees are in the small tree class (9-20.9” dbh), retention of LWM in stream channels may be limited. Conditions that are Not Properly Functioning would continue.

Pool Frequency and Quality

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to pool frequency and quality in the McKay Creek Watershed. Current rates of wood recruitment and growth rates of standing trees would continue at a relatively slow pace. Because the majority of riparian trees are in the small tree class (9-20.9” dbh), retention of LWM in stream channels may be limited. Because LWM can create and maintain pools, pool development may be affected by slow rates of LWM recruitment and retention.

Substrate

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to dominant substrate in the streams in the McKay Creek Watershed. Currently straightened and incised channels would remain incised, which would maintain the limited number of bed features with adequate spawning gravels as a continuation of the existing condition. In the long-term, upstream migration of headcuts would extend impaired habitats relative to substrate in the upstream direction. In addition, fine sediment sources would remain and the potential for wildfire would continue as discussed in the Fine Sediment/Turbidity section above.

Off-channel Habitat and Refugia

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to off-channel habitat and refugia in the McKay Creek Watershed. Current rates of wood recruitment and growth rates of standing trees would continue at a relatively slow pace. Because the majority of riparian trees are in the small tree class (9-20.9” dbh), retention of LWM in stream channels may be limited. Because LWM can create and maintain off-channel habitat and refugia, their development may be affected by slow rates of LWM recruitment and retention. Existing headcuts could continue to migrate upstream and new headcuts could form, further disconnecting the floodplain and off-channel habitat.

Vegetation Conditions in Riparian Habitat Conservation Areas

Native Riparian Vegetation

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to native riparian vegetation in the McKay Creek Watershed. Current rates of

conifer tree growth, mortality, and encroachment into meadows, wetlands, and riparian areas would continue, shading out hardwoods, shrubs and herbaceous vegetation. Conifers lack the same capacity as hardwoods and shrubs to control bank stability, maintain channel stability, and filter contaminants and nutrients out of the water and soil. Current fire suppression tactics would continue, further moving the watershed away from the historic fire regime and vegetation conditions that result from wildfire. Wildfire risk would continue to increase as conifer densities and fuel loading increase.

Stream Shade

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to stream shade in the McKay Creek Watershed. Existing conditions contributing to impaired stream shade would continue.

Under this alternative, cattle distribution would remain as it currently is, with cattle concentrating in some riparian areas, effectively maintaining reduced levels of stream shade. Shallow water tables in floodplains disconnected from stream channels on McKay Creek would remain impaired, which would maintain existing limited riparian vegetation and associated stream shade.

Alternative 1 would be a continuation of existing conditions and would not include fuel reductions in riparian or upland areas, potentially resulting in increased risk of wildfire in some riparian and upland areas in the Project Area due to high densities of fuels resulting from a history of fire suppression (Messier et al. 2012). Increased risk of wildfire would mean an increased risk of riparian vegetation shading reductions along the streams.

Channel Condition and Dynamics

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to channel condition or dynamics in the McKay Creek Watershed. Existing conditions contributing to existing of width/depth ratio, bank stability, and floodplain connectivity would continue. In the long-term, unstable banks in some reaches of Allen Creek, Lower McKay Creek, and portions of Upper McKay Creek would continue to widen, resulting in further bank instability and wider width/depth ratios. Since most stream reaches in Allen Creek and McKay Creek are dominated by moderately confined channel types (i.e. Rosgen B-chennel types) with moderate sensitivity to disturbance and an excellent recovery potential, it is likely that bank instability will be more concentrated downstream in the less confined portions of McKay Creek (Rosgen 2009). These gravel dominated, less confined channel types mostly found in Lower McKay Creek have a very high sensitivity to disturbance and do not recover as quickly as the more confined channel types found in Allen Creek and Upper McKay Creek. Floodplain connectivity would continue to impair reaches of McKay Creek and Allen Creek, resulting in continued channel incision and contributing to continued bank instability.

Hydrology

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to hydrology in the McKay Creek Watershed. Existing conditions contributing to existing peak flows, base flows, and drainage networks would continue. In the long-term with the implementation of Alternative 1, the no action alternative, limited road maintenance and no road reconstruction would occur, potentially resulting in an increase in connectivity of road drainage with the streams, effectively increasing drainage networks. Increased drainage networks then have the potential to change the timing and magnitude of peak flows and reduce baseflows in the stream channel. Existing irrigation diversions would also continue to effect the baseflows in portions of Allen Creek and McKay Creek.

Watershed Condition

Road Density/Location

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to road densities and road locations in the McKay Creek Watershed. Existing road densities and their current locations would continue. In the long-term with the implementation of Alternative 1, the no action alternative, no temporary roads would be built and no existing roads would be decommissioned or reconstructed.

Disturbance History

No actions would take place as a result of Alternative 1; therefore, no direct or indirect effects would result from Alternative 1 relative to disturbance history in the McKay Creek Watershed. Historic timber harvest effects to water yield within the McKay Watershed would continue to recover with time.

Alternative 2 (Proposed Action)

Table 69 summarizes the potential effects of Alternative 2 on habitat indicators for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds. Effects vary by subwatershed in Alternative 2.

Water Quality

Water Temperature

Alternative 2, the proposed action, includes thinning and prescribed burning in riparian areas and water drafting for roads.

Project Design Criteria (PDC) for the McKay Fuels and Vegetation Project that pertain to protecting water temperatures in the stream include those specific to prescribed burning in RHCA, thinning in RHCA, and water drafting for use on roads for dust abatement. Water temperatures are protected from potential effects from prescribed burning in the RHCA using PDC that require site-specific plans coordinated with an Interdisciplinary Team, including a Hydrologist, as well as criteria that require that generally no intentional ignition would take place within 100 feet of stream channels. PDC that protect water temperatures from thinning activities include conservative no-cut buffers applied to streams not currently identified and included in the riparian prescriptions (see Chapter 2); cut-and-leave trees would be felled in a way to reduce livestock access resulting in increased density and vigor of riparian vegetation; and burning of handpiles within 50 feet of streams would be avoided. PDC also exist that encourage revegetation of native vegetation at stream crossings, on skid trails, and on temporary roads. Through implementation of these PDC, vegetation growth would be encouraged in disturbed around near the stream, potentially resulting in increased stream shade in the long-term. If stream shade is increased substantially, maximum stream temperatures may be reduced. Finally, the Water Conservation Plan for the Ochoco National Forest would protect streams from stream temperature increases, particularly on streams exceeding temperature standards.

Netmap Thermal Load Modeling was used to estimate the no-cut buffer widths along perennial streams needed to maintain an immeasurable change to solar radiation on the stream (<1% change from existing) in the stream. Details of this modeling effort are described in Appendix C. Thermal load values for all perennial streams within the project area were estimated using topography of the watershed, stream bankfull dimensions, average riparian tree heights, varying co-cut buffer widths, and estimated existing and anticipated vegetation densities for the buffer and outside of the buffer. The vegetation density reduction outside of the no-cut buffer was assumed to be approximately 10%, which roughly equates to a 10% reduction in canopy closure and was used to mimic estimated vegetation reductions from pre-commercial thinning based on professional judgment of the Silviculturalist (Ringold et al. 2003). The riparian prescriptions

described in Chapter 2 for Alternative 2 meet or exceed these no-cut buffers and are expected to have an immeasurable effect on stream temperatures. Generally, no-cut buffers are wider for lower order streams (i.e. Class III streams) because they tend to have smaller drainage areas and smaller bankfull width conditions, resulting in higher sensitivities to stream shade from vegetation. Streams with an East-West aspect had varying buffer widths on the North side of the stream compared to the South side of the stream, since trees on the North side provide essentially no protection from solar radiation. No-cut buffers for the South side of perennial streams tend to need to be highest, no-cut buffers on the East and West sides of streams are generally intermediate, and no-cut buffers on the North side of streams can be minimal without impacting stream temperatures. In the long-term, it is possible that Alternative 2 would have a slight beneficial effect as a result of taller streams within the riparian areas and improved riparian vegetation from trees cut and left on the ground in riparian areas in such a way to deter cattle grazing on hardwood vegetation in the riparian zones.

Implementation of Project Design Criteria and riparian prescriptions specific to each unit and perennial stream channel would result in negligible effect in the short-term and possibly slight beneficial effects in the long-term of the proposed action on water temperatures in the Upper McKay Creek and Lower McKay Creek Subwatersheds. No effect to stream temperature would result as a result of Alternative 3 in the Allen Creek Subwatershed, due to the limited amount of activity proposed along the stream channel.

Table 69. Summary of Existing Condition and Effects of Alternative 2 by Subwatershed in both the short-term (< 5 years) and the long-term (> 5 years).

Habitat Indicator	Existing Condition	Potential Impacts of Alternative 2 on Habitat Indicator by Subwatershed (+/–/N)[2]		
		Allen Creek	Lower McKay	Upper McKay
water temperature (RMO[1])	NPF	ST: N LT: N	ST: N LT: N/+	ST: N LT: N/+
fine sediment/turbidity (RMO)	PF	ST: N LT: N	ST: N LT: N	ST: N/+ LT: +
chemical contamination/ nutrients	FAR	ST: N LT: N	ST: + LT: +	ST: + LT: +
physical barriers	NPF	ST: N LT: N	ST: N LT: /+	ST: N LT: N/+
substrate	Lower McKay: PF Allen and Upper McKay: FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
large woody material (RMO)	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
pool frequency (RMO)	Allen and Upper McKay: NPF Lower McKay: FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
pool quality	Lower McKay: PF Allen: FAR Upper McKay: NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
off-channel habitat	FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
refugia	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
native riparian vegetation (RMO)	NPF	ST: + LT: +	ST: + LT: +	ST: + LT: +
shade	NPF	ST: N LT: /+	ST: N LT: /+	ST: N LT: +

width/depth ratio (RMO)	PF	ST: N LT: N	ST: N LT: N	ST: N LT: N
bank stability (RMO)	Allen & Lower McKay: NPF Upper McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: N
floodplain connectivity	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
change in peak/base flows	FAR	ST: N LT: N	ST: N LT: N	ST: N LT: +
increase in drainage network	Allen: NPF Lower McKay: PF Upper McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: +
road density/location	Allen and Upper McKay: FAR Lower McKay: PF	ST: N LT: N	ST: N LT: N	ST: - LT: N
disturbance history	PF	ST: N/- LT: N	ST: N/- LT: N	ST: N/- LT: N

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified .
[2] + stands for beneficial, - stands for adverse, and N stands for neutral.

Cumulative Effects

Mill Creek AMP Project Area overlaps with the McKay Fuels and Vegetation Project Area. The Mill Creek AMP includes fuel reductions and changes to grazing management within the Mill Creek Allotment. Fuel reduction units do not overlap in space between the two projects; however, some of them are located within in the same subwatershed (i.e. Upper McKay Subwatershed) and would have the potential to cumulatively impact stream temperatures downstream. PDCs covering prescribed burning in RHCAs are essentially identical to McKay Fuels and Vegetation PDCs and are anticipated to protect stream channels from fuels reduction activities within the Project Area. In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would bring stream temperatures closer to meeting Forest Plan Standards and 303(d) listings for water temperature. Since the effect to stream temperature from Alternative 2 is anticipated to have immeasurable in the short-term and beneficial in the long-term, cumulatively this alternative along with the implementation of the Mill Creek AMP is expected to have immeasurable effect in the short-term and beneficial effects in the long-term relative to stream temperatures in the project area.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on stream temperatures in the long-term as vegetation along riparian areas is reestablished providing increased shade to the stream and improved wetland meadow integrity arrests further degradation of the water storage capacity. Water storage capacity has the potential to reduce stream temperatures during baseflow, typically when maximum stream temperatures occur. Cumulatively, this would also result in immeasurable effects to stream temperature in the short-term and beneficial effects in the long-term.

Fine Sediment/Turbidity

Within RHCAs, six percent of the RHCAs within the project area would include commercial harvest followed by precommercial thinning and prescribed burning, 11 percent would include precommercial thinning followed by prescribed burning, 16 percent would include juniper removal followed by jackpot and prescribed burning, 12 percent would include fuels reductions

and 10 sites of restoration of riparian special plant communities. These percentages represent the percentage of the area that overlaps proposed units; however, by following the riparian prescriptions, the percentage of the RHCAs with each treatment would be reduced. A majority of these treatments within RHCAs are proposed within the Upper McKay Subwatershed; however, juniper removal is concentrated in the Lower McKay Subwatershed with minor amounts of commercial harvest and some fuel reduction treatments are proposed in the Allen Creek Subwatershed.

Connected actions for Alternative 2 include one streambank stabilization, 1 mile of new and 6 miles of existing disturbance temporary roads, and 11 miles of road reconstruction all of which are located in the Upper McKay Subwatershed. Alternative 2 road proposal activities located within 300 feet of intermittent or perennial stream channels include 1.1 miles of temporary roads, 99% of which are on existing disturbance and 2.4 miles of road reconstruction. Expansion of the Highland Material Source will have no effect on stream fine sediments or turbidity; it is located 1500 feet from the nearest stream channel.

PDCs were designed to reduce impacts of fine sediment delivery to stream channels within the McKay Fuels and Vegetation Project Area (see Chapter 2). Erosion and delivery of fine sediment to stream channels is minimized or eliminated relative to potential effects from prescribed burning in the RHCA using PDC that require site-specific plans coordinated with an Interdisciplinary Team, including a Hydrologist, as well as criteria that require that generally no intentional ignition would take place within 100 feet of stream channels and criteria minimizing firelines and requiring their rehabilitation near stream channels. PDC that protect streams from fine sediment delivery as a result of thinning activities include conservative no-cut buffers applied to streams not currently identified and included in the riparian prescriptions, as well as numerous other PDCs that limit disturbances within RHCAs in order to minimize erosion and potential sediment delivery to streams from thinning activities, including avoiding new skid trails, landing, and temporary roads within RHCAs and ephemeral draws and limiting reuse of them within zones typical for sediment delivery to streams. Cut-and-leave trees would be felled in a way to reduce livestock access resulting in increased density and vigor of riparian vegetation and enhanced bank stability; and burning of handpiles within 50 feet of streams would be avoided. PDC also exist that encourage revegetation of native vegetation at stream crossings, on skid trails, and on temporary roads. Through implementation of these PDC, vegetation growth would be encouraged in disturbed areas near streams, potentially resulting in denser vegetated buffers along streams and sediment delivery prevention.

Alternative 2 would slightly reduce fine sediment contributions from streambank erosion as a result of the streambank stabilization activity and reductions in grazing pressure along reaches of the stream where juniper and precommercial thinning is implemented and trees are placed to reduce cattle access to streams. Both of these treatment units also include cutting and leaving trees, some of which may land in the stream channel, which would create more scour along confined sections of stream banks in the short-term. Fine sediment would also continue to be transported through high energy, incised stream reaches downstream to lower energy reaches resulting in higher concentrations of fine sediment deposition in the downstream direction similar to the no action alternative.

Since roads have been found to be the dominant contributor of sediment to streams relative to other timber harvest activity, the temporary road and road construction is likely to have effect fine sediment in the stream the most. The 1.1 miles of temporary roads within 300 feet of stream channels, almost entirely on existing disturbance, will increase erosion in the short-term (up to 3 years). Reopened abandoned forest roads have been found to produce two to three times the sediment concentrations of brushed-in roads (Foltz et al. 2009). Since they are located on existing disturbance, erosion will likely be less than for new temporary roads under similar environmental circumstances relative to the existing condition. PDCs require temporary and

reconstructed roads with stream crossings to have adequate relief drainage and filter strips or other filtering structures in order to reduce channelization of flow and to catch sediment prior to reaching the stream channel. The purpose of this PDC is to substantially reduce sediment delivery from temporary and reconstructed roads. PDCs also require temporary roads to be removed after completion of logging operations (see Chapter 2). Three years after the disturbance, 90 percent recovery of erosion from the temporary roads is anticipated assuming they are not reopened by unauthorized OHV use (Luce and Black, 2001). Temporary roads may contribute to slight increases in fine sediment in stream channels within the Project Area in the short-term; however, these effects should become negligible in the long-term (5+ years).

Localized locations are expected to have short-term adverse effects. These locations include approximately 1.1 miles of temporary road located within 300 feet of perennial or intermittent streams, 0.6 miles of which consists of one temporary road on existing disturbance that is currently a chronic source of sediment to an unnamed intermittent tributary to McKay Creek (used to access Units 38 and 97). By removing the temporary road upon completion of treatments, a beneficial effect to fine sediment and turbidity in this stream would result. In addition, approximately 0.35 miles of temporary road on existing disturbance (i.e. the McKay Pit) are proposed for use in order to access unit 39. Prior to 2011, the site had been highly manipulated resulting in modified drainage patterns and chronically contributing sediment to an ephemeral draw located at the base of the hillslope. In 2011 this site was rehabilitated by recontouring it and by burying large logs to deter unauthorized OHV use. By converting this area back into a temporary road, strategically placed drainage contours and buried logs would be removed and the potential for the area to again become a source of chronic sediment would result.

Road reconstruction of approximately 2.4 miles within 300 feet of stream channels would involve improved drainage or graveling of road segments as needed. Overall, improved drainage would reduce occurrences of channelized flow and would encourage overland flow, improving the efficacy of the stream buffers. Adding gravel to road surfaces has been found to reduce erosion by up to 80 percent (Elliot 2000). Alternative 2 proposed road reconstruction would result in fine sediment reductions to streams within the project area.

Alternative 2 would include fuel reductions and should reduce the risk of wildfire in some riparian and upland areas in the Project Area. Reduced risk of high-intensity wildfires would reduce the risk of large contributions of sediment to stream channels in the project area.

Overall, implementation of Project Design Criteria, riparian prescriptions specific to each unit and stream channel, and proposed road reconstruction should result in neutral to slight beneficial effects of the proposed action on fine sediments and turbidity within streams in the Upper McKay Subwatershed in the short-term (< 5 years) and beneficial effects in the long-term (> 5 years). Negligible fine sediment/turbidity effects would be seen in streams in the Lower McKay Subwatershed and Allen Creek Subwatersheds. This overall beneficial effect of the proposed action is based on anticipated slight reductions in streambank erosion, implementation of temporary road project design criteria, road reconstruction of approximately 2.4 miles of road within 300 feet of streams, and reduced risk of high-intensity wildfires within the project area.

Cumulative Effects

Mill Creek AMP Project Area overlaps with the McKay Fuels and Vegetation Project Area. The Mill Creek AMP includes fuel reductions and changes to grazing management within the Mill Creek Allotment. Fuel reduction units do not overlap in space between the two projects; however, some of them are located within in the same subwatershed (i.e. Upper McKay Subwatershed) and would have the potential to cumulatively impact fine sediment downstream. PDCs covering prescribed burning in RHCAs are essentially identical to McKay Fuels and Vegetation PDCs and are anticipated to protect stream channels from fuels reduction activities within the Project Area. In addition, the Hydrology Report prepared for the Mill Creek AMP

indicates that implementation of the selected alternative, the proposed action, would bring bank stability closer to meeting Forest Plan Standards. Since the effect to stream fine sediment and turbidity from Alternative 2 is anticipated to be potentially beneficial, cumulatively this alternative along with the implementation of the Mill Creek AMP is expected to have both short-term and long-term beneficial effects relative to fine sediments and streams in the project area.

It is anticipated that Phase I of the McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. In the short-term (<3 years), installation of fencing and boulders would result in soil disturbance and the potential for erosion; however in the long-term as vegetation along riparian areas is reestablished, riparian buffers would become more effective and bank stability would be increased, resulting in improved long-term fine sediment and turbidity in streams within the project area. Cumulatively, short-term (< 5 years) potential increases in sediment delivery to streams would be outweighed by beneficial effects from implementation of Alternative 2. In the long-term (>5 years), the McKay Meadow and Wetland Protection Project and the McKay Fuels and Vegetation Project would cumulatively have a beneficial effect on fine sediment and turbidity in streams within the project area.

Chemical Contamination/Nutrients

Alternative 2, the proposed action, includes thinning and prescribed burning in riparian areas. Implementation of Project Design Criteria and riparian prescriptions specific to each unit and perennial stream channel would result in negligible effect and possibly slight beneficial effects of the proposed action on chemical contamination and nutrients relative to the existing condition.

PDCs designed to protect stream temperatures and fine sediment/turbidity in streams discussed above, would also in effect protect stream channels from delivery of chemical contaminants and nutrients through enhanced riparian buffers and reduced sediment delivery. By reducing fine sediment delivery to streams, chemical contaminants and nutrients adsorbed to sediment particles would also be filtered out prior to reaching the stream channel. In addition to reduced chemicals and nutrients adsorbed to fine sediment, cut-and-leave trees would be felled in a way to reduce livestock access to riparian areas within juniper and precommercial thinning units, resulting in reduced cattle waste on floodplains. Reduced cattle waste in riparian zones would reduce the source for *E. coli* to the stream and may improve BOD levels in the stream.

Increased nutrient supply to channels is greatest in underburn units in which fire is allowed to back down into no- treatment buffers. Increased quantities of nitrate and phosphate may be available to the channel. The small area of effect and rare occurrence of fire escaping during fuels treatment; however, reduces potential increases in nutrients to aquatic habitat to less than available within the historic fire regime. Relative to levels of nutrients resulting from high-intensity wildfires, nutrient supplies to the stream from underburning would be relative minor. By implementing the PDCs for prescribed burning in RHCAs, the probability of affecting nutrient concentration in streams in the project area is discountable.

Various studies in the Pacific Northwest have found that timber harvest “causes no increase in chemical constituents in streamwater of a magnitude that would adversely affect water quality” relative to drinking water standards (Tiedemann et al. 1988). By limiting cattle access to riparian areas in Upper McKay Creek and Lower McKay Creek Subwatersheds, Alternative 2 is expected to have a slight beneficial effect to streams relative to *E. coli* and BOD once cut and leave activities are completed in the riparian areas. With implementation of the PDCs, prescribed burning in RHCAs is anticipated to have negligible effect on nutrients in the stream channel. Since no juniper treatments or precommercial thinning is proposed in the RHCA in the Allen Creek Subwatershed, no effect to chemical contamination is expected.

Cumulative Effects

Mill Creek AMP Project Area overlaps with the McKay Fuels and Vegetation Project Area. The Mill Creek AMP includes fuel reductions and changes to grazing management within the Mill Creek Allotment. Fuel reduction units do not overlap in space between the two projects; however, some of them are located within in the same subwatershed (i.e. Upper McKay Subwatershed) and would have the potential to cumulatively impact *E.coli* concentrations and BOD downstream. PDCs covering prescribed burning in RHCAs are essentially identical to McKay Fuels and Vegetation PDCs and are anticipated to protect stream channels from fuels reduction activities within the Project Area. In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would reduce grazing pressure in riparian areas. This cumulative reduction of grazing pressure between implementation of Alternative 2 and the Mill Creek AMP is expected to have both short-term and long-term beneficial effects relative to *E. coli* concentrations in streams in the project area.

It is anticipated that Phase I of the McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would include protecting select meadows and wetlands within the Upper McKay Subwatershed by fencing sensitive riparian areas near Divide Spring and near the forest boundary. In both the short-term (<5 years) and the long-term (> 5 years), exclusion of cattle from these areas would have beneficial effects relative to *E. coli* concentrations in stream channels in McKay Creek. The cumulative effect of cattle exclusion along select reaches of McKay Creek and its tributaries from the McKay Meadow and Wetland Protection Project along with reduced grazing pressure in riparian areas where cut and leave has occurred (i.e. in juniper and precommercial thinning units) as part of the McKay Fuels and Vegetation Project, should result in both short and long-term beneficial effects relative to *E.coli* concentrations in McKay Creek.

Habitat Access

Physical Barriers

The only in-stream actions proposed in Alternative 2 are cut-and-leave conifer treatments in PCT units and Aspen release units. Some trees that are felled will land in stream channels and be left in place. Trees naturally fall into streams and very rarely become barriers to fish migration and fish are very adept at finding navigable channels through or around wood structures (Opperman et al 2006). There is potential to create physical barriers, but the probably is extremely low due to the size of trees that will be felled in the channel (<9 inches diameter). There is potential to have a benefit to physical barriers. LWM reduces stream energy and increases floodplain connectivity and may help reduce the formation of new headcuts. Overall, there would be no measureable short-term impact. In the long-term, there may be a slight beneficial effect to physical barriers.

Cumulative Effects

There are no past, present, or reasonably foreseeable actions that would substantially affect physical barriers in the McKay Creek Watershed.

Habitat Elements

Large Woody Material

To account for a diversity of watershed and riparian conditions in the project area, we propose unit-specific treatments based on site-specific conditions. There are eight habitat features listed under the Riparian Management Objectives (RMO; Table 46) for the project. In some cases, attaining each one of these objectives can be a balancing act. For example, to meet the riparian vegetation objectives ("increase density of hardwood, shrub, and herbaceous vegetation based on site potential and plant association group and increase density of understory vegetation associated

with sensitive plants along meadow and riparian edges") in a dense, young conifer stand, a common silvicultural tool is to remove overstory density to encourage understory growth. Removal of overstory density could potentially lead to increased thermal loading and reduction of wood volume available for recruitment. In our unit-specific treatments, we carefully balance conflicting RMO, but stream temperature and LWM receive priority.

To develop unit-specific riparian treatments that don't hinder attainment of the LWM objective, we first determined LWM source area distances from each stream channel in each unit. According to Benda and Bigelow (2011), LWM source areas are highly variable, but are strongly correlated to tree height and the dominant wood recruitment process for each stream reach. In their study, the inland geomorphic provinces – Cascade Range and Sierra Nevada – more closely match the geomorphic province of the project area, though precipitation rates are still considerably higher. They found that in managed forests of those provinces, where bank erosion and tree mortality are the dominant LWM recruitment processes, 90% of in-stream LWM originated from within 10 meters of stream channels and the remaining 10% is supplied from a distance equivalent to one tree height (Figure 20). In less managed forests, 90% of in-stream LWM originated from 15 to 35 meters of stream channels.

In Meleason et al (2003), the simulation model OSU STREAMWOOD was used to evaluate the potential effects of different riparian thinning scenarios on LWM recruitment to streams over time. In one scenario, they modeled the contribution of wood from forest plantations (up to 120 years old in a Douglas-fir – western hemlock forest), beyond no-treatment buffers of varying widths. The results suggest that no-treatment buffers greater than 10 meters from the stream channel contributed minimal amounts of wood volume to streams. In McDade et al (1990), the mean LWM source distance for first, second, and third order Cascade and Coast Range streams in mature and old growth stands was approximately 10 meters. Conifer tree heights in these stands ranged from 40 to 80 meters.

Robison and Beschta (1990) determined that the probability of a riparian tree falling into a stream channel is primarily a function of tree height and distance from the stream. The upper crown of a tree, however, particularly in managed stands, is not of sufficient size to be considered of functioning size in the channel (i.e. large enough to influence stream morphology). Therefore, the "effective tree height" – the height to the minimum diameter and length necessary for the wood to qualify as "of functioning size" – is a more appropriate standard to use for assessing source area distance.

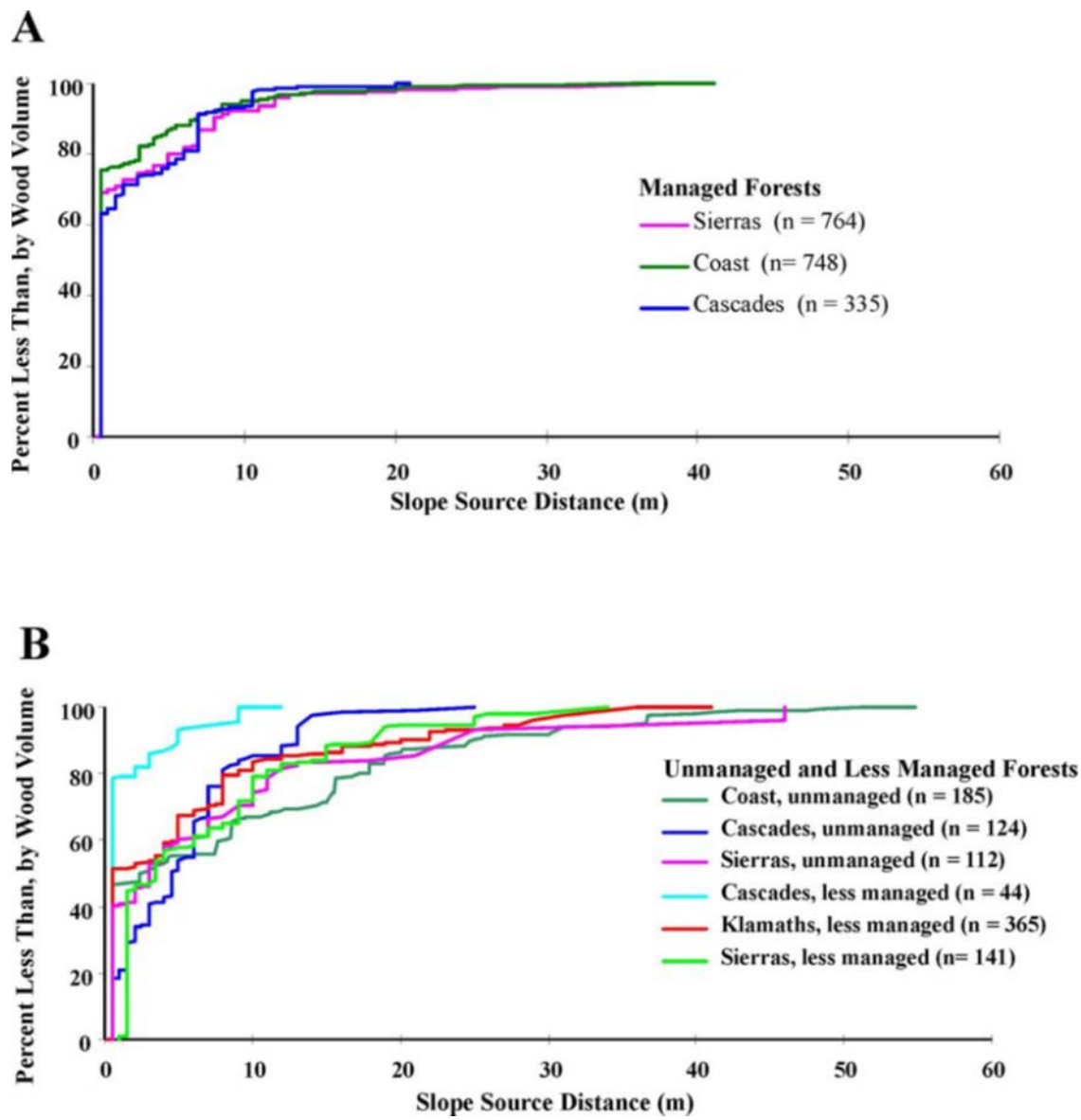


Figure 20. Figure from Benda and Bigelow (2011) showing source distance curves for study areas.

Based on these findings, in managed stands/plantations within the project area (average tree height is typically < 50 feet tall), where bank erosion and tree mortality are the dominant LWM recruitment processes, we defined a LWM recruitment zone of 30 feet from each side of the stream channel. (Average tree height data was calculated from LiDAR first return data within the RHCA of streams within units, after eliminating all shrubs/small trees under 5 feet tall.) It is believed that in stands of this size, a 30-foot distance will protect at least 90% of trees that could potentially be recruited to the stream channel. In some stands where older trees were present (tree heights ranged from 50 to 136 feet; Units 25, 37, 41, 42, 50, 51, A1, A2, A8, A9, A13) larger LWM recruitment zones were defined based on "effective tree heights" (Robison and Beschta 1990). Where major roads parallel streams within LWM recruitment zones, treatment prescriptions allow cutting on opposite side of road. These roads effectively intercept all wood from upslope because the wood must be removed from the road for public access.

Actions associated with the project that have the potential to affect the amount and frequency of LWM in streams include prescribed burning (RXF and TWF), juniper removal (JUT), pre-commercial thinning (PCT), commercial thinning (HSA and HTH), and aspen release treatments

(ASPEN). All unit-specific treatments and project design criteria (PDC) are designed to minimize removal of wood volume from LWM recruitment zones. In some units, cut-and-leave treatments are prescribed to achieve both the LWM objectives as well as the riparian vegetation objectives. Cut-and-leave treatments are prescribed after shade requirements are met and stream banks are protected (at least a 5-foot no-cut on all streams).

In prescribed fire units (RXF and TWF), the PDC state that there would be no intentional ignition within 100 feet of stream channels. Fire would be allowed to back into the RHCA and burn in a mosaic pattern. This treatment would kill some standing trees and encourage them to fall into stream channels, having a beneficial effect. If fire intensity reaches high levels, it could also consume some trees and down wood within the LWM recruitment zone, having an adverse effect. Because each burn plan would be designed to burn in a mosaic pattern, and retain at least 80% of wood volume adjacent to the channel, the adverse and beneficial effects balance out, resulting in a neutral effect to LWM frequency.

In juniper removal units (JUT) and pre-commercial thinning units (PCT), there would be no cutting of trees within 5 feet of the stream channel, and cut-and-leave only from 5 to 30 feet. (There are exceptions to this prescription when a larger no-cut buffer is needed to protect shade.) This prescription protects the 30-foot LWM recruitment zone defined for these units, and accelerates recruitment by falling a certain number of trees (some into stream channels) to meet the silvicultural prescription. These treatments would therefore have a beneficial effect to LWM frequency.

In commercial thinning units (HSA and HTH), we prescribed no-cut treatments only within LWM recruitment zones for each stream channel. No cut-and-leave treatments were prescribed in these units. These treatments would therefore have a neutral effect to LWM frequency.

In aspen release units (ASPEN), we prescribed cut-and-leave treatments within LWM recruitment zones for each stream channel. This prescription protects the LWM recruitment zone defined for each unit, and accelerates recruitment by falling a certain number of trees (some into stream channels) to meet the silvicultural prescription. These treatments would therefore have a beneficial effect to LWM frequency.

Because removal of wood volume would be minimized in all LWM recruitment zones and cut-and-leave treatments would accelerate recruitment, actions associated with the project would have a combined beneficial effect to LWM frequency in the short-term.

In units where cut-and-leave treatments are prescribed and LWM recruitment is accelerated, there would be an immediate benefit but there may be a reduction in recruitment availability in the long-term. However, units with the cut-and-leave treatment (JUT, PCT, and ASPEN) make up only approximately 27 percent of total RHCA acres in the project area. Thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. The residence time of LWM felled into the channel is expected to be up to about 50 years, based on studies of similar inland sites (Benda and Bigelow 2011). This should give the adjacent stand time to grow and become available for future recruitment. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect LWM frequency in the McKay Creek watershed is implementation of underburning under the

Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency. Therefore, there are no additional effects to LWM frequency.

Pool Frequency and Quality

Pool frequency and quality is closely tied to LWM frequency (see Analysis Design section) and therefore the effects of the project would be very similar. Because removal of wood volume would be minimized in all LWM recruitment zones and cut-and-leave treatments would accelerate recruitment, actions associated with the project would have a combined beneficial effect to LWM frequency in the short-term. Thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as important key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. An increase in LWM size and frequency would lead to an increase in pool frequency and quality. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently pool frequency in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect pool frequency and quality in the McKay Creek watershed is implementation of underburning under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency and consequently pool frequency and quality. Therefore, there are no additional effects to pool frequency and quality.

Substrate

Channel substrate is also closely tied to LWM frequency (see Analysis Design section) and therefore the effects of the project would be very similar. An increase in LWM size and frequency would lead to an increase in spawning gravels in the stream channel and substrate quality. In the short-term (< 5 years), because removal of wood volume would be minimized in all LWM recruitment zones and cut-and-leave treatments would accelerate recruitment, actions associated with the project would have a combined beneficial effect to LWM frequency and substrate quality in the short-term within the Upper McKay Subwatershed and small portions of the Lower McKay Subwatershed. No short-term or long-term effects are anticipated for the Allen Creek Subwatershed due to the limited activity proposed there. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations as a result of Alternative 2 balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently substrate quality.

Alternative 2 effects to fine sediment in the streams in the project area are analyzed in the Fine Sediment/Turbidity section of the Alternative 2 Water Quality Environmental Consequences.

Cumulative Effects

No cumulative effects would occur relative to substrate if Alternative 2 were implemented, since no direct or indirect effects to substrate quality would occur. A potential for cumulative

beneficial effects to fine sediment/turbidity in streams is discussed in the Fine Sediment/Turbidity section of the Alternative 2 Water Quality Environmental Consequences.

Off-channel Habitat and Refugia

Off-channel habitat and refugia are closely tied to channel complexity, which in a forested system is created primarily by LWM. Therefore the effects of the project would be very similar to the effects on LWM. Because removal of wood volume would be minimized in all LWM recruitment zones and cut-and-leave treatments would accelerate recruitment, actions associated with the project would have a combined beneficial effect to LWM frequency in the short-term. Thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as important key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. An increase in LWM size and frequency would lead to an increase in off-channel habitat and refugia. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently off-channel habitat and refugia in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect off-channel habitat and refugia in the McKay Creek watershed is implementation of underburning under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency and consequently off-channel habitat and refugia. Therefore, there are no additional effects to off-channel habitat and refugia.

Vegetation Conditions in Riparian Habitat Conservation Areas

Native Riparian Vegetation

Actions associated with the project that have the potential to affect the ability of RHCA to provide (1) adequate LWM recruitment, (2) habitat protection and connectivity, and (3) vegetation conditions similar to the potential natural community and composition include prescribed burning (RXF and TWF), juniper thinning (JUT), pre-commercial thinning (PCT), commercial thinning (HSA and HTH), and aspen release treatments (ASPEN).

To protect wood recruitment, all unit-specific treatments and project design criteria (PDC) are designed to minimize removal of wood volume from LWM recruitment zones. In some units, cut-and-leave treatments are prescribed to achieve both the LWM objectives as well as the riparian vegetation objectives. (See Large Woody Material section above for details.)

As discussed in the Existing Conditions section, the vegetation conditions in RHCA are Not Properly Functioning. Riparian stands are overstocked, dominated by coniferous tree species, and vegetative structure is dominated by the small tree category (9-20.9" dbh). The current types and densities of riparian vegetation lack the same capacity as historic vegetation to control bank stability, maintain channel stability, filter contaminants and nutrients out of the water and soil, supply woody material to streams, and provide shade. Historically, streams in this area were once populated with aspen, willow, black cottonwood, and red osier dogwood. Riparian areas are also at greater risk of stand replacing wildfire due to effective fire suppression.

The silvicultural and fuels treatments were specifically designed to move riparian conditions closer to what they were historically and closer to the potential natural vegetation conditions. The

treatments would in turn help create and maintain habitat and connectivity for riparian dependent species that are more adapted to a hardwood, shrub, and herbaceous composition and structure. In addition, the cut-and-leave treatments would create down wood obstacles that would deter grazer access in riparian areas, further improving riparian vegetation conditions. The project would have a beneficial effect on vegetation conditions in the RHCA in both the short-term and the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect riparian vegetation conditions in the McKay Creek watershed is implementation of underburning and grazing under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the Mill Creek AMP, grazing, about 800 acres of underburning will occur in RHCA within allotment pastures. Riparian restoration treatments will also be implemented. According to the FEIS, the Mill Creek AMP will improve stream shade and stream temperatures by increasing bank stability and improving channel morphology. Because the Mill Creek AMP will benefit riparian conditions, implementing Alternative 2 would incrementally benefit riparian vegetation conditions even further.

Stream Shade

Alternative 2, the proposed action, includes thinning and prescribed burning in riparian areas. Implementation of Project Design Criteria and riparian prescriptions specific to each unit and perennial stream channel would result in negligible effect in the short-term (< 5 years) and beneficial effects of the proposed action on stream shade in the long-term (> 5 years).

With the exception of water drafting criteria, PDCs discussed in the Water Temperature section of the Alternative 2 Water Quality Environmental Consequences along with unit-specific riparian prescriptions will protect stream shade in the project area, resulting in negligible effect to stream shade in the short-term (< 5 years). In the long-term (> 5 years) beneficial effects to stream shade from Alternative 2 are anticipated as riparian vegetation is improved (see Native Riparian Vegetation Section) and it as well as conifers in the riparian areas both grow to heights that would improve shade to stream channels in project area. Beneficial effects will primarily effect streams in the Upper McKay Creek Subwatershed, since project activities are mostly focused there with some lesser beneficial effects in the Allen Creek and Lower McKay Creek Subwatersheds.

Cumulative Effects

Mill Creek AMP Project Area overlaps with the McKay Fuels and Vegetation Project Area. The Mill Creek AMP includes fuel reductions and changes to grazing management within the Mill Creek Allotment. Fuel reduction units do not overlap in space between the two projects; however, some of them are located within in the same subwatershed (i.e. Upper McKay Subwatershed) and therefore should not affect stream shade along the same stream reaches. In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would improve vegetated cover, which should in effect improve stream shade.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on stream shade in the long-term as vegetation along riparian areas is reestablished providing increased shade to the stream.

Channel Condition and Dynamics

Width/depth Ratio, Bank Stability, Floodplain Connectivity

Within RHCAs, six percent of the RHCAs within the project area would include commercial harvest followed by precommercial thinning and prescribed burning, 11 percent would include precommercial thinning followed by prescribed burning, 16 percent would include juniper removal followed by jackpot and prescribed burning, 12 percent would include fuels reductions and 10 sites of restoration of riparian special plant communities. These percentages represent the percentage of the area that overlaps proposed units; however, by following the riparian prescriptions in **Error! Reference source not found.**, the percentage of the RHCAs with each treatment would be reduced. A majority of these treatments within RHCAs are proposed within the Upper McKay Subwatershed; however, juniper thinning is concentrated in the Lower McKay Subwatershed with minor amounts of commercial harvest and some fuel reduction treatments are proposed in the Allen Creek Subwatershed. Connected actions for Alternative 2 include one streambank stabilization, 1 mile of new and 6 miles of existing disturbance temporary roads, and 11 miles of road reconstruction all of which are located in the Upper McKay Subwatershed. An estimated additional three stream crossings of temporary roads are anticipated based on estimated temporary road locations in Alternative 2.

PDC that protect bank stability as a result of thinning activities include conservative no-cut buffers applied to streams not currently identified and included in the riparian prescriptions, as well as numerous other PDCs that avoid new and existing skid trails that cross streams. Cut-and-leave trees would be felled in a way to reduce livestock access resulting in increased density and vigor of riparian vegetation and enhanced bank stability. PDC also exist that encourage revegetation of native vegetation at stream crossings. Through implementation of these PDC, vegetation growth would be encouraged in disturbed areas near streams, potentially resulting in denser vegetation along streams and consequently improved rooting strength and increased bank stability in the long-term.

In the short-term (< 5 years), Alternative 2 activities that would affect bank stability and width/depth ratios include the addition of approximately three temporary stream crossings. All three stream crossing locations are on streams located within the Upper McKay Subwatershed. These three locations would likely effect the bank stability and width/depth ratios in the localized location of the stream crossings in the short-term; however, they would only account for < 1 percent of the total stream length within the subwatershed and would resulting in a negligible increase in cutbanks. In the long-term (> 5 years) with implementation of the PDCs that include revegetation at stream crossings and proper removal of temporary roads, stream banks at crossing locations should recover to their pre-project stability and w/d ratios. In addition, Alternative 2 would improve bank stability in the long-term (>5 years) along a limited stream reach (50-100 feet) as a result of the streambank stabilization activity at one of the three temporary stream crossing locations that currently has bank stability concerns on an unnamed tributary to McKay Creek located within the Upper McKay Subwatershed. Bank stability would not be affected by Alternative 2 in the Allen Creek and Lower McKay Creek Subwatersheds.

Once juniper treatment units and precommercial thinning units are treated, grazing pressure and bank trampling by cattle should be minimized in the short-term (< 5 years). Bank stability and width/depth ratios; however, would likely take some time (> 5 years) to see a beneficial effect from these changes resulting from implementation of Alternative 2. These precommercial thinning units are primarily located within the Upper McKay Subwatershed and juniper treatment units are primarily located in the Lower McKay Subwatershed. Both of these treatment units also include cutting and leaving trees, some of which may land in the stream channel. Initially (< 5 years), this added LWM would create more scour along confined sections of stream banks; however, this would be balanced out as added roughness would result in more streamflows spreading out across the floodplain, relieving near bank stresses in the stream channel. In the long-term (> 5 years), LWM would add stability to stream banks, in part by adding roughness and restoring appropriate W/D ratios.

Overall, in the long-term, existing unstable banks in some reaches of Allen Creek, Lower McKay Creek, and portions of Upper McKay Creek would continue to widen, resulting in further bank instability and wider width/depth ratios. Since most stream reaches in Allen Creek and McKay Creek are dominated by moderately confined channel types (i.e. Rosgen B-chennel types) with moderate sensitivity to disturbance and an excellent recovery potential, it is likely that bank instability will be more concentrated downstream in the less confined portions of McKay Creek (Rosgen 2009). These gravel dominated, less confined channel types mostly found in Lower McKay Creek have a very high sensitivity to disturbance and do not recover as quickly as the more confined channel types found in Allen Creek and Upper McKay Creek.

In the short-term (< 5 years), Alternative 2 is expected to have negligible effect to channel condition overall within the Upper McKay Subwatershed. In the long-term (> 5 years), once stream crossings are removed and streambanks are stabilized and with the addition of LWM to stream channels, Alternative 2 will result in improved bank stability and w/d ratios in the Upper McKay Subwatershed. Alternative 2 would have negligible effects to bank stability and w/d ratios in Allen Creek and Lower McKay Creek Subwatersheds. Floodplain connectivity would continue to impair reaches of McKay Creek and Allen Creek, resulting in continued channel incision and contributing to continued bank instability; however, slight beneficial effect would result from added LWM in the short-term.

Cumulative Effects

Mill Creek AMP PDCs covering prescribed burning in RHCAs are essentially identical to McKay Fuels and Vegetation PDCs and are anticipated to protect stream channels from fuels reduction activities within the Project Area. In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would bring bank stability closer to meeting Forest Plan Standards. Since the effect to bank stability from Mill Creek AMP is anticipated to be beneficial, cumulatively this alternative along with the implementation of Alternative 2 is expected to have short-term neutral or minor adverse effects and long-term beneficial effects on bank stability and w/d ratios in Upper McKay Subwatershed. Effects to Allen Creek Subwatershed and Lower McKay Subwatershed would still be negligible.

In the short-term (<3 years), installation of fencing and boulders as part of Phase I of the McKay Meadow and Wetland Protection Project would result in soil disturbance and the potential for erosion; however in the long-term as vegetation along riparian areas is reestablished, vegetated rooting densities would increase and consequently bank stability would be improved along stream reaches that are associated with the meadow and wetland protection activities. Cumulatively, short-term (< 5 years) effects would still be slightly adverse as a result of Alternative 2 activities. In the long-term (>5 years); however, the McKay Meadow and Wetland Protection Project and the McKay Fuels and Vegetation Project would cumulatively have a beneficial effect on bank stability and w/d ratios on streams in the Upper McKay Subwatershed. Effects to Allen Creek Subwatershed and Lower McKay Subwatershed would still be negligible.

Hydrology

Change in Peak/Base Flows

Alternative 2 proposed road activities are all located within the Upper McKay Subwatershed and include reconstructing approximately 11 miles of road and constructing 1 mile of new temporary road and six miles of temporary road on existing disturbance. No new specified roads are proposed for construction. The only water withdrawals proposed as part of Alternative 2 are for water drafting for use road dust abatement. No proposed activities have the potential to effect peakflows or baseflows within the streams located within the Allen Creek Subwatershed or Lower McKay Subwatershed.

Water drafting must follow the Water Conservation Plan for the Ochoco National Forest, which limits the quantity of water withdrawal based on the time of year and prohibits water withdrawals when the flow falls below 1 cubic foot per second (1996). These withdrawals should have a negligible effect on the overall hydrograph of streams in any of the three subwatersheds.

The estimated six miles of temporary road located on existing disturbance would have an immeasurable effect on the peak flow and baseflow of streams in in the Upper McKay Subwatershed. The existing disturbance is likely already effecting runoff patterns from these locations and therefore, by essentially reopening them, peak flows and baseflows would only be negligibly affected. In the short-term (< 5 years), one mile of new temporary road would only have a negligible effect on the hydrograph of streams in the Upper McKay Subwatershed, since it would equate to a temporary increase in the road miles by approximately 1% and would essentially have no effect on overall road densities in the Upper McKay Subwatershed. Reconstruction of 11 miles of road has the potential to reduce channelized flow and encourage sheet flow infiltration through a combination of improved drainage and gravel surfacing. Enhanced infiltration has the potential to dampen peak flows and increase baseflows in stream channels in the short-term and assuming continued road maintenance, in the long-term as well.

Overall, negligible to slightly beneficial short-term and beneficial long-term effects to peak flows and baseflows in the streams in the Upper McKay Subwatershed are anticipated. In both the short-term and long-term, effects to peak flows and baseflows in the Allen Creek and the Lower McKay Creek Subwatersheds would be negligible.

Cumulative Effects

Mill Creek AMP would have negligible effect on peak flows or baseflows in streams in the McKay Watershed. One new water development and reconstruction of 12 water developments were proposed as part of the selected alternative of Mill Creek AMP. Since existing peak flows and baseflows are already being affected by almost all of the water developments, the slight changes resulting from reconstruction 12 water developments and constructing one new one, should have no measurable effect on peak flows and baseflows in the Upper McKay Subwatershed. No water developments were proposed in the Allen Creek or Lower McKay Subwatersheds.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on baseflows by improving wetland meadow integrity and arresting further degradation of water storage capacity, in both the short-term (< 5 years) and the long-term (> 5 years).

Increase in Drainage Network

Effects from the proposed action on the drainage networks in the McKay Watershed are primarily tied to road construction and reconstruction activities. Alternative 2 proposed activities are all located within the Upper McKay Subwatershed and include reconstructing approximately 11 miles of road and constructing 1 mile of new temporary road and six miles of temporary road on existing disturbance. No new specified roads are proposed for construction.

Alternative 2 is expected to result in a temporary increase in road densities from 2.8 miles per square mile to 3.0, both of which are considered as functioning at risk for the Upper McKay Subwatershed (see Analysis Design). An additional three temporary stream crossings would increase stream crossing densities from 2.5 to 2.6 crossings per square mile, which makes the stream crossing densities in Upper McKay Subwatershed high relative to the number of stream crossings in numerous subwatersheds across the Ochoco National Forest (see Analysis Design).

Based on a moderate drainage density and the temporary nature of the stream crossings and roads, a slight adverse effect is anticipated as a result of Alternative 2. In the long-term, once temporary roads have been removed, these effects to the drainage network are anticipated to fully recover.

Reconstruction of 11 miles of road in the Upper McKay Subwatershed has the potential to reduce channelized flow and encourage sheet flow infiltration through a combination of improved drainage and gravel surfacing. Enhanced infiltration has the potential to reverse some of the effects of road construction on the drainage network by disconnecting some of the connectivity between streams and roads in the Upper McKay Subwatershed in both the short-term and the long-term.

In the short-term (< 5 years), the slight increases in stream crossing and road densities are negated by road reconstruction improvements to the drainage network in the Upper McKay Creek Subwatershed. In the long-term, beneficial effects are anticipated as a result of 11 miles of road reconstruction resulting a disconnection of select segments of road that are likely connected to the stream network in the Upper McKay Subwatershed. Alternative 2 does not include road work in the Allen Creek or Lower McKay Creek Subwatersheds, therefore it will have no effect on the drainage network in those subwatersheds.

Cumulative Effects

Mill Creek AMP does not include road construction activities and therefore has no effect on the drainage network.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would is expected to include some minor specified road and user-created road decommissioning, as well as new specified road construction. Approximately 0.12 miles of road with poor drainage will be decommissioned and replaced with approximately 0.05 miles of road that avoids a spring channel. In addition, approximately 0.17 miles of user-created roads are planned for decommissioning. This project would have a beneficial effect on drainage networks in the Upper McKay Subwatershed in the both the short-term and long-term. Cumulatively, this project and implementation of Alternative 2 of the McKay Fuels and Vegetation Project would result in beneficial effects to drainage networks in the Upper McKay Subwatershed in both the short-term and long-term.

Watershed Condition

Road Density/Location

Effects from the proposed action on the road densities and location of roads in the McKay Watershed are primarily tied to temporary roads. Alternative 2 proposed activities are all located within the Upper McKay Subwatershed and include constructing 1 mile of new temporary road and six miles of temporary road on existing disturbance. No new specified roads are proposed for construction.

Alternative 2 is expected to result in a temporary increase in road densities from 2.8 miles per square mile to 3.0, both of which are considered as functioning at risk for the Upper McKay Subwatershed (see Analysis Design). 1.1 miles of the temporary roads are located within 300 feet of stream channels, 0.6 miles of which is made up of a single temporary road that parallels and unnamed tributary to McKay Creek in the Upper McKay Subwatershed. Of the 1.1 miles of temporary road within 300 feet of stream channels, 99 percent of them are on existing disturbance.

Based on the temporary nature of the roads, a slight adverse effect is anticipated as a result of Alternative 2, in the short-term. In the long-term, once temporary roads have been removed, these effects to the road densities are anticipated to fully recover.

Cumulative Effects

Mill Creek AMP does not include road construction activities and therefore has no effect on the drainage network.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would is expected to include some minor specified road and user-created road decommissioning, as well as new specified road construction. Approximately 0.12 miles of road with poor drainage will be decommissioned and replaced with approximately 0.05 miles of road that avoids a spring channel. This reduction in road densities equates to less than a one percent decrease from the existing condition. In addition, approximately 0.17 miles of user-created roads are planned for decommissioning. This project would have a slight beneficial effect on road densities in the Upper McKay Subwatershed in the both the short-term and long-term. Cumulatively, this project and implementation of Alternative 2 of the McKay Fuels and Vegetation Project would result in a slight adverse effect in the short-term (< 5 years) with a larger increase in road densities from temporary roads relative to the slight decrease from implementation of the McKay Meadow and Wetland Protection Project. In the long-term (> 5 years); however, very slight beneficial effects to road densities in the Upper McKay Subwatershed would result from less than a one percent decrease in road densities.

Disturbance History

Commercial harvest, precommercial thinning, restoration of riparian special plant communities and prescribed fire all have some effect on the EHA. Alternative 2 includes all three of these activities (see Chapter 2 for acreages of each activity). One indication of high levels of disturbance is when EHA estimates exceed a threshold of 25 to 30 percent (see Analysis Design). In addition, disturbance activities concentrated in unstable or sensitive areas can put a watershed at risk of impairment. Based on a combination of historic timber harvest, prescribed burning, and wildfire activities and activities proposed in Alternative 2 within the Ochoco National Forest Boundary portion of the McKay Watershed, EHA were estimated and projected through the estimated time period of the McKay Fuels and Vegetation Project Since some historic and proposed activities are located on unstable dormant landslide terrain and in sensitive areas (e.g. RHCAs), including riparian areas, Alternative 2 would still result in the Ochoco National Forest portion of the McKay Watershed condition as functioning at risk. Since the magnitude of disturbance from implementation of Alternative 2 is minimal, as evidenced by the relatively small change in EHA and relatively quick recovery, it is expected to have a minimal short-term adverse effect on the condition of the McKay Watershed relative to EHA and the level of disturbance in all three subwatersheds. Long-term effects would be negligible. Implementation of Alternative 2 would still meet the Forest Plan standards for EHA (Table 70). These estimates indicate EHA percentages well below the threshold.

Disturbance history is also a factor of the amount of disturbance concentrated in potentially unstable areas and/or refugia and/or riparian areas. Based on the Geology Report, the percentage of the McKay Fuels and Vegetation Planning Area overlapping dormant landslide terrain in the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds is <1 percent, 1 percent, and 34 percent, respectively. In Alternative 2, the percentage of the total RHCA within the project area with treatments proposed for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds are 72 percent, 57 percent, and 37 percent, respectively. Due to this concentration of activities within RHCAs in all three subwatersheds and unstable terrain in the Upper McKay Creek Subwatershed, disturbance levels are anticipated to be mildly adverse in the short-term; however, in the long-term disturbance levels will level out and become negligible.

Since some historic and proposed activities are located on unstable dormant landslide terrain and in sensitive areas (e.g. RHCAs), including riparian areas, Alternative 2 would still result in the

Ochoco National Forest portion of the McKay Watershed condition as functioning at risk. Since the magnitude of disturbance from implementation of Alternative 2 is minimal, as evidenced by the relatively small change in EHA and relatively quick recovery, it is expected to have a minimal short-term adverse effect on the condition of the McKay Watershed relative to EHA and the level of disturbance in all three subwatersheds. Long-term effects would be negligible. Implementation of Alternative 2 would still meet the Forest Plan standards for EHA.

Table 70. Projection of EHA for McKay Watershed based on a combination of historic activities and Alternative 2.

Calendar Year	Alternative 2 EHA (%)
2013	3.64%
2014	7.27%
2015	7.60%
2016	7.41%
2017	7.12%
2018	6.83%
2019	6.40%
2020	6.03%
2021	5.82%
2022	5.64%
2023	5.46%

Cumulative Effects

Mill Creek AMP includes underburning activities in the McKay Watershed in order to improve forage for cattle grazing purposes. Prescribed burning activities are anticipated to have negligible effect on the EHA (Table 71). In addition, PDCs for prescribed burning in RHCAs would minimize or eliminate disturbance in sensitive riparian areas.

Table 71. Projection of EHA for McKay Watershed based on a combination of historic activities, Alternative 2 and Mill AMP.

Calendar Year	Alternative 2 Cumulative EHA (%)
2013	3.64%
2014	7.39%
2015	7.72%
2016	7.52%
2017	7.23%
2018	6.93%
2019	6.48%
2020	6.11%
2021	5.90%
2022	5.71%
2023	5.53%

Alternative 3

Water Quality

Table 72 summarizes the potential effects of Alternative 3 on habitat indicators for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds. Effects vary by subwatershed in Alternative 3 more than the other alternatives.

Water Temperature

Additional treatment activities are proposed in Alternative 3 as compared to Alternative 2. These differences include additional commercial thinning, precommercial thinning, prescribed burning

and treatments targeted at riparian areas along the mainstem of McKay Creek and Little McKay Creek that were not already being treated. In addition, Alternative 3 includes a proposal at two sites along McKay Creek for reconnection of the stream channel to its floodplain. Unit-specific riparian prescriptions for Alternative 3 also include slightly varied no-cut buffer widths and allow for some treatments in RHCAs to further enhance riparian and aquatic habitat. The same project design criteria listed under Alternative 2 that protect stream temperatures from proposed project activities will be implemented for Alternative 3.

Unit-specific riparian prescriptions developed for proposed commercial and precommercial thinning located within RHCAs as well as riparian treatments, all of which are located within RHCAs, would result in an immeasurable effect to stream temperatures, similar to Alternative 2. Additional commercial harvest cut-and-leave treatments within RHCAs, along with precommercial thinning units, would deter cattle grazing on hardwood vegetation in the riparian zones, resulting in improved stream shade and consequently reduced stream temperatures. In addition, thinning of riparian areas outside of the no-cut buffers would accelerate growth of remaining trees, resulting in taller trees that may contribute to more stream shade and reduced stream temperatures, depending upon the location of the tree relative to the stream channel. In the short-term, Alternative 3 proposed treatments would have negligible effect on stream temperatures. In the long-term, Alternative 3 proposed treatments would result in slight beneficial effects to stream temperature.

By reconnecting McKay Creek to its floodplain, a shallower water table will be created resulting in a larger area for riparian vegetation to establish. This would assist with increasing riparian vegetation density and diversity. Relic channels would be reactivated or new stream channels would be created on the floodplain and aggrading the existing channel in phases. By partially aggrading the channel, prior to moving to the channel to the floodplain connected channel, riparian vegetation would be established on the new or relic channel before it takes all of the flow. In the short-term (< 5 years), floodplain reconnection activities would have a minimal effect on stream shade. Stream temperature increases would only effect the small portion of surface flow that is diverted to the channel connected to the floodplain during Phase I while planted riparian vegetation is still growing. This increase in stream temperatures should; however, be balanced out at baseflow, when peak stream temperatures occur, as a result of increased floodplain water storage releases to the stream channel. In the long-term (> 5 years), once riparian vegetation has been established on the floodplain connected channel, the floodplain connection component of Alternative 3 would result in beneficial effects to stream temperatures.

Table 72. Summary of Existing Condition and Effects of Alternative 3 by Subwatershed in both the short-term (< 5 years) and the long-term (> 5 years).

Habitat Indicator	Existing Condition	Potential Impacts of Alternative 3 on Habitat Indicator by Subwatershed (+/–/N)[2]		
		Allen Creek	Lower McKay	Upper McKay
water temperature (RMO[1])	NPF	ST: N LT: +	ST: N LT: +	ST: N LT: ++
fine sediment/turbidity (RMO)	PF	ST: - LT: -	ST: N LT: N	ST: N LT: ++
chemical contamination/ nutrients	FAR	ST: N LT: +	ST: N LT: +	ST: N LT: ++
physical barriers	NPF	ST: N LT: N/+	ST: N LT: N/+	ST: N LT: +
substrate	Lower McKay: PF Allen and Upper McKay: FAR	ST: + LT: N	ST: + LT: N	ST: ++ LT: +
large woody material (RMO)	NPF	ST: + LT: N	ST: + LT: N	ST: ++ LT: N
pool frequency (RMO)	Allen and Upper	ST: + LT: N	ST: + LT: N	ST: ++ LT:

	McKay: NPF Lower McKay: FAR			N
pool quality	Lower McKay: PF Allen: FAR Upper McKay: NPF	ST: + LT: N	ST: + LT: N	ST: ++ LT: N
off-channel habitat	FAR	ST: + LT: N	ST: + LT: N	ST: ++ LT: N
refugia	NPF	ST: + LT: N	ST: + LT: N	ST: ++ LT: N
native riparian vegetation (RMO)	NPF	ST: + LT: +	ST: + LT: +	ST: ++ LT: ++
shade	NPF	ST: N LT: +	ST: N LT: +	ST: N LT: ++
width/depth ratio (RMO)	PF	ST: - LT: N	ST: N LT: +	ST: N LT: ++
bank stability (RMO)	Allen & Lower McKay: NPF Upper McKay: FAR	ST: - LT: N	ST: N LT: +	ST: N LT: ++
floodplain connectivity	NPF	ST: + LT: N	ST: + LT: N	ST: ++ LT: +
change in peak/base flows	FAR	ST: N LT: N	ST: N/+ LT: +	ST: ++ LT: +
increase in drainage network	Allen: NPF Lower McKay: PF Upper McKay: FAR	ST: - LT: -	ST: N LT: N	ST: N LT: +
road density/location	Allen and Upper McKay: FAR Lower McKay: PF	ST: - LT: -	ST: N LT: N	ST: - LT: N
disturbance history	PF	ST: N/- LT: N	ST: N/- LT: N	ST: N/- LT: N

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified (see Table 1).
[2] + stands for beneficial, - stands for adverse, and N stands for neutral.

Overall, the combination of vegetation treatments and floodplain reconnection activities would result in an immeasurable effect to stream temperature in the short-term and beneficial effects to stream temperature in the long-term in the Upper McKay Creek Subwatershed, with slightly less beneficial effects in the Lower McKay Subwatershed. Alternative 3 will have negligible effect on stream temperatures in the Allen Creek Subwatershed.

Cumulative Effects

Mill Creek AMP Project Area overlaps with the McKay Fuels and Vegetation Project Area. The Mill Creek AMP includes fuel reductions and changes to grazing management within the Mill Creek Allotment. Fuel reduction units do not overlap in space between the two projects; however, some of them are located within in the same subwatershed (i.e. Upper McKay Subwatershed) and would have the potential to cumulatively impact stream temperatures downstream. PDCs covering prescribed burning in RHCAs are essentially identical to McKay Fuels and Vegetation PDCs and are anticipated to protect stream channels from fuels reduction activities within the Project Area. In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would bring stream temperatures closer to meeting Forest Plan Standards and 303(d) listings for water temperature. Since the effect to stream temperature from Alternative 3 is anticipated to have immeasurable in the short-term and beneficial in the long-term, cumulatively this alternative along with the implementation of the Mill Creek AMP is expected to have immeasurable effect in the short-term and beneficial effects in the long-term relative to stream temperatures in the project area.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on stream temperatures in the long-term as vegetation along riparian areas is reestablished providing increased shade to the stream and improved wetland meadow integrity arrests further degradation of the water storage capacity. Water storage capacity has the potential to reduce stream temperatures during baseflow, typically when maximum stream temperatures occur. Cumulatively, this would also result in immeasurable effects to stream temperature in the short-term and beneficial effects in the long-term.

Fine Sediment/Turbidity

The percentage of the RHCAs within commercial harvest, precommercial thinning, and prescribed burning units in Alternative 3 are essentially equal to the percentages of these treatment units in Alternatives 2 and 4. In addition, there are 10 aspen treatment units located within RHCAs, similar to the other two alternatives. However, Alternative 3 includes an additional 16 percent of the total RHCA acres in the project area proposed for treatment in the form of "riparian treatments" (see Chapter 2 for more complete description of riparian treatments). These percentages represent the percentage of the area that overlaps proposed units; however, by following the riparian prescriptions in **Error! Reference source not found.**, the percentage of the RHCAs with each treatment would be reduced. A majority of these treatments within RHCAs are proposed within the Upper McKay Subwatershed; however, juniper removal is concentrated in the Lower McKay Subwatershed with minor amounts of commercial harvest and some fuel reduction treatments are proposed in the Allen Creek Subwatershed.

Connected actions for Alternative 3 include one streambank stabilization, one mile of new and 4.5 miles of existing disturbance temporary roads, 12 miles of road reconstruction, one mile of new specified road and two floodplain connection sites all of which are located in the Upper McKay Subwatershed. These connected actions differ somewhat from Alternative 2 connected actions. Alternative 3 proposes 1.5 miles less of temporary road on existing disturbance, one mile of new specified road that is not included in Alternatives 2 or 4, and two floodplain connection sites also exclusive to Alternative 3. Alternative 3 road proposal activities located within 300 feet of intermittent or perennial stream channels include 0.5 miles of temporary roads, 99% of which are on existing disturbance located in the Upper McKay Creek Subwatershed, 2.4 miles of road reconstruction located in the Upper McKay Creek Subwatershed and 0.8 miles of previously decommissioned road in the Allen Creek Subwatershed reconstructed and closed after use (i.e. Operational Maintenance Level I Road).

The same project design criteria listed under Alternative 2 that protects streams relative to fine sediment and turbidity from proposed project activities will be implemented for Alternative 3. Erosion and delivery of fine sediment to stream channels is minimized or eliminated relative to potential effects from prescribed burning in the RHCA using these PDCs. PDC also exist that minimize erosion and potential sediment delivery to streams from thinning activities. In addition, through implementation of these PDC, vegetation growth would be encouraged in disturbed areas near streams, potentially resulting in denser vegetated buffers along streams and sediment delivery prevention.

In the short-term, Alternative 3 may increase fine sediment and turbidity in McKay Creek in the Upper McKay Subwatershed as a result of instream activities, including the streambank stabilization and the floodplain reconnection components of the project. In the long-term; however, the streambank stabilization and floodplain reconnection components of the McKay Fuels and Vegetation Project will result in more stable streambanks and lower stream energy, resulting in reduced levels of fine sediment and turbidity in McKay Creek. Reductions in grazing pressure along reaches of the stream where juniper and precommercial thinning is

implemented and trees are placed will reduce cattle access to streams and bank trampling, resulting in less fine sediment and turbidity in streams in both the Upper McKay Creek Subwatershed and the Lower McKay Creek Subwatershed. Both of these treatment units also include cutting and leaving trees, some of which may land in the stream channel, which would create more scour along confined sections of stream banks in the short-term. Other than the two proposed floodplain reconnection sites, fine sediment, would continue to be transported through high energy, incised stream reaches downstream to lower energy reaches resulting in higher concentrations of fine sediment deposition in the downstream direction. Overall, Alternative 3 would result in neutral to slightly adverse conditions relative to bank erosion in the short-term. In the long-term; however, Altermative 3 would have a beneficial effect on streambank erosion.

Since roads have been found to be the dominant contributor of sediment to streams relative to other timber harvest activity, the temporary road and road construction is likely to have effect fine sediment in the stream the most. Within 300 feet of stream, 0.5 miles of temporary roads, almost entirely on existing disturbance, will increase erosion in the short-term (up to 3 years). Reopened abandoned forest roads have been found to produce two to three times the sediment concentrations of brushed-in roads (Foltz et al. 2009). Since most of the temporary roads are located on existing disturbance, erosion will likely be less than for new temporary roads under similar environmental circumstances. PDCs require temporary and reconstructed roads with stream crossings to have adequate relief drainage and filter strips or other filtering structures in order to reduce channelization of flow and to catch sediment prior to reaching the stream channel. The purpose of this PDC is to substantially reduce sediment delivery from temporary and reconstructed roads. PDCs also require temporary roads to be removed after completion of logging operations (see Chapter 2). Three years after the disturbance, 90 percent recovery of erosion from the temporary roads is anticipated (Luce and Black, 2001). Temporary roads and reconstructed decommissioned roads may contribute to fine sediment increases in stream channels within the Project Area in the short-term within the Upper McKay Creek. In the long-term, removal of the temporary roads will result in a negligible effect of fine sediment and turbidity on streams in the Upper McKay Creek Subwatershed. No temporary roads are anticipated for the Lower McKay Creek or Allen Creek Subwatersheds.

Approximately 0.8 miles of previously decommissioned road within 300 feet of an unnamed intermittent stream in the Allen Creek Subwatershed is proposed with Alternative 3, which equates to approximately 67 percent of the total length of the road. This proximity to the stream channel provides very little room to provide an adequate buffer to filter out sediment from entering the stream channel. By gravelling the entire length of the road, erosion can be reduced by up to 80 percent relative to a native surface road; however, 20 percent or more of the erosion of the road may continue as a chronic source of sediment delivery, particularly during large precipitation events (Elliot 2000). Currently established vegetation is providing on the road surface is providing stability of the existing decommissioned road, so relative to the existing condition, by reconstructing this previously decommissioned road, sediment delivery to the unnamed intermittent tributary in the Allen Creek Subwatershed would be anticipated in both the short-term and the long-term, with greater fine sediment and turbidity effects in the short-term in particular.

Road reconstruction of approximately 2.4 miles within 300 feet of stream channels within the Upper McKay Subwatershed would involve improved drainage or graveling of road segments as needed. Overall, improved drainage would reduce occurrences of channelized flow and would encourage overland flow, improving the efficacy of the stream buffers. Adding gravel to road surfaces has been found to reduce erosion by up to 80 percent (Elliot 2000). Alternative 3 proposed road reconstruction would result in fine sediment reductions to streams within the Upper McKay Subwatershed.

Alternative 3 would include fuel reductions and should reduce the risk of wildfire in some riparian and upland areas in the Project Area. Reduced risk of high-intensity wildfires would reduce the risk of large contributions of sediment to stream channels in the project area.

Overall, implementation of Alternative 3 proposed road activities and instream work would balance out to a negligible short-term effect to fine sediment and turbidity in the streams in the Upper McKay Subwatershed. The primary activity effecting fine sediment and turbidity in the Allen Creek Subwatershed in Alternative 3 is the reconstruction of a previously decommissioned road in close proximity to a stream channel, which would result in both short-term and long-term adverse effects. In the long-term, beneficial fine sediment and turbidity effects are anticipated in the Upper McKay Creek Subwatershed as a result of streambank stabilization and floodplain reconnection activities. Negligible fine sediment/turbidity effects would be seen in streams in the Lower McKay Creek Subwatershed in either the short-term or the long-term.

Cumulative Effects

The Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would bring bank stability closer to meeting Forest Plan Standards. Cumulatively, the negligible fine sediment and turbidity effect of Alternative 3 on the Upper McKay Subwatershed would result in a negligible to slight beneficial effect in the short-term. In the long-term, bank stability is anticipated to improve resulting in a beneficial effect to fine sediment and turbidity in streams in the Upper McKay Creek Subwatershed. The Mill Creek AMP Project Area only overlaps 117 acres of the 455 acres of McKay Fuels and Vegetation Project area located within the Allen Creek Subwatershed. This limited overlap will likely result in slightly adverse cumulative effects to fine sediment and turbidity and streams in the Allen Creek Subwatershed in both the short-term and the long-term. Since Alternative 3 is anticipated to have negligible effect to fine sediment and turbidity in streams in the Lower McKay Creek Subwatershed, cumulative effects with implementation of the Mill Creek AMP are anticipated to result in negligible short-term effects and beneficial long-term effects.

It is anticipated that Phase I of the McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Subwatershed through a combination of fencing and boulder placement. In the short-term (<5 years), installation of fencing and boulders would result in soil disturbance and the potential for erosion; however in the long-term as vegetation along riparian areas is reestablished, riparian buffers would become more effective and bank stability would be increased, resulting in improved long-term fine sediment and turbidity in streams within the project area. Cumulatively, short-term (< 5 years) potential increases in sediment delivery to streams may occur with implementation of both the McKay Meadow and Wetland Protection Project and the McKay Fuels and Vegetation Project in the Upper McKay Subwatershed. In the long-term (>5 years), the McKay Meadow and Wetland Protection Project and the McKay Fuels and Vegetation Project would cumulatively have a beneficial effect on fine sediment and turbidity in streams within the Upper McKay Subwatershed. No McKay Meadow and Wetland Protection activities are planned within the Allen Creek and Lower McKay Creek Subwatersheds.

Chemical Contamination/Nutrients

Alternative 3, the proposed action, includes thinning and prescribed burning in riparian areas. Implementation of Project Design Criteria and riparian prescriptions specific to each unit and perennial stream channel would result in negligible effect and possibly slight beneficial effects of the proposed action on chemical contamination and nutrients relative to the existing condition.

PDCs designed to protect stream temperatures and fine sediment/turbidity in streams discussed above, would also in effect protect stream channels from delivery of chemical contaminants and nutrients through enhanced riparian buffers and reduced sediment delivery. By reducing fine

sediment delivery to streams in the long-term, chemical contaminants and nutrients adsorbed to sediment particles would also be filtered out prior to reaching the stream channel. In addition to reduced chemicals and nutrients adsorbed to fine sediment, cut-and-leave trees would be felled in a way to reduce livestock access to riparian areas within juniper units, precommercial thinning units, riparian treatment units, and floodplain reconnection site exclosures resulting in reduced cattle waste on floodplains. Reduced cattle waste in riparian zones would reduce the source for *E. coli* to the stream and may improve BOD levels in the stream.

Increased nutrient supply to channels is greatest in underburn units in which fire is allowed to back down into no- treatment buffers. Increased quantities of nitrate and phosphate may be available to the channel. The small area of effect and rare occurrence of fire escaping during fuels treatment; however, reduces potential increases in nutrients to aquatic habitat to less than available within the historic fire regime. Relative to levels of nutrients resulting from high-intensity wildfires, nutrient supplies to the stream from underburning would be relative minor. By implementing the PDCs for prescribed burning in RHCAs, the probability of affecting nutrient concentration in streams in the project area is discountable.

Various studies in the Pacific Northwest have found that timber harvest "causes no increase in chemical constituents in streamwater of a magnitude that would adversely affect water quality" relative to drinking water standards (Tiedemann et al. 1988). By limiting cattle access to riparian areas, Alternative 3 is expected to have a slight beneficial effect to streams relative to *E. coli* and BOD once cut and leave activities are completed in the riparian areas. With implementation of the PDCs, prescribed burning in RHCAs is anticipated to have negligible effect on nutrients in the stream channel. These effects are common to all three subwatersheds; however, most beneficial effects are anticipated to occur in the Upper McKay Subwatershed, since most beneficial activities are located within it.

Cumulative Effects

The Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would reduce grazing pressure in riparian areas. This cumulative reduction of grazing pressure between implementation of Alternative 3 and the Mill Creek AMP is expected to have both short-term and long-term beneficial effects relative to *E. coli* concentrations in streams in all three subwatersheds in the project area.

It is anticipated that Phase I of the McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would include protecting select meadows and wetlands within the Upper McKay Subwatershed by fencing sensitive riparian areas near Divide Spring and near the forest boundary. In both the short-term (<5 years) and the long-term (> 5 years), exclusion of cattle from these areas would have beneficial effects relative to E. Coli concentrations in stream channels in McKay Creek. The cumulative effect of cattle exclusion along select reaches of McKay Creek and its tributaries from the McKay Meadow and Wetland Protection Project along with reduced grazing pressure in riparian areas where cut and leave has occurred (i.e. in juniper and precommercial thinning units and riparian treatment units) as part of the McKay Fuels and Vegetation Project, should result in both short and long-term beneficial effects relative to *E.coli* concentrations in McKay Creek within the Upper McKay Subwatershed. No McKay Meadow and Wetland Protection activities are planned within the Allen Creek and Lower McKay Creek Subwatersheds.

Habitat Access

Physical Barriers

In-stream activities proposed in Alternative 3 include up to 1 mile of stream channel and floodplain reconstruction, and approximately 39 miles of cut-and-leave treatments (i.e. commercial, precommercial, riparian, and juniper units) within RHCA. The stream channel and

floodplain reconstruction treatments would be designed to allow full passage through the treatment reaches. In the cut-and-leave treatments, some trees that are felled will land in stream channels and be left in place. Trees naturally fall into streams and very rarely become barriers to fish migration and fish are very adept at finding navigable channels through or around wood structures (Opperman et al 2006). There is potential to create physical barriers, but the probably is extremely low. There is potential to have a benefit to physical barriers. LWM reduces stream energy and increases floodplain connectivity and may help reduce the formation of new headcuts. Overall, there would be no measureable short-term impact. In the long-term, there may be a slight beneficial effect to physical barriers.

Cumulative Effects

There are no past, present, or reasonably foreseeable actions that would substantially affect physical barriers in the McKay Creek Watershed.

Habitat Elements

Large Woody Material

To account for a diversity of watershed and riparian conditions in the project area, we propose unit-specific treatments based on site-specific conditions. The unit-specific treatment prescriptions and the rationale behind them is the same as Alternative 2 with some additional treatments that would even further enhance riparian and aquatic habitat, particularly LWM frequency.

In Alternative 3, we added three Riparian units (RIP – Units 162, 163, and 164), where treatment was needed to reduce the density of overstocked, small conifers (average tree height <37 feet), to accelerate the growth of old forest structure, and to increase the amount of hardwoods, shrubs, and herbaceous vegetation. In these units, we propose cut-and-leave treatments within the LWM recruitment zone after shade requirements are met (see Shade section) and stream banks are protected (at least a 5-foot no-cut on all streams). These additional units would contribute to a greater overall benefit to LWM frequency in the watershed.

Also in Alternative 3, we added 2 sites where McKay Creek would be reconnected to its historic floodplain, resulting in a shallower water table for better establishment of riparian vegetation and better stream channel conditions. At these sites, LWM would be used as a tool to accomplish the objectives, further increasing LWM frequency.

Another feature of Alternative 3 is the change in riparian treatment prescriptions for commercial thinning units (HSA and HTH). Within the no-cut buffers on streams that don’t have shade restrictions in Alternative 2, a cut-and-leave treatment is proposed in Alternative 3. For example, in Alternative 2 there are Class II and III perennial streams in Unit 35 that have treatment restrictions to protect shade. The Class IV intermittent stream in Unit 35 doesn’t have restrictions to protect shade, but has a 30-foot no-cut buffer to protect potential large wood recruitment. In Alternative 3, Unit 35 has a cut-and-leave treatment within the 30-foot no-cut buffer on the Class IV stream; the 5-foot no-cut buffer is to protect bank stability. The changes in Alternative 3 result in more LWM being felled into stream channels, and thus a greater benefit to LWM frequency.

Another important change that is made in Alternative 3 is inclusion of the statement "cut-and-leave until large wood RMO is met" to the treatment prescriptions. This means wood that is cut to meet the silvicultural prescription should be left on site within the LWM recruitment zone; once the large wood RMO is met at the unit scale, then wood may be extracted from site (following other restrictions and PDC) if needed to meet the native riparian vegetation RMO. The inclusion of this statement, combined with the other cut-and-leave treatments, may result in a reduction in recruitment availability in the long-term. However, thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a

greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. The residence time of LWM felled into the channel is expected to be up to about 50 years, based on studies of similar inland sites (Benda and Bigelow 2011). This should give the adjacent stand time to grow and become available for future recruitment. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect LWM frequency in the McKay Creek watershed is implementation of underburning under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency. Therefore, there are no additional effects to LWM frequency.

Pool Frequency and Quality

Pool frequency and quality is closely tied to LWM frequency (see Analysis Design section) and therefore the effects would be very similar to the effects on LWM discussed above. The changes to riparian treatments in Alternative 3 would greatly benefit LWM frequency and therefore pool frequency and quality in the short-term. Thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as important key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. An increase in LWM size and frequency would lead to an increase in pool frequency and quality. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently pool frequency and quality in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect pool frequency and quality in the McKay Creek watershed is implementation of underburning under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency and consequently pool frequency and quality. Therefore, there are no additional effects to pool frequency and quality.

Substrate

As discussed in Alternative 2, channel substrate is also closely tied to LWM frequency (see Analysis Design section) and therefore the effects of the project would be very similar with the additions in Alternative 3 of riparian-specific treatment units and two floodplain reconnection sites. The riparian treatment units would even further enhance short-term LWM and therefore would result in similar enhanced short-term effects on stream substrate. An increase in LWM size and frequency would lead to an increase in spawning gravels in the stream channel and substrate quality. In addition, since incised channels have more stream power and therefore tend to carry larger channel materials compared to unimpaired reference channels, therefore by

reconnecting the floodplain to McKay Creek along two stream reaches, more spawning gravels are anticipated in pool tailout locations of the stream.

In the short-term (< 5 years), because removal of wood volume would be minimized in all LWM recruitment zones and cut-and-leave treatments would accelerate recruitment, actions associated with the project would have a combined beneficial effect to LWM frequency and substrate quality in the short-term within the Upper McKay Subwatershed and small portions of the Lower McKay Subwatershed. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations as a result of Alternative 3 balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently substrate quality in the Lower McKay Creek Subwatershed. In the Upper McKay Creek Subwatershed, spawning gravel improvements in McKay Creek as a result of floodplain reconnection activities are expected to outweigh other effects to substrate, resulting in long-term beneficial effects in the Upper McKay Creek Subwatershed. No short-term or long-term effects are anticipated for the Allen Creek Subwatershed due to the limited activity proposed there.

Alternative 3 effects to fine sediment in the streams in the project area are analyzed in the Fine Sediment/Turbidity section of the Alternative 3 Water Quality Environmental Consequences.

Cumulative Effects

No cumulative effects to substrate quality are anticipated to occur as a result of implementation of the Mill Creek AMP or the McKay Meadow and Wetland Protection Project, other than the changes to fine sediment in the streams, which is discussed in the Fine Sediment/Turbidity section for Alternative 3.

Off-channel Habitat and Refugia

Off-channel habitat and refugia are closely tied to LWM frequency and therefore, the effects would be very similar to the effects on LWM discussed above. The changes to riparian treatments in Alternative 3 would greatly benefit LWM frequency and therefore off-channel habitat and refugia in the short-term. Thinning of the adjacent stand would accelerate growth of remaining trees, increasing their ability to act as important key pieces if recruited to the stream channel. Key pieces are expected to be retained for longer periods of time and have a greater morphological influence on the channel. Also, the expected increase in growth and subsequent future recruitment of hardwoods would contribute to complex LWM accumulations. An increase in LWM size and frequency would lead to an increase in off-channel habitat and refugia. In the long-term, the benefit of larger available key pieces and more complex LWM accumulations balances out the minor reduction in recruitment availability while the stand and understory grow, leading to a neutral effect to LWM frequency and consequently off-channel habitat and refugia in the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect off-channel habitat and refugia in the McKay Creek watershed is implementation of underburning under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the AMP, about 800 acres of underburning will occur in RHCA within allotment pastures. Because streams and riparian areas through pastures are already lacking LWM, and similar PDC will be followed to limit consumption of any existing down wood, underburning would have an immeasurable effect on LWM frequency and consequently off-channel habitat and refugia. Therefore, there are no additional effects to off-channel habitat and refugia.

Vegetation Conditions in Riparian Habitat Conservation Areas

Native Riparian Vegetation

To account for a diversity of watershed and riparian conditions in the project area, we propose unit-specific riparian treatments based on site-specific conditions. The unit-specific treatment prescriptions and the rationale behind them is the same as Alternative 2 with some additional treatments that would even further enhance riparian and aquatic habitat.

In Alternative 3, we added 3 Riparian units (RIP – Units 162, 163, and 164), where treatment was needed to reduce the density of overstocked, small conifers (average tree height <37 feet), to accelerate the growth of old forest structure, and to increase the amount of hardwoods, shrubs, and herbaceous vegetation. In these units, we propose cut-and-leave treatments within the LWM recruitment zone after shade requirements are met (see Shade section) and stream banks are protected (at least a 5-foot no-cut on all streams). These additional units would contribute to a greater overall benefit to native riparian vegetation condition in the watershed.

Also in Alternative 3, we added 2 sites where McKay Creek would be reconnected to its historic floodplain, resulting in a shallower water table for better establishment of riparian vegetation and better stream channel conditions. These treatments would further improve riparian vegetation condition and habitat connectivity for aquatic species.

Another feature of Alternative 3 is the change in riparian treatment prescriptions for commercial thinning units (HSA and HTH). Within the no-cut buffers on streams that don't have shade restrictions in Alternative 2, a cut-and-leave treatment is proposed in Alternative 3. This would result in a greater area of treatment to help attain the native riparian vegetation RMO.

Another change that is made in Alternative 3 is inclusion of the statement "cut-and-leave until large wood RMO is met" to some of the treatment prescriptions. This means wood that is cut to meet the silvicultural prescription should be left on site within the LWM recruitment zone; once the large wood RMO is met at the unit scale, then wood may be extracted from site (following other restrictions and PDC) if needed to meet the native riparian vegetation RMO. The extraction of wood after meeting the large wood RMO would have less of a benefit than leaving the wood on-site because it would remove down wood obstacles that would deter cattle access in riparian areas. However, the area of treatment where wood may be extracted is only a 6 percent of the RHCAs in the project area. Most of the streams have shade requirements that would eliminate the ability to fell and extract wood.

The activities proposed in Alternative 2 combined with activities in Alternative 3 would move riparian conditions closer to what they were historically and closer to the potential natural vegetation conditions. The treatments would in turn help create and maintain habitat and connectivity for riparian dependent species that are more adapted to a hardwood, shrub, and herbaceous composition and structure. Implementing Alternative 3 would have a beneficial effect on vegetation conditions in the RHCA in both the short-term and the long-term.

Cumulative Effects

The only past, present, and reasonably foreseeable future action that may incrementally affect riparian vegetation conditions in the McKay Creek watershed is implementation of underburning and grazing under the Mill Creek Allotment Management Plan (AMP) Record of Decision. Under the Mill Creek AMP, grazing, about 800 acres of underburning will occur in RHCA within allotment pastures. Riparian restoration treatments will also be implemented. According to the FEIS, the Mill Creek AMP will improve stream shade and stream temperatures by increasing bank stability and improving channel morphology. Because the Mill Creek AMP will benefit riparian conditions, implementing Alternative 3 would incrementally benefit riparian vegetation conditions even further.

Stream Shade

Alternative 3 includes thinning and prescribed burning in riparian areas. Implementation of Project Design Criteria and riparian prescriptions specific to each unit and perennial stream

channel would result in negligible effect in the short-term (< 5 years) and beneficial effects of Alternative 3 on stream shade in the long-term (> 5 years).

With the exception of water drafting criteria, PDCs discussed in the Water Temperature section of the Alternative 2 Water Quality Environmental Consequences along with unit-specific riparian prescriptions will protect stream shade in the project area, resulting in negligible effect to stream shade in the short-term (< 5 years). In the long-term (> 5 years) beneficial effects to stream shade from Alternative 3 are anticipated as riparian vegetation is improved (see Native Riparian Vegetation Section) and it as well as conifers in the riparian areas both grow to heights that would improve shade to stream channels in project area. Beneficial effects will primarily effect streams in the Upper McKay Subwatershed, since project activities are mostly focused there.

Cumulative Effects

In addition, the Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would improve vegetated cover, which should in effect improve stream shade, primarily in the Upper McKay Subwatershed and portions of the Lower McKay Subwatershed. Negligible effects are expected in the Allen Creek Subwatershed, since the Mill Creek AMP area overlaps only 25 percent of the McKay Fuels and Vegetation Project area that's located there.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Creek Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on stream shade in the long-term as vegetation along riparian areas is reestablished providing increased shade to the stream.

Channel Condition and Dynamics

Width/depth Ratio, Bank Stability, Floodplain Connectivity

The percentage of the RHCAs within commercial harvest, precommercial thinning, and prescribed burning units in Alternative 3 are essentially equal to the percentages of these treatment units in Alternatives 2 and 4. In addition, there are 10 aspen treatment units located within RHCAs, similar to the other two alternatives. However, Alternative 3 includes an additional 16 percent of the total RHCA acres in the project area proposed for treatment in the form of "riparian treatments" (see Chapter 2 for more complete description of riparian treatments). These percentages represent the percentage of the area that overlaps proposed units; however, by following the riparian prescriptions in Chapter 2, the percentage of the RHCAs with each treatment would be reduced. In addition, Alternative 3 includes a proposal at two sites along McKay Creek for reconnection of the stream channel to its floodplain.

Connected actions for Alternative 3 include one streambank stabilization, one mile of new and 4.5 miles of existing disturbance temporary roads, 12 miles of road reconstruction, one mile of new specified road and two floodplain connection sites all of which are located in the Upper McKay Subwatershed. These connected actions differ somewhat from Alternative 2 connected actions. Alternative 3 proposes 1.5 miles less of temporary road on existing disturbance, one mile of new specified road that is not included in Alternatives 2 or 4, and two floodplain connection sites also exclusive to Alternative 3. Alternative 3 road proposal activities located within 300 feet of intermittent or perennial stream channels include 0.5 miles of temporary roads, 99% of which are on existing disturbance located in the Upper McKay Creek Subwatershed, 2.4 miles of road reconstruction located in the Upper McKay Creek Subwatershed and 0.8 miles of previously decommissioned road in the Allen Creek Subwatershed reconstructed and closed after use (i.e. Operational Maintenance Level I Road).

The same project design criteria listed under Alternative 2 that protect channel condition from proposed project activities will be implemented for Alternative 3. Through implementation of these PDC, vegetation growth would be encouraged in disturbed areas near streams, potentially resulting in denser vegetation along streams and consequently improved rooting strength and increased bank stability in the long-term.

In the short-term (< 5 years), Alternative 3 activities that would affect bank stability and w/d ratios include the addition of approximately two temporary stream crossings in the Upper McKay Creek Subwatershed and approximately five stream crossings located along the previously decommissioned road proposed for reconstruction within the Allen Creek Subwatershed. These stream crossing locations would likely effect the bank stability and width/depth ratios in the localized location of the stream crossings in the short-term; however, they would only account for < 1 percent of the total stream length within the Upper McKay Subwatershed and approximately 3 percent of the total stream length within the Allen Creek Subwatershed portion of the project area, resulting in a negligible increase in cutbanks. All of these stream crossing locations would likely effect the bank stability and w/d ratios in the localized location of the stream crossings in the short-term. In the long-term (> 5 years) with implementation of the PDCs that include revegetation at stream crossings and proper removal of temporary roads, stream banks at the temporary crossing locations should recover to their pre-project stability and w/d ratios; however, the stream crossings along the reconstructed decommissioned road would likely be maintained as stream fords, which would have slight adverse effects on channel condition in the localized area of the stream crossings within the Allen Creek Subwatershed. Properly constructed ford crossings would have less impact to the channel condition relative to culvert crossings by not constricting the channel and not increasing flow velocities and scour, downstream portions of the stream channel should see negligible effects. Alternative 3 would also improve bank stability in the long-term (>5 years) along a limited stream reach (50-100 feet) as a result of the streambank stabilization activity at one of the three temporary stream crossing locations that currently has bank stability concerns on an unnamed tributary to McKay Creek located within the Upper McKay Subwatershed.

By reconnecting McKay Creek to its floodplain, channel condition would improve along the restored reaches of channel as well as downstream of these sections of McKay Creek. Stream form and function would be reestablished with more meander, reduced stream power, and restoration of width/depth ratios that are in balance with streamflows in McKay Creek. By restoring the connection to the floodplain, the channel will no longer be incised, resulting in improved bank stability and maintenance of proper width/depth ratios. In the short-term (< 5 years) and the long-term (> 5 years), floodplain reconnection activities would have a beneficial effect on channel condition, including width/depth ratios, bank stability, and floodplain connection in the Upper McKay Subwatershed In the short-term, additional beneficial effects to floodplain connectivity from Alternative 3 would include more streamflow accessing floodplains during high flows with the addition of LWM to the stream channel for all three subwatersheds. In the long-term, as added LWM approaches the amount of LWM that would have eventually been recruited, these effects would become less apparent, resulting in negligible long-term effects to floodplain connectivity in the Allen Creek and Lower McKay Creek Subwatersheds.

Once juniper treatments units, precommercial thinning units, riparian treatment units, and commercial units are treated with cut-and-leave trees, grazing pressure and bank trampling by cattle should be minimized in the short-term (< 5 years). Bank stability and W/D ratios; however, would likely take some time (> 5 years) to see a beneficial effect from these changes resulting from implementation of Alternative 3. Precommercial thinning units and riparian treatment units are primarily located within the Upper McKay Subwatershed and juniper treatment units are primarily located in the Lower McKay Subwatershed. Allen Creek Subwatershed includes primarily commercial thinning units. All of these treatment units also include cutting and leaving trees, some of which may land in the stream channel. Initially (< 5 years), this added LWM

would create more scour along confined sections of stream banks; however, this would be balanced out as added roughness would result in more streamflows spreading out across the floodplain, relieving near bank stresses in the stream channel. In the long-term (> 5 years), LWM would add stability to stream banks, in part by adding roughness and restoring appropriate W/D ratios.

Overall, in the long-term, existing unstable banks in some reaches of Allen Creek, Lower McKay Creek, and portions of Upper McKay Creek would continue to widen, resulting in further bank instability and wider width/depth ratios other than at and downstream of floodplain reconnection sites and at the streambank stabilization site. Since most stream reaches in Allen Creek and McKay Creek are dominated by moderately confined channel types (i.e. Rosgen B-chennel types) with moderate sensitivity to disturbance and an excellent recovery potential, it is likely that bank instability will be more concentrated downstream in the less confined portions of McKay Creek (Rosgen 2009). These gravel dominated, less confined channel types mostly found in Lower McKay Creek have a very high sensitivity to disturbance and do not recover as quickly as the more confined channel types found in Allen Creek and Upper McKay Creek. Since the Lower McKay Creek Subwatershed is located downstream of where floodplain reconnection sites, as well as all of the LWM enhancement locations, the benefits of these activities would balance these effects somewhat.

In the short-term (< 5 years), effects of adding two temporary stream crossings, as well as the initial effects of potential additions of LWM to stream channels as a result of cut-and-leave in treatment units within RHCAs are expected to be balanced by implementation of the floodplain reconnection, streambank stabilization activities, and enhanced floodplain connectivity with the addition of LWM resulting in a negligible to slightly beneficial effect of Alternative 3 on channel condition within the Upper McKay Creek Subwatershed. Long-term effects of Alternative 3 in the Upper McKay Subwatershed are expected to be beneficial to channel condition as a result of LWM placement and floodplain reconnection at two sites on McKay Creek. Downstream of these sites in the most upstream portions of McKay Creek within the Lower McKay Creek Subwatershed, some minor beneficial effects are anticipated in the long-term as well as a result of reduced stream powers flowing in from upstream. In the short-term, bank stability the Lower McKay Creek Subwatershed would effects to bank stability and width/depth ratio would be balanced out resulting in negligible effect; however, in the long-term this material would be beneficial to bank stability once the channel has completed adjustment (> 5 years). In the Allen Creek Subwatershed, the addition of five crossings of the reconstructed decommissioned road would likely effect the bank stability and width/depth ratios in the localized location of the stream crossings in both the short-term and the long-term; however, these crossing locations only make up approximately 3 percent of the total stream length within the project area portion of Allen Creek Subwatershed. Both short-term and long-term effects to channel condition in the Allen Creek Subwatershed would be negligible.

Cumulative Effects

The Hydrology Report prepared for the Mill Creek AMP indicates that implementation of the selected alternative, the proposed action, would bring bank stability closer to meeting Forest Plan Standards. Since the effect to bank stability from Mill Creek AMP is anticipated to be beneficial, cumulatively this alternative along with the implementation of Alternative 3 is expected to have short-term neutral and long-term beneficial effects on bank stability and w/d ratios in Upper McKay Creek Subwatershed and the upstream portions of McKay Creek within the Lower McKay Subwatershed. Effects to Allen Creek from the Mill Creek AMP would be negligible due to limited overlap between project areas in the Allen Creek Subwatershed.

In the short-term (<3 years), installation of fencing and boulders as part of Phase I of the McKay Meadow and Wetland Protection Project would result in soil disturbance and the potential for erosion; however in the long-term as vegetation along riparian areas is reestablished, vegetated

rooting densities would increase and consequently bank stability would be improved along stream reaches that are associated with the meadow and wetland protection activities. Cumulatively, short-term (< 5 years) effects would be negligible to slightly adverse as a result of the McKay Meadow and Wetland Protection Project and Alternative 3 activities within the Upper McKay Subwatershed. In the long-term (>5 years); however, the McKay Meadow and Wetland Protection Project and the McKay Fuels and Vegetation Project would cumulatively have a beneficial effect on bank stability and w/d ratios on streams in the Upper McKay Subwatershed. Effects to Allen Creek Subwatershed and Lower McKay Subwatershed would not be affected by the McKay Meadow and Wetland Protection Project.

Hydrology

Change in Peak/Base Flows

Road activities in Alternative 3 include one mile of new and 4.5 miles of existing disturbance temporary roads, 12 miles of road reconstruction, and one mile of new specified road. All road activities proposed in Alternative 3 are located within the Upper McKay Creek Subwatershed, except approximately 1.2 miles of reconstructed decommissioned road located within the Allen Creek Subwatershed. In addition to road work, two floodplain connection sites are proposed and located in the Upper McKay Subwatershed. These activities differ somewhat from Alternative 2 proposed actions. Alternative 3 proposes 1.5 miles less of temporary road on existing disturbance, one mile of new specified road that is not included in Alternatives 2 or 4, and two floodplain connection sites also exclusive to Alternative 3. The only water withdrawals proposed as part of Alternative 3 are for water drafting for use road dust abatement, similar to Alternatives 2 and 4. No proposed activities have the potential to effect peakflows or baseflows within the streams located within the Lower McKay Subwatershed.

Water drafting must follow the Water Conservation Plan for the Ochoco National Forest, which limits the quantity of water withdrawal based on the time of year and prohibits water withdrawals when the flow falls below 1 cubic foot per second (1996). These withdrawals should have a negligible effect on the overall hydrograph of streams in any of the three subwatersheds.

By reconnecting McKay Creek to its floodplain at two sites in the Upper McKay Creek Subwatershed, flows above bankfull would again flow out of the channel and on top of the floodplain. This would result in a reduced peakflows and enhanced baseflows in McKay Creek at the sites as well as downstream. In the Upper McKay Subwatershed, slight beneficial effects are anticipated to occur in McKay Creek in the short-term (< 5 years) with even more beneficial effects on peak flows and baseflows in McKay Creek occurring once all of the flow has been moved into the floodplain connected channel (> 5 years). Similar, but lesser, beneficial effects would result from Alternative 3 additions of LWM to stream channels in commercial, precommercial, juniper, and aspen treatment units. LWM in the stream channels would result in high flows accessing floodplains during higher flows, resulting in slightly reduced peakflows and enhanced baseflows as stored water is released by to the stream channel. As a result beneficial effects to floodplain connectivity from Alternative 3 are anticipated in all three subwatersheds, with the most benefit occurring in the Upper McKay Subwatershed.

The estimated 4.5 miles of temporary road located on existing disturbance would have an immeasurable effect on the peak flow and baseflow of streams in in the Upper McKay Subwatershed. The existing disturbance is likely already effecting runoff patterns from these locations and therefore, by essentially reopening them, peak flows and baseflows would only be negligibly affected. In the short-term (< 5 years), one mile of new temporary road and one mile of new specified road would only have a negligible effect on the hydrograph of streams in the Upper McKay Subwatershed, since it would equate to only a one mile increase in road miles by approximately 1 percent. Reconstructing the 1.2 miles of decommissioned road in the Allen Creek Subwatershed would have a slight effect on streamflows in the unnamed intermittent

stream that it parallels. Since the roadbed is already on the ground, this effect would primarily be a result of removal of well-established vegetation and the proximity of the road to the stream, resulting in slightly increased peak flows in the short-term (< 5 years) and potentially negligible effects in the long-term (> 5 years) as vegetation is reestablished. Reconstruction of 11 miles of road in the Upper McKay Subwatershed has the potential to reduce channelized flow and encourage sheet flow infiltration through a combination of improved drainage and gravel surfacing. Enhanced infiltration has the potential to dampen peak flows and increase baseflows in stream channels in the Upper McKay Subwatershed in the short-term and assuming continued road maintenance, in the long-term as well.

Overall, beneficial short-term and beneficial long-term effects to peak flows and baseflows in the streams in the Upper McKay Subwatershed are anticipated. Effects to streamflows in the Allen Creek Subwatershed are anticipated to be balanced out between slightly adverse effects of roads and slightly beneficial effects from the addition of LWM in the short-term (< 5 years) and negligible in the long-term (>5 years). In the short-term, effects to peak flows and baseflows in the Lower McKay Subwatershed would be negligible to slightly beneficial. Negligible to slight beneficial effects to peak flows or baseflows are anticipated to occur in the Lower McKay Subwatershed in the long-term (> 5 years) once the full benefit of the floodplain reconnection activities are fully realized.

Cumulative Effects

Mill Creek AMP would have negligible effect on peak flows or baseflows in streams in the McKay Watershed. One new water development and reconstruction of 12 water developments were proposed as part of the selected alternative of Mill Creek AMP. Since existing peak flows and baseflows are already being affected by almost all of the water developments, the slight changes resulting from reconstruction 12 water developments and constructing one new one, should have no measurable effect on peak flows and baseflows in the Upper McKay Subwatershed. No water developments were proposed in the Allen Creek or Lower McKay Subwatersheds.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would involve protecting select meadows and wetlands within the Upper McKay Creek Subwatershed through a combination of fencing and boulder placement. Implementation of this project is anticipated to have a beneficial effect on baseflows by improving wetland meadow integrity and arresting further degradation of water storage capacity, in both the short-term (< 5 years) and the long-term (> 5 years) in the Upper McKay Creek Subwatershed. Cumulatively, this would result in beneficial effects to peak flows and baseflows in the Upper McKay Creek Subwatershed in both the short-term and long-term.

Increase in Drainage Network

Effects from Alternative 3 on the drainage networks in the McKay Watershed are primarily tied to road construction and reconstruction activities. Road activities in Alternative 3 include one mile of new and 4.5 miles of existing disturbance temporary roads, 12 miles of road reconstruction, and one mile of new specified road. All road activities proposed in Alternative 3 are located within the Upper McKay Creek Subwatershed, except approximately 1.2 miles of reconstructed decommissioned road located within the Allen Creek Subwatershed.

Alternative 3 is expected to result in a temporary increase in road densities from 2.8 miles per square mile to 3.0, both of which are considered as functioning at risk for the Upper McKay Subwatershed (see Analysis Design). Ultimately, once the temporary roads have been removed, road densities would then become 2.9 miles per square mile, which is also considered functioning at risk. The addition of approximately two temporary stream crossings in the Upper McKay Creek Subwatershed increase stream crossing densities from from 2.5 to 2.6 crossings per square

mile in Upper McKay Creek Subwatershed, which makes the stream crossing densities in Upper McKay Subwatershed high relative to the number of stream crossings in numerous subwatersheds across the Ochoco National Forest (see Analysis Design). The addition of approximately approximately five stream crossings located along the previously decommissioned road proposed for reconstruction within the Allen Creek Subwatershed would increase stream crossing densities from 3.9 to 4.1 crossings per square mile, both of which represent high stream crossing densities relative to other subwatersheds within the Ochoco National Forest. Based on a moderate drainage density and the temporary nature of the stream crossings and roads in the Upper McKay Creek Subwatershed, a slight adverse effect is anticipated as a result of Alternative 3. In the long-term, once temporary roads have been removed, these effects to the drainage network are anticipated to fully recover within the Upper McKay Subwatershed. Based on the high drainage densities and the non-temporary nature of the road work in the Allen Creek Subwatershed, both short-term and long-term effects to the drainage network are anticipated to be adverse as a result of Alternative 3.

Reconstruction of 11 miles of road in the Upper McKay Subwatershed has the potential to reduce channelized flow and encourage sheet flow infiltration through a combination of improved drainage and gravel surfacing. Enhanced infiltration has the potential to reverse some of the effects of road construction on the drainage network by disconnecting some of the connectivity between streams and roads in the Upper McKay Subwatershed in both the short-term and the long-term.

In the short-term (< 5 years), the slight increases in stream crossing and road densities are negated by road reconstruction improvements to the drainage network resulting in a negligible effect in the Upper McKay Subwatershed. In the long-term, beneficial effects are anticipated in the Upper McKay Subwatershed as a result of 11 miles of road reconstruction resulting a disconnection of select segments of road that are likely connected to the stream network. Based on the high drainage densities and the non-temporary nature of the road work in the Allen Creek Subwatershed, both short-term and long-term effects to the drainage network are anticipated to be adverse as a result of Alternative 3. No road work is proposed in the Lower McKay Subwatershed and therefore Alternative 3 should have a neutral effect on the drainage network there.

Cumulative Effects

Mill Creek AMP does not include road construction activities and therefore has no effect on the drainage network.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would is expected to include some minor specified road and user-created road decommissioning, as well as new specified road construction. Approximately 0.12 miles of road with poor drainage will be decommissioned and replaced with approximately 0.05 miles of road that avoids a spring channel. In addition, approximately 0.17 miles of user-created roads are planned for decommissioning. This project would have a beneficial effect on drainage networks in the Upper McKay Subwatershed in the both the short-term and long-term. Cumulatively, this project and implementation of Alternative 3 of the McKay Fuels and Vegetation Project would result in beneficial effects to drainage networks in the Upper McKay Subwatershed in both the short-term and long-term.

Watershed Condition

Road Density/Location

Effects from the Alternative 3 on the road densities and locations in the McKay Watershed are primarily tied to road construction and reconstruction activities. Road activities in Alternative 3

include one mile of new and 4.5 miles of existing disturbance temporary roads, 12 miles of road reconstruction, and one mile of new specified road. All road activities proposed in Alternative 3 are located within the Upper McKay Creek Subwatershed, except approximately 1.2 miles of reconstructed decommissioned road located within the Allen Creek Subwatershed.

Alternative 3 is expected to result in a temporary increase in road densities from 2.8 miles per square mile to 3.0, both of which are considered as functioning at risk for the Upper McKay Subwatershed (see Analysis Design). Ultimately, once the temporary roads have been removed, road densities would then become 2.9 miles per square mile, which is also considered functioning at risk. 0.5 miles of the temporary roads, 99 percent of which are on existing disturbance, and 0.3 miles of new specified road are located within 300 feet of streams within the Upper McKay Creek Subwatershed. The 0.3 miles of new specified road are; however, located outside the intermittent streams (Class IV) RHCA. Road densities in the Allen Creek Subwatershed would remain essentially the same at 2.5 miles per square mile, which is considered functioning at risk, with the reconstruction of 1.2 miles of decommissioned road. 0.8 miles of decommissioned road reconstructed to ultimately be converted to Operational Maintenance Level I Road (i.e. closed road) is located within 300 feet of an intermittent stream channel in the Allen Creek Subwatershed.

Based on the temporary nature of the roads proposed in Alternative 3 within the Upper McKay Creek Subwatershed, a slight adverse effect is anticipated in the short-term. In the long-term, once temporary roads have been removed, these effects to the road densities are anticipated to fully recover within the Upper McKay Subwatershed. In the Allen Creek Subwatershed, slight adverse short-term and long-term effects relative to road location are anticipated as a result of the close proximity of the 2705-037 road to the intermittent stream channel. No road work is proposed in the Lower McKay Subwatershed and therefore Alternative 3 should have a neutral effect on the road density and location.

Cumulative Effects

Mill Creek AMP does not include road construction activities and therefore has no effect on the road density and location.

It is anticipated that Phase I of McKay Meadow and Wetland Protection Project would begin during the summer of 2013 and continue for approximately 2-3 years. This project would is expected to include some minor specified road and user-created road decommissioning, as well as new specified road construction. Approximately 0.12 miles of road with poor drainage will be decommissioned and replaced with approximately 0.05 miles of road that avoids a spring channel. This reduction in road densities equates to less than a one percent decrease from the existing condition. In addition, approximately 0.17 miles of user-created roads are planned for decommissioning. This project would have a slight beneficial effect on road densities in the Upper McKay Subwatershed in the both the short-term and long-term. Cumulatively, this project and implementation of Alternative 3 of the McKay Fuels and Vegetation Project would result in a slight adverse effect in the short-term (< 5 years) with a larger increase in road densities from temporary roads relative to the slight decrease from implementation of the McKay Meadow and Wetland Protection Project. In the long-term (> 5 years); however, very slight beneficial effects to road densities in the Upper McKay Subwatershed would result from less than a one percent decrease in road densities.

Disturbance History

Commercial harvest, precommercial thinning, restoration of riparian special plant communities and prescribed fire all have some effect on the EHA. Alternative 3 includes all three of these activities (see Chapter 2 for acreages of each activity). One indication of high levels of disturbance is when EHA estimates exceed a threshold of 25 to 30 percent (see Analysis Design). In addition, disturbance activities concentrated in unstable or sensitive areas can put a watershed

at risk of impairment. Based on a combination of historic timber harvest, prescribed burning, and wildfire activities and activities proposed in Alternative 3 within the Ochoco National Forest Boundary portion of the McKay Watershed, EHA were estimated and projected through the estimated time period of the McKay Fuels and Vegetation Project (Table 73). These estimates indicate EHA percentages well below the threshold.

Disturbance history is also a factor of the amount of disturbance concentrated in potentially unstable areas and/or refugia and/or riparian areas. Based on the Geology Report, the percentage of the McKay Fuels and Vegetation Planning Area overlapping dormant landslide terrain in the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds is <1 percent, 1 percent, and 34 percent, respectively. In Alternative 3, the percentage of the total RHCA within the project area with treatments proposed for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds are 100 percent, 57 percent, and 59 percent, respectively. Due to this concentration of activities within RHCAs in all three subwatersheds and unstable terrain in the Upper McKay Creek Subwatershed, disturbance levels are anticipated to be mildly adverse in the short-term; however, in the long-term disturbance levels will level out and become negligible.

Table 73. Projection of EHA for McKay Watershed based on a combination of historic activities and Alternative 3.

Calendar Year	Alternative 3 EHA (%)
2013	3.64%
2014	7.49%
2015	7.85%
2016	7.66%
2017	7.36%
2018	7.06%
2019	6.59%
2020	6.20%
2021	5.99%
2022	5.79%
2023	5.61%

Since some historic and proposed activities are located on unstable dormant landslide terrain and in sensitive areas (e.g. RHCAs), including riparian areas, Alternative 3 would still result in the Ochoco National Forest portion of the McKay Watershed condition as functioning at risk. Since the magnitude of disturbance from implementation of Alternative 3 is minimal, as evidenced by the relatively small change in EHA and relatively quick recovery, it is expected to have a minimal short-term adverse effect on the condition of the McKay Watershed relative to EHA and the level of disturbance in all three subwatersheds. Long-term effects would be negligible. Implementation of Alternative 3 would still meet the Forest Plan standards for EHA.

Cumulative Effects

Mill Creek AMP includes underburning activities in the McKay Watershed in order to improve forage for cattle grazing purposes. Prescribed burning activities are anticipated to have negligible effect on the EHA (Table 74). In addition, PDCs for prescribed burning in RHCAs would minimize or eliminate disturbance in sensitive riparian areas.

Table 74. Projection of EHA for McKay Watershed based on a combination of historic activities, Alternative 3 and Mill AMP.

Calendar Year	Alternative 3 Cumulative EHA (%)
2013	3.64%
2014	7.61%
2015	7.97%
2016	7.77%
2017	7.46%

2018	7.15%
2019	6.68%
2020	6.28%
2021	6.07%
2022	5.87%
2023	5.68%

Alternative 4

Table 75 summarizes the potential effects of Alternative 4 on habitat indicators for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds. Effects vary by subwatershed in Alternative 4.

Relative to effects on habitat indicators, proposed activities in Alternative 4 are essentially the same as Alternative 2, with the following exceptions:

- The treatment acres in RHCAs are less in Alternative 4 than in Alternative 2, but acreages changed only slightly (32 acres) and the percentage of the total RHCA within the project area with treatments is one percent less than in Alternative 2. 70 percent of the difference in treatments within RHCAs are located within wetland or spring RHCAs versus stream RHCAs and therefore would not change the anticipated effects relative to Alternative 2 to the aquatic habitat indicators.
- Alternative 4 proposes fewer miles of temporary roads. Alternative 4 proposes 2.1 miles fewer temporary roads on existing disturbance and 0.2 miles fewer new temporary roads. This difference in temporary road miles between Alternative 2 and 4 results in a minor reduction in road density from 3.0 to 2.9. 0.83 miles of temporary roads are proposed in Alternative 4 w/in 300 feet of streams as compared to 1.1 miles for Alternative 2.
- Alternative 4 proposes 2.5 miles less of road reconstruction relative to Alternative 2; however, the number of road miles reconstructed within 300 feet of streams would remain the same as Alternative 2. This may result in slightly less beneficial effects to water quality and hydrology relative to Alternative 2; however, the slight difference in effect would be balanced out by the slightly more beneficial effects of having 0.3 miles of temporary road on existing disturbance.
- The differences in disturbance levels equates to the differences in treatment acres across the project area. These include a reduction in commercial harvest of 579 acres, which equates to no mistletoe treatments. Activities proposed in Alternative 2 for the mistletoe treatments included commercial thinning followed by precommercial thinning and prescribed burning.

Based on these minimal changes to proposed activities in the project area, Alternative 4 is expected to have the same effect on the habitat indicators as Alternative 2. Due to slight differences in disturbance levels, EHA estimates were still made for Alternative 4 and are discussed below.

Table 75. Summary of Existing Condition and Effects of Alternative 4 by Subwatershed in both the short-term (< 5 years) and the long-term (> 5 years).

Habitat Indicator	Existing Condition	Potential Impacts of Alternative 4 on Habitat Indicator by Subwatershed (+/–/N)[2]		
		Allen Creek	Lower McKay	Upper McKay
water temperature (RMO[1])	NPF	ST: N LT: N	ST: N LT: N/+	ST: N LT: N/+
fine sediment/turbidity (RMO)	PF	ST: N LT: N	ST: N LT: N	ST: N/+ LT: +
chemical contamination/	FAR	ST: N LT: N	ST: + LT: +	ST: + LT: +

nutrients				
physical barriers	NPF	ST: N LT: N	ST: N LT: /+	ST: N LT: N/+
substrate	Lower McKay: PF Allen and Upper McKay: FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
large woody material (RMO)	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
pool frequency (RMO)	Allen and Upper McKay: NPF Lower McKay: FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
pool quality	Lower McKay: PF Allen: FAR Upper McKay: NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
off-channel habitat	FAR	ST: N LT: N	ST: + LT: N	ST: + LT: N
refugia	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
native riparian vegetation (RMO)	NPF	ST: + LT: +	ST: + LT: +	ST: + LT: +
shade	NPF	ST: N LT: /+	ST: N LT: /+	ST: N LT: +
width/depth ratio (RMO)	PF	ST: N LT: N	ST: N LT: N	ST: N LT: N
bank stability (RMO)	Allen & Lower McKay: NPF Upper McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: N
floodplain connectivity	NPF	ST: N LT: N	ST: + LT: N	ST: + LT: N
change in peak/base flows	FAR	ST: N LT: N	ST: N LT: N	ST: N LT: +
increase in drainage network	Allen: NPF Lower McKay: PF Upper McKay: FAR	ST: N LT: N	ST: N LT: N	ST: N LT: +
road density/location	Allen and Upper McKay: FAR Lower McKay: PF	ST: N LT: N	ST: N LT: N	ST: - LT: N
disturbance history	PF	ST: N/- LT: N	ST: N/- LT: N	ST: N/- LT: N

[1]RMO refers to habitat indicators that are also Riparian Management Objectives for the project. The criteria for condition ratings may have been modified.
[2] + stands for beneficial, - stands for adverse, and N stands for neutral.

Watershed Condition

Disturbance History

Commercial harvest, precommercial thinning, restoration of riparian special plant communities and prescribed fire all have some effect on the EHA. Alternative 4 includes all three of these activities (see Chapter 2 for acreages of each activity). One indication of high levels of disturbance is when EHA estimates exceed a threshold of 25 to 30 percent (see Analysis Design). In addition, disturbance activities concentrated in unstable or sensitive areas can put a watershed at risk of impairment. Based on a combination of historic timber harvest, prescribed burning, and wildfire activities and activities proposed in Alternative 4 within the Ochoco National Forest Boundary portion of the McKay Watershed, EHA were estimated and projected through the estimated time period of the McKay Fuels and Vegetation Project (Table 76Disturbance history is also a factor of the amount of disturbance concentrated in potentially unstable areas and/or refugia and/or riparian areas. Based on the Geology Report, the percentage of the McKay Fuels and Vegetation Planning Area overlapping dormant landslide terrain in the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds is <1 percent, 1 percent, and 34 percent, respectively. In Alternative 4, the percentage of the total RHCA within the project area with

treatments proposed for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds are 72 percent, 57 percent, and 37 percent, respectively. Due to this concentration of activities within RHCAs in all three subwatersheds and unstable terrain in the Upper McKay Creek Subwatershed, disturbance levels are anticipated to be mildly adverse in the short-term; however, in the long-term disturbance levels will level out and become negligible.

Since some historic and proposed activities are located on unstable dormant landslide terrain and in sensitive areas (e.g. RHCAs), including riparian areas, Alternative 4 would still result in the Ochoco National Forest portion of the McKay Watershed condition as functioning at risk. Since the magnitude of disturbance from implementation of Alternative 4 is minimal, as evidenced by the relatively small change in EHA and relatively quick recovery, it is expected to have a minimal short-term adverse effect on the condition of the McKay Watershed relative to EHA and the level of disturbance in all three subwatersheds. Long-term effects would be negligible. Implementation of Alternative 4 would still meet the Forest Plan standards for EHA.). These estimates indicate EHA percentages well below the threshold.

Table 76. Projection of EHA for McKay Watershed based on a combination of historic activities and Alternative 4.

Calendar Year	Alternative 4 EHA (%)
2013	3.64%
2014	6.54%
2015	6.84%
2016	6.68%
2017	6.44%
2018	6.19%
2019	5.82%
2020	5.51%
2021	5.34%
2022	5.17%
2023	5.02%

Disturbance history is also a factor of the amount of disturbance concentrated in potentially unstable areas and/or refugia and/or riparian areas. Based on the Geology Report, the percentage of the McKay Fuels and Vegetation Planning Area overlapping dormant landslide terrain in the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds is <1 percent, 1 percent, and 34 percent, respectively. In Alternative 4, the percentage of the total RHCA within the project area with treatments proposed for the Allen Creek, Lower McKay Creek, and Upper McKay Creek Subwatersheds are 72 percent, 57 percent, and 37 percent, respectively. Due to this concentration of activities within RHCAs in all three subwatersheds and unstable terrain in the Upper McKay Creek Subwatershed, disturbance levels are anticipated to be mildly adverse in the short-term; however, in the long-term disturbance levels will level out and become negligible.

Since some historic and proposed activities are located on unstable dormant landslide terrain and in sensitive areas (e.g. RHCAs), including riparian areas, Alternative 4 would still result in the Ochoco National Forest portion of the McKay Watershed condition as functioning at risk. Since the magnitude of disturbance from implementation of Alternative 4 is minimal, as evidenced by the relatively small change in EHA and relatively quick recovery, it is expected to have a minimal short-term adverse effect on the condition of the McKay Watershed relative to EHA and the level of disturbance in all three subwatersheds. Long-term effects would be negligible. Implementation of Alternative 4 would still meet the Forest Plan standards for EHA.

Cumulative Effects

Mill Creek AMP includes underburning activities in the McKay Watershed in order to improve forage for cattle grazing purposes. Prescribed burning activities are anticipated to have negligible effect on the EHA (Table 77). In addition, PDCs for prescribed burning in RHCAs would minimize or eliminate disturbance in sensitive riparian areas.

Table 77. Projection of EHA for McKay Watershed based on a combination of historic activities, Alternative 43 and Mill AMP.

Calendar Year	Alternative 4 Cumulative EHA (%)
2013	3.64%
2014	6.66%
2015	6.96%
2016	6.79%
2017	6.54%
2018	6.28%
2019	5.91%
2020	5.59%
2021	5.41%
2022	5.24%
2023	5.08%

Environmental Consequences –Aquatic Species

Middle Columbia River Steelhead Trout (Oncorhynchus mykiss)

Alternative 1 (No Action)

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to MCR steelhead trout in the McKay Creek Watershed. Current population size, distribution, growth, survival, life history diversity and isolation, and persistence and genetic integrity, which are currently unknown, would not be impacted by any actions associated with this project. However, because habitat conditions are currently on a downward trend, mostly due to incision of stream channels and lowering of the water table, taking no action would lead to an adverse effect in the long term.

Alternative 2 (Proposed Action) and Alternative 4

Under Alternatives 2 and 4 there would be a neutral or beneficial effect to all of the habitat indicators important to steelhead trout (see Table 67). The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance habitat for steelhead trout. The only in-stream activities that would occur are cut-and-leave of conifers. Adding LWM to channels will improve pool frequency and quality, off-channel habitat, floodplain connectivity, and native riparian vegetation. This in turn would increase availability and quality of habitat for MCR steelhead trout.

A recent examination of 30 LWM-placement projects in western Washington and Oregon streams revealed significantly higher densities of juvenile coho salmon in treated reaches than in control reaches during summer and winter and significantly higher densities of juvenile cutthroat trout and steelhead during winter (Roni and Quinn 2001). Where spawning gravels are in low abundance or of low quality, habitat structures, such as channel spanning LWM, boulder clusters, or gabions may recruit and store gravel. House (1996) reported that gravel trapped above and below channel-spanning gabions in Lobster Creek, Oregon, increased suitable spawning habitat by 115%. Following treatment, 60% of steelhead and 56% of coho salmon adults in East Fork Lobster Creek spawned within 5 m of structures, whereas before construction, 18% of coho salmon redds were located in the treatment area (House 1996). Similarly, Anderson et al. (1984), Moreau (1984), and House et al. (1989) observed adults using newly recruited gravels associated

with weir or deflector structures. Crispin et al. (1993) indicated that coho salmon spawner abundance in Elk Creek increased four-fold in the years following placement of instream structures, whereas spawner abundance elsewhere in the Nestucca River basin remained the same or decreased during the study.

In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees could have a short-term adverse impact on individuals. The area of impact, however, from falling of trees is only a small portion of RHCA in the watershed, and the probability of making contact with individuals from falling trees is very low. Therefore, activities associated with Alternatives 2 and 4 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Alternative 3

Under Alternative 3, there would be a neutral or beneficial effect to all of the habitat indicators important to steelhead trout (see Table 67). The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance habitat for steelhead trout. In-stream activities in Alternative 3 include an increase in the number of units where cut-and-leave of conifers would occur, the addition of Riparian units (RIP – Units 162, 163, and 164), and the addition of two sites where McKay Creek would be reconnected to its historic floodplain. These activities would increase availability and quality of habitat for MCR steelhead trout on a larger scale than in Alternatives 2 and 4. The increase in steelhead abundance and available spawning habitat from placement of in-stream structures found in various studies (discussed in the section above) would also apply to Alternative 3, but with a greater area of treatment, we would expect even greater increases throughout the watershed.

In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees and activities associated with floodplain reconnection (see Alternative 3 description) could have a short-term adverse impact on individuals. The area of impact, however, is only a small portion of RHCA in the watershed, and the probability of impacting individuals is low. Therefore, activities associated with Alternative 3 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Redband Trout (Oncorhynchus mykiss ssp.)

Alternative 1 (No Action)

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to redband trout in the McKay Creek Watershed. Current population size, distribution, growth, survival, life history diversity and isolation, and persistence and genetic integrity, which are currently unknown, would not be impacted by any actions associated with this project. However, because habitat conditions are currently on a downward trend, mostly due to incision of stream channels and lowering of the water table, taking no action would lead to an adverse effect in the long term.

Alternative 2 (Proposed Action) and Alternative 4

Under Alternatives 2 and 4 there would be a neutral or beneficial effect to all of the habitat indicators important to redband trout (see Table 67). The riparian treatment prescriptions **Error! Reference source not found.**and PDC were designed to protect, maintain, or enhance habitat for redband trout. The only in-stream activities that would occur are cut-and-leave of conifers.

Adding LWM to channels will improve pool frequency and quality, off-channel habitat, floodplain connectivity, and native riparian vegetation. This in turn would increase availability and quality of habitat for redband trout.

Early work examining the effectiveness of in-stream structures on resident trout suggested moderate increases of abundance, growth, condition, and survival of trout species associated with placement of structures (Tarzwell 1938; Gard 1961). In a review of 71 different in-stream enhancement projects installed between 1953 and 1998 in Wyoming, Binns (1999) detected more than a two fold increase in wild trout abundance either after treatment or between treatment and reference reaches for the 46 projects where fish data were available.

In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees could have a short-term adverse impact on individuals. The area of impact, however, from falling of trees is only a small portion of RHCA in the watershed, and the probability of making contact with individuals from falling trees is very low. Therefore, activities associated with Alternatives 2 and 4 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Alternative 3

Under Alternative 3, there would be a neutral or beneficial effect to all of the habitat indicators important to redband trout (see Table 67). The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance habitat for redband trout. In-stream activities in Alternative 3 include an increase in the number of units where cut-and-leave of conifers would occur, the addition of Riparian units (RIP – Units 162, 163, and 164), and the addition of two sites where McKay Creek would be reconnected to its historic floodplain. These activities would increase availability and quality of habitat for redband trout on a larger scale than in Alternatives 2 and 4. The increase in resident trout abundance, growth, condition, and survival from placement of in-stream structures found in various studies (discussed in the section above) would also apply to Alternative 3, but with a greater area of treatment, we would expect even greater increases throughout the watershed.

In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees and activities associated with floodplain reconnection (see Alternative 3 description) could have a short-term adverse impact on individuals. The area of impact, however, is only a small portion of RHCA in the watershed, and the probability of impacting individuals is low. Therefore, activities associated with Alternative 3 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Columbia spotted frog (Rana luteiventris)

Alternative 1 (No Action)

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to Columbia spotted frog in the McKay Creek Watershed. Current population size, distribution, growth, survival, life history diversity and isolation, and persistence and genetic integrity, which are currently unknown, would not be impacted by any actions associated with this project. However, because habitat conditions are currently on a downward trend, mostly due to incision of stream channels and lowering of the water table, taking no action would lead to an adverse effect in the long term.

Alternative 2 (Proposed Action) and Alternative 4

Habitat indicators important to Columbia spotted frog include stream temperature, chemical contamination/nutrients, LWM, pool frequency and quality, off-channel habitat, refugia, native riparian vegetation, stream shade, floodplain connectivity, change in peak/base flows, and disturbance history. Under Alternative 2, there would be a neutral or beneficial effect to all of these indicators (see Table 67).

The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance streams, ponds, springs, wet meadows, and other wetlands, as well as hydrologic regimes and stream temperature. The only in-stream activities that would occur are cut-and-leave of conifers. Adding LWM to channels will improve pool frequency and quality, off-channel habitat, refugia, floodplain connection, and native riparian vegetation (see Environmental Consequences to each indicator). This in turn would increase availability and quality of habitat for Columbia spotted frog. In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees could have a short-term adverse impact on individuals. The area of impact, however, from falling of trees is only a small portion of RHCA in the watershed, and the probability of making contact with individuals from falling trees is very low. Therefore, activities associated with Alternative 2 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Alternative 3

Habitat indicators important to Columbia spotted frog include stream temperature, chemical contamination/nutrients, LWM, pool frequency and quality, off-channel habitat, refugia, native riparian vegetation, stream shade, floodplain connectivity, change in peak/base flows, and disturbance history. Under Alternative 3, there would be a neutral or beneficial effect to all of these indicators (see Table 67).

The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance streams, ponds, springs, wet meadows, and other wetlands, as well as hydrologic regimes and stream temperature. In-stream activities in Alternative 3 include an increase in the number of units where cut-and-leave of conifers would occur, the addition of Riparian units (RIP – Units 162, 163, and 164), and the addition of two sites where McKay Creek would be reconnected to its historic floodplain. These activities would all improve habitat indicators important to Columbia spotted frog – stream temperature, chemical contamination/nutrients, LWM, pool frequency and quality, off-channel habitat, refugia, native riparian vegetation, stream shade, floodplain connectivity, change in peak/base flows, and disturbance history (see Environmental Consequences to each indicator).

In-stream activities would take place in accordance with Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources (2008). For the project area, the timing for in-water work is July 1 to October 31. Although there would be a long-term habitat benefit to the population, the falling of trees and activities associated with floodplain reconnection (see Alternative 3 description) could have a short-term adverse impact on individuals. The area of impact, however, from falling of trees is only a small portion of RHCA in the watershed, and the probability of making contact with individuals from falling trees is very low. Therefore, activities associated with Alternative 3 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.***

Columbia clubtail (Gomphus lynnae)

Alternative 1 (No Action)

No actions would take place as a result of Alternative 1; therefore, there would be no direct or indirect effects to Columbia clubtail if they occur in the McKay Creek Watershed. Current population size, distribution, growth, survival, life history diversity and isolation, and persistence and genetic integrity, which are currently unknown, would not be impacted by any actions associated with this project.

Alternative 2 (Proposed Action) and Alternative 4

Columbia clubtail are found in a variety of stream habitat types, but generally in slow-moving water. The only known important habitat indicators seem to low fine sediment/turbidity, but it is assumed they require a well-functioning stream ecosystem to thrive.

The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance streams, ponds, springs, wet meadows, and other wetlands where Columbia clubtail may be present. Fine sediment/turbidity is expected to improve with the implementation of Alternative 2. The only in-stream activities that would occur are cut-and-leave of conifers. Adding LWM to channels would improve stream and riparian conditions (see Environmental Consequences to each indicator). Individual Columbia clubtail are small enough that felling of trees would not impact individuals. Therefore, activities associated with Alternative 2 would have ***no impact*** on Columbia clubtail, if they are in fact present in the project area. There is not enough information to determine if Alternative 2 would have a beneficial impact on them.

Alternative 3

Columbia clubtail are found in a variety of stream habitat types, but generally in slow-moving water. The only known important habitat indicators seem to low fine sediment/turbidity, but it is assumed they require a well-functioning stream ecosystem to thrive.

The riparian treatment prescriptions and PDC were designed to protect, maintain, or enhance streams, ponds, springs, wet meadows, and other wetlands where Columbia clubtail may be present. Fine sediment/turbidity is expected to improve with the implementation of Alternative 3. In-stream activities in Alternative 3 include an increase in the number of units where cut-and-leave of conifers would occur and the addition of two sites where McKay Creek would be reconnected to its historic floodplain. These activities would all improve stream and riparian conditions (see Environmental Consequences to each indicator). Individual Columbia clubtail are small enough that felling of trees would not impact individuals. Activities associated with floodplain reconnection (see Alternative 3 description) could have a short-term adverse impact on individuals. The area of impact, however, is less than a mile of stream channel and less than 1% of total stream miles in the watershed. Therefore, if Columbia clubtail are in fact present in the project area, activities associated with Alternative 3 ***may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species***.

Effects Determination for Special Status Species

Based on the effects analysis to habitat indicators and the resultant effects to aquatic species, Table 78 summarizes the Effects Determination for the four project alternatives.

Table 78. Effects determination for aquatic species on the 2011 USFS Region 6 Regional Forester Special Status Species list that do or may occur in the project area.

Species	ESU/DPS/ SMU	Listing Category	No Action (Alt 1)	Proposed Action (Alt 2)	Alt 3	Alt 4
Steelhead (*Oncorhynchus mykiss)*	Middle Columbia River	Nonessential Experimental Population (Proposed); Ochoco NF Management Indicator Species	NE	MIIH	MIIH	MIIH
Redband trout (*Oncorhynchus mykiss* ssp.)	Malheur Lakes	Sensitive in Oregon; Ochoco NF Management Indicator Species	NI	MIIH	MIIH	MIIH
Columbia spotted frog (*Rana luteiventris*)	Outside Great Basin	Sensitive in Oregon	NI	MIIH	MIIH	MIIH
Columbia clubtail (*Gomphus lynnae*)	N/A	Sensitive in Oregon	NI	NI	MIIH	NI

Effects Determinations

Proposed, Threatened, and Endangered Species

NE	No Effect
NLAA	May Effect, Not Likely to Adversely Affect
LAA	May Effect, Likely to Adversely Affect
BE	Beneficial Effect

Sensitive Species

NI	No Impact
MIIH	May Impact Individuals or Habitat, but Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species
WIFV	Will Impact Individuals or Habitat with a Consequence that the Action May Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species
BI	Beneficial Impact

Comparison of Alternatives

Table 79 summarizes the overall potential effects to aquatic pathways for comparison by alternative.

Table 79. Summary of Overall Potential Effects to Pathways for each alternative.

Pathway	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Water Quality	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: +	ST: N/+ LT: N/+
Habitat Access	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: N/+	ST: N LT: N/+
Habitat Elements	ST: N LT: N	ST: + LT: N	ST: +/++ LT: N	ST: + LT: N
Vegetation Conditions in RHCAs	ST: N LT: -	ST: N/+ LT: +	ST: + LT: +/++	ST: N/+ LT: +
Channel Condition & Dynamics	ST: N LT: N/-	ST: N/+ LT: N	ST: N/+ LT: +	ST: N/+ LT: N
Hydrology	ST: N LT: N/-	ST: N LT: N/+	ST: N LT: N/+	ST: N LT: N/+
Watershed Condition	ST: N LT: N/+	ST: N/- LT: N	ST: N/- LT: N	ST: N/- LT: N

The no-action alternative (Alternative 1) would have a neutral affect to habitat indicators in the short-term, maintaining conditions that are mostly Not Properly Functioning. In the long-term, some conditions would slowly recover, but a large majority of habitat indicators would continue to deteriorate. Because no actions would be implemented, there would be no impact to aquatic species.

The proposed action (Alternative 2) would implement silvicultural and fuels treatments that would have either neutral or beneficial effects to habitat indicators in both the short-term and long-term. Activities associated with logging systems, however, would have adverse impacts to road density and disturbance history in the short-term (< 5 years). Short-term adverse effects to road densities are located primarily in the Upper McKay Creek Subwatersheds as a result of temporary roads. Because most habitat indicators would improve under this alternative, impacts to aquatic species are mostly beneficial. However, some of the in-stream work may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species. Even though the overall effects Alternative 2 on the habitat indicators, localize locations are expected to have short-term adverse effects. These locations include approximately 1.1 miles of temporary road located within 300 feet of perennial or intermittent streams, 0.6 miles of which consists of one temporary road on existing disturbance that is currently a chronic source of sediment to an unnamed intermittent tributary to McKay Creek (used to access Units 38 and 97). By removing the temporary road upon completion of treatments, a beneficial effect to fine sediment and turbidity in this stream would result. In addition, approximately 0.35 miles of temporary road on existing disturbance are proposed for use in order to access unit 39. Converting this area into a temporary road may result in reactivating chronic sediment inputs to a nearby ephemeral draw.

Alternative 3 would implement silvicultural and fuels treatments that would have either neutral or beneficial effects to habitat indicators in both the short-term and long-term except for sedimentation in the Allen Creek Subwatershed. Adverse fine sediment and turbidity effects would potentially result from reconstructing a 1.2 mile long decommissioned road that parallels and unnamed intermittent tributary to Allen Creek in order to access commercial harvest units 116a, 117, and 158. Compared to the other alternatives, Alternative 3 has the largest amount of in-stream, floodplain, and riparian restoration treatments, with the greatest benefit to habitat

indicators and aquatic species. Some of the in-stream work, however, may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Effects to aquatic habitat indicators from Alternative 4 are essentially identical to effects from Alternative 2 (see Environmental Consequences).

Wildlife

The McKay Creek Watershed includes a transition from irrigated low elevation agricultural lands that occur on private lands through juniper woodlands and dry ponderosa pine forests to moderately high elevation mixed coniferous forest types within the public forest lands. The watershed primarily drains to the southwest. The lower elevations on the forest are dominated by the ponderosa pine plant associations with juniper scattered on ridges and south slopes with rocky and shallow soils. Dry grand fir and Douglas-fir plant associations occur at mid-slope positions and on north facing slopes of the McKay and Little McKay drainages. Moist grand fir plant associations are limited to the highest elevations within the watershed. Shrub fields are scarce within the watershed. The low numbers of upland shrubs that occur in the watershed are likely the result of a lack of fire cycles and resulting forested and woodland stands that are dominated by high conifer densities. McKay Creek, Little McKay Creek and tributaries support alder, willow and dogwood. Aspen and cottonwood do occur in the watershed although they are scattered or in small patches. Riparian hardwoods in this watershed are often limited to narrow strips along streams and in occasional patches on lower slopes where groundwater is near the surface or emerges in springs or seeps. This combination of vegetation types provides habitat for a variety of terrestrial wildlife species. Several species that are considered to be relatively uncommon or rare on the forest have been observed and recorded within this watershed, including: bald eagle, black-backed woodpecker, wood duck, mountain quail, wolverine, Williamson's sapsucker, prairie falcon and the peregrine falcon. Unconfirmed reports from the public have also been received for horned sheep, which may have wandered into the watershed from game farms or ranches on private land or which could be dispersing individuals from populations outside of the project area. The following more common species have also been recorded in the watershed: badger, beaver, black bear, bobcat, coyote, cougar, great horned owl, long-tailed weasel, northern goshawk, pileated woodpecker, pronghorn, pygmy nuthatch, red-tailed hawk, Rocky Mountain elk, ruffed grouse, western bluebird and white-headed woodpecker. Introduced species of terrestrial fauna that have sightings in the watershed include the wild turkey. Many other species of terrestrial wildlife are likely to occur within the watershed but have not been included in the sighting records.

Species of interest include those that are listed as Management Indicator Species (MIS) in the LRMP, federally listed species and those on the Regional Forester's Sensitive Species list, and those that have management direction that amended the LRMP. The latter category includes late and old structure (LOS) forest associated species, northern goshawk, and landbirds. The terrestrial MIS for this watershed are the same as those listed for the Forest: pileated woodpecker; northern flicker, primary cavity excavators (including, but not limited to woodpeckers and sapsuckers); Rocky Mountain elk and mule deer; bald eagle; golden eagle and prairie falcon. Threatened, endangered and sensitive terrestrial species potentially occurring on the Ochoco National Forest include: bald eagle; wolverine; peregrine falcon; upland sandpiper; bufflehead; tricolored blackbird; white-headed woodpecker; Lewis's woodpecker; greater sage-grouse; pygmy rabbit; Townsend's big-eared bat; silver-bordered fritillary and Johnson's hairstreak. Other featured species include: pronghorn antelope, raptors, species associated with dead and down logs; species associated with various plant communities and successional stages; and species associated with springs, bogs and other unique habitat. Focal species have been selected to help describe conditions and trends for species associated with various structural/seral stages of

plant communities (including LOS), and for species associated with riparian areas and other special habitats.

Management Indicator Species

The Ochoco National Forest (NF) and the Crooked River National Grassland (CRNG) must maintain viable populations of all native and desired non-native plant and animal species (NFMA 1976). Maintaining viable populations was addressed in the Final Environmental Impact Statement for the Ochoco NF and CRNG Land and Resource Management Plan (LRMP) by defining management requirements for those species that were considered limiting or sensitive to management activities (LRMP pp 3-95). These species and habitats are represented by management indicator species (MIS). The Ochoco NF LRMP identified the Rocky Mountain elk, mule deer, pileated woodpecker, common (northern) flicker, primary cavity excavators, bald eagle, golden eagle, and prairie falcon as terrestrial MIS (Table 80).

Table 80. Management indicator species and reason for selection.

Species	REASON FOR SELECTION
Rocky Mountain Elk and Mule Deer	**Species that are commonly hunted.** Rocky Mountain Elk were selected as an indicator species to reveal changes in big game habitat. The elk was selected because of public interest and the recreational value of big game (FEIS pp 3-22). Big game capability models should be used in project planning to determine habitat effectiveness (HE), as affected by quality and quantity of cover and forage, and open road density (LRMP 4-245).
Pileated Woodpecker	**Old growth habitat.** Pileated woodpeckers serve as an indicator for other species that require large snags, large amounts of down-dead wood, and large trees with defect. 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).
Common (Northern) flicker	**Old growth juniper habitat.** The common flicker (Northern Flicker) was selected to represent species that utilize old growth juniper habitat. The flicker is probably the only primary cavity excavator that is capable of creating cavities in juniper (Thomas 1979, FEIS pp 3-21).
Primary Cavity Excavators	**Snag habitat.** Primary cavity excavators were selected to represent the species that require snag habitat that is often reduced by forest management activities. The primary cavity nesters serve as ecological indicators for a large number of species and for secondary cavity users, like swallows, blue birds and bats (FEIS pp 3-22).
Bald Eagle	**State or Federal Threatened or Endangered species.** Preserve the integrity of actual and potential bald eagle winter roost sites. Utilize the findings and recommendations of a bald eagle winter roost survey, conducted by the Oregon Cooperative Wildlife Research Unit in 1986 and 1987 (LRMP 4-245).
Golden Eagle and Prairie Falcon	**Cliff, talus, or cave habitats.** Carefully evaluate activities having the potential to alter or disturb cliffs, talus, or cave habitats (LRMP 4-245).

Management indicator species 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 1982 National Forest System Land Resource Management Planning Regulations (implementing the National Forest Management Act of 1976) directed that fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed across the Forest. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can

interact with others across the Forest. The planning regulations further state that in order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate species present in the area shall be identified and selected as management indicator species and the reasons for their selection will be stated.

For project-level planning and environmental analysis the use of habitat abundance and quality, and the distribution of habitat have been used to estimate project effects on MIS. It has been determined by court decision that where population monitoring data are not available, due to lack of funding or feasibility of monitoring populations, the amount and quality of habitat can be used as a proxy for determining viability effects of projects on MIS (Lands Council v. McNair, 2010). In order to use habitat as a proxy the project analysis must at a minimum include: 1) a clear relationship between the species and its habitat based on habitat relationship models that utilize the best available science; 2) the amount of habitat available at the Forest scale; 3) species presence in the project area; 4) the amount of habitat being impacted at the project level in terms of both quality and quantity; 5) a determination of the project impact on viability at the Forest scale. The MIS species and species groups are discussed in below.

Primary Cavity Excavators

Primary Cavity Excavators (PCE) are species of birds that excavate their own cavities in dead, decayed or defective wood. PCE are Management Indicator Species (MIS) listed in the Ochoco National Forest Land and Resource Management Plan (LRMP) as a group. This group includes the Pileated Woodpecker and Northern Flicker (which are also individual MIS); white-headed woodpecker and Lewis' woodpecker (which are also TES and focal species); black-backed woodpecker and red-naped sapsucker (which are also a focal species); and other species listed below. The list of MIS species associated with the analysis area are listed below (Thomas et al., 1979). The species with an asterisk (*) are also dead wood insect users.

Pileated Woodpecker*	Pygmy Nuthatch*
White-headed Woodpecker	Red-naped Sapsucker*
Northern Flicker	Hairy Woodpecker*
Lewis' Woodpecker*	Three-toed Woodpecker*
Williamson's Sapsucker*	Red-breasted Nuthatch*
Black-backed Woodpecker*	Downy Woodpecker*
White-breasted Nuthatch*	

Background and Desired Condition for PCE Habitat

Forested ecosystems with standing dead or defective trees provide habitat for species such as the woodpeckers and a variety of other wildlife species that nest in cavities. The primary cavity excavator species excavate cavities in wood and are dependent upon snags and/or live trees with internal rot for nesting or roosting cavities and as a forage producing substrate. Dead wood (standing or down) plays an important role in overall ecosystem health, soil productivity and numerous species' habitat. It is crucial in the continuation of species that depend on snags for all or parts of their life cycle (Laudenslayer 2002). Bird and mammal species rely on the structure for dens, nests, resting, roosting and/or feeding on the animals and organisms that use dead wood for all or parts of their life cycle. Snags come in all sizes and go through breakdown and decay processes that change them from standing hard to soft, then on the ground to continue decaying into soil nutrients. Not every stage of the snag's demise is utilized by the same species, but rather a whole array of species at various stages or conditions (Rose et al 2001). For a large number of primary cavity excavators the green tree component is also an important habitat component. There is a desire to maintain a range of snag densities and sizes, in association with suitable habitat to meet other life needs, across the landscape, so as to meet the needs of the variety of species dependent on dead wood habitats at a landscape scale.

The Ochoco Land and Resource Management Plan (1989) 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 (USDA Forest Service, ONF, 1995) amended the Ochoco LRMP. The Regional Forester's Forest Plan Amendment # 2 requires managing snags at 100% maximum potential for primary cavity excavators, which is a minimum of 2.25 snags/acre (Thomas 1979). The Ochoco National Forest is currently using the Viable Ecosystem Management Guide (VEMG, 1997) to guide snag management within vegetation management projects (see Table 81). VEMG snag levels were agreed upon with the Regional Office to meet the amendment standards and guidelines, except that snags would not be managed below a minimum of 2.25 snags/acre (USDA Forest Service 1997).

Table 81. 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 pileated woodpeckers and northern flickers represent opposite conditions in forest canopy density, hollow trees and snags are important habitat components for both species. Generally, the pileated woodpecker and its habitat associates would be favored by the more dense structural stages with Douglas-fir and grand fir well represented in the dominant and co-dominant canopy layers. In contrast, northern flicker and its habitat associates would be favored by more open structural stages dominated by ponderosa pine or juniper. While the flicker is a habitat generalist and can be found nesting in a wide variety of habitat types, this species can excavate nests in old growth juniper, where other species of woodpeckers do not serve as primary cavity excavators. Therefore, the northern flicker was chosen as a management indicator species for old growth juniper. The other species of primary cavity excavators would find habitat in a variety of habitat types and structural conditions. This variety of habitats is captured in discussions for pileated woodpecker (dense forest), white-headed woodpecker and Lewis' woodpecker (open forest), Lewis's woodpecker and red-naped sapsucker (riparian woodland), northern flicker (old growth juniper) and black-backed woodpecker (abundant recently dead trees). These detailed discussion can be found in the Primary Cavity Excavator; Threatened, Endangered and Sensitive Species (TES); and Landbird sections of this report. Within this section the analysis and discussion of PCE has a focus on overall dead wood habitat characteristics, abundance and distribution within the analysis area and the presence and potential effects upon PCE as a group.

Background and Desired Condition for Pileated Woodpecker Habitat

The pileated woodpecker was chosen as a terrestrial management indicator species (MIS) for mature and old-growth forest (LRMP 1989, p. 243 and 251). It is assumed that if good habitat is provided for pileated woodpeckers and their population is maintained at some desired level, that adequate habitat is also being provided for other species that share similar habitat requirements (LRMP FEIS p. 3-21). The pileated woodpecker plays an important ecological role by excavating nest cavities that are later used by other birds and small mammals (Thomas 1979) and by feeding on forest insect pests. They nest in large diameter (> 21"d.b.h.) and tall snags, and depend heavily on carpenter ants for food. They commonly feed on dead or dying grand fir trees and downed logs. They also roost in large hollow trees and tend to select relatively dense stands with grand fir common. As a result, an abundance of snags and downed logs are important habitat components. They typically select for multi-strata mixed conifer LOS. The pileated woodpecker's habitat associates prefer dense forest conditions, and they include Townsend's warbler, hermit thrush and red-breasted nuthatch among others. Some of these are discussed

further in the Landbirds section of this report. As dense mixed coniferous stands often contain a high density of dead or dying trees, habitat for this species also represents habitat for the black-backed and three-toed woodpeckers, which are attracted to stands with abundant snags and activity by bark beetles and wood boring beetles. The pileated woodpecker occurs primarily in dense mixed conifer forests in late seral stages or in deciduous stands in valley bottoms (Marshall et al. 2003).

The pileated woodpecker is widely distributed in North America. It occurs primarily in dense, late seral stages of mixed conifer or deciduous tree stands. Its conservation status globally and nationally is secure and it is apparently secure in the State of Oregon (NatureServe). The pileated woodpecker does not have any special federal listing status as Candidate, Threatened or Endangered but it is listed as Vulnerable in the Blue Mountains on the State of Oregon Sensitive Species list. The State Vulnerable status indicates that the pileated woodpecker is facing one or more threats to their populations but is not currently imperiled with extirpation. The pileated woodpecker is not considered a focal species in the Partners in Flight *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington* and is not a priority species on the USFWS *Birds of Conservation Concern*. Population trend data from the North American Breeding Bird Surveys indicate that the pileated woodpecker has an increasing population trend in Oregon and in the Northern Rockies Bird Conservation Region. The trend represents the yearly percentage change in breeding bird detections. During the period of the 1966 to 2006, there was an estimated 2 percent population increase per year in Oregon and a 4.6 percent population increase per year in the Northern Rockies BCR. While the interpretation of this data should be done with caution, a steady population increase is indicated. The Partners in Flight species assessment database also indicates a large population increase in the Northern Rockies Bird Conservation Region. The Partners in Flight population assessment database indicates that in the portion of the Northern Rockies Bird Conservation Region that is in Oregon (Blue Mountains, including the WWNF) the average number of pileated woodpeckers seen per breeding bird survey route was 1.02.

The pileated woodpecker is considered to be an uncommon species in Oregon, limited by habitat availability, and they are an uncommon permanent resident in the Blue Mountains (Marshall et al. 2003). The Oregon State Heritage Program 2009 list states the pileated woodpecker species ranking as S4, Apparently Secure. NatureServe (2009) listed the following as the top five major threats affecting pileated woodpeckers: (1) conversion of forest habitats to non-forest habitats, (2) short rotation, even-age forestry, (3) monoculture forestry, (4) forest fragmentation, and (5) removal of logging residue, downed wood, and pine straw that would ultimately put nutrients back into the ecosystem and provide foraging substrate.

Pileated woodpecker habitat is managed through guidelines in the Ochoco Forest Plan and available research findings. The Ochoco National Forest Land and Resource Management Plan allocated Old Growth Management Areas (OGMA) across the forest to serve as reproductive habitat for the pileated woodpecker. An additional 300 ac. of supplemental feeding habitat has been designated adjacent to the 300 ac. of reproductive habitat at each OGMA. Currently there are three allocated old growth areas at least partially within the watershed totaling 718 acres in the analysis area. Two OGMAs lie partially in the Mill Creek watershed and partially in the McKay Creek watershed. Old Growth Management Areas (OGMA) were surveyed for the presence or absence of pileated woodpeckers in the early 1990's. No records were found to indicate that pileated woodpeckers were found in the OGMAs in this watershed during those efforts. A woodpecker survey was conducted at OGMAs and along the upper end of Little McKay in 2008. Pileated woodpeckers were detected during that survey near the junction of Road 27 and Road 2700-203, as well as at the Little McKay OGMA (OG-D3-10). This survey was primarily aimed at white-headed and Lewis's woodpeckers, but often elicited responses from a variety of other woodpecker species. Pileated woodpecker sightings have also been recorded in the tributary to Allen Creek (southwest of Highland Flat); south of AY Spring, north of Gopher

Flat, at headwaters on main McKay Creek near Divide Spring and near Harvey Gap; as well as near Hunt Spring and north of Horse Spring on Little McKay Creek.

Background and Desired Condition (Northern Flicker)

The northern flicker was chosen as a terrestrial management indicator species (MIS) for old growth juniper (LRMP FEIS 3-21 and 4-96). Many researchers have reported on aspects of behavior and nest use by flickers as part of general studies of cavity nesting birds. Recently such interest has intensified as flickers have been recognized as "keystone" excavators which may influence the abundance of secondary cavity nesters in forest systems (Martin et al. 2004). Northern flickers are habitat generalists and can be found nesting in a wide variety of habitat types, as long as snags or hollow trees or nest boxes of the appropriate dimensions are present. The common flicker is generally most abundant in open forests and forest edges and in relatively dry or low elevation areas such as juniper woodland or open pine forests. The flicker was selected as a management indicator species for old growth juniper because this species can excavate nests in old growth juniper, where other species of woodpeckers do not serve as primary cavity excavators.

The northern flicker is a common, primarily ground-foraging woodpecker that occurs in most wooded regions of North America. Breeding Range (Figure 1) is broadly distributed in diverse woodland habitats throughout North America. Flickers may be common in clearcuts if snags remain standing (Conner et al. 1975, Conner and Adkisson 1977). In the west, woodland types include subalpine (subalpine fir, Engelmann spruce, limber pine, lodgepole pine; Snyder 1950), oak-juniper-pine woodland (Balda 1970), pine-oak woodland (Marshall 1957), pinyon-juniper, and montane forests (yellow pine, ponderosa pine, Engelmann spruce, Douglas fir, white fir, quaking aspen; Rasmussen 1941, Mannan and Meslow 1980). Also found in cottonwoods in riparian woodlands (WSM), and in burned woodlands (Raphael and White 1984). Nest-tree species are strikingly variable; flickers reported nesting in most tree species in the wide range of woodlands they inhabit. The conservation status was identified at the global, national and State of Oregon geographical areas and all categories list the population status as “secure.” Breeding Bird Survey data indicate significant declines in abundance. Reasons for these declines are unclear, but likely explanations are loss of habitat and competition with the European starling for nest cavities. BBS survey trends (1966-2005) suggest flicker populations are declining in the U.S. (2.5% annual decline) and Canada (0.8%), with a 2.0% average annual decline throughout North America. See *http://www.mbr-pwrc.usgs.gov* for details. No clear reasons for these declines were given, although competition with other hole-nesting species may be a significant factor. Despite these reported declines, the northern flicker remains abundant and well distributed across a wide range of habitats.

Northern flickers are described as a common inhabitant of Oregon (Marshall et al. 2003). The northern flicker is a common species and is often observed in relatively open forest conditions, particularly at lower elevations. Northern flickers are habitat generalists and occur throughout the analysis area, especially in open stands. Though this species is not dependent on juniper habitat, this analysis will disclose conditions of old growth juniper because the northern flicker is listed as a MIS for this type of habitat in the current LRMP. Non-significant population decline ranging from 0.4-0.6 percent per year based on Breeding Bird Surveys 1966-2000 was reported by Marshall et al. (2003) for the this species. Northern flickers are ranked as S5, Secure (NatureServe 2009). Competition for nesting sites by starlings was listed as a possible reason for population declines. This is most likely to be a problem in low elevation areas associated with towns and agricultural lands.

It is recommended that woodland stands with large trees and snags be maintained in a relatively open condition on dry sites. The northern flicker is a common species and is often observed in relatively open forest conditions, particularly at lower elevations. There has been no specific survey conducted for this species, although this species was detected and recorded in surveys

conducted on the Forest between 1992 and 1995, and in 2008 and 2010. Within the McKay watershed northern flickers were detected during woodpecker surveys in 2008 near Hunt Spring and at Little McKay OGMA (OG-D3-10). This species was considered to be so common in this watershed that historically sightings were not recorded in the database.

Existing Condition (PCE)

A forest-wide and watershed level snag analysis has been completed. Refer to Ochoco National Forest 2011 Snag Analysis (USDA, 2011) for details on the data sources and methods used in the forest-wide snag analysis process. The results of the forest-level snag analysis are summarized as follows:

Existing Condition of Snags on the Ochoco National Forest

The DecAID habitat types and predicted HRVs for the Forest were evaluated first. Viable Ecosystems Management Guide (VEMG) gives the Historic Range of Variability (HRV) by Plant Association Group, seral stage and structural condition. Ponderosa pine and Douglas-fir PAGs were combined into the Ponderosa Pine/Douglas-fir habitat type. While dry and moist grand fir PAGs were combined into the Eastide Mixed Conifer (EMC) habitat type. Then the VEMG seral/structural stages were assigned to DecAID habitat types using a crosswalk as shown in Table 82.

Table 82. VEMG and DecAID habitat structure crosswalk.

VEMG STRUCTURE	DECAID STRUCTURE
Grass/forb/shrub, Seedling and sapling, Pole	Open
Small	Small
Medium, and Large	Large

For each DecAID habitat type and structural condition, VEMG seral/structural conditions that would contribute to that habitat type (based on PAG and structural condition) were grouped and the HRVs combined using a weighted average (based on relative percent of each VEMG category's contribution toward the DecAID category) to derive an overall HRV for each DecAID habitat type and structural condition. Then the existing conditions in each DecAID habitat type were compared to the predicted HRVs. Table 83 displays the Ochoco N.F DecAID habitat types by structure classes, the existing acreages and percent of area HRVs. Cells highlighted in red are where the existing values are below the HRV, cells highlighted in green are where existing values are above HRV, while ones not highlighted are within HRV.

Table 83. Acres of Existing DecAID habitat types on the Ochoco N.F. and HRV values.

HABITAT TYPE	STRUCTURE	ACRES	EXISTING %	LOW HRV	HIGH HRV
EMC	OPEN	37,228	6%	2	6
	SMALL	101,378	16%	4	8
	LARGE	59,916	9%	4	8
PPDF	OPEN	132,151	20%	5	12
	SMALL	54,075	8%	1	6
	LARGE	37,515	6%	8	14
NOT DecAID Hab	NOT DecAID Hab	228,610			
TOTAL		**650,873**			

The Forest is within HRV in the "EMC Open" habitat type, is above HRV in the "EMC Small," "EMC Large," "PPDF Open" and "PPDF Small" habitat types and is below HRV in the "PPDF Large" habitat type. Remember that these figures only contain the habitat types represented by DecAID; the other habitat types such as western juniper are not included in the analysis.

The next step in the snag analysis was evaluating predicted snag density from plot data assigned to each piece of the landscape (pixel) using the Gradient Nearest Neighbor (GNN) model. This model estimates snag abundance (which is based on inventory plot data) according the similarity of spectral (reflectivity) and environmental characteristics of each pixel to each inventory plot. Estimated snag abundance from GNN analysis is displayed in Table 84. As shown on this table, the percent of area with snags across the Forest fall into many different categories, some above, some below and some within HRV. As in Table 83, cells highlighted in red are where the existing values are below the HRV, cells highlighted in green are where existing values are above HRV, while ones not highlighted are within HRV. Figure 21, Figure 22, Figure 23 and Figure 24 show the same information in chart form.

Table 84. HRVs for all DecAID habitat types for snags ≥ 10" dbh and ≥ 20" dbh.

Habitat Type	% of Ochoco NF with snags ≥10" (24.5cm) dbh snag/acre (snags/ha)					
	0 (0)	0 - 6 (0-15)	6 - 12 (15-30)	12 - 24 (30-60)	24 - 36 (60-90)	36+ (90+)
EMC *HRV %*	17 - 26	27 - 31	15 - 17	15 - 24	6 - 10	5 - 8
EMC % *Existing*	12	43	25	14	5	1
PP/DF *HRV %*	54 - 62	18 - 27	12 - 15	3 - 5	1 - 1	0 - 1
PP/DF % *Existing*	22	51	20	3	4	0

Information from DecAID tables (unharvested plots for snags ≥10" (24.5cm) dbh) PP/DF_O.Inv-14, PP/DF_S.Inv-14, PP/DF_L.Inv-14, EMC_ECB_O.Inv-14., EMC_ECB_S.Inv-14, EMC_ECB_L.Inv-14 with HRV information from Viable

Habitat Type	% of Ochoco NF with snags ≥20" (50.5cm) dbh snag/acre (snags/ha)						
	0 (0)	0-2 (0-5)	2-4 (5-10)	4-6 (10-15)	6-10 (15-25)	10-18 (25 - 45)	18+ (45+)
EMC *HRV %*	32 - 44	14 - 20	13 - 17	9 - 13	9 - 14	5 - 7	1 - 2
EMC % *Existing*	32	21	17	17	12	1	0
PP/DF *HRV %*	67 - 75	14 - 19	7 - 10	1 - 2	1 - 2	0	0
PP/DF % *Existing*	50	35	10	1	4	0	0

Information from DecAID tables (unharvested plots for snags ≥20" (50cm) dbh) PP/DF_O.Inv-15, PP/DF_S.Inv-15, PP/DF_L.Inv-15, EMC_ECB_O.Inv-15., EMC_ECB_S.Inv-15, EMC_ECB_L.Inv-15, and modified with HRV information from Viable

Open stands dominated by large diameter pine trees were more abundant historically than what exists today. Historically fire regimes would have played a more prominent role in creating a mosaic of stand conditions, snag abundance and snag distribution across the landscape. For example in both the ponderosa pine/Douglas-fir habitat type (PPDF) and in the eastside mixed conifer habitat type (EMC) there would have been more area devoid of snags than there is today. This is represented in Table 84 by the red (below HRV) in both snag size classes with 0/snags per acre in PP/DF, and in the ≤ 10" dbh size class in EMC. This is because stands that have skipped one or more fire return cycles may have more snags currently than they would have had historically due to reduced opportunities for combustion. The result is acreage above HRV in stands containing 1-12 snags (≥ 10"dbh) per acre and 0-2 snags (≥ 20" dbh). Localized outbreaks of mountain pine beetle, can contribute to pockets of higher snag densities such as in the area of the Forest that contains 24-36 snags (≥ 10"dbh) or 6-10 snags (≥ 20" dbh) per acre in the ponderosa pine/Doug-fir habitat type.

On the other end of the scale, stands with very high snag densities in the mixed conifer habitat type (EMC) would have been more common than what is present on the current landscape. This is represented in Table 84 by the red (below HRV) in the snag size class ≤ 10" dbh with 12 to 36+

snags per acre, and in the ≤ 20” dbh size class with 12 t0 18+ snags ber acre in EMC. This is at least to some extent the result of fire suppression which has limited high intensity fire and thus limited the production of high density snag patches. Snags have been reduced in some areas due to past timber harvest practices in the last four to five decades.

In general, multistoried, dense mixed conifer stands with large tree structure and a significant fir component with abundant large snags is the preferred habitat for the pileated woodpecker. Such stands are less abundant today when compared to what would have existed historically. Open forest dominated by large diameter pine trees with large snags present is the preferred habitat for white-headed woodpeckers. Though large snag abundance is within or above HRVs for all densities in PP/DF (other than devoid of snags) as shown in Table 5, PPDF stands dominated by large size class were more abundant historically than what exists today as shown in Table 83. Open stands dominated by medium and large trees in dry site pine and juniper woodlands, within which the northern flicker serves as a management indicator for old-growth juniper, would have also been more abundant historically as discussed below in the section on existing condition for northern flickers.

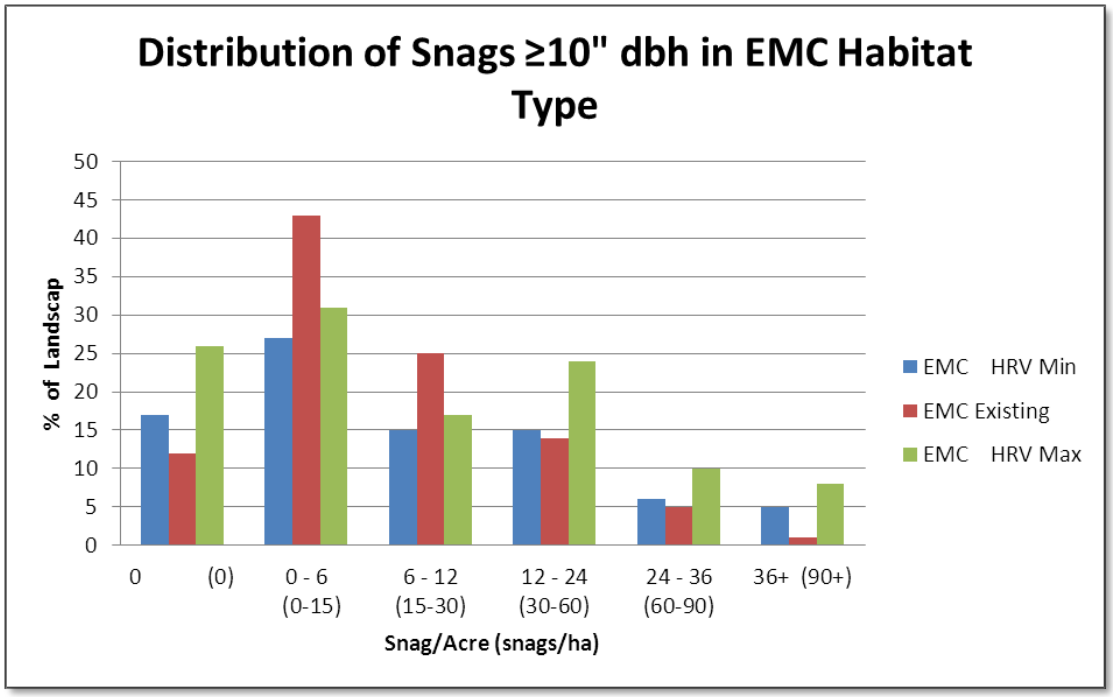


Figure 21. Distribution of snags ≥10” in the EMC habitat type.

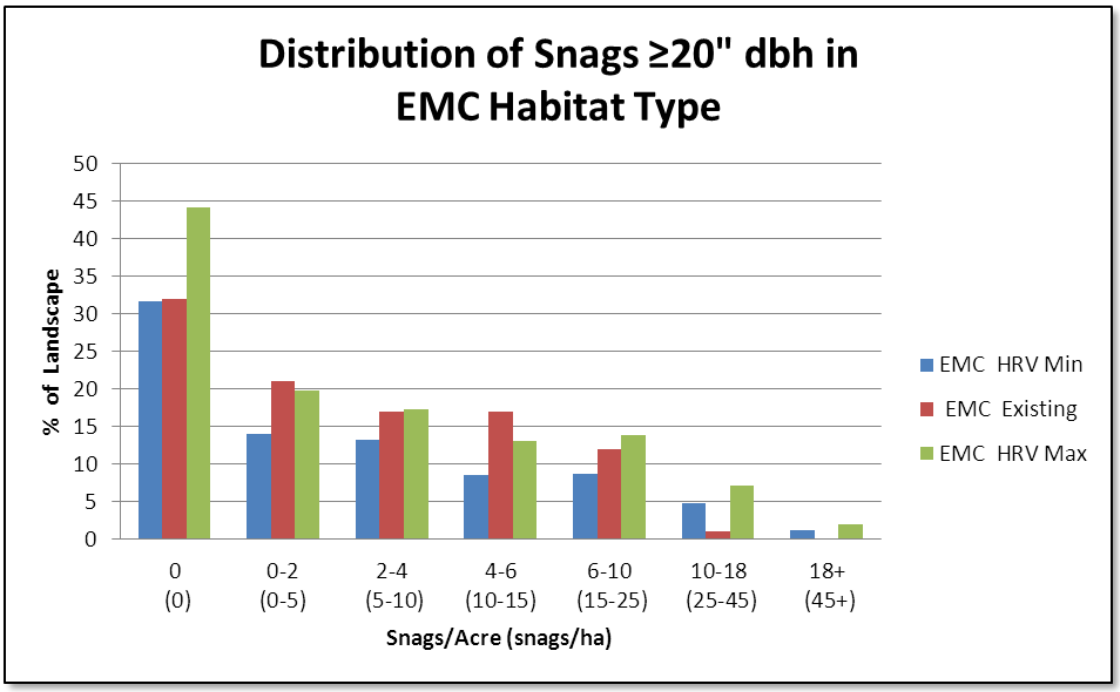


Figure 22. Distribution of Snags ≥20" in the EMC habitat type.

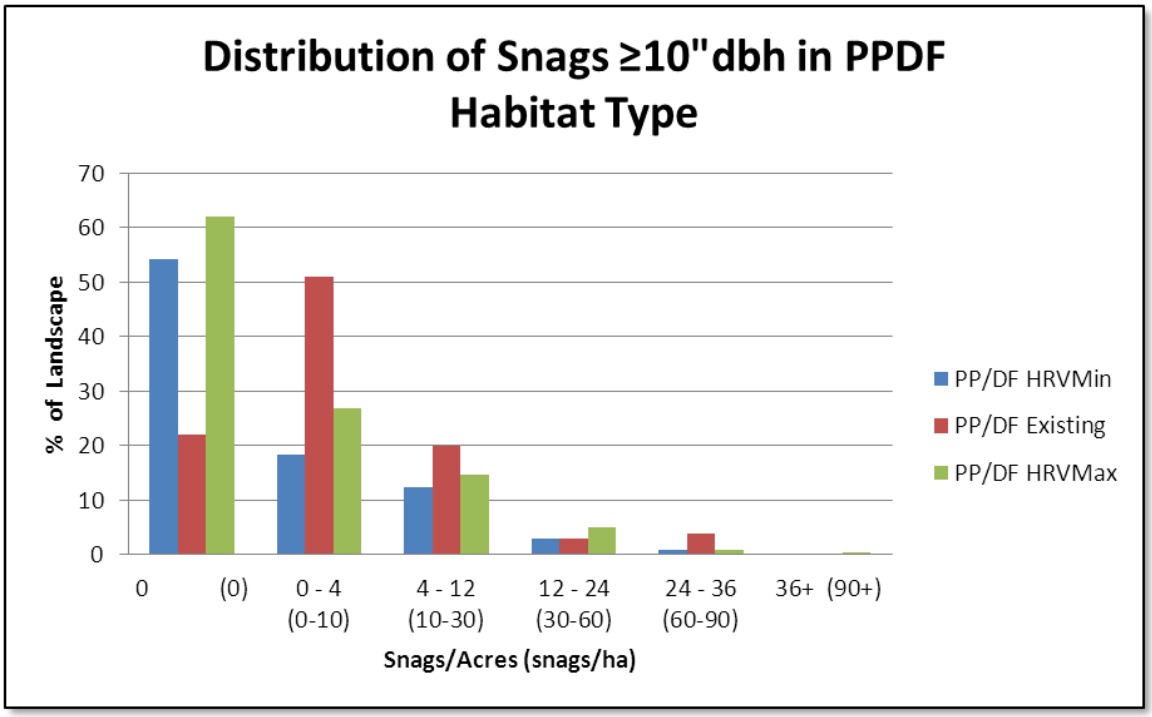


Figure 23. Distribution of snags ≥10" in the PPDF habitat type.

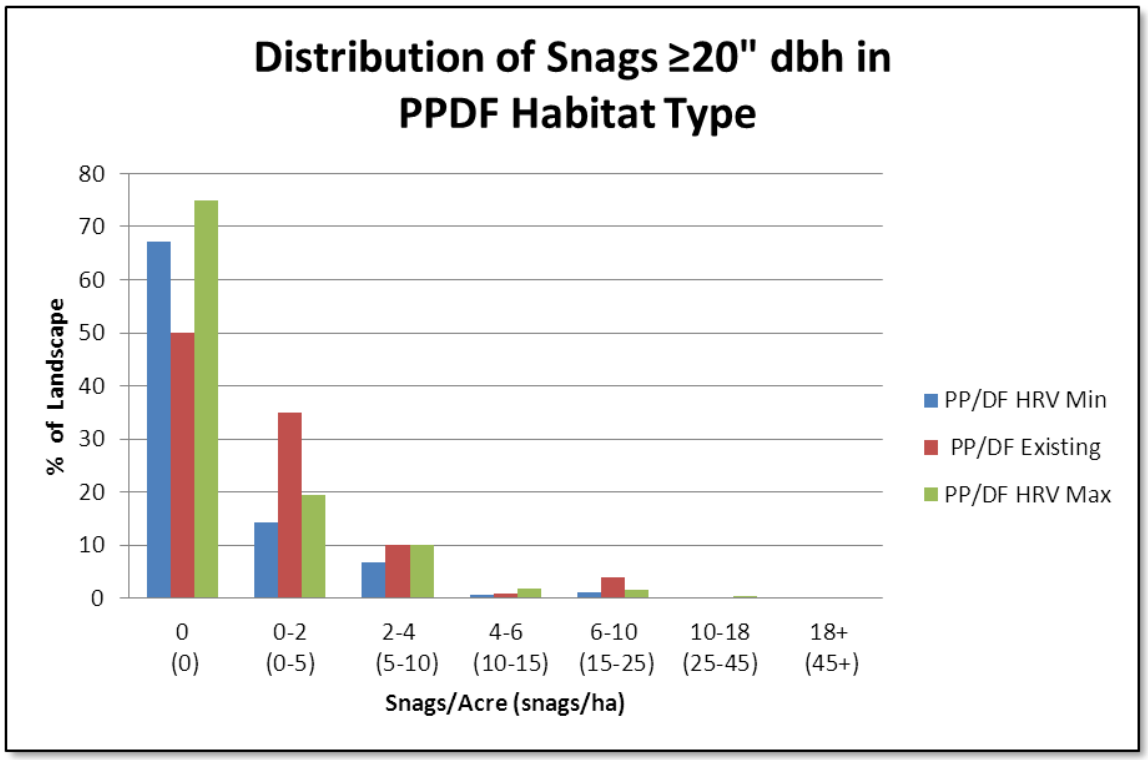


Figure 24. Distribution of snags ≥20" in the PPDF habitat type.

Based on knowledge of the Forest's existing transportation system and ongoing fuel wood removal, snag levels in portions of the Forest may be slightly overestimated by the snag analysis as the model does not reflect changes from hazard tree or small firewood removal areas. The unroaded or low road density areas on the Forest are more likely to retain higher snag levels than mixed conifer stands in more accessible areas.

The McKay watershed includes 11,284 acres in EMC habitat type (5.7 percent of EMC forest-wide). Of the EMC acres within the McKay watershed, 3.243 are in large (5.4 percent of forest-wide), 2, 675 are in open (7.2 percent of forest-wide), and 4,864 are in small structure class (4.8 percent of forest-wide). The McKay watershed also includes 10,927 acres in the PP/DF habitat type (4.9 percent of PP/DF forest-wide). Of the PP/DF habitat type acres within the McKay watershed, 2,671 are in large (7.1 percent of forest-wide), 2,859 (2.2 percent of forest-wide), and 5,248 are in small structure class (9.7 percent of forest-wide).

The Decayed Wood Advisor (DecAID [Mellen-Mclean et al. 2009]) 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.

Within the McKay watershed a woodpecker survey was conducted along the upper end of Little McKay in 2008. During that survey the following species of woodpeckers were detected: northern flicker, hairy woodpecker, Williamson's sapsucker, red-naped sapsucker and pileated woodpecker. This survey was primarily aimed at white-headed and Lewis's woodpeckers, but often elicited responses from a variety of other woodpecker species.

Existing Condition (Pileated Woodpecker)

Habitat for the pileated woodpecker on the Ochoco National Forest is defined as stands with Douglas-fir and grand fir understories, or mixed conifer stands with greater than 15-20 inch in diameter trees and a dense canopy condition in the grand fir and Douglas-fir PAGs. In general, multistoried large tree structure with a significant fir component with abundant snags is the

preferred habitat for the pileated woodpecker. The broad-scale source habitat analysis conducted by Wisdom et al. (2000) indicated that there have been basin-wide declines of source habitat of the pileated woodpecker in the interior Columbia Basin, however, habitat of the pileated woodpecker is strongly increasing in the Blue Mountains Ecological Reporting Unit. In the Blue Mountains ERU there was more than a 100% increase in the amount of source habitat from historical conditions. This analysis was a coarse-scale analysis and based on a large pixel size (100 hectares or 247 acres), and included both private and public lands. In addition, priority nesting habitat of the pileated woodpecker (based on GNN analysis with more restrictive criteria) is available in adequate amounts and distribution to maintain pileated woodpecker viability on Ochoco National Forest. Currently, there are approximately 14,508 acres of priority nesting habitat on Ochoco National Forest, within 23 of the 34 watersheds (68%) on the Forest (including Crooked River National Grassland). Of the watersheds that historically provided priority nesting habitat (Ochoco National Forest excluding Crooked River National Grassland), 23 of 24 watersheds (96%) currently provide priority nesting habitat. Within the McKay Watershed priority nesting habitat (based on GNN vegetation data) occurs on 319 acres.

There are 12,677 acres of grand fir and 7,163 acres of Douglas-fir plant association groups (PAGs) well distributed within the analysis area (refer to Map X). Dense stands in these relatively moist PAGs, when dominated by large tree structure would have provided the best primary nesting habitat for pileated woodpeckers. Satellite imagery from 2004 was used to characterize vegetation, which was subsequently used to estimate pileated woodpecker primary reproductive habitat within the watershed. The predictive model (Viable) indicates that the HRV for pileated woodpecker nesting habitat would have been between 2,306 and 5,017 acres in the watershed. Currently pileated woodpecker primary reproductive habitat based on Viable includes approximately 5,934 acres, which is above HRV. However, the satellite imagery alone only provides a broad scale look at the live-tree component and does not provide information on stand specific snag or down log levels. Another model using GNN data extrapolates site specific data including snag and down log abundance from stand exams and Continuous Vegetation (CVS) plots to all stands that reflect the same satellite image properties. This allows a prediction of priority nesting habitat based on tree species, size, density and estimated snag and down log abundance. Using this more restrictive method, priority nesting habitat for pileated woodpeckers is estimated to include 319 acres within the analysis area. These acres represent the best available nesting habitat for this species based on estimated canopy, snag and down wood conditions assumed to be present according to the reflectance of satellite imagery (extrapolation of plot data to a landscape scale).

Existing Condition (Northern Flicker)

Primary northern flicker nesting habitat, for the purpose of this analysis, on the Ochoco National Forest is defined as dry site ponderosa pine with size class 4 or 5 trees dominant and juniper woodland with size class 4 or 5 trees dominant. There are 910 acres of dry site pine in the project area. Of these 753 acres are currently in size class 4 or 5, within the HRV of 272 to 910. Historically xeric pine forest acres would have had less acreage dominated by small and medium to large sized trees (size class 4 and 5) in dense conditions (greater than 50% crown closure) especially in the mid and late seral stages. A larger percentage of acres in this PAG would have been dominated by pine stands (size class 4 and 5) in open condition (less than 50% crown closure), across all seral stages. There are 1,360 acres of juniper woodland in the project area. Of these 1034 acres are currently in size class 4 or 5, above the HRV of 204 to 571. The majority of the juniper PAG acres (929 acres) are currently represented by trees between 9 inches dbh and 21 inches dbh (size class 4) in dense condition (greater than 50% crown closure). Historically juniper woodlands would have had less acreage dominated by pole sized trees (size class 3) compared to what currently exists. Proportionately more acres would have been in late seral stages with small to large trees (size class 4 and 5) in an open condition (less than 50% crown closure). A larger percentage of juniper acres would be more than 100 years old or dominated by

larger size trees (size class 5) in open condition (less than 50% crown closure), or would have been absent, sparse or quite young (size class 1) as a result of historic fire which limited juniper distribution historically. All size classes of juniper woodland trees (size classes 2 to 5) would have been more open and large trees would be primarily confined to rocky areas that would not produce enough fine fuels to carry frequent fires under a natural fire regime. It is expected that the majority of medium to large tree habitat would have been on very dry and rocky slopes and ridges in juniper woodland sites. Wildfires would have periodically moved 7 to 952 acres into an early seral condition dominated by grass, forbs and shrub species. Conversely, 204 to 571 acres of juniper woodland would have been in late seral condition with open stands of medium to large trees dominate (size class 4 to 5). Using size class 4 and 5 in juniper woodland and dry site ponderosa pine PAGs as an indicator of primary nesting habitat for northern flicker, we estimate that primary nesting habitat includes 1787 acres within the analysis area. Primary nesting habitat for northern flickers is currently slightly above the range of what is believed to have been the historic level (726 to 1764 acres).

Direct and Indirect Effects (PCE)

All PCEs listed above are included in this overall PCE discussion in this section. Some of these species are also discussed elsewhere in this document as a specifically named MIS (see pileated woodpecker and northern flicker below), as Sensitive Species (see white-headed and Lewis's woodpecker in the TES section) or as Focal Species (see red-naped sapsucker, Lewis's and black-backed woodpeckers in the Landbirds section).

The models used in and the process for conducting snag analysis, as well as further information, tables and graphs detailing the snag analysis are documented in the Project Record. analysis are included in. These are incorporated by reference into this report.

Under all action alternatives harvest units would not have snags marked for removal, except as required to meet OSHA requirements for safety. Harvest treatments should not substantially alter the available snag habitat directly. Snag abundance and distribution requirements would be met to the extent that snags are present in the existing condition or are present after fuels treatment. However, 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. It is predicted that having fewer trees competing for light, moisture and soil nutrients will result in more rapid attainment of diameter along with greater longevity. As a result, thinning should yield larger snags in the future. Though the snag count is likely to be less, and the rate of recruitment is likely to be slower, the quality of the habitat structure based on height and diameter is likely to superior in a thinned stand than in a stagnant stand. Fuels treatments may alter snag availability as described above.

Treatments within the ponderosa pine/Douglas-fir habitat type (DecAID PP/DF) are very similar by alternative. Proposed treatments would improve the availability of open stands dominated by large diameter trees in ponderosa pine/Douglas-fir habitat type within the watershed.

Alternatives treat similar amounts of acres within the eastside mixed conifer habitat type (DecAID EMC). However, there are more acres of treatment in this habitat type under Alternative 2 than Alternative 4, while there are more acres of treatment in Alternative 3 than in Alternative 2 in this habitat type. Proposed treatments would improve the availability of open stands dominated by large diameter trees in the mixed conifer habitat type within the watershed. Refer to the discussion of pileated woodpeckers for species that select for dense canopy conditions in this habitat type.

Conclusion: Given that treatments do not salvage snags or down wood, that there would be minimal snag removal for hazards, and that there is potential creation of snag patches through burning (especially in the EMC habitat type), direct changes in landscape level snag abundance would be minimal at the landscape scale, but would likely move conditions slightly toward HRV. There would also be changes in snag recruitment over time. Given that in most categories snag densities are within or above HRV, that the proposed alternatives only propose thinning from below (except for 205 acres of group selection harvest in Alternatives 2 and 3), and that proposed alternatives only propose thinning on 16 to 18% of the forest PAG acres, the resulting snag abundance at the landscape scale should continue to remain within or above HRV and to provide viable habitat for primary cavity excavators and the species and habitat they were selected as an indicator for.

Cumulative Effects (PCEs in General)

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions. Records from the Lookout Mountain Ranger District indicate that a total of 6,245 acres were treated with timber harvest in the watershed between 1975 and 1996. Refer to Table Z for details on past timber sale and other activities in the analysis area.

Of the regeneration harvest areas, those that were treated with clear cut harvest prescriptions (HCC), would have lost most or all of the overstory trees and primary cavity excavator habitat. The same is true for shelterwoods and Partial cuts that subsequently had most or all of their overstory removed. Many of the remaining forested stands outside of Green Mountain Roadless Area without documented harvest history have been entered for selective removal, salvage, hazard tree removal and/or firewood cutting at some time in the past. As a result many stands outside of the harvest history acres described above have had snag density reduced by previous activities. Wildfires, prescribed burns and ongoing activity by snag cutters, and recruitment as a result of insects and disease have also affected snag levels within the watershed. At the same time, fire suppression allowed development of dense understory trees which are now experiencing mortality and contributing to snag abundance.

Using the Decayed Wood Advisor (DecAID) it is possible to relate the abundance of dead wood habitat, both snags and logs, to the frequency of occurrence of various wildlife species that require dead wood habitat for some part of their life cycle. The data displayed in DecAID is merely a summary of the conditions present in research plots that have been studied and is dependent on available research data. DecAID predicts the following species will use snags among live eastside mixed conifer vegetation: American marten (AMMA), Long-legged myotis (LLMY), Pileated woodpecker (PIWO), Silver-haired bat (SHBA), and White-headed woodpecker. DecAID also predicts that the following species will use snags in ponderosa pine/Douglas-fir large tree vegetation type: black-backed woodpecker (BBWO), flamulated owl (FLOW), northern flicker (NOFL), white-headed woodpecker (WHWO), pileated woodpecker (PIWO), pygmy nuthatch (PYNU), red-naped sapsucker (RNSA) and Williamson's sapsucker (WISA). The effects of the activities proposed and the past management actions are reflected in the snag analysis discussion presented above in the section on direct and indirect effects to primary cavity excavators. The existing condition and snag density HRVs are further detailed in Appendix WL-B. The existing complex diversity and arrangement of snag and down wood habitat conditions across the landscape is displayed in the snag analysis discussion above and in greater detail in Appendix WL-B. When the existing condition is considered in combination with this project and the reasonably foreseen Mill AMP prescribed burn, there is potential that the watershed may move toward HRV. This is because there is potential for patches of high density snag habitat to develop following prescribed burn treatments within the eastside mixed conifer habitat type (DecAID EMC). As noted above the very high density snag category is below HRV in that habitat type. Returning fire to this watershed has potential to move conditions toward HRV, as long as the amount of high density snag patches do not exceed the amount necessary to

place the very high density snag categories within HRV. Therefore creation of a few small patches of snags during prescribed burning would contribute toward providing a type of snag habitat that is currently deficient on the landscape. 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. The intent of the Viable Ecosystems dead wood guidelines is to provide a mix of habitat conditions at the landscape scale that would be consistent with historic or reference conditions, and that would be more sustainable over time. This project would work toward meeting those objectives. Since all trees greater than or equal to 21 inches would be left (except on 205 acres of group selection harvest under Alternatives 2 and 3), and trees less than 21 inches would be thinned, 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.

Direct and Indirect Effects (Pileated Woodpecker)

Effects to this species are described separately as it is named as a MIS separately from PCEs in general. All other PCEs are included in the overall PCE effects described above. Some are discussed elsewhere in this document as another MIS, as a Sensitive Species (TES section) or as Focal Species (Landbirds section).

Alternative 1: This alternative would not treat LOS stands or forest stands within pfh or designated OGMAs. This alternative would maintain the existing acres of fir-dominated understory and canopy closure, at least in the short term. Grand fir or Douglas-fir plant associations offer relatively more mesic areas which are the most likely to be able to sustain multi-strata LOS in the long term and provide nesting habitat for pileated woodpeckers. Lack of treatment of the understory in these stands would perpetuate development of fir understory conditions with a positive effect on the pileated woodpecker habitat abundance and quality at least in the short term. Overtime however, high stand densities may lead to mortality due to insects, disease or high intensity fire. 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.

Conclusion: This alternative would maintain the suitability of all existing habitat for pileated woodpeckers in the short term. Over time the suitability for nesting is expected to decline on sites that cannot sustain high densities of conifers. As trees on such sites succumb to insect invasion they would provide a foraging substrate for a variety of woodpeckers, including the pileated. 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 remain suitable for this species. This is most likely to be sustainable on the more mesic PAGs, especially moist grand fir sites.

Common to All of Alternatives:

In all action alternatives, all existing snags would be left that are not deemed to be safety hazards. Since the action alternatives do not propose harvest of snags, the amount of existing snags present within the project area should not be directly altered by timber harvest under any alternative. However, the alternatives do set treated stands on different courses for rate of large snag

development and overall snag recruitment. Trees retained in thinned stands should have increased diameter growth rate, and thus are more likely to provide large snag recruitment in the future. On the other hand trees retained in thinned stands should generally stay healthy longer, and thus will not provide snags as quickly as overstocked 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 will not contribute to future snag habitat. Compared to untreated stands, thinned stands are not likely to provide a large number of dead trees quickly. 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 Vegetation section for more details on predicted response of released trees to thinning.

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. The result of these potential effects is that the abundance of snags and trees with well developed heart rot may be reduced and thus the structure that contributes to nesting and roosting habitat for pileated woodpeckers would be reduced on acres treated with prescribed fire. Foraging substrate may be increased in the short term as fire intolerant trees succumb to cambium scorch and become sites for carpenter ant production and thus.

No harvest, noncommercial thinning or natural fuels burning is prescribed within mapped Old Growth Management Areas. The action alternatives would commercially thin timber on 93 acres of mapped pfh. They would harvest in grand fir and Douglas-fir PAGs (which are the sites most likely to provide habitat for pileated woodpeckers). As the canopy is likely to be reduced to less than 60% crown closure after treatment, this alternative would reduce the suitability of these stands as foraging or nesting habitat for pileated woodpeckers, at least in the short term. 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. Thinning of mid-story trees would promote the development of large structure trees in the future, ultimately providing a source of recruitment for large snags and down logs. Thus, this treatment could facilitate the development of higher quality nesting and roosting habitat in the future. The prescription calls for preferential retention of ponderosa pine and larch, but grand fir and Douglas-fir will also be retained as individuals or clumps within these stands, especially on north and east facing slopes and in draws.

Pre-commercial thinning (including hardwood treatments) would occur on 44 acres of mapped pfh. Thinning would also occur in grand fir and Douglas-fir PAGs (outside of commercial harvest units). Thinning of these small trees would help to promote the development of larger trees in the stand. Thus, this treatment could facilitate the development of higher quality habitat in the long term. Where pre-commercial thinning occurs in grand fir and Douglas-fir PAGs it may result in retention of sufficient tree density to maintain suitability for use by pileated woodpeckers as foraging habitat immediately after treatment, but in some areas where the PCT occurs in the understory of currently suitable primary nesting habitat, the suitability for nesting may be reduced in the short term. Whether or not this occurs is dependent on the tree size class and the original stand density. In cases where currently suitable nesting habitat receives understory thinning and canopy closure is reduced to less than 50% then the stands would no longer meet the criteria for primary nesting habitat.

Prescribed natural fuels burning would occur within mapped pfh on 17 acres. Prescribed fire would also occur in grand fir and Douglas-fir PAGs (outside of thinning units). This activity may reduce habitat suitability by reducing 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 later within stand mortality is expected to decline and thus foraging opportunities. 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 assumed that across the majority of prescribed burn units forested stands are expected to retain sufficient tree density within these PAGs to maintain suitability for use by pileated woodpeckers immediately after treatment where it occurs outside of harvest areas.

Conclusion: The action alternatives are expected to reduce quantity of primary nesting habitat within the project area in the short term. Over time, as canopy closure recovers in treated areas and as other stands develop larger trees, primary nesting habitat would increase. Pileated woodpeckers generally would not be expected to nest within areas that are commercially treated under this alternative for a period of 25 to 30 years on mesic sites (grand fir and Douglas fir PAGs). Non-commercially thinned stands on such sites are expected to remain suitable for nesting after treatment. Impact of prescribed burning on nesting habitat is dependent on residual stocking and degree of crown scorch. It is assumed that prescribed burning on grand fir and Douglas-fir PAGs is likely to reduce suitability for nesting by pileated woodpeckers due to the relatively high fuel loads and higher representation by fire intolerant species in the mix. On xeric sites (ponderosa pine and juniper PAGs) primary nesting habitat would not occur whether treated or not. The amount of mapped pileated feeding habitat (pfh) treated is displayed in Table 85. It is the same amount under all of the action alternatives.

Table 85. Treatment acres in mapped pileated woodpecker habitat.

Treatment Option	Pileated wp Harvest in pfh	Pileated wp Non-comm. Thin in pfh	Pileated wp Natural Fuel burning in pfh	Total Treatment Acres in pfh
Alternative 1	0	0	0	0
Alternatives 2, 3 and 4	93	44	17	154 (23%)

Cumulative Effects (Pileated Woodpecker)

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions involving 6,245 acres between 1975 and 1996. Refer to the list of past harvest activity displayed in Table Z.

The regeneration harvest areas received prescriptions (HCC, HCR), which would have removed most or all of the overstory trees and pileated woodpecker habitat. Overstory removal treatments can vary depending on understory stocking and harvest prescription, but often they resemble a HCC or HCR upon completion, and thus would have in many cases removed or degraded pileated woodpecker habitat. Among these acres, units that retain approximately four to six live overstory trees would provide for some future large snag and log habitat as the younger stand around them develops into a mature stand, but would have largely eliminated pileated woodpecker habitat in the short term. Shelterwoods and Partial cuts generally do not retain enough overstory trees to provide pileated woodpecker nesting habitat in the short term, but may be used as foraging areas. Such stands do retain structure that could contribute to both the overstory and the snag and down wood components in the future as the stand develops around them. As thinning tends to target grand fir and Douglas-fir for removal, and reduces stand density so that less tree die, most thinned stands would have limited ability to serve as either nesting or forageing habitat for pileated woodpeckers. The historic individual and group selection harvest that occurred prior to the 1970's usually did not render habitat unsuitable for nesting by pileated woodpeckers, as the

majority of the stand was retained. These high-grade and sanitation salvage operations did remove large trees and snags that could have otherwise served as roost trees or nest trees for pileated woodpeckers. However many occupied and productive nest stands do contain evidence of these historical logging operations. Mapped pfh are generally delineated outside of previously harvested areas, though some acres within mapped pfh have received some level of hazard tree removal, salvage or woodcutting in the past. 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.

There is currently a decision to implement prescribed fire within the Mill Allotment, a portion of which is within the McKay Watershed. This treatment is likely to reduce pileated woodpecker nesting habitat, but may offer a flush of foraging substrate for a period of time while fire stressed trees become invaded by carpenter ants, a favored food source for pileated woodpeckers. At the same time, stands that have developed densities and species compositions that are not sustainable due to site capability, would be brought closer to a sustainable level.

At the watershed scale, the combined effect of the proposed action alternatives with these reasonably foreseeable actions is that the abundance and distribution of pileated woodpecker habitat would be within the range of what is believed to have been the historic level. Habitat for pileated woodpeckers would be concentrated on sites that are more likely to sustain such stand densities and species distributions, and would be eliminated from sites that are less likely to sustain it in the long term.

Ongoing grazing, 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. This project proposes to harvest up to 3,795 acres with ground based equipment and proposes to reuse up to 5.7 miles of existing temporary roads, construct up to 1.0 miles of new temporary roads, reconstruct up to 26.4 miles of existing open roads and construct up to 0.8 miles of new system road. Though all skid trails, temporary roads 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.

Conclusion –

The pileated woodpecker is distributed across the Ochoco National Forest and there are adequate amounts, quality, and distribution of habitat to provide for pileated woodpecker population viability. Given the relatively wide range of this species, increasing population and habitat trends, and the amount and distribution of habitat remaining within the project area, at the forest level and across the eco-region, viability for this species is expected to be provided for on Ochoco National Forest. Given that this project impacts less than 1% of the suitable priority nesting habitat across the Forest, the overall direct, indirect and cumulative effects will result in a small negative trend of habitat in the short term. However, this reduction in nesting habitat is insignificant at the Forest scale and is not expected to reduce the viability of this species at the

Forest level. For these reasons the McKay Vegetation and Fuels Management Project is expected to result in continued viability of pileated woodpeckers on Ochoco National Forest.

Direct and Indirect Effects (Northern Flicker)

Effects to this species are described separately from PCEs in general as it is named as a MIS in the Ochoco N.F. LRMP.

Alternative 1: Using tree size class 4 or 5 as the criteria for modeling habitat for northern flickers it was determined that there are 1,787 acres of primary nesting habitat for this species. Under this alternative all of these acres would retain their current suitability as nesting habitat at least in the short term. Open forest stands that are closing in would continue to transition from open forest habitat to closed forest habitat in the near future. Snags and downed logs would be retained and recruited at their current level and trend. This alternative would have no direct effects on this species. Trends in risk of stand mortality to insect, disease and wildfire would not be altered. Refer the Vegetation section and the Fire and Fuels section of this document for detailed discussion of risk of these disturbance agents. Since this species tends to occupy open forest and woodland areas and is a habitat generalist, future disturbances are not likely to result in large scale loss of occupancy by this species. However, temporary disruption in food availability and increased vulnerability to predation could alter abundance and nesting success for this species at localized areas where high intensity disturbances occur.

Alternatives 2, 3 and 4: Treatments in juniper PAGS with size class 4 or 5 are the same under all action alternatives. Where size class 4 trees (other than old growth) are removed in juniper woodlands potential existing and future nesting sites would be reduced. However, the majority of trees to be removed in that size class would be less than 15 inches in diameter and thus not of sufficient size to provide nesting substrate for this species. Since juniper woodland stands may be reduced to less than 10% crown closure even when all of the largest trees are retained, and since a minimum of 10% crown closure is required to establish a tree size class, many of the treated stands would be classified as early seral size class 1 following treatment, even though scattered medium to large size trees are present (but at less than 10% crown closure). In these cases, habitat modeled would be reduced when size class 4 is changed to size class 1. In most cases a sufficient number of old growth trees or younger trees exceeding 15 inches in diameter would be present after treatment to provide current and future nesting habitat for this species across the treated areas even when they have less than 10% crown closure.

Treatments in dry site pine with size class 4 or 5 vary by action alternative. These treatments would all result in more open conditions on these sites and retention of all but incidental amounts of the size class 5 trees. In some stand this would result in less than 10% crown closure. As with juniper woodlands, this would result in a size class shift from 4 to 1. On the other hand treating stands dominated by small diameter trees can move the stand toward a larger size class following treatment. The net effect on primary nesting habitat for northern flickers that results from the reduction due to conversion of size class 4 class 1 (thinning to less than 10% crown closure) and increases in size class due to removal of smaller trees is a net reduction in habitat within the analysis as follows: Alternative 2 has in a 260 acre reduction (15 % of available) resulting in 1,527 acres; Alternative 3 has a 180 acre reduction, resulting in 1,607 acres; while Alternative 4 has a 185 acre reduction, resulting in 1,602 acres (both10% of available). Following these reductions, primary nesting habitat for northern flickers would be within the range of what is believed to have been the historic level under all action alternatives (726 to 1764 acres).

Cumulative Effects (Northern Flicker)

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions involving 6,245 acres between 1975 and 1996. Refer to the list of past harvest activity displayed in Table Z. Where these past activities occurred in dry site pine and juniper PAGs the abundance of snags available for nesting sites has been reduced. These changes are

reflected in the snag analysis tables displayed in the section on PCE. Where treatments or woodcutting have reduced the abundance of juniper greater than 15 inches in diameter at breast height, there would also be a reduction in potential existing and future nesting substrate. Treatments that retained old growth juniper or large diameter juniper would have retained nesting substrate, and opening up of the shrub steppe habitat by removing juniper trees less than 100 years of age and/or small diameter juniper would likely promote foraging opportunities and longevity of habitat suitability. At the watershed scale, the combined effect of the proposed action alternatives with these reasonably foreseeable actions is that the abundance and distribution of northern flicker habitat would be within the range of what is believed to have been the historic level under all action alternatives. Habitat for northern flickers would be more open than they are today on acres treated in dry site ponderosa pine and juniper woodland PAGs.

Conclusion –

The proposed action alternatives do include thinning in dry site ponderosa pine with size class 5. In addition, dry site pine would be treated by prescribed burning under all actions alternatives. All treatments in juniper woodlands are prescribed to promote vigor of upland shrubs such as mountain mahogany, service berry, wild rose and mountain ash. These noncommercial treatments generally limit cutting to smaller diameter trees or prescribed burning. Therefore these treatments are not likely to remove old-growth juniper or other juniper trees with sufficient size and defect to serve as potential nest sites for northern flickers. Treatments intended to open up pine stands that are becoming closed in may improve habitat conditions for northern flickers in the project area, as they tend to select open habitat types. Even though the flicker was selected as an indicator for old growth juniper, they do nest in a wide variety of forest types. A variety of forest types do exist in abundance and well distributed across the Forest and in this project area, and this species is widespread and common. For these reasons this project will not contribute to a negative trend in viability for northern flickers on Ochoco National Forest.

Bald Eagle

Effects to bald eagles are disclosed in the section on Threatened, Endangered and Sensitive Species. Please refer to that section for the discussion and disclosure of potential impacts to bald eagles.

Golden Eagle and Prairie Falcon

These species occupy cliff habitat, have specific management direction in the LRMP and are discussed below.

Background and Desired Condition (Golden Eagle and Prairie Falcon)

The golden eagle was chosen as a terrestrial management indicator species (MIS) for cliff, talus or cave habitat (LRMP 4-245). The prairie falcon was chosen as a terrestrial management indicator species (MIS) for cliff, talus or cave habitat (LRMP 4-245).

Golden eagles and prairie falcon are generally cliff nesters. Golden eagles inhabit shrub-steppe, grassland, juniper, and open ponderosa pine, and mixed conifer/deciduous habitats. They forage in a variety of habitat types and successional stages, preferring areas with an open shrub component where small mammals, especially jackrabbits are common. Prairie Falcons breed throughout the open country east of the Cascades wherever cliffs and outcrops provide opportunities for nesting. They prefer grasslands or hayfields where ground squirrels are abundant as foraging sites. A combination of rimrock or other outcrops and adjacent open country provides ideal breeding habitat.

In the North America golden eagles breed from Alaska and Canada south to Central Mexico. In Oregon, golden eagles are common to uncommon year round residents in all counties east of the Cascade Range (Marshall, 2003). On the Ochoco National Forest, including Crooked River

National Grassland, there are historic records for 147 nesting sites. The majority of the nests are associated with extensive rimrock habitat present in Jefferson County, as noted below in the section on Habitat Analysis. Of 147 sites forest-wide, only 12 occur in Crook County. Of 506 occupied nests in Oregon surveyed in 1982, 35% were in mature trees and 65% on ledges along rims and cliffs (Isaacs and Opp 1991). Nest trees are typically large live ponderosa pine with sturdy open branching and a trunk dbh >30 in. Conservation status is secure globally and nationally. It is listed as apparently secure in Oregon. However, the population trend in Oregon is unknown. In 2011 a state-wide effort is underway to determine the status of historic nesting territories across the State of Oregon.

Prairie falcons breed from central British Columbia east to North Dakota, south to Baja California and Texas. It winters over much of its breeding range south to Mexico (Marshall 2003). They breed throughout the open country east of the Cascades wherever cliffs and outcrops provide opportunities for nesting (SWJ) (Marshall 2003). Prairie Falcons are most common in rimrock country, where they nest, but may travel great distances in search of prey (Marshall 2003, Birds of Oregon). A combination of rimrock or other outcrops and adjacent open country provides ideal breeding habitat. Grasslands are the preferred habitat although they also occur in less-productive areas dominated by sagebrush. The principal requirement for foraging appears to be low and sparse vegetation that accommodates their foraging style. Prey most often consists of small mammals, usually ground squirrels (Denton 1976, Haak 1982b). Conservation status is secure globally and nationally, and apparently secure in Oregon. Populations, including those in Oregon, appear to be stable (White 1994).

Existing Condition (Golden Eagle and Prairie Falcon):

Of the occupied golden eagle nests in Oregon studied by Isaacs and Opp in 1982, 65% were on rock ledges. A forest-level analysis was conducted in 2012 using updated GIS data on rock features. The output from this analysis reflects the majority of rock features with potential nesting habitat. Rock features identified in the GIS data are those that are of sufficient size to be detected from aerial photographs and/or Lidar imagery. The rock categories included in estimating potential nesting habitat for this species included the following: rimrock, rock, rock/limestone, rocky knob, talus, talus/rocky knob, talus/rimrock. The GIS data layer is estimated to be 80% accurate in detecting rock features with cliff faces that have any potential as nesting sites. Some small cliffs may have been overlooked in the aerial photo interpretation, and some rock features identified as potentially having cliff habitat, may not be suitable for nesting sites. However, this data is expected to be representative of the majority of suitable nesting substrate and of sufficient accuracy for a comparison of potential rock habitat within the project area and across the landscape at a forest-wide scale. From this analysis it was estimated that at the forest level there are approximately 18,838 acres of rock habitat that may include cliff nesting habitat (234 acres within the McKay watershed). There are a total of 34 watersheds (5th field HUC) on Ochoco National Forest. Potential cliff nesting habitat is distributed within all 34 of the watersheds on Ochoco National Forest and Crooked River National Grassland, though some locations (Crooked River Grassland, Headwaters Deschutes River, Lake Billy Chinook, Lower Metolius River and Willow Creek) have substantially more cliff habitat than other places across the Forest. As noted above, 234 acres of rock habitat with potential cliff nesting habitat occur within the project area (1.2% of that found forest-wide). Where cliff habitat occurs in proximity to agricultural land or shrub steppe habitat it has potential to provide nesting habitat for golden eagles. Where cliffs occur in proximity to grasslands or hayfield they have potential to provide nesting sites for prairie falcons. Of the potential cliff nesting habitat within the analysis area, that which is within 1 mile of pasture/hayfield foraging habitat are known to be utilized by nesting prairie falcons as well as by migrating peregrine falcons (one prairie falcon nest has been recorded within the analysis area).

Given the abundance of rimrock in the McKay watershed there could be more prairie falcon nests that have not yet been discovered. However, the probability of occupancy by prairie falcons decreases with increasing distance from preferred foraging habitat (grass pasture and hayfields occupied by ground squirrels). Records of prairie falcons indicate sightings are limited to the area of the cliffs near the Forest Boundary and downstream.

Golden eagle nests that are not on cliffs are typically on large ponderosa pine trees or snags in open stands, or on scattered individual large pine trees in otherwise open habitat such as rocky canyons, juniper woodland, shrub/steppe or grassland settings. These individual scattered pines may occur in a variety of plant associations including juniper woodland, juniper steppe or xeric ponderosa pine. In this project area juniper woodland occupies 1,360 acres and xeric ponderosa pine occurs on 910 acres. No golden eagle nests are known within the analysis area. However there are historic records of golden eagle nests elsewhere in the watershed and adjacent watersheds. Incidental golden eagle records with the analysis area include sightings of golden eagles northeast of Horse Spring, near the junction of roads 27 and 2705 and at the cliffs near the Forest Boundary.

Direct and Indirect Effects (Golden Eagle and Prairie Falcon)

Alternative 1

This alternative would have no direct effects on any prairie falcons or golden eagles. Attainment of large trees in stands that don't currently have them would follow the current trend (would not be accelerated), and open forest stands that are closing in would continue to transition from open forest habitat to closed forest habitat in the near future. Snags and large trees would be retained and recruited at their current level and trend, thus there would be no direct impact on potential golden eagle perch or nest trees. Upland shrubs, meadows, hardwood patches and riparian zones which are important for some prey species would not be stabilized or improved through proactive treatment. Small mammals that prefer open habitat such as ground squirrels and jack rabbits would gradually become less abundant as open forage areas transition into brushy or forested areas. This could reduce prey availability for both prairie falcons and golden eagles, until future disturbance events such as fire or insects return patches to early succession. Trends in risk of habitat loss (large trees and snags for golden eagle nest and perch sites) to insect, disease and wildfire would not be altered. Refer the Vegetation and the Fire and Fuels sections of this document for detailed discussion of risk of these disturbance agents. While future disturbance events could remove trees with potential as nests and perches for golden eagles, such disturbance would also have potential to improve foraging habitat for both prairie falcons and golden eagles by creating open areas with an abundance of small mammals.

Common to All Alternatives

Golden eagles and prairie falcons prefer open areas such as wetlands, meadows, sage flats or open prairies which afford good viewing from the air or tall perches (rock ledges or large snags), and thus would likely benefit from treatments that reduce stand density especially on dry pine or juniper sites. Movement of non-forest and juniper PAGs toward HRV should be beneficial to these species. The action alternatives should generally have net beneficial effects by improving habitat for prey species, by increasing visibility for hunting and by increasing habitat sustainability and resiliency.

One prairie falcon nest has been recorded within the analysis area. Action alternatives would treat the same stands in proximity to the known prairie falcon nest with the same prescriptions. Potential nesting cliffs would not be modified and any nest ledges discovered would be buffered as described in the Project Design Criteria (Chapter 2 of this document).

There are no known golden eagle nests within the project area. There is one known nesting territory on private land downstream from the project area that is in a drainage that is shielded

from the main haul road out of the project area. Thus the action alternatives would not disturb known nesting golden eagles. There is some potential for increased collision hazard due to increased traffic between the project area and Prineville adjacent to foraging and perch habitat. This is could occur as an indirect effect due to big game animals crossing roads that access the project area. When big game animals are mortally wounded due to vehicle collisions, they often die on or adjacent to the road. When scavengers (including eagles) visit these road-side dining spots they are at a greater risk of being struck by a vehicle. This is a short term effect, limited to the period of proposed project implementation. Following timber operations, traffic on roads associated with this project area should return to pre-project levels. Eagles in this vicinity are accustomed to some truck traffic due to the presence high use roads, agricultural lands and an active gravel pit in the area.

With implementation of seasonal restrictions described above, implementation of the action alternatives should not affect reproductive activities of prairie falcons or golden eagles. It is possible that the action alternatives could cause disturbance to nests that are not currently known to be present within the project area. Contract clauses would be included to allow for protection of newly discovered nests in order to minimize potential impacts.

Cumulative Effects (Golden Eagle and Prairie Falcon)

Refer to the list of past harvest activities in Table 111. The clear-cut regeneration harvest areas received prescriptions (HCC) which would have removed most or all of the overstory trees and snags. This would have resulted in more open foraging opportunities for these species, until regeneration developed and closed in. Golden eagles sometimes nest in large trees or snags with little regard for tree density or understory conditions. Prescriptions that retained approximately four to six live overstory trees (HCR) would have provided for some future large tree and snag habitat. Such treatments could still provide suitable nesting areas for golden eagles which prefer open stands, if the retained trees have the appropriate size and structure to support the size and weight of an eagle nest. Shelterwood harvest (HSH) and partial cut (HTH, HIM, HPR, HSV) areas may provide nesting habitat for golden eagles if the retained trees have appropriate size and structure. Overstory removal treatments can vary depending on post-treatment stocking and harvest prescription, but often they resemble a HCC upon completion, and thus would have in many cases removed potential nest sites for golden eagles.

Additional partial removal harvest occurred prior to the 1970s and primarily occurred in the flatter and lower elevation lands. This older harvest was primarily focused on individual tree harvest, often removing large high value trees which were deemed to be at risk to insect mortality. Visual reconnaissance of the private lands in the area indicates that the majority has also been selectively harvested and much of the original overstory removed. The historic individual and group selection harvest that occurred prior to the 1970s usually removed the largest trees with crowns that had flattened with age, and these trees would have had the highest potential as nest sites for golden eagles.

There have also been a number fires in the area, both prescribed and wildfires. Past fires in that burned at low intensity within the analysis area (such as the recent Green Mountain Fire) and had little effect on the overstory. Such fires did little to promote availability of small mammal prey populations, or to reduce nesting habitat. There have been no large scale high intensity wildfires in the analysis area recently. Therefore past fires in this watershed do not have effects that combine with effects of this project to result in cumulative impacts.

No alternative would modify potential cliff nesting habitat. However treatments in proximity to potential habitat could improve foraging opportunities in proximity to potential nest sites. Thinning of overstocked stands of xeric pine and prescribed burning could improve foraging opportunities by making the habitat more open and increasing small mammal populations.

No alternative would remove scattered large ponderosa pine trees that could serve as nest sites for golden eagles. No alternative would remove trees greater than 21" dbh (that could serve as future nest trees) or snags, other in 205 acres of thinning to promote establishment of larch in patchy openings or as needed for safety, road right-of-ways or at landings. However, treatments in proximity to potential nesting habitat could improve the likelihood of potential habitat occupancy by creating more open foraging opportunities in proximity to potential nest sites. Thinning of overstocked stands of xeric pine could improve potential nesting habitat by improving the growth and longevity of large pines, and by making the habitat more open. However, this project's potential to influence potential nesting and foraging habitat for golden eagles is limited due to the small extent and limited distribution of rock cliff features in proximity to habitat for primary prey species within the project boundary. Similarly this project area is likely to have a relatively minor influence on potential nesting and foraging habitat for prairie falcons due to a limited availability of grassland and shrubland habitat associated with cliff features within the project boundary. There are potential incidental impacts such as increased collision hazard which are could affect individuals over a relatively short timeframe. Though there is no certainty that impacts would occur at all, there is some potential for negative impacts in a localized area, in a small subset of the overall population and in the short term. These potential affects both positive and negative are insignificant at the Forest-level and within the eco-region. For these reasons implementation of any alternative proposed in this project is not likely to affect the viability of golden eagles or prairie falcons at the forest-level.

Big Game Habitat (Rocky Mountain Elk, Mule Deer, Pronghorn)

Background and Desired Condition

Rocky Mountain elk was selected as a terrestrial management indicator species (MIS) for populations of big game and their habitat (FEIS 3-21 to 3-23) However both elk and mule deer are listed as MIS species in the LRMP (pp 4-245). A great deal of research and scientific literature on Rocky Mountain elk and mule deer was generated from studies conducted in the Blue Mountains. Research conducted at the Starkey Experimental Forest beginning in the 1980's has defined much of the science and current understanding of big game habitat and behavior including habitat selection and the effects of various management activities such as timber management, roads and traffic, and competition for forage among elk, deer, and livestock.

The desired condition is to provide forage, cover and security to maintain quality of habitat and 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). To support this desired condition, this project is intended to increase the number, distribution, and age class of a variety of big game browse species such as mountain mahogany, ceanothus, elderberry, bitterbrush, upland willow, service berry and various riparian hardwood species including aspen, cottonwood and willow.

The Habitat Effectiveness Index (HEI) for elk was used to describe the existing and desired habitat conditions within the Watershed. There are Standards and Guidelines in the Ochoco National Forest Land and Resource Management Plan (LRMP) for HEI for General Forest (GF), Winter Range (WR) and General Forest Winter Range (GFWR). This watershed contains two of the management areas with road density guidelines for HEI. HEI includes variables for cover quality and amount along with open road density. The minimum standards for percent cover, road density, and HEI value for General Forest and General Forest Winter Range in the third decade following publication of the LRMP are displayed in Table 86. Cover for this analysis includes forested area with at least 40% crown closure.

Table 86. Forest Plan objectives for big game habitat.

Management Area	Cover Percentage	Road Density	HEI
General Forest	11% in P. Pine, 34% in Mxd. Conifer	3 mi./sq.mi.	28
GF Winter Range	18% in P. Pine, 23% in Mxd. Conifer	1 mi.sq.mi Dec. 1 to May 1	8

Existing Condition

The watershed lies within one Oregon Department of Fish and Wildlife (ODFW) management zone, the Grizzly Game Management Unit (GMU 38). The Grizzly GMU contains 72% private lands and 28% public lands. The estimated 2011 population for elk and deer was 1,300 elk and 6,800 deer. 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).

In the Grizzly WMU the MOs are 1,500 elk and 8,500 deer. Mule deer populations have been generally declining across the Western States. This decline is evident in the Grizzly WMU as well. The mule deer MO was met or exceeded in multiple years between 1970 and 2002, with a notable dip between 1989 and 1997. Deer population estimates within the WMU between 2008 and 2011 ranged from 6800 to 7800. The elk population steadily increased from the 1970's through the early 1996, and then consistently met or exceeded the 1,500 elk MO from 1994 through 2004. Between 2008 and 2009 the elk population in the WMU was at or above the MO. No survey was conducted in 2010 and the population estimate for 2011 was down to 1,300 elk.

Deer and elk may utilize the watershed throughout the year during normal snow years. The watershed analysis area contains approximately 10,013 acres (11,083 including visual corridors) within the General Forest Winter Range, and 11,845 acres (14,442 including visual corridors, old-growth groves and historic properties) of General Forest LRMP allocations. Calving and fawning can occur throughout the watershed although they primarily occur in proximity to riparian areas that provide high quality forage and cover. Aspen stands and other riparian hardwoods such as willow are likely to be attractive areas for calving and fawning as are meadow complexes. Upland shrub and herbaceous plant species provide the majority of forage for big game. Upland shrub species that provide forage for big game including mountain mahogany, service berry, ceanothus, upland willow and bitterbrush do occur within the watershed, especially in open areas on south and west facing slopes, and ridges. Upland shrubs were likely represented by higher populations and wider distribution historically because ponderosa pine stands, juniper woodland and shrub steppe habitat were more open under a natural fire regime. The area in dry grand fir and Douglas-fir PAGs, which comprise the majority of the watershed, would have had a larger proportion of open structural stages which would have supported more understory shrub and herbaceous vegetation. Seasonally lichens and fungi also provide sustenance. Cover is provided by vegetation, such as in forested stands or thickets, as well as by topographic features, such as dissected terrain, hidden drainages or remote areas.

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 be a response to hunting pressure, forage quality and availability, an increase in disturbance from motor vehicle use or a combination of these factors.

Specific guidelines in the Land and Resource Management Plan for elk are for the General Forest and General Forest Winter Range management allocations forest-wide (see Table 86). The road densities, cover conditions and Habitat Effectiveness Index (HEI) values displayed below (see Table 87) are for the portion of the watershed that is on Forest Service Managed land. For the purpose of this analysis, overlaying allocations such as visual corridors, old-growth groves and

historic properties were combined into the General Forest and General Forest Winter Range areas. This allows an unbiased analysis based on conditions that affect big game habitat (open roads, forage and cover), rather than clipping out all the major roads due to the presence of visual allocations or discounting cover and forage based on the presence of an LRMP allocated boundary. The acres, percentages and densities provided in this section are based on the biological boundaries without exclusion for overlaying LRMP allocations. The road density is currently within the levels prescribed in the LRMP (3 miles per square mile in General Forest, 1.0 miles per square mile in General Forest Winter Range) in the McKay Watershed.

Table 87. Existing condition percent cover, road density and forage/cover ratio.

Management Area*	P. Pine % Cover	Mixed Con: % Cover	Road Density (mi./sq.mi)	Forage/Cover Ratio
Project Area	36%	55%	1.06	50/50
GFWR	36%	58%	0.63	51/49
GF	34%	53%	1.39	50/50
*visual corridors blended into overlay of General Forest and General Forest Winter Range				

Within General Forest the forage/cover ratio is approximately 50/50, while on General Forest Winter range the forage/cover ratio is approximately 51/49. A forage cover ratio of 60/40 is considered to be an optimal ratio to provide for elk habitat. Therefore if the ratio of forage to cover is considered without regard to other factors that may affect habitat use, then this analysis area is currently low on forage and high on cover. However, recent studies have shown that other factors may compromise the availability of forage and cover such as seasonal nutritional value and human disturbance. The Habitat Effectiveness Index includes a human disturbance element based on the density of open roads as well as measures for cover quality and quantity.

Direct, Indirect Effects

Alternative 1

No satisfactory cover or marginal cover would be treated under this alternative, and no roads would be closed outside of what would normally occur under current programs or due to factors present in the environment (such as landslides) or the lack of funding for maintenance (natural growing in of vegetation). Percent cover and HEI would remain at the current levels for a period of time. Habitat effectiveness would continue to follow the current trend, with gradual development of additional cover as the canopy of forested stands continue to close. Forage area and the abundance of herbaceous and shrubby vegetation would decline as coniferous cover develops to greater density and extent. T©he development of understory vegetation would gradually increase the risk of future loss of cover to fire, insects and disease. The overall open road density is expected to remain at approximately the current level of 1.39 miles per square mile in General Forest, and 0.63 miles per square mile in General Forest winter Range.

Open road density standards would be met across General Forest and General Forest Winter Range within the analysis area as would standards for percent cover and HEI as displayed in Table 88 (General Forest) and Table 89 (General Forest Winter Range).

Alternative 2

Within General Forest (GF) this alternative would reduce satisfactory cover by 339 acres, and have a net decrease in marginal cover of 1678 acres. This shift results in a reduction in the percent cover from 50% to 36%, resulting in a slight decrease in the cover quantity index to 98. However, the cover quality index remains at 44.8 as both marginal and satisfactory cover are reduced proportionately under this alternative. Total cover acres would be reduced by 2,017 acres, resulting in a 14 % decrease in percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through

these treatments 2,017 acres of additional forage would be created bringing the forage/cover ratio to 64/36 (optimal is 60/40). Improved forage availability would be achieved through creation of forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would not change and the overall HEI would remain unchanged with a HEI of 51 well above the forest-wide standard of 28 for the third decade following LRMP implementation.

Within General Forest Winter Range (GFWR) this alternative would reduce satisfactory cover by 176 acres, and have a net decrease in marginal cover of 1538 acres. This shift results in a slight increase in the cover quality index from 43.6 to 43.9 due to proportionately more marginal cover being reduced. Total cover acres would be reduced by 1,714 acres, resulting in a 16 % decrease of percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through these treatments 1,714 acres of additional forage would be created bringing the forage/cover ratio to 67/33 (optimal is 60/40). Improved forage availability would be achieved through creation of forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would not change but the overall HEI would be reduced to a HEI of 60 well above the forest-wide standard of 8 for this allocation in the third decade following LRMP implementation.

Open road density standards would be met across General Forest and General Forest Winter Range within the analysis area, as would standards for percent cover and HEI as displayed in Table 88 (General Forest) and Table 89 (General Forest Winter Range).

Alternative 3

Within General Forest (GF) this alternative would reduce satisfactory cover by 385 acres, and have a net decrease in marginal cover of 1696 acres. This shift results in a reduction in the percent cover from 50% to 35%, resulting in a slight decrease in the cover quantity index to 94. However, the cover quality index remains at 44.8 as both marginal and satisfactory cover are reduced proportionately under this alternative. Total cover acres would be reduced by 2,171 acres, resulting in a 15 % decrease in percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through these treatments 2,171 acres of additional forage would be created bringing the forage/cover ratio to 65/35 (optimal is 60/40). Improved forage availability would be achieved through creation of forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would not change but the overall HEI would drop slightly to a HEI of 49, still well above the forest-wide standard of 28 for this allocation for the third decade following LRMP implementation.

Within General Forest Winter Range (GFWR) this alternative would reduce satisfactory cover by 245 acres, and have a net decrease in marginal cover of 1654 acres. This shift results in no change to the cover quality index of 43.6 as both marginal and satisfactory cover are reduced proportionately under this alternative. Total cover acres would be reduced by 1,899 acres, resulting in a 17 % decrease of percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through these treatments 1,899 acres of additional forage would be created bringing the forage/cover ratio to 68/32 (optimal is 60/40). Improved forage availability would be achieved through creation of

forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would increase during operations from 0.63 to 0.68 miles per square mile, and the cover and road effects would combine to reduce HEI from63 to 59, but the overall HEI would be well above the forest-wide standard of 8 for this allocation in the third decade following LRMP implementation.

Open road density standards would be met across General Forest and General Forest Winter Range within the analysis area as would standards for percent cover and HEI as displayed in Table 88 (General Forest) and Table 89 (General Forest Winter Range).

Alternative 4

Within General Forest (GF) this alternative would reduce satisfactory cover by 339 acres, and have a net decrease in marginal cover of 1656 acres. This shift results in a reduction in the percent cover from 50% to 37%, resulting in a slight decrease in the cover quantity index to 98. However, the cover quality index remains at 44.8 as both marginal and satisfactory cover are reduced proportionately under this alternative. Total cover acres would be reduced by 1,995 acres, resulting in a 13 % decrease in percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to slightly below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through these treatments 1,995 acres of additional forage would be created bringing the forage/cover ratio to 63/37 (optimal is 60/40). Improved forage availability would be achieved through creation of forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would not change and the overall HEI would remain at 51, well above the forest-wide standard of 28 for this allocation for the third decade following LRMP implementation.

Within General Forest Winter Range (GFWR) this alternative would reduce satisfactory cover by 176 acres, and have a net decrease in marginal cover of 1524 acres. This shift results in an increase in the cover quality index to 43.9 due to proportionately more marginal cover being reduced. Total cover acres would be reduced by 1,700 acres, resulting in a 15 % decrease of percent cover on Forest Service managed lands. This would reduce the percent cover from above the optimal level to below the optimal level immediately after treatments are completed. However this would be a short term effect to the cover effectiveness scores because ingrowth of vegetation would replace cover over time. Through these treatments 1,700 acres of additional forage would be created bringing the forage/cover ratio to 66/34 (optimal is 60/40). Improved forage availability would be achieved through creation of forage areas in thinned and/or burned stands and some existing forage areas would be treated to delay closing in of tree canopy, thus extending their period of forage availability. Open road density would not change, but the overall HEI would be reduced to a HEI of 60 well above the forest-wide standard of 8 for the third decade following LRMP implementation.

Open road density standards would be met across General Forest and General Forest Winter Range within the analysis area as would standards for percent cover and HEI as displayed in Table 88 (General Forest) and Table 89 (General Forest Winter Range).

Table 88. Alternative comparison: HEI, road density, and percent cover in General Forest.

	GF Open Road Density (mile/sq.mile)	GF HEI	GF % Cover P. Pine	GF % Cover Mix. Con.	GF Project Area % Cover
Alt. 1	1.39	51	34	53	50
Alt. 2	1.39	51	24	38	36
Alt. 3	1.39	49	23	37	35

Alt. 4	1.39	51	24	39	37
Goal:	**LRMP 3.0 summer**	**LRMP 28**	**LRMP 11 %**	**LRMP 34 %**	**Optimal 40%**

Table 89. Alternative comparison: HEI, road density, and percent cover in General Forest Winter Range.

	GFWR Open Road Density (mile/sq.mile)	**GFWR HEI**	**GFWR % Cover P. Pine**	**GFWR % Cover Mix. Con.**	**GFWR Project Area % Cover**
Alt. 1	0.63	63	36	58	49
Alt. 2	0.63	60	22	42	33
Alt. 3	0.68	59	22	40	32
Alt. 4	0.63	60	22	42	34
Goal:	**LRMP 1.0 wtr, 3.0 smr**	**LRMP 8**	**LRMP 18 %**	**LRMP 23 %**	**Optimal 40%**

Cumulative Effects

Refer to the list of past harvest activities included in Table 111. These past harvest activities are reflected in the existing condition data used to evaluate the HEI. These activities would have reduced satisfactory and marginal cover, but would have also created forage areas, often improving the forage/cover ratio. Over time, with continued succession and fire suppression many of these forage areas closed in with coniferous cover and forage availability decreased. The effects of the harvest history and fire suppression have influenced the availability of cover within this watershed. In association with past harvest activities, road construction and development of a network of skid trails occurred. The resulting increase in accessibility for human use and motor vehicles would have reduced habitat quality for big game. The proposed alternatives reduce the percent cover, restore some of the area to forage production and modify the density of open roads. Implementation of the Mill AMP prescribed burn would alter some cover currently exceeding 70% crown closure to less than 70% crown closure, affecting the cover quality index. In some areas cover would be reduced to less than 40% crown closure resulting in additional forage area being created. This is likely to improve the forage/cover ratio by moving it toward the optimal value of 60% forage to 40% cover. Combined with the proposed action the net cumulative effect is that the percent cover, open road density and HEI will be as displayed in Table 88 (General Forest) and Table 89 (General Forest Winter Range).

Livestock use of forage is planned within the watershed. Forage utilization levels were established to provide adequate forage to support big game population management objectives (MO) established by ODFW. However, the combined impact of livestock grazing and wild ungulates is impacting forage availability within the project area, especially in riparian zones. Some of the treatments proposed in the action alternatives would restore upland forage availability and help to relieve some of the pressure, especially in aspen stands. Past aspen improvement projects have been implemented in a few of the stands in this watershed. Maintenance of these improvements would complement hardwood improvement actions proposed in this project in moving toward the LRMP Biological Diversity goals of "identify and protect unique ecological situations" including aspen clones, and "Manage aspen stands to produce a vigorous population, Forest-wide" (LRMP, page 4-121).

Conclusion

Rocky Mountain elk and mule deer occur in populations across the State of Oregon, and across Ochoco National Forest that have a demonstrated harvestable surplus. These species are widely distributed across Ochoco National Forest, and Oregon Department of Fish and Wildlife monitors these populations annually and sets harvest levels based on the results of annual monitoring. The potential effects described above, indicate that this project would reduce cover and HEI within both General Forest and General Forest Winter Range. There is some potential that proposed

treatments may improve the forage/cover ratio in the long term following recovery or development of cover in the future. For these reasons the project's overall direct, indirect and cumulative effects may result in a small negative trend (at least in the short term), but this impact is insignificant at the scale of the Forest. The McKay Project is consistent with the Ochoco National Forest Plan standards and guidelines for deer and elk, and thus continued viability of Rocky Mountain elk and mule deer is expected on Ochoco National Forest.

Threatened, Endangered and Sensitive Species (TES)

Background and Desired Condition (TES)

Sensitive species were analyzed using the 2011 update to the R6 Regional Forester's Sensitive Species list. The Regional Forester's Sensitive Species list was updated in December of 2011 and this list identifies all sensitive plant and animal species documented or suspected to occur on the Ochoco National Forest. Species classified as sensitive by the Forest Service are to be considered by conducting biological evaluations (BE) to determine potential effects of all programs and activities on these species (FSM 2670.32). The BE is a documented review of Forest Service activities in sufficient detail to determine how a proposed action may affect sensitive species. Refer to the Aquatics Report for sensitive fish, amphibians and aquatic invertebrates. Refer to the Botany Report for sensitive plants. The following discussion is the review for terrestrial wildlife species that are federally listed, proposed for federal listing, candidates for federal listing or that are on the Regional Forester's Sensitive Species List.

Threatened, endangered and sensitive (TES) terrestrial species potentially occurring on the Ochoco National Forest include: bald eagle, wolverine, peregrine falcon, upland sandpiper, bufflehead, tricolored blackbird, Lewis's woodpecker, white-headed woodpecker, Townsend's big-eared bat, silver bordered fritillary, Johnson's hairstreak, western sage grouse and pygmy rabbit. Greater sage-grouse and California wolverine are the only terrestrial wildlife species currently federally listed or under review for listing under the Endangered Species Act that are likely to occupy any portion of this project area. Both of these species were found to be warranted for federal listing in 2010. The greater sage-grouse is warranted for for listing, but precluded from listing action due to higher listing priorities. The California wolverine was proposed for listing as a threatened species in February of 2013.

The desired condition is to provide habitat, where the potential exists, to maintain existing populations or habitat of the threatened, endangered, and sensitive species that occur or could be expected to occur in this watershed in the short term, and to increase populations or improve habitat in the long term.

Existing Condition (TES)

Bald Eagle

The northern bald eagle *(Halaieetus leucocephalus)* was officially de-listed as a federal threatened species on August 8, 2007. The Federal Register (Vol. 72, No. 130/Monday July 30, 2007) stated the bald eagle has made a dramatic resurgence from the brink of extinction. The banning of DDT, couple with cooperative conservation efforts of the Service, States, other Federal agencies, non-government organizations, and individuals, have all contributed to the recovery of our National symbol. While the bald eagle has been de-listed they are still protected under the Bald and Golden Eagle Protection Act of 1940. This law provides for the protection of bald eagles and the golden eagle by prohibiting the take, possession, sale, purchase, barter, offer to sell, transport, export or import, of any bald or golden eagle, dead or alive, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668(a); 50 CFR 22). The U.S. Fish and Wildlife Service (2007) prepared Bald Eagle Management Guidelines to help landowners, land managers, and others to meet the intent of this Act. In addition, monitoring of selected bald eagle

nest sites would continue to occur including sites on national forest system lands. The Land and Resource Management Plan (LRMP) also provides direction for the management of habitat through the designation of Bald Eagle Management Areas (BEMAs) and protection of known nest and roost sites. Bald eagle habitat is determined to a large extent by the availability of foraging sites that would attract bald eagles. A detailed account of bald eagle habitat requirements can be found in the Pacific Bald Eagle Recovery Plan (USDI 1986). Bald eagle nesting territories are normally associated with lakes, reservoirs, or rivers. Nests are usually located in large conifers in uneven-aged, multi-storied stands with old-growth components (Anthony et al. 1982). Nest trees usually provide an unobstructed view of the associated body of water. Live, mature trees with deformed tops are often selected for nesting. East of the Cascade Mountains in Oregon, bald eagles prefer nesting in ponderosa pine trees that average 46 inches in diameter (range 21-76 inches) and tend to be larger than the surrounding trees (Anthony et al 1982).

There are no large open bodies of water capable of providing sufficient resources to facilitate occupancy by nesting bald eagles within the analysis area. However, there is one known nest in the watershed on private land. Irrigated hay fields and pastureland in valleys along McKay and Allen Creeks contribute food resources to this pair of eagles and their young, as do habitats along creeks, canals, irrigation reservoirs and ponds in Crooked River basin surrounding Prineville. Bald eagles are known to feed on dead animals within the project area.

Wolverine

In December of 2010 the USFWS found that the California wolverine was warranted for federal listing under the Endangered Species Act, but was precluded from listing action due to higher listing priorities until February, 2013. The wolverine is now proposed for listing as a threatened species. The wolverine (*Gulo gulo*) is the largest terrestrial member of the mustelid family with males weighing 26 to 40 pounds and females 17 to 26 pounds. Wolverines are opportunistic feeders consuming a variety of foods depending on availability. There is no evidence hunting by wolverines is limited by habitat structure. Primarily a scavenger rather than a hunter, the wolverine forages where carrion can be found (Ruggiero 1994). In addition to carrion they would also prey on small animals and birds and eat fruits, berries, and insects. Wolverines occupy a wide variety of habitats from the arctic tundra to coniferous forest. The most common habitats are those that contain a high diversity of microhabitats and high prey populations. Wolverines occupy habitat in a high elevation band from 6,888 feet to 8,528 feet in the mountains of the lower 48 states (Federal Register/ Vol. 73, No. 48/ Tuesday, March 11, 2008). The intervening valleys in this area range from 3,198 feet to 4,920 feet and are unsuitable for long-term wolverine habitat because they do not have the snow conditions or other habitat features required by wolverines (Aubry et al. 2007 in Federal Register/ Vol. 73, No. 48/ Tuesday, March 11, 2008). High elevation alpine wilderness areas appear to be preferred in summer, which tends to effectively separate most wolverine and human interactions. Aubry et al. (2007) reported that virtually all of the wolverine records located in the Pacific states were within or near alpine areas. Copeland et al. (2007) reported that adult males tend to travel more widely than females and as such, they are more likely found in lower, coniferous-dominated habitats simply by chance. Potential wolverine denning habitat does not occur in this watershed due to a lack of remote northeast facing slopes that hold snowpack late into the summer. Any areas with talus or large accumulations of down wood have potential to provide den sites when they occur at sufficient elevation to accumulate and hold snowpack, and where they are free from human disturbance throughout the winter. Reproductive habitat would primarily be located on north slopes in moist grand fir or subalpine fir plant associations. This watershed does have limited potential to provide reproductive habitat in moist grand fir sites at the highest elevations in the watershed, but the likelihood of occupancy by denning wolverines is inherently low due to the very low population density and wide ranging nature of this species and the relatively scarcity of snowpack holding capacity in this watershed. The wolverine is known for having very large home range

area, and being very mobile. As such, this animal could forage through this watershed even if the associated den site was elsewhere. Critical components to Wolverine habitat seem to be an absence of human activity, ample big game and low road densities (Butts, 1992). Projects that benefit big game, a potential food source, and which control the level or distribution of human presence would potentially improve foraging habitat for this species. There are historic records of this species in this watershed.

Peregrine falcon

Reproductive habitat for peregrine falcons (*Falco pergrinus anatum*) has likely always been limited in this planning area by the limited distribution of vertical cliff or pinnacle faces greater than 75 feet in height with horizontal ledges or cave-like openings. In Oregon peregrine falcons occur as resident and migratory populations. They nest on cliffs greater than 75 feet in height and within one mile of some form of water (Pagel 1992). Nesting occurs in xeric areas of eastern Oregon, marine habitats of western Oregon, montane habitats to 6,000 feet elevation, small riparian corridors statewide, and more recently urban habitats of the lower Willamette and Columbia Rivers. Riparian corridors are used for travel and as hunting areas (90-95 percent of all prey items are birds that may come from these systems, Pagel 1992). There are no known peregrine falcon eyries on Ochoco National Forest. There are rock features near the Forest boundary along the western edge of the project area. A single peregrine falcon was sighted in the area during the spring of 2012 and was suspected to be a late migrant. Further visits to the site during 2012 did not confirm nesting activity in the area by peregrine falcons.

Upland Sandpiper

Habitat for upland sandpiper (*Bartramia longicauda)* is not present in this watershed due to the lack of large wetland or prairie habitat. The only records of upland sandpipers near this Forest were historical records on private land at Summit Prairie. 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. Continental range has been decreasing over the last two centuries due to hunting in the late 1800's, and conversion of prairie habitat to farming and grazing (White 1983). 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). Marshall et al offered as possible reasons for the western population declines the following: 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. There are no confirmed locations for this species within this watershed.

Bufflehead

The bufflehead (*Bucephala albeola*) is North America's smallest diving duck. It winters throughout Oregon but is an uncommon breeder in the central and southern Cascades (Marshall 2003). The bufflehead would use tree cavities or artificial nest boxes in trees close to water. Marshall (1996) stated that human disturbance from high recreation use at Cascade Lakes and a shortage of suitable nesting cavities due to forestry practices may be having an impact on their population status. The Oregon breeding population is considered sensitive by the ODFW because of small size and limited nesting habitat (Marshall et al 2003). On the Lookout Mountain Ranger District buffleheads are not commonly seen. However, an occasional bufflehead is spotted during migration on small ponds and reservoirs on the Forest. Bufflehead habitat is present but very limited in the watershed due to scarcity of open water sites that could attract this species.

Bufflehead may make use of small reservoirs on private land or borrow pit or stock ponds on the Forest during migration. There is limited potential for ponds in this analysis area to provide suitable habitat for nesting bufflehead ducks. This species has not been recorded within the Forest boundary within McKay watershed. There are no confirmed locations for this species within this watershed.

Tricolored blackbird

The Tricolored blackbird (*Agelaius tricolor)* is a highly gregarious colonial breeder largely endemic to California. 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). 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. While the tricolored blackbird has been documented to occur between Prineville and Madras (Marshall et al. 2003) and they occasionally are posted as sightings near Powell Butte by local birders, there are no known breeding locations 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. 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. Suitable habitat for this species is not present in this analysis area, there are no records for this species in the project area, and this species is not expected to occur here.

White-headed woodpecker

White-headed woodpecker is a species that prefers open ponderosa pine stands with large diameter trees and snags and low or no shrub cover and sparse understory trees. White-headed woodpeckers nest in relatively large diameter snags (within 20’ of the ground) and forage on large live ponderosa pine trees. White-headed woodpecker habitat would have been more common on dry sites under a natural fire regime. It is expected that the majority of this habitat would have been on relatively dry slopes and ridges, particularly in ponderosa pine sites, where single-strata old growth forest structure would have been more common. The white-headed woodpecker prefers ponderosa pine habitat that has a more open stand conditions with large pine for foraging and large snags for nesting habitat. They prefer stands with live, old ponderosa pine, abundant snags and relatively open understory conditions. White-headed woodpeckers favor live ponderosa pine as foraging substrate, but have also been observed in lodgepole pine, sugar pine, Engelmann spruce and other species. They concentrate their foraging activities on live ponderosa pine, but they may also glean insects from other tree species. They generally select large diameter ponderosa pine snags as nest sites, though they are not always in tall snags (Dixon, 1995; Marshall, 1997). They typically select for single-strata ponderosa pine dominated LOS. It is recommended that ponderosa pine stands with large trees and snags be maintained in a relatively open condition with sparse understory to promote use by white-headed woodpeckers (“Status of the White-headed Woodpecker in Oregon and Washington”, Marshal, 1997). Though the population of white-headed woodpeckers has been reported as increasing across the western states (Wisdom et. al, 2000), there have been local population declines in the Blue Mountains (Csuti et. al, 1997) and on Deschutes and Winema National Forests (Marshall et. al, 1997). White-headed woodpeckers were a focus of surveys conducted in 2008. White-headed woodpeckers were not detected during woodpecker surveys conducted in 2008 within the McKay watershed. Incidental records for this species within the analysis area include one sighting northeast of Salt Butte and one just north of OG-D3-10.

White-headed woodpeckers are a resident of montane forests from southern interior British Columbia south through Central Washington, Northern Idaho, Eastern Oregon and Southwest Oregon, Northern and Central California, and the eastern edge of Central Nevada to the

mountains of Southern California (Marshall et al. 2003). The presence of old growth pine is thought to be important to white-headed woodpeckers. Larger diameter pines provide bark crevices for the invertebrate prey of white-headed woodpeckers and are good cone producers. During the winter months they rely on seeds from ponderosa pine and sugar pine. Old-growths stands also have greater densities of the large-diameter snags that white-headed woodpeckers appear to select for nesting (Frenzel 2002). He also reported that the presence of sugar pine may be important at high elevation sites as an alternate food source. They usually excavate nest cavities in snags, but other recorded substrates include stumps, leaning logs, and the dead tops of live trees. Frenzel's study area on the Deschutes and Winema National Forests (2002) determined that nest trees ranged from 23.6 to 118.1 cm (9-46 inches) with an average diameter of 27 inches and 89 percent of the nest trees were in ponderosa pine. He also measured canopy closure at the nest tree which ranged from 0 percent to 57 percent with a mean of 13 percent. Frenzel (2002) reported that shrub growth, increased understory tree densities from fire suppression, may be factors affecting levels of mammalian nest predation and vulnerability of adults to avian predation. Marshall et al. (2003) stated that the long-term stability of this woodpecker in Oregon and Washington appears to rest with reversing the declining health of ponderosa pine forest. Refer to the Vegetation section of this DEIS for a detailed discussion of in the late and old structure (LOS) pine forest and factors affecting the health of pine stands.

Lewis's woodpecker

Lewis' woodpeckers are associated with open woodland habitat near water. They prefer open park-like ponderosa pine forests similar to the white-headed woodpecker for breeding, although Lewis' woodpecker is favored by a shrubby understory. Recent burns and logged areas provide habitat for Lewis' woodpecker as long as a shrub understory is present. Lewis' woodpeckers are also known to be attracted to cottonwood galleries in the Blue Mountains. Habitat for Lewis's woodpecker (*Melanerpes lewis*) is limited in this watershed by the abundance and distribution of areas with high tree mortality (such as wildfires) and areas with abundant large old cottonwood. This woodpecker is a medium-sized bird that relies on flycatching during the spring and summer and stored mast and fruits in the fall. They feed on insects in the spring and summer, but rely on seeds, nuts and fruits in the fall and winter, which they cache under bark or in cracks and crevices on tree boles. They breed in low numbers in open habitats along Eastern Oregon river and stream valleys. The species is most common in open habitats (e.g. burns) in and uses cottonwood galleries in the Blue Mountains (Marshall et al. 2003). Wisdom (2000) reported that burned ponderosa pine forest created by stand-replacing fires provide highly productive habitats as compared to unburned pine. They are not considered strong cavity excavators but require large snags in an advanced stage of decay that are easier to excavate. Lewis' woodpeckers would also use old cavities created by other woodpeckers. Forty-two percent of the nest trees on the eastern edge of the Mt. Hood National Forest were in ponderosa pine (typically snags) and 43 percent were in living and declining Oregon white oak. The mean diameter of nest trees was 26 inches and mean nest tree height was 41 feet (Marshall et al. 2003). Haggard and Gaines (2001) determined that the Lewis' woodpecker was most abundant in low snag density stands within a stand replacement fire study conducted on the Wenatchee National Forest in Washington. Marshall et al. (2003) reports the species is declining throughout its range possibly due to loss of suitable habitat, competition for nest holes, and the effects of pesticides. Woodpecker surveys conducted between 1992 and 1995 (targeting pileated, white-headed, black-backed and three-toed) did not produce any records for Lewis' woodpecker. Surveys conducted in 2008 (targeting white-headed a*nd* Lewis' woodpeckers). Within the McKay watershed Lewis's woodpeckers were not detected during woodpecker surveys in 2008. No incidental records for this species within the analysis area were found. Records (2003 to 2007) from the local chapter of the Audubon Society (formerly East Cascade Bird Conservancy) had the majority of its Lewis' woodpecker records at lower elevations (off the Forest), during migration.

This species was formerly "abundant" in Oregon, but the population has been declining throughout its range. The declines are more severe at low elevations, especially the Willamette Valley, and losses are attributed reduction of nest and food storage trees, pesticides, to loss of oak woodland habitat and competition with European starlings (Marshall et al. 2003). As is the case for white-headed woodpeckers, it is recommended that woodland stands with large trees and snags be maintained in a relatively open condition. The Lewis's woodpecker is usually observed in relatively open forest conditions, in burned over forests and in the Blue Mountains of Oregon within cottonwood stands. Lewis's woodpecker habitat on Ochoco National Forest at a landscape scale is reflected in the abundance of open pine dominated forests with a shrubby understory and mature riparian woodlands. Loss of shrubby understory and declining abundance of cottonwood is likely the limiting factor for the suitability of habitat within the watershed. Recent fire events in the watershed may attract Lewis's woodpeckers for a period of 3 to 5 years. Outside of the recent fire areas, browsing by both wild and domestic ungulates and the effective suppression of wild fires may be the primary factors limiting shrub production in open stands. Discussion of Lewis' woodpecker is also contained in the Landbird section of this document as this species is identified as a focal species representing dry forest and riparian woodland habitat types. There are no confirmed locations for this species within this watershed.

Townsend's big-eared bat

Habitat for the Townsend's big-eared bat (*Corynorhinus townsendii*) has likely always been limited in this watershed by the scarcity of caves and abandoned wooden buildings and cavern-like bridge abutments. Townsend big-eared bat maternity and hibernation colonies are typically in caves and mine tunnels. They roost almost exclusively in cavity roosts, both in human-made structures (that is, buildings, bridges, and mines) and caves (Christy and West 1993). They are extremely sensitive to disturbance while roosting, because they hang directly from the ceiling of the roost and do not go into torpor (temporary hibernation) during the day in summer colonies (Barbour and Davis 1969 and Dalquist 1948 cited in Christy and West 1993). Perkins and Levesque (1987) estimated the Oregon population at 2,300-2,600 bats and Gaines (1997 cited in NatureServe 2008) estimated 3,000-5,000 individuals in Oregon. The species range extends from southwestern British Columbia, western Washington, western and central Oregon, and northwestern and west-central California. NatureServe (2009) gives them a status of S2, Imperiled in the state of Oregon. The greatest threat to the species is vandalism and disturbance by humans. Disturbance of a nursery colony or of a hibernating group is likely to cause the bats to abandon the site and move to an alternate roost. An additional threat is blockage of cave/mine entrances through collapse or human activities (NatureServe 2009). There are no confirmed locations for this species within this watershed.

Silver-bordered fritillary

Habitat for the silver-bordered fritillary butterfly (*Boloria selene*) has likely always been limited in this watershed by the scarcity of marsh and fen habitat with marsh violet and bog violet. The silver-bordered fritillary butterfly has a holarctic range extending from northern Canada southward into the United States and as far south as New Mexico (NatureServe 2008). While the species is common and widespread in northeastern Washington and northern Idaho, colonies are extremely local and isolated southward, and are particularly vulnerable to local extinctions. Only two primary colonies are found in Oregon, one at Big Summit Prairie on the Ochoco National Forest and one in the Strawberry Mountains Wilderness on the Malheur National Forest (Miller and Hammond 2007). NatureServe (2008) lists this species as G5, demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery. In Oregon its ranking is listed as S2, Imperiled. Suitable habitat for this species is described as mostly wet meadows, marshes, bogs, and more open parts of shrubbier wetlands (NatureServe 2008, Miller and Hammond 2007). This species is dependent on the maintenance of open and wet meadow habitats (Miller and Hammond 2007). Food sources for the adults include nectar sources such as

composite flowers, including goldenrod and black-eyed susans (Opler et al. 2006). Eggs are laid singly near host plants and caterpillar hosts are violets including Viola glabella and Viola nephrophylla (Opler et al. 2006). There are no confirmed locations for this species within this watershed.

Johnson's hairstreak

Habitat for Johnson's hairstreak butterfly (*Callophrys johnsoni)* may be associated with the abundance and distribution of mistletoe. The Johnson hairstreak butterfly is found from southwest British Columbia southward into the Coast Ranges to San Francisco in California; south in the Cascades and Sierra Nevada to Yosemite and also in the Blue Mountains of eastern Oregon. In Oregon its ranking is listed as S2, Imperiled while globally its status is G3, very rare or local throughout its range or found locally in a restricted range (NatureServe 2008). Suitable habitat for this species is described as coniferous forests, especially old growth (Opler et al. 2006) and old growth coniferous forests with red firs, western hemlocks, or gray pines on which its parasitic (mistletoe) hosts grows (NatureServe 2008). Johnson's hairstreak is believed to feed generally on all dwarf mistletoe species throughout its range, and to perhaps specialize on locally available dwarf mistletoes in specific localities (Miller per comm. 2008 cited by Schmitt and Spiegel 2008). Miller and Hammond (2007) describe suitable habitat as almost identical to that of the northern spotted owl except that the butterfly does not occur south of central California. The caterpillar food plant is western dwarf mistletoe. Adults find nectar on low growing plants in the composite family such as Oregon grape, ceanothus and pussypaws (NatureServe 2008; Pyle, 1981; and USDA, NRCS 2008). Miller and Hammond (2007) described management practices to benefit this species need to promote the maintenance of mature and old-growth conifers at middle to low elevations on the west slope of the Cascade Mountains and Coast Range. Opler et al. (2006) shows Johnson hairstreak documentation for western and central Oregon plus the Blue Mountains in northeastern Oregon. The species is suspected to occur on the Ochoco National Forest, but currently there is no confirmed documentation for this species anywhere in on Ochoco National Forest. It is not known which (if any) species of mistletoe serve as a host for the larva of this butterfly in the forests of Central Oregon. A variety of mistletoe species are present in the watershed. Schmitt and Spiegel (2008) state that in the absence of recent large scale disturbance, dwarf mistletoe infestation levels can occur in early, mid, and late successional stands. The project area has not experienced a large scale fire event in recent years. Therefore, mistletoe infection is assumed to be present in all stand age classes which could serve as a host for the caterpillar, if it occurs in association with the mistletoe present on this Forest. Refer to detailed discussions in the forest health section of this report. At present this species has not been determined to be present in Central Oregon or specifically associated with the species of mistletoe that occur in the analysis area. There are no confirmed locations for this species within this watershed.

Greater sage-grouse

Habitat for the greater sage grouse (*Centrocercus urophasianus)* has likely always been limited in this watershed by the absence of extensive tracts of treeless shrub steppe and sagebrush/grassland habitats. 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 which could conceal a predator. 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. While this habitat type and sage grouse are known to occur on the Ochoco National Forest, this habitat type does not occur in large enough patches to provide nesting and brood rearing habitat within the project area. A key component of sage-grouse habitat is a wide open sage-steppe setting largely free of trees or other vertical structures that could serve as perches for birds of prey. Though sage-grouse are known to use portions of Ochoco National Forest, this watershed is not identified as habitat for this species (ODFW, 2010) and is outside of the known current range for this species (BLM, 2012). Suitable habitat for this species is not present in this analysis area, there are no records for this species in the project area, and this species is not expected to occur here.

Pygmy rabbits

Pygmy rabbits (*Brachylagus idahoensis)* typically occur in dense stands of big sagebrush growing in deep loose soils (NatureServe 2008). Habitat for the pygmy rabbit has always been limited in this watershed by the absence of sagebrush habitats with deep friable soil types. Suitable habitat for this species is not present in this analysis area, there are no records for this species in the project area, and this species is not expected to occur here.

Direct, Indirect and Cumulative Effects

Alternative 1

Habitat for bald eagle, wolverine, peregrine falcon, upland sandpiper, bufflehead, tricolored blackbird, Lewis's woodpecker, white-headed woodpecker, Townsend's big-eared bat, silver bordered fritillary, Johnson's hairstreak, greater sage grouse and pygmy rabbit would not be treated and current trends in habitat condition would continue. For example habitat for species such as white-headed woodpecker and Lewis' woodpecker would remain below HRV and habitat would continue to decline. Trends in risk of habitat loss to insect, disease and wildfire would not be altered. Refer the sections on Vegetation and on Fire and Fuels for detailed discussion of risk of loss to these disturbance agents. This alternative would have no direct effects on any TES species, but could ultimately lead to an elevated level of risk of habitat loss in some areas.

Action Alternatives

Alternative 2 includes 4,301 acres of commercial harvest, 4,906 acres of pre-commercial thinning, and up to 2,075 acres of prescribed fire outside of thinning areas. Alternative 3 includes 4,532 acres of commercial harvest, 4,952 acres of pre-commercial thinning, and up to 2,043 acres of prescribed fire outside of thinning areas. Alternative 4 includes 3,564 acres of commercial harvest, 4,906 acres of pre-commercial thinning and up to 2,075 acres of prescribed fire outside of thinning areas. These treatments combined have potential to have effects on TES species as described below. Given that the three action alternatives are very close in acres, arrangement and prescriptions when viewed at a landscaped scale or compared to the range of these species, the effects were determined to be approximately the same among the action alternatives. These potential impacts are described below and apply to each action alternative.

Bald eagle (*Haliaeetus leucocephalus*):

The action alternatives could improve habitat for this species by creating more open forest conditions which could make prey and carrion more accessible, but the project may also have some potential to result in disturbance to nesting, roosting or foraging eagles. This alternative could lead to increased longevity of large live ponderosa pine in the future which could maintain potential future nesting habitat. The determination of effect of the action alternatives on the bald eagle 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).

Peregrine falcon (*Falco peregrinus anatum*):

There would be no alteration of nesting habitat. The action alternatives could improve foraging habitat for this species by creating more open forest conditions which could make prey more accessible, but the project may also have some potential to result in disturbance to nesting or foraging falcons. Therefore, the determination of effect of the action alternatives on the peregrine falcon 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).

Bufflehead (*Bucephala albeola*):

The action alternatives would not alter habitat for this species. There would be no modification of shoreline habitat. This alternative would have no impact on this species or its habitat. The determination for this alternative is "No impact" (NI) to bufflehead.

Lewis' woodpecker (*Melanerpes lewis*):

The action alternatives could 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 in habitat for this species at the landscape scale. The determination of effect of the action alternatives on the Lewis's 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).

White-headed woodpecker (*Picoides albolarvatus*):

The action alternatives 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 habitat for this species. Protective measures incorporated in the project design should reduce the loss of large snags, but some will still be consumed during prescribed burning. The alternative would result in a net increase in habitat for this species at the landscape scale, based on structural/seral stages. Refer to the PCE section for further details on predictions of habitat for this species. The determination of effect of the action alternatives on white-headed 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).

Townsend's big-eared bat (*Corynorhinus townsendii*):

The action alternatives would not alter habitat for this species. No abandoned wooden structures, bridges, caves or mines would be altered. This alternative would have no impact on this species or its habitat. The determination for the action alternatives is "No impact" (NI) to Townsend's big-eared bat.

Tricolored blackbird (*Agelaius tricolor*):

Nesting habitat for this species is not present within the project area and the action alternatives would not alter habitat for this species. No extensive wetlands would be altered. This alternative would have no impact on this species or its habitat. The determination for the action alternatives is "No impact" (NI) to tricolored blackbirds.

California wolverine (*Gulo gulo*):

The action alternatives would alter habitat for this species. Some densely forested areas would be made more open, and road density would be reduced upon completion of the project. Over time, development of large down wood may be accelerated in stands where it is currently lacking. Forage availability would be increased for small mammals and big game. These features may contribute to wolverine habitat by increasing food resources and by promoting potential future denning habitat associated with large down woody debris. There is also potential for project activities to cause disturbance to wolverine that may be moving through the area. Therefore the determination is that any action alternatives "May impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause loss of viability to the population or species" (MIIH).

Silver-bordered fritillary (*Boloria selene atrocostalis*):

This alternative would not alter habitat for this species. No wetland habitat would be altered. The determination for the action alternatives is "No impact" (NI) to Silver-bordered fritillary.

Johnson's hairstreak (*Mitoura johnsoni*):

The action alternatives would alter habitat for this species. Some densely forested areas would be made more open, which could improve the abundance of nectar producing plants in the understory upon which adult hairstreak butterflies feed. However the alternative would also substantially reduce the level of mistletoe infection in treated stands. This could result in modification of food source for larval hairstreak caterpillars. It is unknown whether this species actually occurs on this forest as described in the Background Information section above. However, there is some potential that it could occur in the project area. Mistletoe will not be eradicated at and landscape scale by this project and likely not completely controlled within treated units. Mistletoe is abundant throughout the watershed and will be retained in abundance in specially designated fish and wildlife habitat areas such as PFAs, nest cores, pfh and a variety of riparian buffers as well as in other untreated areas. Therefore mistletoe should remain in abundance and well distributed throughout the watershed. This proposal does not include any spraying, trapping or other controls for Lepidoptera. For these reasons the determination is that any action alternative "May impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause loss of viability to the population or species" (MIIH).

Upland Sandpiper (*Bartramia longicauda*)

The action alternatives would not alter habitat for this species. No extensive wetlands would be altered. This alternative would have no impact on this species or its habitat. The determination for this alternative is "No impact" (NI) to upland sandpipers

Greater sage-grouse (*Centrocercus urophasianus*)

Habitat for this species is not present in this analysis area. No extensive expanses of sagebrush habitat in proximity to know lek sites occur in the project area. The action alternatives would have no impact on this species or its habitat. The determination for this alternative is "No impact" (NI) to greater sage-grouse.

Pygmy rabbit (*Brachylagus idahoensis*)

Habitat for this species is not present in this analysis area. No sagebrush habitat with deep soils conducive to burrowing occurs in the project area. The action alternatives would have no impact on this species or its habitat. The determination for this alternative is "No impact" (NI) to pygmy rabbit.

Cumulative Effects (TES)

Past activities, ongoing projects and reasonably foreseeable activities (see Table Z) are not expected to combine with effects from this project to result in cumulative effects that would be greater than the effects described above for each alternative. The combination of effects from past projects in combination with the effects from this project are not likely to adversely affect any listed or proposed species or lead to a trend toward federal listing or cause loss of viability to the population or species of any Sensitive Species on the Regional Forester's Sensitive Species List. Refer to Table 90.

Conclusion

This document includes a Biological evaluation for this project as required by Forest Service Manual (FSM 2670, 2671 and 2672). The project has been compared to the Project Design Criteria (PDC) included in the Joint Aquatic and Terrestrial Programmatic Biological Assessment, and was found to be consistent with the PDCs as described in that document. For these reasons this project is determined to be consistent with the Endangered Species Act and no consultation for threatened, endangered or proposed terrestrial wildlife species is required.

Table 90. Effect determinations for Threatened, Endangered and Sensitive Species.

Species	Status	Habitat	Alt. 1	Alt. 2	Alt. 3
Northern Bald Eagle	R6 Sen.	present	NI	MIIH	MIIH
Peregrine Falcon	R6 Sen.	present	NI	MIIH	MIIH
Bufflehead	R6 OR-Sen.	present	NI	NI	NI
Lewis' Woodpecker	R6 OR-Sen.	present	NI	MIIH	MIIH
White-headed Woodpecker	R6 Sen.	present	NI	MIIH	MIIH
Townsend's big-eared bat	R6 Sen.	present	NI	NI	NI
Tricolored Blackbird	R6 OR-Sen.	not present	NI	NI	NI
California Wolverine	Federal Proposed	present	NI	MIIH	MIIH
Silver-bordered fritillary	R6 OR-Sen.	present	NI	NI	NI
Johnson's hairstreak	R6 Sen.	present	NI	MIIH	MIIH
Upland Sandpiper	R6 Sen.	present	NI	NI	NI
Greater Sage-grouse	Federal Can-didate	not present	NI	NI	NI
Pygmy Rabbit	R6 Sen.	not present	NI	NI	NI

Federal Proposed = species that has been proposed for listing under ESA (USFWS, 2013).
Federal Candidate = federal candidate for listing under ESA. This species was found to be warranted for federal listing, but precluded due to higher listing priorities (USFWS, 2010).
NI = no impact
MIIH= may impact individuals or habitat, but not likely to likely contribute to a trend towards federal listing or cause loss of viability to the population or species.

Other Featured Species

Pronghorn antelope

Antelope can be seen on the forest during early spring green up, and throughout the summer on the Forest. Kidding may occur in more open and dry habitat where predator detection is better. Rocky Mountain Elk has been selected as an indicator for this species. This species is also represented by Gray Flycatcher in the Landbird section of this document and the greater sage-grouse in the Threatened, Endangered and Sensitive Species section of this document. Please refer to those sections of this document for further discussion.

Raptors

This section discusses potential effects to birds of prey that were not previously discussed.

Please refer to "Threatened, Endangered and Sensitive Species" for further discussion on bald eagles and peregrine falcon, refer to "Management Indicator Species" for further discussion on golden eagle and prairie falcon.

Background and Desired Condition

Goshawk: The goshawk is a forest dwelling accipiter that uses a wide variety of forest ages, structural conditions, and successional stages for a range of life needs and during different seasons. Nest areas are typically on north or east facing aspects, in drainages, and are often near streams or springs. Nest areas contain one or more stands of large, old trees with a dense canopy cover. Goshawks normally have alternate nest sites within a dense stand or in multiple stands in proximity to each other. As a result multiple suitable nest areas may be included in a nesting territory. The Regional Forester's Forest Plan Amendment 2 provides interim management direction for the management of goshawk habitat: 30 acres of the most suitable nesting habitat surrounding all active and historical nest trees will be protected; a 400 acre Post Fledging Area (PFA) will be established around every known active nesting territory. PFAs are important for fledglings as they provide cover and prey for the developing young. Up to 60% of the area should be retained in an LOS condition, and management should enhance younger stands towards LOS condition where possible. Snags and downed logs are important for many goshawk prey species and should be abundant.

Other raptors: Hawks, osprey, owls and falcons use a wide variety of forest ages, structural conditions, and successional stages. A variety of habitat conditions should be present across the landscape, so that features are present that would support populations of raptors at the landscape scale. Snags and downed logs, upland shrubs, meadows, hardwood patches and riparian zones are important for many prey species and should be abundant and in stable or improving condition.

Existing Condition

Goshawk: There are two documented goshawk nesting territories within the watershed. One of these continues to be managed as an active territory (Deer Creek), and a post fledging area (PFA) has been mapped for it. This area was surveyed in 2012 and an unoccupied nest (suspected red-tail hawk) was discovered in proximity to the historic goshawk nest stand. The other has had significant changes to habitat suitability due to a wind throw event and subsequent salvage activities (Harvey Salvage). The historic nest area (southwest of Harvey Gap) is now harvested and the area is occupied by nesting red-tailed hawks (active 2012). A single goshawk was observed near the historic territory in 2008 and another in 2012. It appears that the center of activity for this goshawk territory has moved into the Mill Creek Watershed (Harvey Creek) adjacent to the project area. However, goshawks are still utilizing habitat in the McKay watershed (west of Harvey Gap) for foraging. Another historic center of goshawk activity along Little McKay Creek is included in the records (Little Horse). A single goshawk was observed in the area in 2003. A Nest location at Little Horse was never confirmed despite suspected nesting

status in 1991 and numerous recorded sightings and protocol surveys conducted in the in the 1990s. A broadcast survey was conducted in potential habitat north of Green Mountain in 2012. No responses or sign of occupancy were discovered. In another area, 1.5 miles upstream on main McKay Creek above the confluence with Little McKay Creek, a single goshawk was observed in 2003 (Salt South). A broadcast survey was conducted in this area in 2012 with no responses or evidence of occupancy discovered. Surveys to determine the current status and nest stand locations for all of these known and potential territories are ongoing.

Standards and Guidelines for this species were amended with the Interim Management Direction (Eastside Screens) specified in the Regional Forester's Plan Amendment 2. Seasonal restrictions would be employed for habitat modifying disturbance activities within ½ mile of known nest sites in occupied territories from March 1 to August 31 of each year. At this time, only one known nest site is known and currently suitable for occupancy by nesting goshawks. For non-habitat modifying activities associated with this project (such as road reconstruction) restrictions would be employed within ¼ mile of nest sites during the same time period. The restrictions would not apply to haul on arterial or collector roads. These restrictions may be waived on a case-by-case basis following evaluation by a Wildlife Biologist in consideration of nesting activity, terrain, type and duration of activity and other relevant factors. In addition, nest cores would have no treatments prescribed under any action alternative. Known reproductive territory site names, identifying number, occupancy status and reproductive history are listed below:

- Deer Creek, # 5061: first recorded 1994, last nesting record 1994, one nest grove and one nest on record. Broadcast surveys were conducted in the area in 2010 and 2012 with no responses. An inactive, suspected red-tail hawk nest was found in the historic goshawk nest area in 2012.
- Harvey Creek #0924: first recorded 1977, last nesting record 1977, one nest grove and one nest on record (destroyed by wind throw). Sightings of single goshawks were obtained west of Harvey Gap in 2008 and southeast of Harvey Gap in 2012. Evidence of roosting was discovered in a stand south of Harvey Gap, outside of the analysis area, which may be associated with a new center of activity. A broadcast survey was conducted between the historic nest site and the suspected roost area, and no responses were elicited. However, during that 2012 survey effort an active red-tail hawk nest was found in the historic goshawk nest area.
- Little Horse # 5097, single bird observed 2003, numerous database entries between 1991 and 1997. A suspected nest area in 1991, but no nest location ever recorded or described. Habitat in the historic center of activity is now highly fragmented by past timber harvest activity. Priority habitat to survey has been identified and survey efforts are ongoing.
- Salt South # 0920, single bird observed in 2003. No historic territory or nests were found in the records at this location. Historic red-tail hawk activity was recorded nearby. A broadcast survey was conducted in 2012 with no response.

Landscape scale primary nesting habitat was analyzed using GNN vegetation data as described in the section on Primary Cavity Excavators. Based on that analysis priority nesting habitat within the McKay watershed was estimated to occur on 1,653 acres of USFS managed land. This habitat represents the best available nesting habitat based on tree size, canopy density and abundance of snags and down wood as estimated by reflectance of satellite imagery and extrapolation of plot data to the landscape scale based on those reflectance properties.

Other raptors: One prairie falcon nest has been found within the analysis area (refer to MIS section). Three red-tail hawk nests have been verified within the project boundary. Other raptor nests may occur within the project boundary, but which have not yet been located. A Cooper's hawk was observed near Upper Ray Spring in 2008 and a single peregrine falcon was observed near the Forest boundary in 2012. Outside of USFS lands within the watershed there are two

historic golden eagle territories and one bald eagle territory. Refer to the Management Indicator Species section of this document for discussion of golden eagles and prairie falcons. Refer to the Threatened, Endangered and Sensitive Species section of this document for discussion of bald eagles and peregrine falcons.

Direct and Indirect Effects (Goshawks)

Alternative 1

This alternative would not treat forest stands within PFAs or core nest areas. This alternative would not result in modification of existing habitat conditions in priority nesting habitat. It is estimated that the untreated area would retain habitat suitability in the short term, but may potentially be exposed to long-term risk of disturbance and loss of overstory trees due to continued competition for moisture and the presence or development of ladder fuels over time. As this alternative does not propose any actions near goshawk nests, seasonal restrictions would not be necessary under this alternative other than what would be employed for ongoing activities or reasonably forseeable actions described under cumulative effects.

This alternative would result in short-term retention of existing amount and distribution of goshawk habitat at the landscape scale, 1,653 acres of priority nesting habitat within the the analysis area. This alternative would also retain existing amounts and structural conditions within the PFA in the planning area, at least in the short-term. Goshawks are expected to continue to utilize the PFA and other suitable habitat until conditions change. Many stands that were previously treated would attain increased tree diameters over time, while in some stands not previously treated diameter growth would not be as rapid as that of retained trees in treated stands. As a result, the amount of primary nesting habitat available at the landscape scale is predicted to increase over time in the absence of large scale disturbance.

Alternative 2

No harvest units overlap the mapped PFA or its nest core. This alternative would commercially harvest timber on 179 acres, and would non-commercially thin trees on 116 acres of priority nesting habitat based on GNN. This alternative would implement 69 acres of underburning of natural fuels outside of cutting units within priority nesting habitat based on GNN. It is estimated that commercially treated areas would express a reduction in habitat suitability at least in the short term especially in units where the mistletoe reduction prescription is applied (205 acres under this alternative). The remainder of the treated area within priority nesting habitat (understory burning or pre-commercial thinning) would likely retain existing habitat suitability so long as burn plans and unit prescriptions include goshawk habitat objectives and are implemented in accordance with those objectives. In some cases habitat may be improved through opening up of overly dense understory conditions and creating a patchy distribution of dense clumps and canopy gaps in a matrix of intermediate understory conditions (a mosaic). In other cases treatments may reduce suitability as nesting habitat due in reduction in stand complexity, canopy density and/or prey habitat.

Alternative 3

No harvest units overlap the mapped PFA or its nest core. This alternative would commercially harvest timber on 182 acres, and would non-commercially thin trees on 170 acres of priority nesting habitat based on GNN. This alternative would implement 61 acres of underburning of natural fuels outside of cutting units within priority nesting habitat based on GNN. It is estimated that commercially treated areas would express a reduction in habitat suitability at least in the short term especially in units where mistletoe reduction prescription is applied (205 acres under this alternative). The remainder of the treated area within priority nesting habitat (understory burning or pre-commercial thinning) would likely retain existing habitat suitability so long as burn plans and unit prescriptions include goshawk habitat objectives and are implemented in

accordance with those objectives. In some cases habitat may be improved through opening up of overly dense understory conditions and creating a patchy distribution of dense clumps and canopy gaps in a matrix of intermediate understory conditions (a mosaic). In other cases treatments may reduce suitability as nesting habitat due in reduction in stand complexity, canopy density and/or prey habitat.

Alternative 4

No harvest units overlap the mapped PFA or its nest core. This alternative would commercially harvest timber on 174 acres, and would non-commercially thin trees on 116 acres of priority nesting habitat based on GNN. This alternative would implement 69 acres of underburning of natural fuels outside of cutting units within priority nesting habitat based on GNN. It is estimated that commercially treated areas would express a reduction in habitat suitability at least in the short term. The remainder of the treated area within priority nesting habitat (understory burning or pre-commercial thinning) would likely retain existing habitat suitability so long as burn plans and unit prescriptions include goshawk habitat objectives and are implemented in accordance with those objectives. In some cases habitat may be improved through opening up of overly dense understory conditions and creating a patchy distribution of dense clumps and canopy gaps in a matrix of intermediate understory conditions (a mosaic). In other cases treatments may reduce suitability as nesting habitat due in reduction in stand complexity, canopy density and/or prey habitat.

Common to All Alternatives

Seasonal restrictions on habitat modifying disturbance activities would be employed from March 1 to August 31 within ½ mile of known nests. Restrictions on road reconstruction and hauling would be applied within ¼ mile of active nests on local roads, but not on arterial or collector roads. There are currently no confirmed nest sites within ½ mile of any activity proposed under any of the action alternatives.

Stands being treated may be converted from small tree size class to large tree size class, thus meet the criteria to be identified as primary nesting habitat based on tree size. However, treated stands would be structurally less complex following treatment and thus, though still suitable, they may have reduced habitat quality immediately following treatment. Thus, though the amount of habitat available at the landscape scale may increase in stands that are moved from being dominated by small sized trees to stands dominated by medium to large sized trees, not all of the recruited habitat would be of optimal quality in the short term. 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 that become stagnant. This alternative is expected to improve habitat availability at the landscape scale in 30 years or more due to increase in size class and improved growth and vigor in treated stands. This dynamic in forest development is dependent on many factors such as weather, insects and disease, future management actions or fire.

Conclusion

For the purposes of this analysis the nesting habitat resulting from the GNN data will be referred to as priority nesting habitat. From that analysis it was estimated that at the forest level there are approximately 73,531 acres of priority nesting habitat (1,653 acres within the project area). There are a total of 34 watersheds (5th field HUC) on Ochoco National Forest. Priority nesting habitat for the goshawks is distributed within 26 of these watersheds. The action alternatives would treat priority nesting habitat on a total of 359 to 413 acres. Of those, 174 to 182 acres would be treated with commercial thinning, 116 to 170 acres would be treated with non-commercial thinning outside of commercial thins, and 61 to 69 acres would be treated with

prescribed burning as the only treatment. Of the priority nesting habitat present in the project area 22 to 25% would receive treatments, while less than 1 % of that available forest-wide would be treated under any action alternative.

Direct and Indirect Effects (Other raptors)

Alternative 1

Hawks, osprey, owls and falcons use a wide variety of forest ages, structural conditions, and successional stages. A variety of habitat conditions would continue to occur across the landscape at least in the short term, so that features that are currently present that would support populations of raptors at the landscape scale would be provided at the level that they currently exist, and would be recruited at the rate that they are currently developing. Thus attainment of large trees in stands that don't currently have them would be delayed, and open forest stands that are closing in would continue to transition from open forest habitat to closed forest habitat in the near future. Trends in risk of habitat loss to insect, disease and wildfire would not be altered and over time some areas that currently provide suitable nesting or foraging habitat for forest dwelling raptors such as Cooper's hawks may be converted to habitat for open country raptors such as red-tailed hawks. Refer the Silviculture Report and the Fire and Fuels Report for detailed discussion of risk of loss to these disturbance agents. This alternative would have no direct effects on any raptor species, but could ultimately lead to an elevated level of risk of habitat conversion in some areas. Snags and downed logs would be retained and recruited at their current level and trend. Upland shrubs, meadows, hardwood patches and riparian zones which are important for many prey species would not be stabilized or improved through proactive treatment.

Common to All Action Alternatives

Seral and structural stages in forested PAGs is most relevant to forest dwelling raptors when it occurs in the medium to large tree size classes as these provide the majority of nesting sites. Thus changes in forest structural and seral stages may impact or benefit forest nesting raptors such as Cooper's hawk, sharp-shinned hawk, red-tailed hawk, great horned owl or osprey. For example species that nest in forested stands with high density patches of understory fir trees such as Cooper's hawks may be impacted in the short term by treatments intended to reduce forest stand density. On the other hand species that prefer open stands with a view for nesting such as red-tailed hawks and osprey would likely benefit from treatments that reduce stand density. Species that nest in snags, hardwoods, rocks or on the ground would have their nesting habitat represented by factors other than forest structural seral stages. For example, kestrels, ferruginous hawks, northern harriers and golden eagles may prefer open areas such as wetlands, meadows, sage flats or open prairies that are not represented by forest seral and structural stages. The variety of raptor species present within the project area occupy a variety of habitat features. Treatments that benefit some species or habitat needs (such as foraging areas) are likely to reduce habitat quality for other species that select different habitat conditions, or for specific habitat needs (such as post-fledging cover). The action alternatives should generally have net beneficial effects to most hawks and owls in the project area by improving habitat for prey species, by increasing visibility for hunting and by increasing habitat sustainability and resiliency. Providing a diverse variety and arrangement of habitat features across the landscape should provide a mosaic of habitat for a diverse community of raptor species at the landscape scale and over time.

The action alternatives would treat the same stands in proximity to known raptor nests. Alternatives would include commercial and non-commercial treatments in the vicinity of raptor nests. Nests would be buffered, and seasonal restrictions would be applied, as described in the Project Design Criteria in Chapter 2 of this document.

With implementation of seasonal restrictions described above, implementation of the action alternatives should not affect reproductive activities at known raptor nests. It is possible that the action alternative could cause disturbance to raptors that are not currently known to be present

within the project area. Contract clauses will be included to allow for protection of newly discovered raptor nests in order to minimize potential impacts.

Cumulative Effects (Goshawk)

Refer to the list of past activities in Table Z. The clear-cut regeneration harvest areas received prescriptions (HCC) which would have removed most or all of the overstory trees, snags and goshawk habitat. Many species of hawks nest in large trees, and most owls nest in cavities in snags or hollow trees or in abandoned stick nests in trees. Where these structures have been removed, potential nesting habitat has been eliminated. However, these open areas do provide foraging opportunities for many species that forage over open ground, such as harriers, red-tailed hawks and kestrels, as well as flammulated, barn, great-horned, great gray and pygmy owls. Red-tailed hawks and pygmy-owls select trees along or near the edges of forest openings for nesting. Great gray owl nest in soft snags in forested areas adjacent to opening, whether natural meadows or created clear-cuts. Prescriptions that retained approximately four to six live overstory trees (HCR) would have provided for some future large snag and log habitat as the younger stand develops into a mature stand, but would have eliminated habitat characteristics that would provide nesting habitat for the forest dwelling species of hawks and owls. Such treatments are often still suitable as nesting areas for the species that prefer open stands, such as red-tailed hawks, great-horned owls and osprey. As with the other intensive regeneration treatments, foraging habitat would be available in these sites for species that hunt in open areas.

Shelterwood harvest (HSH) areas may provide nesting habitat for some raptors that will use open forests such as osprey and red-tailed hawk, but they would likely be too open for the forest dwelling accipiters. Ferruginous hawks, kestrels, flammulated owls and long-eared owls are known to prefer relatively open forests. Shelterwoods and partial cuts implemented between 1970 and 1995 generally do not retain enough overstory trees to provide goshawk nesting habitat in the short term, but may be used as foraging areas. Such stands do retain structure that could contribute to both the overstory and the snag and down wood components in the future as the stand develops around them. In some cases, thinned stands may remain suitable for goshawks after treatment depending on residual canopy closure and stand structural diversity.

Overstory removal treatments can vary depending on understory stocking and harvest prescription, but often they resemble a HCC or HCR upon completion, and thus would have in many cases removed or degraded goshawk habitat. Among these plantations units that retained approximately four to six live overstory trees would provide for some future large snag and log habitat as the younger stand around them develops into a mature stand, but would have largely eliminated goshawk habitat in the short term. As stated above for HCR and HSH, open stands with scattered residual trees may provide nesting habitat for species that prefer open forest conditions.

Additional partial removal harvest occurred in the area which is not included in the acreage figures above. This cutting primarily occurred prior to the 1970's and primarily occurred in the flatter and lower elevation lands surrounding Big Summit Prairie. This older harvest was primarily focused on individual tree harvest, often removing large high value trees which were deemed at risk to insect mortality. Visual reconnaissance of the private lands in the area indicates that the majority has also been selectively harvested and much of the original overstory removed. The historic individual and group selection harvest that occurred prior to the 1970's usually did not render habitat unsuitable for nesting by goshawks, as the majority of the stand was retained. These high-grade and sanitation salvage operations did remove large trees that would have contributed to stand diversity, large snag recruitment, and habitat quality. However many occupied and productive nest stands do contain evidence of these historical logging operations, and the old logging corridors provide canopy gaps and flyways which are commonly associated with nesting sites.

The combined effect of the proposed activities with past harvest history provides for maintenance of habitat for species that select for more open stands, as well as further reduction of habitat for species that select for dense forest structure or large soft snags.

The Green Mountain Fire burned at low intensity within the analysis area and had little effect on the overstory. But it removed some understory tree density and ground fuels which could have reduced habitat for prey species in some areas, while improving habitat in other areas. Riparian planting and riparian restoration work that has been completed in the analysis area has improved habitat by enhancing habitat for prey (primarily birds). At the same time, utilization by both wild and domestic ungulates (big game and livestock) have likely impacted the development of riparian hardwood habitat in some areas and thus habitat for shrub nesting birds, which could also provide prey for goshawks. Past management activities have substantially altered the amount, quality and distribution of priority goshawk nesting habitat available to goshawks at the landscape scale. The alternatives further affect the amount of priority nesting habitat. The rate of development of future habitat (based on tree size) can also be accelerated by density control treatments in younger stands. Yet it is important to keep in mind that goshawks prefer stands with patches of very dense cover in their nest areas, so predominant tree size class may not reflect all the habitat components needed to ensure high quality nesting habitat. Over time, as canopy closure recovers and trees in the stand attain diameter growth, primary nesting habitat would develop, be regained or improve in treated areas, and in other areas as well.

Species associated with dead and down logs

Refer the section on primary cavity excavators (PCE), to the landbird section (Vaux's swift), and to wolverine in the TES section for discussion of how these species use of snags and other woody debris. American (pine) marten are most commonly associated with high elevation mixed coniferous forests, especially where lodgepole pine is common. They utilize accumulations of dead and down wood for shelter, travel and hunting sites. Black bear are found in a variety of timber types and they utilize hollow trees and logs during hibernation and for den sites. A variety of small mammals, such a squirrels and rabbits, utilize woody debris for cover, food storage and reproduction. A variety of bats also use snags for roosting or nursery sites. Potential effects of proposed alternatives on dead and down logs are similar to those described in the section on PCE for snags. Please refer to that section for a description of direct, indirect and cumulative effects of alternatives on dead wood, including both standing snags and down logs. On Ochoco National Forest down log guidelines included in the Viable Ecosystem Management Guide (VEMG) are used to assure that adequate amounts of down wood are retained during project implementation. These guidelines are displayed in Table 91.

Table 91. Viable Ecosystem Management Guide down log levels.

Plant Community	PCS. Per Acre	DIA. 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.

DecAID provides data on how wildlife species use logs greater than 5 inches for nesting, denning, roosting, resting and/or foraging. Wildlife use relative to log sizes and down wood percent cover is based on various studies conducted within the relevant habitat types, but not necessarily in the project area or on Ochoco National Forest.

DecAID predicts that black bear (BLBE) may use down logs in live eastside mixed conifer forests in open forest condition.

DecAID predicts the following species may use down logs in live eastside mixed conifer forests with small to medium sized trees: three-toed woodpecker (TTWO), black-backed woodpecker (BBWO), pileated woodpecker (PIWO), small ants (SANT), carpenter and formica ants (LANT), deer mice (DEMO), American marten (AMMA) and black bear (BLBE).

DecAID predicts the following species may use down logs in live eastside mixed conifer forests with large sized trees: three-toed woodpecker (TTWO), black-backed woodpecker (BBWO), pileated woodpecker (PIWO), small ants (SANT), carpenter and formica ants (LANT), deer mice (DEMO), American marten (AMMA) and black bear (BLBE).

DecAID predicts the following species may use down logs in live ponderosa pine/ Douglas-fir forests with large sized trees: various woodpeckers (WOPE), small ants (SANT), carpenter and formica ants (LANT).

DecAID predicts the following species may use down logs in live ponderosa pine/ Douglas-fir forests with small to medium sized trees: various woodpeckers (WOPE), small ants (SANT), carpenter and formica ants (LANT).

DecAID has no data on species use of down logs in live ponderosa pine/ Douglas-fir forests with open conditions.

The McKay project does not propose to harvest existing down wood, so the amount of logs present within the project area should not be substantially altered by implementation of this project in the short term. The project could remove trees greater than 21" dbh (or up to 20.9" dbh in Alternative 4), so could affect abundance and size of trees available for recruitment of future down logs. Treatments that promote the development of large trees would also promote the development of future large wood in the long term, while reducing the abundance of small and medium size dead wood in the mid-term. The abundance, size and condition class distribution of logs may be affected by prescribed burning as decaying logs are very susceptible to ignition and consumption by fire. All alternatives would retain options for future log recruitment or creation, but existing down wood is likely to be substantially reduced in areas treated with prescribed fire.

Species associated with various plant communities and successional stages (Landbirds -Conservation Focal Species)

Refer to other sections of this document for discussions of other species associated with plant communities and successional stages (ie. PCE and TES sections). The following section addresses the effects of the alternatives on landbirds, including, but not limited to neotropical migratory birds, described in the Partners In Flight - Northern Rocky Mountains Bird Conservation Plan. The focal species represent guilds of species that are associated with various plant communities, successional stages and structural conditions.

In January 2001, President Clinton issued an executive order on migratory birds, directing federal agencies to avoid or minimize negative impacts of their actions on migratory birds, and to take active steps to protect birds and their habitat. A Memorandum of Understanding (MOU) between the U. S. Fish and Wildlife Service and the U. S. Forest Service was signed in 2008 to conserve migratory birds, including habitat restoration and enhancement, prevention of pollution affecting birds, and incorporation of migratory bird conservation into the planning process whenever possible. This planning effort focuses on the Landbird Strategic Plan described below to address conservation of migratory and other landbirds.

Landbird Strategic Plan

The Forest Service has prepared a Landbird Strategic Plan (January 2000) to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations to achieve biological objectives. The primary purpose of the strategic plan is to provide guidance for the Landbird Conservation Program and to focus efforts in a common direction. On a more local level, individuals from multiple agencies and organizations within the Oregon-Washington Chapter of Partners in Flight participated in developing five publications for conserving landbirds in this region (Oregon and Washington). A Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington was published in May 2000 (Altman, 2000) is one of five plans that cover all priority habitats for landbirds in Oregon and Washington. This

strategy has been used since its development in planning and projects analysis on Ochoco National Forest.

This project area falls within the Northern Rocky Mountains Planning Unit and the Blue Mountains Subprovince. This strategy emphasizes ecosystems and important habitat conditions and features used by landbirds, rather than individual species. However, species were selected in the conservation strategy to represent habitat types or features considered at risk. Table 92 lists the habitats and species listed for the Blue Mts Subprovince for the habitats that occur within the project area. As focal species, each of the species listed in Table 92 provides a focus for describing desired conditions and attributes of priority habitats. Establishment of conditions favorable to focal species will also likely benefit a wider group of species with similar habitat requirements. The existing conditon for neotropical birds is addressed by looking at focal species that represent communities of birds that occupy priority habitats.

White-headed woodpecker was analyzed and is described above in the Primary Cavity Excavators section. The gray flycatcher was modeled as a surrogate for steppe shrublands (in lieu of vesper sparrow), and black-backed woodpecker was modeled as an indicator for mature true fir forest conditions in Mesic Mixed Conifer priority habitat. Of the remaining species listed in Table 92, the upland sandpiper is discussed in the threatened, endangered and sensitive species section of this report. This Region 6 Regional Forester's Sensitive Species and its habitat are not affected by the project proposals as they occupy expansive wetland habitats which do not occur in the planning area. The Vesper sparrow inhabits steppe shrublands found at lower elevations and are not present within forested habitats or in the planning area. The gray-crowned rosy finch inhabits alpine habitats that do not occur within this planning area. Therefore, the proposed activities would have no effect to these species or their habitats.

Table 92. Blue Mountains Subprovince priority habitats and focal species.

Priority Habitats	Focal Species for the Blue Mts. Province
Dry Forest	White-headed woodpecker, flammulated owl, chipping sparrow, Lewis' woodpecker
Mesic Mixed Conifer	Townsend's warbler, Vaux's swift, varied thrush, MacGillivray's warbler, olive-sided flycatcher
Riparian Woodland	Lewis' woodpecker, red-eyed vireo, veery
Riparian Shrub	Willow flycatcher
Subalpine Forest	Hermit thrush
Montane Meadows	Upland sandpiper
Steppe Shrublands	Vesper sparrow
Aspen	Red-naped sapsucker
Alpine	Gray-crowned rosy finch

Existing Condition

The existing amount of priority habitat for forest dwelling species is based on forest conditions in various habitat types. Generally, there is a relative shortage of habitat for those species associated with open forest conditions. This trend is primarily the result of past management practices and fire suppression activities. Species whose habitat is currently below predicted historic abundance are: chipping sparrow, Lewis's woodpecker, olive-sided flycatcher and gray flycatcher. The species that is above the predicted historic of abundance is the hermit thrush. Species whose habitat is currently within predicted historic abundance are: varied thrush, MacGillivray's warbler, Townsend's warbler, and black-backed woodpecker. The species above or within predicted historic abundance tend to be those that favor dense forest conditions or thickets in moderate density forests, or stands with high levels of tree mortality or structural complexity.

Species that require specialized habitats such as riparian vegetation, meadows, hollow trees, aspen or alpine are not specifically associated with forest structural/seral stages. The red-eyed

vireo, veery and willow flycatcher are associated with riparian woodland and shrub plant communities. None of the alternatives include reducing shrub or meadow habitat. The action alternatives do include restoration activities for aspen stands and prescribed burning may result in restoration or alteration of upland shrub and grassland habitats. The Vaux's swift is associated with late-successional mesic mixed conifer forest, and dependent on very large, hollow snags for nests and roosts. The best variables to predict Vaux's swift occurrence is the number of snags greater than 20 inches dbh and the number of trees with conks of Indian paint fungus (Bull and Beckwith, 1993). Conservation issues listed in the landbird plan include loss of large snags during intensive forest management and insufficient recruitment of large snags through harvest rotations. Habitat objectives include retention and development of snags greater than 27 inches dbh and 82 feet in height in different stages of decay, including hollow snags. Effects of alternatives on special habitat obligates will be described in each of the alternative discussions in the Environmental Effects section.

Environmental Effects

Alternative 1

No activities outside of the on-going operation and maintenance that occur on the forest would occur. This alternative would continue to perpetuate the abundance of wildlife species associated with dense forests having true-fir and Douglas fir understories. The no action alternative would not directly change the existing acres of habitat. Under this alternative there would be a continued decline in habitat abundance for all species that select open forest and early seral conditions as denser, mid to late seral conditions continue to develop. In the long-term, Alternative 1 results in the least amount of habitat for species that select open or early seral forest conditions. In the long-term, this alternative would result in the most habitat for the species associated with denser, mid to late seral conditions. This alternative does not propose any treatments that would directly modify the existing amount of habitat therefore post treatment acres are equal to existing acres. However, this alternative does result in a higher risk of habitat change due to insects, disease or wildfire. Please refer to the Vegetation section for details on risk of insect and disease, and to the Fire and Fuels section for risk of large scale and high intensity wildfire. Barring large scale disturbance the amount of habitat for four species that rely on open forest conditions would have less habitat available over time (chipping sparrow, Lewis's woodpecker, olive-side flycatcher and gray flycatcher. These are the species all select for open forest, woodland or shrub/steppe conditions. Under the same scenario of no large scale disturbance within the next 30 years, species that prefer very dense riparian forest conditions would gradually have more habitat available over time (MacGillivray's warbler). This species requires brushy thickets in riparian areas which as susceptible to shading out through forest succession. Assuming that large scale disturbance does not occur in the next 30 years, the species that select denser upland forest conditions would also find more habitat over time (hermit thrush).

The red-eyed vireo, veery and willow flycatcher are associated with riparian woodland and shrub plant communities. These habitats exist within the planning area, but are typically small in size and fragmented. These species may be present and utilizing the habitats as available. The no action alternative would retain the current trends in displacement of riparian vegetation due to encroachment by young conifers in portions of this habitat type. The red-naped sapsucker is a bird that uses aspen dominated vegetation and riparian woodlands almost similar to the vireo, veery and willow flycatcher. The no action alternative does not propose aspen restoration activities involving thinning of conifers which are competing with aspen. This alternative would not promote retention of habitat for red-naped sapsucker and other species that prefer aspen stands such as Williamson's sapsucker.

The Vaux's swift is associated with large snags in mesic mixed conifer forests. Recommended conservation measures include retention of broken topped trees, especially those over 40' inches dbh, large snag retention and recruitment of replacement snags (large live trees with defect). The

selection of Alternative 1 would result in no change in the current abundance of large hollow snags and trees in the project area. This alternative may result in a higher risk of loss of snags to wildfire, or to reduced development of hollow trees due to increased risk of rapid mortality from bark beetles preventing the slow development of heart rot columns (which develop over many years while the tree is defective but alive). Refer to the Vegetation and Fire sections for detailed discussions of future risk of wildfire, insects and disease. On the other hand, this alternative does not propose prescribed burning, so it would retain all hollow trees and snags as well as down logs in the short term.

Conclusion: Alternative 1 would maintain habitat for species that select for dense forest conditions and continues the decline in habitat conditions for species that use open forest conditions and riparian hardwood habitat, until one or more disturbance events (insects or fire) create open conditions in the future. This alternative would retain all existing hollow tree habitat in the short term, but may result in localized reduction in future hollow tree development due to more rapid rates of tree mortality.

Common to All Action Alternatives

Measures prescribed to restrict activities within nesting seasons for goshawk and other raptors will also afford reduced disturbance to nesting birds where their home ranges overlap with restricted areas. In addition, due to logistical limitations on harvest, thinning and burning activities, some of the work would be scheduled outside of the nesting season. However, a portion of the project work would occur during the nesting season and some individuals would likely be impacted by management activities. Since most migratory birds occupy relatively small nesting season home ranges and are present in relatively large numbers, it is expected that suitable habitat outside of active treatment units will provide alternate cover for birds that are displaced during activities. The area outside of active treatment units would also provide source populations for reoccupation of areas after treatment activities are completed. Birds that are disturbed early in the nesting season may move out of the treatment area during operations and may re-nest later, or outside of the area of activity. In some cases, habitat outside of the unit may be limiting or fully occupied, in which case the displaced birds may become non-reproductive during the year of operation. These would be short-term impacts to individual birds or pairs of birds. This is a trade-off under the action alternatives for the long term benefits of providing increased amounts of habitat for the focal species (and the communities they represent) that are currently below the minimum historic levels within this watershed. This trade-off also would allow for the restoration of habitat for species that utilize herbaceous and shrubby vegetation and for protection of habitat against risk of future large scale or high intensity disturbance. The project also proposes treatments to promote the longevity, vigor and extent of riparian hardwood habitats and the development or retention of stands of large diameter live pine. These treatments are consistent with the goals and objectives for these habitats as listed in the Partners in Flight, Landbird Conservation Strategy for the Northern Rocky Mountains (Altman, 2000).

The action alternatives would implement commercial and non- commercial thinning and prescribed fire. Some of this treatment would occur in habitat for neotropical birds during the nesting season and potentially impact nesting birds. These alternatives would result in increases in habitat for species that select for open forest and early seral conditions due to stand density reduction and the favoring of early seral species (chipping sparrow, Lewis's woodpecker and olive-sided flycatcher). The amount of habitat for MacGillivray's warblers, due to thinning of understory vegetation in moist grand fir sites, would be reduced in the short term but may increase in the long term. The effect on MacGillivray's warblers would be short term as thick patches of understory vegetation would recover relatively quickly on these mesic sites, especially in riparian areas and other seasonally moist areas. Habitat for gray flycatcher would be reduced in the short term, primarily due to reduction in small tree and tall shrub structure on ponderosa pine and western juniper sites. The extent and duration of impacts on gray flycatcher nesting

habitat will depend on how thoroughly small tree and shrub structure (ground fuels) are removed from potential habitat and subsequent maintenance treatments, such as repeated underburning. As shrub cover may be reduced by scorch as well as by consumption, it is expected that upland shrub habitat will be reduced on more than 40 to 70% of the area treated with prescribed burning on upland shrub sites in the short-term. There is potential for treatments to promote the development of gray flycatcher habitat over time, where upland shrub regeneration is promoted and tall shrubs are allowed to develop after the initial treatments on xeric sites (dry pine and western juniper PAGs). Proposed treatments would cause a reduction in the amount of habitat for species that select for denser forests or late seral conditions (varied thrush, Townsend's warbler and hermit thrush).

The action alternatives would increase habitat for black-backed woodpeckers based on dominant tree size in grand fir and Douglas-fir PAGs. However, the treatments would capture tree mortality resulting in a lower rate and abundance of sick and dying trees and thus less foraging substrate for this species.

The action alternatives would alter the current trend in displacement of riparian vegetation due to encroachment by young conifers in the portions of this habitat type where riparian thinning or prescribed fire is employed. The alternatives would also include treatments to restore riparian function, floodplain interaction and to prevent shading out of special habitats. This would result in a beneficial effect to species associated with riparian woodland and shrub plant communities (downy woodpecker, red-eyed vireo, veery and willow flycatcher). This alternative also proposes aspen restoration activities involving thinning of conifers which are competing with aspen clones. This would result in a beneficial effect to species associated with aspen dominated vegetation (red-naped and Williamson's sapsuckers).

Habitat for the Vaux's swift may be altered by the action alternatives. This could occur as a result of incidental loss of hollow trees or snags when they occur in work areas, along road clearings or at landings, and if they are identified as a danger tree. The loss of hollow trees to meet OSHA requirements is not expected to exceed 5% of the available hollow trees within work areas, as these trees usually have the top out of them, making them less likely to be identified as danger trees using the Field Guide for Danger Tree Identification and Response (USDA, 2005). However, prescribed burning could reduce the abundance of large hollow snags and trees in treated areas, as these trees usually have a rotten center and often ignite when exposed to radiant heat or embers which commonly occur during prescribed burn operations. The landbird plan's recommended conservation measures include retention of broken topped trees, especially those over 40' inches dbh, large snag retention and recruitment of replacement snags (large live trees with defect). The impact of prescribed burning on hollow tree and snag habitat is dependent on fuel and weather conditions. This alternative may also improve resilience of large defective trees, as described in the Vegetation section, which may facilitate the long term development of future hollow trees. This would occur through prevention rapid mortality from bark beetles or wildfire, which may allow the slow development of heart rot columns over many years while the tree is defective but still alive.

Conclusion: The action alternatives would reduce habitat for species that select for dense forest conditions and reverses the decline in habitat conditions for species that use open forest conditions, riparian hardwoods and upland shrubs. The action alternatives may reduce existing hollow tree and snag habitat, but may maintain the long term development of hollow trees in the future.

Cumulative Effects

Past harvest activities have occurred as displayed in Table 111. This has occurred across the planning area over the last 40 years. The majority of these treatment areas received harvest prescriptions (HCC, HOR), which would have removed most or all of the overstory trees and

snag habitat. Some of the focal species nest in large hollow trees or snags (Vaux's swift, white-headed woodpecker). Where these structures have been removed, potential nesting habitat has been eliminated. However, the open areas that resulted from past harvest activity do provide foraging and nesting opportunities for many species that forage over open ground or nest in open forests, such as olive-sided flycatchers, chipping sparrow and Lewis's woodpecker. These treatments also change the seral structural stages which are used to model the amount of primary nesting habitat. The outcomes of past activities modify the trajectory of stand development and the amount of habitat available in the future.

Riparian planting and hardwood protection has been implemented at various locations throughout the watershed. These actions have led to improved riparian hardwood habitat in many areas. At the same time, elk populations within the Grizzly WMU have fluctuated at between 6800 and 7800 between 2008 and 2012, and grazing by livestock has continued to occur. The combined grazing and browsing pressure from wild and domestic ungulates has limited the extent and structure of riparian habitat in some areas. The proposed hardwood restoration activities should complement previous restoration efforts and help improve conditions that have resulted from past and ongoing impacts. The benefits of these treatments are not reflected in the estimates of habitat for focal species as these areas are often small or narrow and not classified separately from the larger stands that surround them, and thus they are often not represented in the model outputs.

Conclusion: There are no specific standards and guidelines in the LRMP for neotropical or other landbirds other than raptors, primary cavity excavators or threatened, endangered or sensitive species. The Landbird Conservation Strategy for the Northern Rocky Mountains is supportive of restoration of historic forest types and conditions, as well as restoration of riparian habitats, natural ecological processes and road closures. For these reasons this project is determined to be consistent with the LRMP.

Late and Old Forest and Connective Habitat

Late and old (LOS) forest and connective corridors between LOS stands exceeding 100 acres have been mapped in accordance with the Regional Forester's Plan Amendment #2 (USFS 1995). These features provide habitat for various wildlife species as has been discussed in the sections on pileated woodpeckers, white headed woodpeckers, goshawks and Vaux's swifts. Refer to those sections for details on how LOS habitat contributes to the needs of these species. Existing condition and alternative effects on LOS and connective corridors are disclosed in detail in the Vegetation section of this DEIS. Please refer to that section for a detailed discussion on LOS forest acres, LOS stands and connective corridors.

Species associated with springs, bogs and other unique habitat

Refer to other sections of this document for discussion of species associated with riparian areas and hardwoods (PCE, TES and Landbird sections).

Botany

This section describes expected effects of the proposed action (vegetation and fuels management and the sale of timber) and alternatives upon botanical resources as part of the McKay Environmental Impact Statement (EIS). Included is the Biological Evaluation (BE) for proposed, endangered, threatened, and sensitive plant species within the McKay project area. Also addressed are non-native invasive plants (noxious weeds).

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.

Affected Environment

The most common upland plant associations include grand fir (*Abies grandis*)/pinegrass (*Calamagrostis rubescens*), Douglas-fir (*Pseudotsuga menziesii*)/pinegrass, and ponderosa pine (*Pinus ponderosa*)/Idaho fescue (*Festuca idahoensis*), with upland non-forest communities including western juniper (*Juniperus occidentalis*) and Sandberg bluegrass (*Poa secunda*) occurring primarily on southerly slopes and dry ridges. Riparian vegetation includes a variety of shrubs, with willow (*Salix spp.*) and mountain alder (*Alnus incana*) the most common. Sedges (*Carex spp.*), rushes (*Juncus spp.*), along with native and introduced grasses such as hairgrass (*Deschampsia spp.*) and redtop (*Agrostis gigantea*) also present (Franklin and Dyrness 1988, Johnson and Clausnitzer 1991, USDA 2006).

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:

- Altered hydrology due to road construction, logging, livestock grazing, loss of beaver, fire exclusion, and other influences that resulted in eroded stream channels and reduced area of meadow and riparian habitat due to lower water tables on sites formerly dominated by willow, alder, and other deciduous vegetation (USDA 2006);
- Increased density of fire intolerant conifers and reduced density of understory vegetation (grasses and shrubs) due to fire exclusion and grazing (Agee 1993, USDA 2006);
- Altered species composition due to the introduction of non-native plants, including both introduced perennial grasses and non-native invasive plants, also known as noxious weeds (USDA 2006).

Conditions in the analysis area generally reflect that described in the Interior Columbia Basin Draft Environmental Impact Statements (USDA/USDI 1997, 2000). As a result of human influences, conditions include decline in species diversity and biomass of available forage, increased threats from non-native invasive plants (noxious weeds), and decline in overall landscape health.

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 alternatives on plant species: (1) listed or proposed for listing by the US Fish and Wildlife Service (USFWS) as Endangered or Threatened; and (2) designated by the Pacific Northwest Regional Forester as Sensitive (USDA 2011a). This BE is consistent with the requirements of the Endangered Species Act (ESA) of 1973, Forest Service Manual (FSM, USDA 1995) 2630.3, FSM 2670 and R-6 Supplement 2600-95-3 (6/29/95) and the Ochoco National Forest Land and Resource Management Plan (USDA 1989, 2002b). 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. Potential effects of wildfire are also discussed.

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

…habitat for existing threatened, endangered, and sensitive species of plants and animals will be available as needs are identified over time (USDA 1989).

Pre-field Review

The pre-field review consisted of checking existing records for documented occurrences, determining probability of additional occurrences for any proposed, endangered, threatened, or sensitive species, and if additional surveys are needed. The pre-field review incorporated the following:

- Regional Forester's (R-6) Sensitive Plant Species List and US Fish and Wildlife Service list of Proposed, Endangered, and Threatened Plant Species (USDA 2011a);
- Oregon Biodiversity Information Center (formerly Oregon Natural Heritage Program) Rare, Threatened and Endangered Species List (ORBIC 2010);
- Plant surveys for Ochoco Lumber Land Exchange, Laser, Colt, Lightningbust, and Janzout Timber Sales, Ochoco Summit OHV Trail and other Biological Evaluations, surveys and records (USDA 1990-2011);
- Other literature and information (Hall 1973, Hitchcock and Cronquist 1973, Hopkins and Garrett 1990, Meineke 1995, Croft et al. 1997, Halvorson 2000 and personal communication, and Helliwell personal communication, Christy 2007a, 2007b, Veverka 2010, USDA 2011a, Dewey 2008, 2011). Also included is the knowledge provided by Ochoco NF personnel familiar with the McKay area.

No USFWS proposed, endangered or threatened plant species are known or expected to occur on the Ochoco National Forest. Habitat is not present (USDA 2011a, Halvorson 2000). Therefore, for all alternatives, no effect to proposed, endangered, or threatened plant species is expected. These species will not be discussed further.

Of the 39 sensitive plant species documented or suspected of occurring on the Ochoco National Forest and the Crooked River National Grassland, 17 have been documented in or near the analysis area, or have potential habitat that has not been surveyed (see Table 93). Resources used to identify potential sensitive plant habitat were aerial imagery, vegetation maps, as well as personal knowledge of the analysis area.

Table 93. Summary of Pre-field Review for sensitive plants in the McKay Project Area.

Species	Habitat	Probability of Occurrence	Rationale
Achnatherum hendersonii (Vasey) Bark. Henderson's needlegrass	Sagebrush scablands	DOCUMENTED	~
Achnatherum wallowaensis Maze & K.A. Robson Wallowa needlegrass	Sagebrush scablands	MODERATE	Habitat Present
Astragalus peckii Piper Peck's milkvetch	Sage/juniper/lodgepole pumice/coarse soils	LOW	Outside Doc. range
Astragalus tegetarioides M.E. Jones bastard milkvetch	Sage steppe/ponderosa pine forest	LOW	Outside Doc. range
Botrychium ascendens W.H. Wagner ascending moonwort	Wet meadows, springs, seeps	MODERATE	Habitat Present
Botrychium crenulatum W.H. Wagner crenulate moonwort	Wet meadows, springs, seeps	MODERATE	Habitat Present

Botrychium minganense Vict. Mingan's moonwort	Wet meadows, springs, seeps	MODERATE	Habitat Present
Botrychium montanum W.H. Wagner mountain moonwort	Wet meadows, springs, seeps	MODERATE	Habitat Present
Botrychium paradoxum W.H. Wagner twin-spike moonwort	Wet meadows, springs, seeps	MODERATE	Habitat Present
Calochortus longebarbatus Wats. var. *peckii* Ownbey Peck's mariposa lily	Vernally moist mdws,streambanks	DOCUMENTED	~
Camissonia pygmaea (Dougl. ex Lehm) Raven dwarf suncup	Low elev plains/washes w/ coarse soil or gravel	LOW	No Habitat
Carex diandra Schrank lesser panicled sedge	Sphagnum bog, lakeshores	LOW	No Habitat
Carex lasiocarpa Ehrh. var. *americana* Fernald slender sedge	Very wet sedge mdws, along lakes/streams	MODERATE	Habitat Present
Carex retrorsa Schwein. retrorse sedge	Swamps, marsh, mdws, along lakes, streams	MODERATE	Habitat Present
Cheilanthes feei T. Moore Fee's lip fern	Basalt cliffs but occasionally limestone	MODERATE	Habitat Present
Cyperus lupulinus (Spreng.) Marcks ssp. *lupulinus* Great Plains flatsedge	Riparian edge but dry hackberry, wheatgrass	LOW	No Habitat
Elatine brachysperma A. Gray short-seeded waterwort	Muddy shores, shallow pools	LOW	No Habitat
Eleocharis bolanderi A. Gray Bolander's spikerush	Seasonally wet; low sage/sandberg in basalt	MODERATE	Habitat Present
Eriogonum cusickii M.E. Jones Cusick's buckwheat	Juniper/big sage and low sage scabland	MODERATE	Habitat Present
Heliotropium curassavicum L. salt heliotrope	Moist to dry, saline soils	LOW	No Habitat
Lipocarpha aristulata (Coville) G. Tucker aristulate lipocarpha	Low elev, silty below high water along banks	LOW	No Habitat
Lomatium ochocense Helliwell & Constance Ochoco lomatium	Sagebrush scablands	LOW	Outside Doc. range
Mimulus evanescens R.J. Meinke disappearing monkeyflower	Sage/juniper vernally moist streambanks	LOW	No Habitat
Muhlenbergia minutissima (Steud.) Swallen annual dropseed	Weathered lava soils in riparian	LOW	No Habitat
Penstemon peckii Pennell Peck's penstemon	Stream banks disturbed areas	LOW	Outside Doc. range
Phemeranthus spinescens (Torr.) Hershkovitz) spiny fameflower	Sagebrush scablands Low Elev	LOW	No Habitat
Potamogeton diversifolius Raf. waterthread pondweed	Lakes, ponds, including created habitat	MODERATE	Habitat Present

Rorippa columbiae (Suksd. ex B.L. Rob.) Suksd. ex Howell Columbia yellowcress	Wet meadows, moist plains, streams	LOW	No Habitat
Rotala ramosior (L.) Koehne lowland toothcup	Sand and silt below high water, Low Elev	LOW	No Habitat
Salix wolfii Bebb Wolf's willow	Riparian	MODERATE	Habitat Present
Thelypodium eucosmum B.L. Rob. arrow leaf thelypody	Dry slopes in vernal drainages	LOW	Outside Doc. range
Utricularia minor L. lesser bladderwort	Lowland and montane fens, sedge meadows	LOW	No Habitat
Encalypta brevipes Schljak. Moss	Ledges and crevces on cliffs	LOW	No Habitat
Entosthodon fascicularis (Hedw.) Müll. Hal Moss	Exposed soils along interm seeps/streams	LOW	No Habitat
Helodium blandowii (F. Weber & D. Mohr) Warnst. Blandow's bogmoss	Montane fens	LOW	No Habitat
Schistidium cinclidodonteum (Müll. Hal.) Bremer Schistidium moss	Wet or dry rocks or on soil in crevices	MODERATE	Habitat Present
Tomentypnum nitens (Hedw.) Loeske tomentypnum moss	Montane fens	LOW	No Habitat
Tortula mucronifolia Schwägr. mucronleaf tortula moss	Riparian *Populus* montane *Abies*	MODERATE	Habitat Present
Texosporium sancti-jacobi (Tuck.) Nadv. woven spore lichen	Exposed ridges w/ sage, on dead organic	LOW	No Habitat

Species shaded gray in Table 93 are species associated with habitats on the Crooked River National Grassland. Species with high probability are those likely to occur because high quality habitat is present and the species is known to occur within a few miles of the analysis area. Species with moderate probability of occurrence are those for which habitat is present and the species may occur, but occurrences are not known in the analysis area. Species determined to have low probability of occurrence are those for which habitat is not present or known occurrences are at least several miles outside the analysis area. The rationale for determination of no habitat is that these species are: 1) associated with low elevation, sagebrush habitats outside the "forest zone" or geographically associated with the Crooked River National Grassland, or 2) the particular plant community type associated with the species is not present. Because of low probability of occurrence, all alternatives are expected to result in no impact to these species, and they will not be discussed further.

Field Review and Surveys

Portions of the analysis area were surveyed for sensitive plant species by Ochoco NF and contracted botanists and trained assistants in the early 1990s. Most surveys were completed using an intuitive control survey method and in areas with highest potential for *Calochortus longebarbatus* var. *peckii* and *Oryzopsis hendersonii* Vasey. *O. hendersonii* has since been split taxonomically into the two sensitive *Achnatherum* species (Maze and Robson 1996).

Additional sensitive plant revisits, surveys, and field review was completed in 2012. Survey records can be found at the Lookout Mt. District Office.

Earlier and recent surveys did not target all sensitive plant habitats. Though there is potential for the five *Botrychium spp.* and sensitive *Carex spp*, the particular riparian habitat (sedge and forb communities) associated with these species is generally avoided in vegetation management proposals that initiated the first surveys. Undisturbed "scabland" habitat associated with *Achnatherum hendersonii*, *A. wallowaensis*, and *Eriogonum cusickii* is also generally avoided during ground-disturbing activities. Because these habitats are normally avoided, surveys of all potential habitats have not been completed. Project design includes measures to avoid ground disturbance in habitats associated with sensitive plants. Therefore, surveys of these habitats are not necessary to complete the biological evaluation. Existing information is sufficient to make effects determinations for this project.

Species Information and Effects

Of the 17 sensitive plant species known to occur or have potential habitat within the analysis area, 14 have been grouped where they occupy similar habitats. There are two groups, with the remaining three species addressed individually.

Species associated with riparian habitats

Botrychium ascendens
Botrychium crenulatum
Botrychium minganense
Botrychium montanum
Botrychium paradoxum
Calochortus longebarbatus var. *peckii*
Carex lasiocarpa var. *americana*
Carex retrorsa
Eleocharis bolanderi
Potamogeton diversifolius
Salix wolfii

Existing Condition

MOONWORT or GRAPE FERN (*Botrychium spp.*)

Botrychium ascendens
Botrychium crenulatum
Botrychium minganense
Botrychium montanum
Botrychium paradoxum

Several species of *Botrychium*, also known as moonworts, are on the Regional Forester's Sensitive Species List (USDA 2011a). Five of these species have been documented on the Ochoco National Forest.

The five sensitive *Botrychium spp.* considered here occupy similar riparian habitats, and are discussed as one group. *Botrychium ascendens*, *B. crenulatum*, and *B. paradoxum* are on the ORBIC (2010) List 1, meaning these species are considered by the ORBIC to be threatened with extinction throughout their range. *Botrychium montanum*, is on the ORBIC List 2, meaning this species is considered by the ORBIC to be threatened with extirpation from the State of Oregon. *B. minganense* is less at risk, and is on ORBIC List 4, meaning this species is of conservation concern but is not currently listed as threatened or endangered. In the Northwest, population trends are unknown (Zika 1994, Ahlenslager and Potash 2007).

On the Ochoco NF, documented occurrences have been primarily on the Paulina Ranger District. These populations are partially shaded to fully open, including one within a clearcut. Some surveys have been completed in the analysis area, and no sensitive *Botrychium spp.* have been found. However, these small plants are easily overlooked, except in very intensive surveys, so populations may occur in the analysis area. While populations are difficult to identify, their habitat is readily identified.

Habitat for the five *Botrychium spp.* is primarily moist ground sedge/forb communities associated with seeps, drainages, and the edges of wet meadows at relatively high elevations, generally over 5,000 feet. In the analysis area, habitat is not common. Most of the potential *Botrychium* habitat

(grand fir communities) in the analysis area is on the north facing slopes in the central portion of the project area.

Human impacts, such as road construction and use of timber harvest machinery can result in soil disturbance, compaction and erosion that can reduce habitat quality by changing hydrological patterns. Other activities, such as slash piling and burning, can damage plants and their habitat, and increase risk for introduction and spread of non-native invasive plants that could displace *Botrychium spp*.

Most authorities maintain that *Botrychium spp.* are "seral" species, dependent on some level of disturbance, and the ensuing lack of competition from other plant species for reproduction. These disturbances can be natural, such as flooding or wildfire, but can include clearcutting or road construction, though colonization often takes a decade or more (Zika 1994, Farrar 2006). It is possible that they die out eventually, as forest succession shades out understory plants.

The Ochoco NF has a draft management guide for *Botrychium ascendens*, *B. crenulatum*, *B. paradoxum*, & *B. pedunculosum* (Zika 1994) that provides some guidance. Additional information is included in the Conservation Assessment for 13 Species of Moonworts (*Botrychium* Swartz Subgenus *Botrychium*) (Ahlenslager and Potash 2007).

Maintaining suitable habitat appears the key to continued viability. Along with disturbance that can directly damage populations and habitat, hydrological change is probably the most potentially damaging to *Botrychium* populations. Because effects to *Botrychium spp.* are closely linked to effects on riparian habitat, effects are largely tied to the effects described in the hydrology section of this EIS.

PECK'S MARIPOSA LILY

Calochortus longebarbatus var. *peckii*

Calochortus longebarbatus var. *peckii* is a local endemic, known only from the Ochoco Mountains of central and eastern Oregon. Most populations occur along drainages associated with Big Summit Prairie and Little Summit Prairie, with other populations recorded on McKay Cr., Marks Cr., and the drainages of the Maury Mountains and Snow Mountain. It is currently on the Oregon Natural Heritage Information Center (ORBIC 2010) List 1, meaning it is considered by the ORBIC to be threatened with extinction throughout its range.

Calochortus longebarbatus var. *peckii* occurs in vernally moist areas, low gradient draws and streambeds, especially intermittent drainages, and along meadow margins. Habitat can be described as "transitional riparian" because it occupies the edge of riparian habitat. The Conservation Strategy for *Calochortus longebarbatus* Wats. var. *peckii* Ownbey (Dewey 2011) indicates this species may benefit from changes to riparian habitat that result in increased amounts of transitional habitat. It also indicates that in some areas of the Ochoco NF, habitat for this species has also been eliminated due to human influences. Road construction, grazing, timber harvest, and other influences have resulted in hydrological changes, especially stream down cutting, which have lowered water tables and, in some areas, resulted in loss of riparian and transitional habitat along portions of stream and meadow systems that provide habitat for *C. longebarbatus* var. *peckii*. Other activities, such as slash piling and burning, result in scorched soils, damaging plants and their habitat and increasing risk for introduction and spread of non-native invasive plants that could displace *C. longebarbatus* var. *peckii* (Lesko personal observation).

This plant is a sterile triploid, reproducing asexually through the production of bulblets in the axil of its single leaf or flower bracts. Because flowering plants are less common in drier years, it appears that winter and spring moisture levels determine the level of flowering within the

population. Even in wet years, only a portion of the population may flower. Therefore, completing accurate counts of plants in a population is difficult (Fredericks 1989, Kagan 1996).

The majority of potential *Calochortus longebarbatus* var. *peckii* habitat in the analysis area has been surveyed. No new major populations are expected. Populations are primarily in drainages and meadow systems at the upper end of Little McKay Cr. and near Highland Flat. Compared with other portions of the Ochoco NF, the McKay analysis area contains a relatively small amount of habitat and populations.

Informal monitoring indicates non-native invasive plants, notably Canada thistle (*Cirsium arvense*) and teasel (*Dipsacus fullonum*), are expanding in this and in other areas of the Ochoco National Forest, and have begun to dominate some areas of suitable habitat for this sensitive species (Lesko personal observation, Helliwell 1993). Non-native invasive plants do not appear to pose an immediate threat, but could pose a long term (>10 years) threat to the viability of this sensitive species. Additional discussion of non-native invasive plants is included later in this report.

SENSITIVE SEDGE SPECIES (*Carex spp*.)

Carex lasiocarpa var. *americana* *Carex retrorsa*

Several sedges listed as sensitive are suspected of occurring on the Ochoco National Forest. , *Carex lasiocarpa* var. *americana* (slender sedge), and *C. retrorsa* (retrorse sedge) are on ORBIC (2010) List 2. These species occupy moist to very wet environments. They are found over a wide geographic range in Oregon and across a wide range of states and across Canada.

OTHER RIPARIAN SPECIES

Eleocharis bolanderi *Potamogeton diversifolius* *Salix wolfii*

Eleocharis bolanderi, or Bolander's spikerush, is on ORBIC 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* in Oregon was known only from historic records (1940's) until it was located in Lake and Wallowa counties in 2002-2004 (ORBIC 2011). It also occurs in other eastern Oregon counties, as well as Idaho, California, Nevada, Utah, and Colorado.

Potamogeton diversifolius, also known as Rafinesque's pondweed, is found in most states and is on ORBIC List 2. This aquatic, perennial forb is found in shallow ponds, marshes, and reservoirs in sage grassland or pine woodland communities.

Salix wolfii, or Wolf's willow, is on ORBIC List 2. In Oregon, it has been documented in Wallowa and Harney Counties. It has also been documented in Idaho, Nevada, and the Rocky Mountain states. It is primarily a high elevation species associated with sites that collect cold air (Brunsfeld and Johnson 1985).

Environmental Effects

Riparian habitat conditions vary over the project area. While some riparian areas are presently considered stable, others are in an improving trend, and some are considered unstable and at risk of decline (see "Hydrology" section in Chapter 3 of this document).

While effects such as damage by logging equipment can directly impact sensitive plants and their habitats, one particular indirect effect is the loss of riparian zone, 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.

The critical factor in maintaining viability of sensitive plant species appears to be in maintaining habitat. Along with disturbance that directly damages existing populations and habitat,

hydrological changes (stream down cutting) are probably the most potentially damaging to sensitive riparian plant populations and habitat. Therefore, analysis of effects is tied to the anticipated riparian effects as discussed in the Hydrology section.

Alternative 1

This alternative includes no disturbance through road construction, timber harvest, aspen treatments, thinning, burning or other activities that could directly or indirectly affect viability of sensitive plant species. Habitat would be maintained, at least in the short-term (<10 years). Risk of hydrological changes, such as stream downcutting that could impact riparian habitats, is relatively low (Hopster 2013).

Because *C. longebarbatus* var. *peckii*, and possibly *Botrychium spp.* may decline if competition is not set back due to fire or other disturbance, the continued policy of wildfire suppression and lack of management practices, such as tree thinning and prescribed burning, may lead to a long-term decline of *C. longebarbatus* var. *peckii* and *Botrychium spp.* (Kagan 1996, Halvorson personal communication, Farrar 2006). However, this is expected to be somewhat offset due to foreseeable disturbance from livestock grazing. Grazing is also discussed in the cumulative effects section.

With no timber harvest and fuels reduction activities, accumulations of biomass would increase, potentially increasing wildfire risk that could affect resources, including sensitive plants. Because these sites are moist, wildfire is not expected to reach an intensity level that could directly threaten viability of these plants or damage habitat. Wildfire could indirectly affect sensitive plants associated with riparian habitats by removing vegetation, thereby reducing the buffering capacity during runoff events. This could result in erosion and down cutting that may damage stream systems and reduce riparian habitat. Wildfire could also increase the potential for introduction and spread of non-native invasive plants (noxious weeds) that could displace sensitive plants. However, because these sites are moist, wildfire is not expected to reach an intensity level that could damage habitat and reduce the viability of these plants. Therefore, there would be no measurable difference between the alternatives in indirect risk to riparian habitats from wildfire. Additional discussion of wildfire is included in cumulative effects.

With no timber harvest, road construction, or prescribed burning that would remove vegetation and expose soils, risk for introduction and spread of non-native invasive plants would be less than action alternatives. Therefore, the risk for weeds displacing sensitive plants would be less. Existing roads and areas of damaged soils, such as old burn piles, would remain, and other vectors, such as vehicles and wildlife would still be present, and would contribute to weed susceptibility. Existing untreated infestations are expected to spread. However, non-native invasive plants presently occupy a relatively small portion of riparian habitats, and are not expected to pose a short-term threat (<10 years) to the viability of sensitive plants associated with this habitat. They may pose a long term threat (>10 years), but due to variables that are hard to predict, long term assessment of weed effects on sensitive plants would be speculative. Further discussion of weeds, including long term effects, is discussed in cumulative effects and in the non-native invasive plants (noxious weeds) sections of this report.

Though some noxious weed infestations, such as Canada thistle, are not actively controlled, most infestations are being treated through the use of herbicides or manual treatments. Such treatments are expected to continue, and would benefit sensitive plants. Though there has been limited success on the Ochoco NF, biological control agents (insects) may provide control for Canada thistle in the long term. This is expected to also benefit sensitive plants.

No disturbance through road construction, timber harvest, or burning activities would occur that could directly or indirectly affect populations or habitats for sensitive plant species in the short-term. Therefore, for species associated with riparian habitats (including seasonally-moist habitats, wet meadows, seeps, springs, and aquatic habitats), no impact is expected.

Alternatives 2, 3 and 4

Soil disturbance from heavy machinery can directly impact individual plants. Soil compaction or erosion can impact future recruitment by damaging soils or changing hydrological patterns in riparian habitat. Heavy slash resulting from logging or pre-commercial thinning can bury plants, and burning these higher fuel loads can scorch soils, damaging plants and their habitat, and increasing risk for introduction and spread of non-native invasive plants that could displace sensitive plants.

With protection of specific areas listed in the botany notes table, or through project design elements for sensitive plants and riparian habitat conservation areas (RHCAs), all of the action alternatives avoid mechanical disturbance of known populations and high probability habitat for sensitive plants associated with riparian areas. For example, except for existing roads and selected crossings, no ground-based equipment would be used in any Riparian Habitat Conservation Areas (RHCAs) or other areas identified as habitat for these species. Where some benefit to sensitive plants could occur through vegetation management, such as pre-commercial thinning adjacent to *Calochortus longebarbatus* var. *peckii* habitat, implementation would occur through coordination with the botanist.

Where pre-commercial conifer thinning and prescribed burning would occur along forest/meadow interface that contains habitat for *C. longebarbatus* var. *peckii*, the expected long-term effects (>10 years) would be enhanced habitat resulting from the reduction of shade and the expansion of meadow habitat. This could result in expansion of populations.

While these alternatives would construct new roads and harvest timber, 4 miles of additional road reconstruction and harvest in riparian habitat conservation areas associated with Alternative 3 may result in a slightly higher risk to riparian habitat quality due to sedimentation. However, given project design for road reconstruction and timber harvest, effects from higher levels of road construction and use is not expected to result in meaningful difference between Alternatives 2, 3 and 4.

Seeding native grasses and forbs would take place during rehabilitation of log landings and portions of inactivated roads, including those in riparian areas, to reduce potential for erosion and introduction and spread of noxious weeds. Additional seeded grasses and forbs could move into *C. longebarbatus* var. *peckii* habitat. Observations indicate *C. longebarbatus* var. *peckii* populations and habitat are generally stable (Lesko personal observation). Populations of native and non-native grasses and non-invasive forbs appear to have shared this habitat with *C. longebarbatus* var. *peckii* for decades. Therefore, seeding is not expected to increase of risk to *C. longebarbatus* var. *peckii*. On highly disturbed sites such as roads, seeded grass and forbs can colonize these sites and reduce risk of some invasive plants, such as teasel (*Dipsacus fullonum*), which appears to be a greater threat to *C. longebarbatus* var. *peckii*. Habitat for *Botrychium spp.* and the sensitive *Carex spp.* is very moist. Seeding upland grasses and forbs of the species proposed is not likely to expand into this habitat and affect these species. Though some localized impacts due to non-native invasive plants, such as teasel, are apparent in *C. longebarbatus* var. *peckii* habitat, at present they do not appear to threaten the viability of this or other sensitive species on the Ochoco NF.

The riparian habitat for these species would be protected from heavy equipment. In all action alternatives, thinning of conifers would occur in RHCAs. Piling and burning of thinning slash would impact some habitat, but most of the thinning is expected to occur in the upland areas of the RHCA, and would impact less than 10% of actual riparian habitat. This impact is expected to be offset by increased light and reduced biomass that would enhance habitat diversity by favoring those plant species that are adapted to these conditions. Other than where slash is created, prescribed burning is unlikely to burn the moist habitat associated with riparian areas. Other activities, including thinning without burning, road maintenance, reconstruction and

decommissioning may damage to 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 (e.g. thinning along a meadow edge); 2) are not expected to burn with high intensity; 3) would affect areas already heavily disturbed (e.g. road decommissioning), or 4) would occur primarily in marginal habitat or other 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 a loss of viability.

Scabland habitat species

Achnatherum hendersonii
Achnatherum wallowaensis
Eriogonum cusickii

Existing Condition

SENSITIVE NEEDLEGRASS SPECIES

Achnatherum hendersonii *A. wallowaensis*

These perennial grasses are regional endemic species. As stated previously, *Oyzopsis hendersonii* has been split taxonomically into the two sensitive *Achnatherum* species (Maze and Robson 1996). Both species are on the ORBIC List 1. These species occur sporadically in central and northeastern Oregon. These species are uncommon and widely scattered on the Ochoco NF.

They are found on residual, rocky clay soils commonly referred to as scablands. Scabland soils, also known as lithosols, are typically droughty, shallow, heavy clay to gravelly, with aspect mostly south to southwest, and gentle to moderate slopes. These sites are often associated with rigid sagebrush (*Artemisia rigida*), Sandberg bluegrass (*Poa secunda*), onespike oatgass (*Danthonia unispicata*), and buckwheat (*Eriogonum*) species. Stone circles and rock stripes are common signs of frost heaving in these sites (Vrilakas 1990, Maze and Robson 1996).

Known sites are at elevations of 3,400 to 5,400 feet. *Achnatherum hendersonii* has been documented within the analysis area. The Ochoco NF has no management guide for these species, though a draft Conservation Assessment for *Achnatherum hendersonii and A. wallowaensis* (Dewey 2007) provides some guidance.

Monitoring of some populations of sensitive Achnatherum species across the Ochoco National Forest over the last few years Ochoco NF indicates that some populations of *A. hendersonii* appear to have declined since their original documented occurrences in the early 1990s. Some of this decline may be attributed to displacement by the annual grass *Ventenata dubia* (Lopez 2012, Dewey personal communication, Lesko personal observation).

Though *Ventenata* is present in the McKay area, scabland habitat presently appears to be stable, and, except for road construction and some damage by OHV traffic, has changed little over the last few decades.

CUSICK'S BUCKWHEAT

Eriogonum cusickii

Eriogonum cusickii, also known as Cusick's buckwheat, is on ONRBC List 1. In Oregon, it has been documented in Harney and Lake Counties. Its habitat is sage scablands (lithosol soils) and tall sage (*Artemisia tridentata*) as described above for the sensitive *Achnatherum* species.

Environmental Effects

Invasive, exotic annual grasses such as *Ventenata* may be the biggest long-term threat to sensitive species associated with scablands. Damage to soils by livestock and human activities can increase potential for expansion of *Ventenata* and other invasive annual grasses. However, if soils remain relatively undisturbed by livestock or other factors, effects of exotic annual grasses are less apparent (Lesko personal observation). Long-term effects of exotic grasses on the viability of these species is unknown, but if associated soils remain relatively undisturbed, the risk to continued species viability is reduced.

Alternative 1

This alternative includes no disturbance, such as road construction, timber harvest, burning or other activities on scablands that provide the primary habitat for *Achnatherum hendersonii*, *A. wallowaensis*, and *Eriogonum cusickii*.

With no timber harvest and fuels reduction activities, accumulations of biomass would increase, potentially increasing wildfire risk that could threaten sensitive plants. However, because scabland habitats have inherently low fuel levels, these habitats are less likely to burn, though they are known to burn during wildfire events (Johnson 1998). When they do, the relatively light fuel loads burn with low fire intensity. In addition, these sites would also burn during the driest part of the summer, when plants are dormant and less vulnerable to wildfire. Therefore, wildfire is not likely to affect these species because these species are likely to be adapted to, and remain viable with periodic wildfire.

With no ground disturbance or anticipated adverse wildfire effects, habitat would be maintained. Therefore, this alternative is expected to result in no impact to these species.

Alternative 2, 3 and 4

These alternatives would create soil disturbance from heavy machinery that can directly impact individual plants and habitat. Heavy thinning slash can bury plants, and burning these higher fuel loads can scorch soils, damaging plants and their habitat, and increase risk for introduction and spread of non-native invasive plants that could displace these plants.

Habitat for these species is associated with scablands. Because scabland habitat does not recover from disturbance, protection is emphasized under direction of the Ochoco National Forest and Crooked River National Grassland Land and Resource Management Plan (USDA 1989).

With protection of specific areas listed in the botany notes table, or through project design elements for sensitive plants and scabland habitats, Alternatives 2, 3, and 4 avoid mechanical disturbance of known populations and high probability habitat for sensitive plants associated with scablands. These elements include, for example, buffering scabland habitat from heavy equipment use. Site-specific information is also listed in the McKay Botany Notes Table included with this report in Appendix A. Additional information, including maps and aerial photos, is in the McKay botany file.

Native seed used in rehabilitation of log landing and other areas disturbed by project activities is not expected to colonize undisturbed areas and affect the viability of these species.

Though design elements are expected to protect scabland habitats, other actions including maintenance of existing roads, reconstruction and decommission, pre-commercial thinning, and fuels treatments may damage some individual *Achnatherum hendersonii*, *A. wallowaensis*, *Eriogonum cusickii*, or their habitats. These activities are expected to affect: 1) only affect the periphery of such habitat (e.g. thinning along a scabland edge); 2) would affect areas already heavily disturbed (e.g. road decommissioning); or 3) would occur primarily in marginal habitat that is unlikely to affect viability of populations. Therefore, the anticipated effects would be that some individuals or habitat may be affected, but would not be likely to contribute to a trend

towards federal listing or a loss of viability to sensitive plant species associated with scabland habitats.

Ledge and cliff species

FEE'S LIP FERN (*Cheilanthes feei)*

Existing Condition

Cheilanthes feei, or Fee's lip fern, is on ORBIC List 2. This fern is associated with basalt (and sometimes limestone) cliffs. In Oregon, it has been documented in Wallowa County. It has also been documented in California, Washington, Idaho, and Nevada. The largest area of habitat is present in the central portion of the analysis area along lower McKay Cr.

Environmental Effects

Alternative 1

This alternative includes no road construction, road de-commissioning, timber harvest, aspen treatments, thinning, burning or other activities that could affect viability of this species. Habitat would be maintained.

With no timber harvest and fuels reduction activities, accumulations of biomass would increase, potentially increasing wildfire risk that could threaten the species. However, wildfire is not likely to affect this species because this species are likely to be adapted to, and remain viable with periodic wildfire.

With no ground disturbance or anticipated adverse wildfire effects, habitat would be maintained. Therefore, no impact is expected that would likely contribute to a trend towards federal listing or a loss of viability to populations of *Cheilanthes feei*.

Alternative 2, 3 and 4

This alternative includes road construction and timber harvest activities that could affect this habitat. However, no road construction is planned that would modify basalt cliffs. No timber harvest units include this habitat. Prescribed burning activity could affect this habitat, but prescribed burning is generally of low intensity, and so is not expected to impact the habitat to the extent that would affect viability of *Cheilanthes feei*. Therefore, for these alternatives, project activities may impact some individuals or habitat but will not likely contribute to a trend towards federal listing or loss of viability of *Cheilanthes feei*.

Rock habitat species

SCHISTIDIUM MOSS (*Schistidium cinclidodonteum)*

Existing Condition

Schistidium cinclidodonteum is on ORBIC List 2. In Oregon, it has been documented in Jackson, Klamath, and Union Counties, and in Washington, Idaho, California and Nevada. This moss is found at elevations of 5,000-11,000 feet, on rocks or boulders or on soil between rock, often along intermittent streams. Habitat is likely present in the analysis area. The species fact sheet describes conservation considerations that include revisiting known sites and surveying for new sites at higher elevations (Christy 2006). In 2005 and 2007, surveys were completed on a variety of sites throughout the Ochoco NF for sensitive lichen and moss species. In 2012, additional field reviews for potential habitat and limited-focus surveys occurred in the the McKay analysis area. No *Schistidium cinclidodonteum* was found (Dewey 2008 and personal communication). It may not occur on the Ochoco NF.

Environmental Effects

Alternative 1

This alternative includes no road construction, road de-commissioning, timber harvest, aspen treatments, thinning, burning or other activities that could affect viability of this species. Habitat would be maintained.

With no timber harvest and fuels reduction activities, accumulations of biomass would increase, potentially increasing wildfire risk that could threaten sensitive plants. However, wildfire is not likely to affect these species because these species are likely to be adapted to, and remain viable with periodic wildfire.

With no ground disturbance or anticipated adverse wildfire effects, habitat would be maintained. Therefore, no impact is expected that would likely contribute to a trend towards federal listing or a loss of viability of *Schistidium cinclidodonteum*.

Alternative 2, 3 and 4

The conservation considerations include surveying for additional sites until additional information is available. Though some surveys have occurred, no known sites occur on the Ochoco NF. Habitat is present as rocky areas along intermittent streams. Rock outcrop areas are not present in any areas proposed for timber harvest or road construction. Riparian areas may have some activities such as thinning or prescribed burning, but equipment use would be avoided, and design leements for burning would limit spread into riparian aras. Therefore, for these alternatives, project activities may impact some individuals or habitat but will not likely contribute to a trend towards federal listing or loss of viability of *Schistidium cinclidodonteum*.

Species of variable habitats

TORTULATE MUCRONLEAF MOSS (*Tortula mucronifolia*)

Existing Condition

Tortula mucronifolia, or mucronleaf tortula moss, is on ORBIC List 2. In Oregon, it has been documented in Harney, Jackson, and Wheeler Counties, and throughout the Northern Hemisphere, Africa, and New Zealand. This moss is found on a variety of habitats, ranging from 5000-7000 feet. In Oregon, documented sites include vegetation types ranging from riparian aspen (*Populus tremuloides*) in a high elevation southeast Oregon site, to rock outcrops with white fir (*Abies concolor*) and Shasta red fir (*Abies x shastensis* [*magnifica x procera*]) in Southwest Oregon. Given the variety of vegetation types that can provide habitat for this species, habitat is likely present in the analysis area. The species fact sheet describes conservation considerations that include managing known sites and surveying for new sites until more information is known about this species in the northwest (Christy 2006). In 2005 and 2007, surveys were completed throughout the Ochoco NF for sensitive lichen and moss species, with additional field reviews for potential habitat and limited-focus surveys occurring in 2012 for the McKay project. No *Schistidium cinclidodonteum* was found (Dewey 2008 and personal communication). It may not occur on the Ochoco NF.

Environmental Effects

Alternative 1

This alternative includes no road construction, road de-commissioning, timber harvest, aspen treatments, thinning, burning or other activities that could affect viability of this species. Habitat would be maintained.

With no timber harvest and fuels reduction activities, accumulations of biomass would increase, potentially increasing wildfire risk that could threaten sensitive plants. However, wildfire is not likely to affect these species because these species are likely to be adapted to, and remain viable with periodic wildfire.

With no ground disturbance or anticipated adverse wildfire effects, habitat would be maintained. Therefore, no impact is expected that would likely contribute to a trend towards federal listing or a loss of viability of *Tortula mucronifolia*.

Alternative 2, 3 and 4

The conservation considerations include managing known sites and surveying for additional sites until additional information is available. Though surveys have occurred, no known sites occur on the Ochoco NF. Habitat is present as rock outcrops and riparian areas. Rock outcrop areas are not present in any areas proposed for timber harvest or road construction. Riparian areas may have some timber harvest or prescribed burning activity, but equipment use would be avoided, and design leements for burning would limit spread into riparian aras. Therefore, for Alternatives 2, 3 and 4, the project may impact some individuals or habitat but will not likely contribute to a trend towards federal listing or loss of viability of *Tortula mucronifolia*.

Removing, Avoiding, or Compensating Adverse Effects to Sensitive Plant Species

Project design elements have been developed for the alternatives to maintain habitat and viable populations of sensitive plant species. Specific design elements are listed in Chapter 2 of the EIS. Maps and aerial photos are available for implementation.

All proposed, endangered, threatened, and sensitive plant and animal species will be considered (LRMP Chapter 4, p. 246-247). If any new species or populations 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.

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.

Habitat quality for the majority of sensitive plant species, including those previously-mentioned, has likely declined since pre-settlement conditions. Road construction, livestock grazing, fire suppression, logging, vehicle use, stream channelization, introduction and spread of non-native invasive plants (noxious weeds), and other factors have resulted in changes to forest, scabland, meadow, and riparian habitat. Past timber harvest, pre-commercial thinning, and prescribed burning projects have also reduced tree density and fuels levels that has resulted in enhancement of vegetative diversity.

Continuing influences, such as grazing and unauthorized off-road vehicle use, would contribute to continued risk to sensitive plant viability. Risk of further loss of habitat, such as from downcutting in stream channels or introduction and spread of non-native invasive plants, would still be present.

Among the present and reasonably foreseeable effects considered in the McKay analysis, the most important include:

- Livestock grazing and maintenance of fences and other improvements is expected to continue under the current allotment management plan (Mill Cr. AMP).
- Fire suppression - Suppression of wildfire during fire season will continue.
- Recreation use will continue within the watershed.
- Road maintenance is expected to continue. Maintenance (e.g. road grading) would occur intermittently throughout the watershed.

- Noxious weed control would continue under the Ochoco National Forest and Crooked River National Grassland Integrated Weed Management Plan.
- Other activities - This includes firewood cutting, mushroom picking, etc.

Though habitat quality for both riparian and upland plant communities has declined since pre-settlement, on the Ochoco National Forest, observations and monitoring over the last decade indicate habitats for Ochoco NF sensitive species are generally stable, despite influences from off road vehicles, livestock, non-native invasive plants, etc. There may be some long-term threat to viability of scabland species resulting from exotic annual grasses, but any assessment beyond this would be speculative (Lesko personal observation).

In some areas, riparian improvement projects, such as planting, headcut (stream channel) repair, and development of riparian pastures appear to have enhanced or expanded habitat for sensitive species associated with riparian areas. Where conifer thinning (and follow-up burning) has occurred, forest stands have moved towards conditions more closely approximating pre-settlement. This is expected to benefit sensitive plant species that favor open conditions. An example is where thinning and prescribed burning occurred along a forest/meadow interface where fire suppression has resulted in conifer expansion into meadow habitat (Arno 2000), increasing habitat associated with *Calochortus longebarbatus* var. *peckii*.

On upland forest sites, prescribed burning has resulted in increased exposed soils, which have increased susceptibility to non-native invasive plant introduction and spread. This risk increases when prescribed fire exceeds normal intensities, such as occurs during unanticipated weather changes during burning activity. Burning has improved forage production and palatability, and in some areas, resulted in increased livestock use. Where these areas have burned with high intensity, or where livestock grazing occurred before sufficient recovery of vegetation and the soil organic layer, grazing has impacted these areas by compacting and displacing soil, and increasing risk of erosion, riparian degradation and acting as vectors for introduction and spread of noxious weeds (Wallander et al. 1995, DeClerk 1997, DiTomaso 1997, Miller and Rose 1999, Arno 2000, Asher et al. 2001). This could affect long-term (>10 years) viability of sensitive plants and habitat. However, large-scale burning can also help distribute livestock, and its impacts, over a wider area. Grazing has occurred on what is now the Ochoco National Forest for a century, along with a twenty-year history of prescribed burning and successive livestock use. Sensitive plant populations presently appear stable following these activities (Lesko personal observation).

Non-native invasive plants (noxious weeds) are expected to continue to be introduced by vehicles and livestock, but control measures have been occurring under the 1998 Integrated Weed Management Plan (USDA 1998). The Forest Service Northwest Regional Office has issued a Final EIS (USDA 2005) for treatment of non-native invasive plants. The Deschutes and Ochoco National Forests have recently completed the Invasive Plant Treatments Environmental Impact Statement for site-specific management of non-native invasive plant infestations (USDA 2012). This will result in additional treatment areas on the Ochoco National Forest for non-native invasive plant management. Implementation of additional invasive plant management is expected to have little short-term effect on sensitive plant species, and may have long-term beneficial effects.

Existing roads and areas of damaged soils, such as old burn piles, would remain, and other vectors, such as vehicles and wildlife, would still contribute to weed susceptibility. Existing untreated infestations of non-native invasive plants are expected to spread, and threaten plant communities by directly displacing native vegetation, including sensitive plant species. However, non-native invasive plants presently occupy a relatively small portion of sensitive plant habitats, and are not expected to pose a short-term threat (<10 years) to the viability of sensitive plants associated with this habitat. They may pose a long term threat (>10 years), but due to variables

that are hard to predict, long term assessment of non-native invasive plant effects on sensitive plants would be speculative. Introductions or spread of biological control agents on the Ochoco National Forest may ultimately result in a decline of Canada thistle. Assuming invasive plant control continues, non-native weeds are less likely to affect sensitive plant habitats. Therefore, no cumulative effects are expected on sensitive plant species that would change the direct and indirect effects described in the previous section. Further discussion of weeds is discussed in the non-native invasive plants (noxious weeds) section of this report.

Though wildfire could occur in riparian areas, these species occur in areas that are generally moist year-round, or in the case of *Calochortus longebarbatus* var. *peckii*, are dormant during wildfire season and in areas with generally light fuel loads, and therefore are not expected to burn with high intensity. *Calochortus spp.* are generally recognized as dependent on disturbances such as wildfire (Kagan 1996, Kaye et al. 1990, 1994).

The sensitive species associated with scabland, *Achnatherum hendersonii*, *A. wallowaensis*, and *Eriogonum cusickii*, occur on areas with relatively low fuel density, and can only burn during extreme conditions, such as during high winds on hot summer days (Johnson 1998). This is the time when associated species are dormant, and less susceptible to damage by fire. Therefore, these species are likely to be adapted to, and remain viable with periodic wildfire. Therefore, viability of sensitive species associated with scablands are expected to be unaffected by wildfire.

Determining more specific potential effects of wildfire for alternatives is not possible due to so many unknown variables, such as fuels conditions during a wildfire event, weather, suppression forces available, and other factors. However, risk of future wildfire, and its potential effects to sensitive plants, would vary by alternative, corresponding to the degree of thinning and fuels management activities. Alternative 1 maintains the highest risk, and could decrease with thinning and burning that would occur outside the McKay projects. Other alternatives would result in a more substantial reduction in wildfire risk, with Alternative 3 resulting in the lowest risk of future wildfire, followed by Alternatives 2 and 4.

In view of the past and continuing activities, anticipation of future activities, effects of non-native invasive plants, and assessment of wildfire effects on sensitive plant species, cumulative effects are not expected to change the findings determined in the direct and indirect effects.

Summary of Biological Evaluation for Sensitive Plants:

For all alternatives, assuming all protection measures are implemented as designed, there would be no adverse effect to the viability of any sensitive plant species, and therefore would not cause a trend towards the need for federal listing (see Table 94).

Table 94. Expected effects of the McKay project alternatives to sensitive plant species.

Species	Alt 1	Alt 2	Alt 3	Alt 4
Achnatherum hendersonii	NI	MIIH	MIIH	MIIH
Achnatherum wallowaensis	NI	MIIH	MIIH	MIIH
Astragalus peckii	NI	NI	NI	NI
Astragalus tegetarioides	NI	NI	NI	NI
Botrychium ascendens	NI	NI	NI	NI
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	NI	MIIH	MIIH	MIIH
Carex diandra	NI	NI	NI	NI
Carex lasiocarpa var. americana	NI	NI	NI	NI

Carex retrorsa	NI	MIIH	MIIH	MIIH
Cheilanthes feei	NI	MIIH	MIIH	MIIH
Cyperus lupulinus ssp. lupulinus	NI	MIIH	MIIH	MIIH
Elatine brachysperma	NI	NI	NI	NI
Eleocharis bolanderi	NI	NI	NI	NI
Eriogonum cusickii	NI	MIIH	MIIH	MIIH
Heliotropium curassavicum	NI	MIIH	MIIH	MIIH
Lipocarpa aristulata	NI	NI	NI	NI
Lomatium ochocense	NI	NI	NI	NI
Mimulus evanescens	NI	NI	NI	NI
Muhlenbergia minutissima	NI	NI	NI	NI
Penstemon peckii	NI	NI	NI	NI
Phemeranthus spinescens	NI	NI	NI	NI
Potamogeton diversifolius	NI	NI	NI	NI
Rorippa columbiae	NI	MIIH	MIIH	MIIH
Rotala ramosior	NI	NI	NI	NI
Salix wolfii	NI	NI	NI	NI
Thelypodium eucosmum	NI	MIIH	MIIH	MIIH
Utricularia minor	NI	NI	NI	NI
Encalypta brevipes	NI	NI	NI	NI
Entosthodon fascicularis	NI	NI	NI	NI
Helodium blandowii	NI	MIIH	MIIH	MIIH
Schistidium cinclidodonteum	NI	NI	NI	NI
Tomentypnum nitens	NI	MIIH	MIIH	MIIH
Tortula mucronifolia	NI	NI	NI	NI
Texosporium sancti-jacobi	NI	NI	NI	NI

Determination for Sensitive Species:
NI no impact
MIIH may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or loss of viability to the population or species
WIFV* will impact individuals or habitat with a consequence that the action may contribute to a trend towards federal listing or cause a loss of viability to the population or species
BI beneficial impact
* Trigger for a Significant Action as defined in NEPA

Non-Native Invasive Plants (Noxious Weeds) and Risk Assessment

Introduction

Invasive species are defined in Executive Order 13112 (1999) as alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Noxious weeds are a subset of these plants, and designated “noxious” by the Secretary of Agriculture or responsible state officials (USDA 2000, ODA 2001). Because some non-native species known to be harmful have not been officially designated as “noxious,” the term, “non-native invasive plants” is becoming more common. Many use the term, “noxious weeds” for all non-native invasive plants (Sheley et al. 1999c). In this report, both terms are used to describe plants considered “non-native invasive” on the Ochoco NF.

During the past half century, many non-native invasive plant species have expanded their range in the western United States. The introduction and spread of noxious weeds can reduce the diversity and abundance of native vegetation, forage, diversity, continuity, and quality of wildlife habitat, increase erosion, and decrease water quality (Sheley and Larson 1994, Scott and Pratini 1995, Sheley et al. 1997, USDA/USDI 2000). Non-native weeds have developed many characteristics, such as rapid growth rates, high seed production, and extended growing periods that give them

advantages over native plants. Their spread is often unchecked because their native pathogens and invertebrate feeders are not present (Roché et al. 1994, Sheley et al. 1999b, DiTomaso 2000).

Forest Service policy is to prevent and manage non-native invasive plants (U.S. Congress 1974, U.S. President 1999) and is reflected in the Forest Service Manual (FSM 2090) as well as Region 6 and Ochoco National Forest Plan Standards and Guidelines (USDA 2005, 2006, 2011b). Objectives include prevention, early detection and rapid response, control and management, and rehabilitation and restoration (USDA 2011b). Prevention measures, such as requiring weed-free equipment for National Forest projects, along with early detection (inventory) to identify new infestations, and rapid response are included in the Ochoco NF weed management program (USDA 2006).

The Forest Service Pacific Northwest Regional Office issued a Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for The Pacific Northwest Invasive Plant Program, Preventing and Managing Noxious Weeds (USDA 2005). This FEIS/ROD provides programmatic direction for all Pacific Northwest Region National Forests for management of non-native invasive plants. Included are prevention, treatment, and restoration standards. The ROD includes a set of treatment tools, including an expanded list of herbicides, for managing noxious weeds within the Region's National Forests.

The Ochoco NF has been managing weeds under the 1998 Integrated Weed Management Plan (USDA 1998). In September 2012, the Ochoco NF began managing noxious weeds under the Deschutes and Ochoco National Forest Invasive Plant Treatments Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for integrated weed management (USDA 2012). This was prompted by the need to update the environmental analysis, including weed infestations that have established since or were unknown during the most recent analysis in 1998, and allow for more effective herbicides. Weed management includes a variety of strategies, depending on the species, size of infestation, and location. Included are chemical, cultural, mechanical (hand pulling) and biological controls.

The proposed action in the McKay project would construct roads, harvest timber, thin smaller trees (pre-commercial thinning), and complete fuels treatments. These activities would remove vegetation and expose soils, creating conditions that would increase risk for introduction and spread of non-native invasive plants. Ground-disturbing projects such as McKay require an invasive plant risk assessment and analysis of prevention measures that reduce the risk of introduction and spread of weeds (USDA 2011b). This report discusses and compares potential risks and effects of noxious weeds for the McKay proposed action and alternatives. Potential effects of wildfire are also discussed

Though this direction includes avoiding activities that increase the potential for non-native invasive plants, 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 the recreating public. Because these ongoing activities can increase weed risk, the Forest Service is directed to analyze the risk and implement prevention measures to reduce the risk of introduction and spread of noxious weeds (USDA 2005, 2006, 2011b).

Desired Future Condition

The 2005 Forest Service Pacific Northwest Regional Office Invasive Plant Final Environmental Impact Statement (FEIS) and Record of Decision (ROD)directed the National Forests to add the following to their management plans:

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

communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature or preventative actions, and the success of restoration efforts (USDA 2006).

Factors Related to Non-native Invasive Plant Risk

The following factors were considered in the weeds analysis and risk assessment:

- Most non-native invasive plants are shade intolerant, and therefore have greater potential for invasion forest 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 additional disturbance by removing vegetation and exposing soils, creating an ideal seedbed for noxious weeds (Borman et al. 1991, Alexanian 2010).
- Road construction would create new disturbed areas and pathways into weed-free areas. Roads can lead to increased use of recreational vehicles (especially off-road vehicles). Weed seed can be introduced from weed-infested areas through soils attached to vehicles and road maintenance or other equipment. A corridor of available habitat along a closed road system can allow for expansion of weeds into weed-free areas, even if future vehicle traffic is eliminated.
- Road inactivation (closed but available for future use) and de-commissioning (closed with no anticipated future use) activities can reduce noxious weed risk because introduction vectors (vehicles) would be reduced.
- Non-native plants are often difficult to replace with native species. On disturbed sites, especially where roads or log landings have been constructed, loss of the soil A-horizon has resulted in sites not capable of returning to native plant communities for many years, or perhaps several decades. Non-native plants, including invasive noxious weeds, often out-compete native species on these altered sites (Lesko personal observation).
- The potential for introduction of noxious weeds due to logging activity is much greater than other activities because of soil disturbance and removal of vegetation by log skidding and road and landing construction activity. Logging equipment (skidders, dozers, feller-bunchers, etc.) is much more likely to bring in noxious weed seed or plant material because equipment may be transported from site to site with soil and weed seed or plant parts 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.
- While non-native invasive plants are often associated with disturbance, some studies indicate that disturbance is not necessary for invasion of noxious weeds to occur. Noxious weeds have been documented invading relatively undisturbed, stable plant communities (Lacey et al. 1990, Wagner el al 2001).
- Burning natural and activity fuels (logging and thinning slash) would increase susceptibility to some degree. In general, compared with wildfire, underburning occurs in spring and fall, with generally low intensity, and so vegetation recovers much more quickly (often with greater vigor than before burning). The majority of the soil organic layer is also retained. Conversely, burning dozer, grapple, or hand piles results in fire itensities that result in soil scorching and removal of the soil organic layer that results in increased weed susceptibility. Maintaining vegetation and the soil organic layer results in less susceptibility to noxious weed introduction and spread.

- Following timber harvest and fuels treatments, present and foreseeable livestock grazing can delay recovery of desirable vegetation, resulting in increased potential for introduction and spread by selective grazing of more palatable native and desirable non-native species (Callihan and Evans 1991, Olson 1999, Belsky 2000).
- Present and foreseeable vehicle use, road maintenance, recreation, and riparian work such as stream headcut repair would all contribute to weed risk.
- Not all noxious weeds can be effectively controlled by herbicides or other measures. Current weed management limits herbicide use to knapweed and a few other species on specific sites. Few controls are available for some species in certain locations, such as Canada thistle in riparian zones. Prevention measures that limit the potential for introduction and spread of these species are essential in maintaining existing desirable vegetation.

Affected Environment

Existing conditions favor establishment and spread of non-native invasive plants, and are likely to continue to be introduced and spread to new areas within the McKay area. A history of grazing, road construction, and logging has increased the potential for introduction and spread by removing vegetation and exposing soils, increasing susceptibility to invasion by noxious weeds. Wildfires, wildfire suppression, and prescribed burning can also increase risk (Asher et al. 2001). Vehicle traffic and other ongoing uses are expected to continue to introduce weeds to the area.

Most weed infestations have been present in the McKay area for at least two decades. Weed densities are relatively low, occupying less than 1% of vegetative cover in the analysis area, and currently appear to be causing relatively little noticeable environmental or economic impact. Given the current weed management program (USDA 1998, 2012), weeds do not appear to be anything more than a relatively minor threat to ecosystem or economic values in the short-term (<10 years). However, the risk for spread of existing infestations, and introduction of new infestations, is sufficient that noxious weeds have the potential to affect environmental or economic values in the McKay area and the Ochoco NF in the long-term (>10 years). Therefore, non-native invasive plants have been discussed as a potential issue in the McKay analysis. Weeds were a consideration in alternative development, and two potential pre-commercial thinning units and one prescribed burning unit were dropped or modified due to weed infestations. Site-specific weed concerns are included in the botany notes table (Appendix A), and project design elements include prevention measures that reduce the risk of introduction and spread of noxious weeds.

Site Analysis

Pre-project surveys were completed in the analysis area along both open and closed roads, where most weeds usually occur. Approximately 30 infestations have been documented in the McKay analysis area. Canada thistle and *Ventenata* occupy the most area, and because they are so common, not all infestations of these species have been mapped. Three infestations of 5-40 acres are primarily spotted knapweed, and occur along lower McKay Cr. and in an old clearcut that was private land prior to addition to the Ochoco NF in the 1990s. Other non-native invasive plants include teasel, medusahead, white top, and Scotch thistle. Most of the other infestations are small, under 1/10 acre, and occur on disturbed sites such as road shoulders and old log landings. With most infestations along roads, primary introduction of noxious weeds appears to be through vehicles. Other vectors include water (e.g. streams), wind, livestock, wildlife, and mineral material and heavy equipment used for road maintenance and construction projects.

With the exception of Canada thistle, teasel, and *Ventenata*, all documented infestations are being controlled through either chemical treatments or hand-pulling (see Table 95. The aggressiveness of the treatment strategy varies with the weed species to be managed. For the other species

including spotted knapweed, Scotch thistle, and medusahead, the threshold for initiating control is one plant. Long established infestations, such as along FS 27 and 33 roads, were being controlled using both chemical and manual controls under the 1998 Weed Management Plan. These treatments are expected to continue under the 2012 FEIS/ROD, along with the addition of new treatment areas. The 2012 FEIS/ROD also provides for an early detection and rapid response (EDRR) strategy that, pending a review and concurrence by the invasive plant treatments interdisciplinary team, authorizes the Forest Service to treat new infestations not previously identified for control. Infestations within riparian areas have been controlled using manual (hand pulling) treatments, and are expected to continue.

Table 95. State of Oregon listed noxious weed species and non-native invasive plants and related management strategies in and near the project area.

Species	Code	Life Form	Management Strategy
medusahead (*Taeniatherum caput-medusae*)	TACA8	annual grass	New infestation - Chemical control beginning 2013
Ventenata (*V. dubia*)	VEDU	annual grass	No control
spotted knapweed *(Centaurea biebersteinii*)	CEBI2	perennial forb	Chemical and manual controls
diffuse knapweed (*C. diffusa*)	CEDI3	perennial forb	Chemical and manual controls
white top (*Cardaria draba*)	CADR	biennial forb	Chemical and manual controls
Scotch thistle (*Onopordum acanthium*)	ONAC	biennial forb	Chemical and manual controls
teasel (*Dipsacus fullonum*)	DIFU2	biennial forb	No control
Canada thistle (*Cirsium arvense*)	CIAR4	perennial forb	Biological controls

Where controls are being implemented, density of weeds does not appear to be expanding, and in some areas, has declined. However, on the majority of sites, some seed production still occurs from plants that germinate after treatment, re-sprout after incomplete pulling, or otherwise escape the control. As long as seed production continues, eradication is not possible. This situation is complicated by the persistence of viable seed in the soil for many years (Langland 2009).

Outside of the major road corridors with long-established infestations, and other documented sites that are part of the yearly control program, individual undocumented noxious weed plants are occasionally found by field-going personnel and are hand pulled and removed when encountered. Other undocumented infestations are expected to be controlled with implementation of the early detection and rapid response (EDRR) strategy provided in the 2012 Invasive Plant Treatments FEIS/ROD. Though response to new, undocumented infestations within the analysis area is likely, future limitations in both funding and work force may result in some infestations not being controlled. In addition, new infestations of all invasive plants are occurring and are likely to continue.

Because Canada thistle is so common in the analysis area, it is a low priority for chemical or manual control. This perennial plant has a rhizomatous and especially deep root system, making hand pulling unfeasible. Instead, the current management strategy focuses on the establishment of biological controls (insects). Though biological controls are present over portions of the Ochoco NF, and are present on private lands adjacent to the analysis area, none appear to have established in the analysis area.

Of the non-native invasive plants identified in the McKay area, *Ventenata* appears to occupy the most area. It may occupy over 100 acres across the McKay area, primarily along roadsides and scablands. As with Canada thistle, it is so common in the area that it is infeasible to attempt to implement controls. No biological controls are currently available for this plant.

Teasel is a biennial plant that is common in the lower portions of Big and Little McKay Cr. Because it typically occupies riparian areas, and is relatively common, it is not being controlled with herbicides, and is not a priority for manual control. Biological control agents are not available for this plant.

Prevention Measures

The Forest Service is directed to implement non-native invasive plant prevention standards (USDA 2005, 2006). Prevention measures are included in action alternatives as design elements to reduce the risk for introduction and spread, and are listed in Table 96.

Table 96. Design Elements for reducing the risk of introduction and spread of weeds.

Design Element	Risk Factor
Weed identification training	N/A – not related to any specific risk factor
Document infestations and provide weed map	N/A – not related to any specific risk factor
Retain shade and avoid ignition w/in 100' of infestations	Soil disturbance and removing vegetation
Retain existing vegetation where possible	Soil disturbance and removing vegetation
Re-vegetate closed roads and landings	Soil disturbance and removing vegetation
Post-treatment pasture evaluation for rest from grazing	Soil disturbance and removing vegetation
Requiring clean equipment	Heavy equipment use (as a vector)
Avoiding use of infested landings and other infestations	Heavy equipment use (as a vector)
Use water only from weed-free sites or mitigate risk	Heavy equipment use (as a vector)
Avoid infested mineral material sources	Contaminated material
Use certified weed-free seed	Contaminated seed

As previously stated, the Forest Service is directed to manage noxious weeds and implement prevention measures (U.S. Congress 1974, U.S. President 1999, 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.

Contract Provisions

As a prevention measure to reduce the potential for transport or spread of noxious weeds by 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.

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 from other sources is weed-free.

Environmental Effects

Analysis of effects related to noxious weeds can be described in two ways:

1) Environmental or economic effects of the noxious weeds themselves;
2) Efects of the alternatives on potential for introduction and spread of noxious weeds (weed risk assessment).

Effects Related to Non-native Invasive Plants Themselves

Non-native invasive plants can:

- Alter the composition of plant communities by displacing native plants. This can reduce habitat values for native wildlife species dependent on native plant communities. Reductions in abundance and diversity of wildlife can occur, as well as forage values for livestock (USDA/USDI 2000).
- Cause changes to ecosystems by altering soil properties. Specifically, erosion may increase and organic matter may be reduced, affecting available nitrogen to plant communities. Weeds take up soil nutrients rapidly, further depleting soil nutrient reserves. Weeds can produce compounds that may affect soil microorganisms and affect soil fertility. Weeds can also reduce infiltration and water-holding capacity of soils (Sheley et al. 1997, Olson 1999, USDA/USDI 2000).
- Alter historic disturbance cycles. Medusahead, for example, produces large amounts of fine fuels, reducing fire-return intervals that can lead to reductions or extirpation of native plants that are not adapted to higher fire frequencies (USDA 2002a).

In some areas of the inland Northwest, densities and corresponding ecological impacts can be relatively high for some species, such as cheatgrass (*Bromus tectorum* L.) threatening species associated with sagebrush habitats of the Great Basin (USDI 2000). However, the degree of environmental impact due to noxious weeds is relative to weed density. Infestations in the McKay area are generally limited to road corridors (Appendix B). Due to ongoing weed management, most infestations are small, less than 1/10 acre, and collectively they occupy less than 1% vegetative cover in the analysis area. Therefore, at present, environmental effects due to noxious weeds is relatively low.

Because current effects due to noxious weeds are relatively low, and with current control measures, are not expected to increase substantially in the short-term (< 10 years), the remainder of the effects analysis for noxious weeds will be on evaluating the relative risk for introduction and spread of noxious weeds, by alternative.

Noxious Weed Risk Assessment

Direction from the Forest Service Pacific Northwest Regional Office requires that noxious weed risk assessments be prepared for all projects that may increase risk for introduction and spread of weeds (USDA 2005). 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 (USDA 2005, 2011b). Proposed timber harvest and fuels treatment activities would remove vegetation, disturb the soil organic layer, and result in more vehicle traffic, increasing potential for introduction and spread of noxious weeds.

Natural controls are available through existing vegetation and soil organic layer. Alternative 1 includes no disturbance that would increase risk for introduction and spread of noxious weeds. Alternatives 2, 3 and 4 avoid disturbance near those infestations that pose a higher risk for spread. In all action alternatives, prescribed burning is expected to be of low intensity that will retain most of the soil organic layer, reducing opportunities for weed establishment and spread. Associated 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 for alternatives, and the other uses a checklist of risk factors, such as burning adjacent to infestations, etc. The risk assessment comparison of disturbed acres only includes direct and indirect effects of the alternatives. The risk factors assessment includes these effects, as well as the cumulative effects of recreation use, etc.

SOIL DISTURBANCE ASSESSMENT

Road construction and maintenance, timber harvest, fuels treatments and burning would expose soils, increasing susceptibility to noxious weed introduction and spread. Table 97compares expected soil disturbance, and therefore, weed risk, by alternative.

Table 97. Soil disturbance by alternative in the McKay project.

Activity	Exposed Soil (Acres) Alt #1	Alt #2	Alt #3	Alt #4
Road Construction and Reconstruction*	0	49	56	47
Timber Harvest**	0	754	800	713
Additional Fuels Treatment**	0	1119	1122	1119
Total Area of Disturbance	**0**	**1922**	**1978**	**1879**
* Estimated soil exposure is 1.7 acres/mile ** Est. 20% exposure				

RISK FACTOR ASSESSMENT

A checklist was developed, with various activities rated for risk of introducing or spreading weeds (Mafera 2003). Any high-risk activity results in a HIGH risk ranking for that alternative.

This checklist includes direct, indirect, and cumulative effects. An example of an activity with direct effects would be heavy equipment use, such as timber harvest within infested areas. This activity would likely directly spread weeds. An activity with indirect effects would be burning slash piles adjacent to infestations. These sites would be highly susceptible to weed spread.

The greater amount of road reconstruction in Alternative 3 is reflected in the soil disturbance assessment. While Alternatives 2 and 4 would reconstruct less road, this risk factor is still present, and is included among the risk factors rated HIGH.

The checklist also includes the cumulative effects of reasonably foreseeable activities, such as cattle grazing within weed infestations. Additionally, vehicles are expected to continue to introduce and spread noxious weeds. Table 98 compares risk for each alternative based on these risk factors.

Table 98. Noxious Weed/Invasive Plant Risk Factor Assessment summary.

	Alt #1	Alt #2	Alt #3	Alt #4
Risk of Noxious Weed Introduction/Spread	HIGH	HIGH	HIGH	HIGH
# Risk Factors Rated HIGH	1	6	6	6

Discussion of Risk Assessment

Alternative 1

Soil Disturbance - Alternative 1 includes no road construction, timber harvest, slash piling or burning that would result in ground disturbance. Because no ground disturbance would occur, risk for introduction and spread of noxious weeds would not increase. The present level of risk would continue from existing infestations. Compared with ground disturbance associated with other alternatives, Alternative 1 offers the least amount of risk.

Risk Factors - Alternative 1 includes no activities such as timber harvest near infestations, or other risk factors rated HIGH that would contribute to increased risk for introduction and spread of noxious weeds. The ongoing level of risk is rated HIGH due to foreseeable livestock grazing within weed infestations. However, there is only one risk factor rated HIGH.

Compared with other alternatives, Alternative 1 offers the lowest risk for introduction and spread of noxious weeds. The ongoing level of risk due to existing infestations and reasonably foreseeable activities such as vehicle use and other factors that is included in this assessment. Further discussion of reasonably foreseeable activities and weed risk is discussed in the cumulative effects section below.

Alternatives 2, 3 and 4

Soil Disturbance - Alternatives 2, 3 and 4 would create additional ground disturbance from road construction, timber harvest, slash treatments and prescribed burning. These alternatives are expected to have similar risk, with Alternative 2 resulting in an estimated 1922 acres of ground disturbance, Alternative 3 with 1978 acres of new disturbance, and Alternative 4 with 1979 acres of new disturbance.

Risk Factors – Alternatives 2, 3 and 4 include activities such as prescribed burning near infestations, or other risk factors rated HIGH that contribute to increased risk for introduction and spread of noxious weeds. These and other activities, including livestock grazing within weed infestations results in a rating of HIGH. Alternatives 2, 3 and 4 have 6 HIGH risk factors.

Though risk would increase due to additional ground disturbance and risk factors, these alternatives also include prevention measures, such as minimizing exposed soils and requiring clean equipment. Measures to reduce these risks have been incorporated in the action alternatives, either as project design elements, such as requiring clean equipment, or site-specific, such as the omission of certain units from harvest due to weed concerns. Following project activities, road closures and seeding would reduce risk of weeds. Increased risk from ground disturbance would be partially offset by reduced vehicle use. Post-project weed monitoring would occur and is expected to detect infestations while they are relatively small.

Cumulative Effects

The exact source of non-native invasive plant infestations is unknown, but they are expected to have originated from several areas. The location pattern shows concentrated sites along primary travel corridors. Other infestations are associated with recreation sites and mineral material sites, indicating the primary vector for noxious weeds appears to be vehicles. Vehicle use and other activities will continue in the McKay area, regardless of the alternative chosen, including no action. Additional introduction and spread of noxious weeds appears to be through livestock and wildlife (Lesko personal observation, DeClerck 1997).

In addition, new weed infestations have been documented in the area on sites that have had relatively little disturbance. There is an inherent risk of new infestations (such as from windblown seed) in all alternatives, regardless of forest management activities.

The cumulative effects of present and reasonably foreseeable activities indicate a high risk for introduction and spread of noxious weeds. Weeds will continue to be introduced and spread by vehicles, livestock, the recreating public (horseback riders, hikers, and campers), water, windborne seed, wildlife and other sources. A more detailed description of future actions is included in the cumulative effects section in the sensitive plant biological evaluation portion of this document.

Prevention techniques for weed risk associated with reasonably foreseeable activities, such as clean equipment requirements for road maintenance are expected to be effective in reducing weed risk. The majority of other activities, including legal recreational driving and illegal off-road vehicle use, are more difficult to control. Wet season vehicle use is especially conducive to weed spread due to mud clinging to tires.

Wildfire and fire suppression can result in introduction or spread of weeds by equipment brought in from different areas that may contain weed seed or plant parts. Due to the emergency nature of wildfire, prevention measures including equipment cleaning are not always implemented or feasible. Dozer lines, hand lines, drop points, safety zones, staging areas, etc. all create bare ground with heavy travel and disturbance. Vehicle traffic during and after suppression activity can introduce weeds to highly susceptible soils. Use of fire control lines that avoid line construction with equipment, instead using natural breaks such as rocky ridges or existing roads, can reduce risk. Fire rehabilitation efforts are normally implemented that can mitigate many of the negative effects by fireline rehabilitation, area vehicle closures, and post-wildfire weed control and monitoring (surveys).

Wildfire and suppression effects could exceed action alternatives in degree of exposed soils and reductions of shade, creating conditions highly susceptible to weeds. Completing a more specific analysis of potential wildfire effects, and weed risk, is not possible due to the number of unknown variables, such as fuels conditions during a wildfire event, weather, suppression forces available, and other factors that determine the size and intensity of wildfire, as well as suppression effects such as the extent of construction of dozer line and safety zones.

Human use of the National Forest is increasing and is expected to increase in the future as populations in nearby towns continue to grow. Increased human use and expanding non-native noxious weed infestations outside the McKay area will likely increase potential for new invasive plant infestations.

Where controls have been implemented, weed infestations have either decreased or not expanded. Management of weed infestations included in the 1998 Integrated Weed Management Plan is expected to continue with the 2012 Invasive Plant Treatments FEIS/ROD.

Implementation of the early detection and rapid response (EDRR) strategy provided for in the 2012 Invasive Plant Treatments FEIS/ROD will further reduce the potential for expansion of weeds and their associated impacts.

The weed management program is expected to help reduce the cumulative effects related to weed risk. Untreated infestations would continue to slowly spread, displacing native and desirable non-native vegetation, reducing biodiversity, and increasing potential for other impacts as described previously. However, in the short-term, the cumulative effects described above are not expected to change the anticipated direct and indirect effects described earlier.

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; Curtis et al. 1989; Dukes and Mooney 1999; Johnson et al. 1993; Taylor and Potvin 1997). The complex interaction of multiple and uncertain variables make site-specific predictions speculative.

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.

Projecting the long-term potential effects related to the introduction and spread of weeds in the McKay analysis area is speculative due to many unknown variables, including weather patterns, funding, and especially the completion date and decisions related to the current EIS process for managing non-native invasive plants. For example, if future noxious weed management is limited to measures other than herbicide treatments, and funding for control declines, spread of existing and establishment of new infestations is more likely than a continuation of current management.

Summary of Noxious Weed Risk, by Alternative

Alternative 1

Alternative 1 (no action) creates no additional ground disturbance, and is the baseline for comparison. Therefore, this alternative would have no potential for increasing the risk for introduction and spread of noxious weeds. However, new weed infestations are still likely to

establish within the analysis area as a result of present and reasonably foreseeable activities, such as vehicle use by the public, grazing, etc.

Alternatives 2. 3, and 4

These alternatives include ground disturbance, burning, and other activities that increase risk of noxious weed introduction and spread. Additional ground disturbance from road construction and timber harvest associated with Alternative 2 is likely to create more opportunities for infestation compared with less intensive management associated with Alternatives 3 and 4. All three action alternatives have 6 risk factors rated HIGH. Table 99 summarizes the two weed risk assessments, by alternative.

Table 99. Summary table for noxious weed risk by alternative for the McKay project.

	Alt 1	Alt 2	Alt 3	Alt 4
Total Area of Disturbed Soils	0	1922	1978	1979
Risk Factors Assessment/# HIGH Risk Factors	HIGH/1	HIGH/6	HIGH/6	HIGH/6

All alternatives include the HIGH risk factors of reasonably foreseeable livestock grazing activity near infestations. Vehicles use also contributes to weed risk. Vehicle use and other activities will continue in the McKay area, regardless of the alternative chosen, including no action. There is an inherent risk of new infestations from sources outside the McKay projects (e.g. wildlife, windblown seed) in all alternatives.

Projecting the long-term potential effects related to the risk of introduction and spread of weeds is speculative due to many unknown variables, including funding and availability of herbicides for future weed management.

The degree of environmental impact due to noxious weeds is relative to the acres infested. Collectively they occupy less than 1% of the analysis area. Therefore, at present, environmental effects due to noxious weeds is considered low. Assuming noxious weed control continues, anticipated short-term effects (<10 years) resulting from infestation and spread of noxious weeds is expected to remain relatively low. Projecting the long-term (>10 years) potential effects related to the risk of introduction and spread of weeds is speculative due to many unknown variables such as funding and availability of herbicides.

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.

Range

Introduction

The McKay Vegetation and Fuels Analysis Area is within the 45,700 acre McKay Watershed and is located on the Ochoco National Forest in Crook County. The Analysis Area is located within portions of three grazing allotments: Big Table cattle Allotment, Mill Creek cattle Allotment, and Trout Creek sheep Allotment.

Livestock grazing is permitted throughout the project area by both domestic cattle and sheep, which primarily utilize herbaceous vegetation. To facilitate the management of these Allotments, water developments and fences have been constructed over the years. A majority of the water developments are associated with spring sources or stock ponds. Water developments benefit both wildlife and livestock.

For the purpose of discussing livestock grazing, all of the area located within the Allotments will be included in the discussion.

History of Grazing on Allotments

The project area has been grazed since the late 1800s by sheep and cattle with the main objective of providing forage for livestock. By the 1980's grazing was meeting more objectives than just forage production. Grazing was used to remove herbaceous vegetation from tree plantations, utilization of introduced grass species and reduce fine fuels for fire consumption.

The Big Table Allotment does not show written historical records of livestock use, however most likely it has been grazed since the early 1800s, as the Mill Creek Allotment has been.

In the Mill Creek Allotment, stocking was as high as 2,860 head of livestock (both sheep and cattle) between the years 1917 to 1920. The Wildcat Allotment was within the Mill Creek Allotment boundary until 1973. Both sheep and cattle grazed on the north side of the allotment between 1932 and 1956. The use by 1,700 head of sheep was discontinued in 1957. In 1973, the eastern part of Mill Creek Allotment was separated, which is now the Wildcat Allotment and Steins Pasture. At that time the Steins Pasture, although still part of the Mill Creek Allotment, began to be grazed by a separate herd, in essence being managed as a separate allotment.

The Trout Creek Allotment was grazed primarily by cattle with stocking at 500 cow/calf pair until 1940 when the stocking rate was reduced to 380 pair. This stocking rate remained with a three pasture deferred rotation until 1989 when it was determined that the Allotment would meet the needs of anadromous fish habitat better if utilized by sheep. The Allotment was changed to ewe/lamb pairs with 2 permits for a total of 1,953 pairs. These 2 permits were later combined to one permit.

Allotment Information- Current Management

The project area is made up of three allotments: Big Table cattle allotment, Mill Creek cattle allotment, and Trout Creek sheep allotment. Big Table cattle allotment is a one pasture allotment. A deferred rotation grazing system has been used on Mill Creek cattle allotment. A deferred rotation grazing system means to allow for a deferment for each pasture on a rotating basis (Holechek et al. 2004). Trailing and herders are used to manage the Trout Creek sheep allotment. See Table 100 for allotment information.

Table 100. Summary of information and current management in grazing allotments in the McKay project area.

Allotment	Total Acres	Acres In Project Area	Kind/Class	Permitted Number	Season of Use	AUMs
Big Table	794	793	Cattle-cow/calf	18	04/20-06/10	41
Mill Creek	51,247	18,549	Cattle-cow/calf	385	06/06-10/05	2,067
Trout Creek	27,715	5,688	Sheep-ewe/lamb	1,953	06/16-09/15	1,080

Big Table Allotment

The Big Table Allotment has one pasture. The permit authorizes 18 cow/calf pairs from April 20th through June 10th, for a total of 41 AUMs (Animal Unit Months). The Big Table Allotment has a total of 794 acres, 793 acres which is Forest System lands and fall within the McKay watershed and project area. In the past actual turn-out dates and permitted numbers have varied but not exceeded the total AUMs. This allotment was rested from 2002 to 2010 because of personal convenience by the permittee and resource concerns with drought-like conditions.

Mill Creek Allotment

The Mill Creek Allotment has a total of five pastures: AY, Big, Harvey, Lemon, and McKay. Two permits authorize a total of 385 cow/calf pairs from June 6th through October 5th, equaling 2,067 AUMs. These two permits are operated by two different permittees concurrently; one for 45 cow/calf pairs and one for 340 cow/calf pairs. The Mill Creek Allotment has a total of 51,247 acres and 18,549 acres fall within the watershed in the McKay, AY, and Lemon pastures mainly. A partial deferred rotation is being used going into the Lemon pasture first each year and ending in the McKay pasture because of anadromous fish habitat management requirements; rotating through the other three pastures in various ways. In the past actual turn-out dates have been earlier than the dates on the permit. Range readiness criteria were always met prior to turn-out (2210 Range File, Mill Creek Allotment, Inspection Notes).

Trout Creek Allotment

The Trout Creek Allotment is one pasture utilized with ewe/lamb pairs and managed by herders. The permit authorizes 1,953 ewe/lamb pairs from June 16th through September 15th, for a total of 1,080 AUMs. Herders are with the sheep for the entire grazing season. Sheep are permitted to water at each location only once and only bed in each location once. In the past actual turn-out dates have been consistent with the permit and permitted numbers have slightly varied, not exceeding the total AUMs.

Range Improvements

Throughout the project area there are several range improvements including fences, water developments and exclosures. All range improvements help in keeping livestock distributed throughout the allotment. Permittees are responsible for pasture fence line, allotment boundary fence line and water developments. Permittees maintain fences prior to turn-out every year. Most exclosure maintenance belongs to the Forest Service. Several water developments have been recorded as needing maintained or placed in a different location for resource concern. See Table 101 for range improvement details that are located in the project area.

Table 101. Range improvements in the McKay project area.

Improvement	Number/Amount
Fence	26 miles
Water Developments	9

Existing Condition

Upland Range

The McKay watershed is mainly comprised of an overstory of ponderosa pine, mixed conifer stands and juniper woodland. Dominant understory species include: Kentucky bluegrass, elk sedge, pine grass, tufted hairgrass, and brome species. Dominant tree and shrub species include: ponderosa pine, mixed conifer, big sagebrush and bitterbrush. Condition and Trend (C & T) studies have recently been evaluated in the Mill Creek Allotment and two of these studies are located in the project area.

Mill Creek Allotment

The McKay Pasture C&T 5 is located in a ponderosa pine/pine grass plant community and dominate understory vegetation should be pinegrass (*Calamagrostis rubenscens*) and elk sedge (*Carex geyeri*) (R6-ERW-TP-036-92). Currently the under story is mainly American vetch at 24% species composition and yarrow at 10% species composition. C&T 5 showed a static trend and rated poor in forage condition. It rated as a poor forage condition with a static trend because the site is a forb dominated site, with few grass species. The direct hits on plants decreased from

an average of 21 in 1960 to 16 in 2009. Photos show evidence of increased ponderosa pine and Douglas fir in the cluster site.

The AY Pasture C&T 6 is located in a ponderosa pine/elk sedge plant community and dominate understory vegetation should be elk sedge (R6-ERW-TP-036-92). Currently the under story is mainly Sandberg's bluegrass at 16% species composition, Columbia needlegrass at 18% species composition and willowherb (*Epilobium minutum*) at 14% species composition. C&T 6 showed a downward trend in forage condition and rated poor forage condition. It rated as a poor forage condition because most plant species were increasers, or less palatable species, and not decreasers. Photos showed evidence of an increase in overstory in the cluster site.

Information on condition and trend surveys was taken from the 2210 Range Analysis C&T Files for the Mill Creek Allotment, which is located on the Lookout Mountain Ranger District, Ochoco National Forest.

There has been a change in the upland forest vegetation within the analysis area due to several factors: historic livestock grazing, fire suppression, introduction of noxious plants, and decrease in timber harvest. The combination of these factors has led to a decrease in upland forage production and transitory range (USDA FS 2008).

Riparian Areas

Riparian conditions have been monitored in the McKay Vegetation and Fuels Analysis Area by using a Proper Functioning Condition (PFC) assessment and Multiple Indicator Monitoring (MIM). The PFC assessment determined the physical functioning state of McKay Creek. The MIM data looks at multiple factors that determine trends, including current grazing management. The MIM data was collected on Deer Creek in McKay pasture. See Table 102 and Table 103 for summary information for both plots.

Table 102. PFC results for streams Within the McKay project area.

Allotment	Pasture	Stream	PFC Reach	Determination	Trend	Read
Mill Creek	McKay	McKay Creek	1	FAR	Upward	2009
		McKay Creek	2	Not surveyed; stream stretch is located on private land.		
		McKay Creek	3	FAR	Upward	2009
		McKay Creek	4	FAR	Upward	2009
		McKay Creek	5	FAR	Upward	2009
		McKay Creek	6	PFC		2009
*PFC=Proper Functioning Condition; FAR=Functional at Risk						

Table 103. MIM results within the McKay project area.

Assessed Factors	Mill Creek Allotment/ McKay Pasture-Deer Creek-MIM
Mean Stubble Height (in.)	7
Woody Use (%)	0
Streambank Alt. %	11
Stable Bank %	76
Covered Bank %	90
% Woody Seedling	89
% Woody Mature	11
Ecological Status	Potential Natural Community

The PFC study on McKay Creek was established in the summer of 2009 by an interdisciplinary team. Five reaches were assessed on McKay Creek; Reach 1 and Reachs 3- 6, Reach 2 runs through private land. Four reaches were determined to be Functioning at Risk (FAR) in an

upward trend and one reach was in Properly Functioning Condition (PFC). FAR indicates that there are still improvements needed to be made to the system to be resilient enough to hold together during high-flow events, but the system is heading in the right direction. PFC implies that it is in a state of resiliency that will allow a riparian-wetland area to hold together during high-flow events with a high degree of reliability.

The MIM study on Deer Creek was located in a riparian complex with a ponderosa pine/Douglas-fir overstory. Species composition was dominated by mesic gramminoid species at 40% greenline composition, mesic forb species at 30% greenline composition and horse tail (*Equisetum spp*.) at 14% greenline composition. Both woods rose (*Rosa woodsii*) and willow spp. (*Salix spp*.) provided a large component for cover throughout the transect. Given the results of species composition and cover composition the site rated Potential Natural Community which means all of the components for this type of system are present and this site will be resilient. Stubble height and woody browse all met Forest Plan Standards (LRMP 1989).

Grazing management in the analysis area includes several practices that help livestock distribution and improve riparian habitat. Practices include: active management and riding, trailing and herding, stock driveways, water improvements, rotational grazing strategies and division pasture fences.

Upland shrub 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. Mountain mahogany and other shrubs would continue to decline in abundance.

Proposed treatments in the uplands 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.

Recreation

This section describes the effects of the proposed alternatives to the Ochoco National Forest's recreational visitors. This section is divided into three topic areas:

- Developed recreation sites (MA-F13)
- Dispersed camping (MA-F14)
- Trails

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 is an abundance of dispersed recreation opportunities.

The northwestern part of the Forest is easily accessible from Prineville on Forest Road 33 and Forest Road 27. From Prineville, the watershed boundary is about 12 miles northwest of town on a well-maintained paved road. The McKay watershed has been receiving a slight increase of recreation use within the last 10 years as documented by the National Visitor Use Monitoring of Ochoco National Forest 2005 and 2008.

Recreation use in the project area includes wildlife viewing, hunting, sightseeing, camping, hiking, biking, horseback riding, cross-country skiing, snowmobiling, and off-highway vehicle use.

Developed Recreation Sites MA-F13

The Ochoco Forest Plan (Page 4-71) directs that:

> *Developed recreation areas will be natural appearing areas, but with obvious man-made controls and structures to direct users, provide comfort and sanitation, and protect the natural resources. Developed recreation will be provided for a broad range of recreational opportunities. 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.*

Developed recreation sites within the McKay Fuels and Vegetation project area are:

- **Pot Lid South Trailhead:** The Pot Lid trailhead is within McKay unit #27 (commercial thin, precommercial thin, underburn). This site has an information kiosk, site and trail destination signing, and a parking area that can accommodate 3-5 vehicles but is not structurally delineated. The trailhead receives fairly low use; the non-motorized trail is used for hiking and horseback riding, which generally occur from May through November.
- **Green Mountain North Trailhead:** The Green Mountain trail is open to motorized off-highway vehicles (ATVs and motorcycles). The developed trailhead has an information kiosk but lacks designated parking and other facility features. Most visitors choose to park nearby or travel from adjacent parking and camping sites to access the OHV trail. The trailhead is within unit #34 (commercial thin, precommercial thin, underburn).

Alternative 1

This alternative does not include any vegetative treatments within the project area; the recreational experience would not be directly affected by harvest or non-harvest activities. Understories would continue to develop and the amount of stands in a multi-storied condition would increase. Stand densities would continue to increase, placing additional stress on older overstory trees; risk of large-tree mortality and insect/disease outbreak would increase (see section titled “Forested Stands” in Chapter 3 of this document). Fuel loadings, including small understory trees, would continue to increase, and risk of stand replacement wildfires would increase (see section titled “Fire and Fuels” in Chapter 3 of this document). In the long term, developed recreation sites could be affected as open stands of large diameter ponderosa pine and Douglas-fir become less abundant, or if wildfire occurred in or adjacent to the trailheads.

Alternatives 2, 3 and 4

All three alternatives could result in a short term effect to public use of each trailhead when the unit that overlaps it is being thinned and underburned; however, no long-term direct changes to these facilities or their use are anticipated. Each trail has other access points outside the unit boundaries; therefore public use of the trails is expected to be only slightly affected for a short duration.

Commercial and precommercial thinning can create visual impacts and noise; slash debris piles and burning treatments can create temporary changes to the scenic quality. No structural changes of the trailheads or limitations to the public recreational user are anticipated. Overall use of the developed sites is anticipated to remain the same with little to no displacement or change of use.

There may be some immediate interface between recreation visitors and harvest activity when units 27 and 34 are treated. Noise, dust and hauling traffic would be observed when treatment activity is occurring.

Dispersed Camping MA-F14

Dispersed recreation is defined as any recreation use that occurs outside of developed recreation sites and/or trail facilities. Dispersed recreation includes a range of activities including but not limited to driving for pleasure, camping, picnicking, shooting, off-road/trail OHV use, hiking, hunting, fishing, horseback riding, mountain biking, snowmobiling, and cross country skiing. Dispersed camping sites are located throughout the Ochoco National Forest but generally are located along roads near riparian areas and streams. 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, Page 12). The camp site vicinity includes the barren core of centered activity and the influence area immediately around it. Forest users are continually creating new sites and use patterns change over time; therefore only Forest Plan inventoried sites are included for analysis.

Dispersed sites tend to be concentrated near McKay Creek and adjacent to Forest Roads 33 and 2710. Visitors tend to be attracted to streams, ponderosa pine stands, and the abundance of roads and diverse terrains to recreate on. The highest use season for this area is noticeably during fall deer and elk hunting seasons, but there is moderate use in the spring and into the summer. The increase in motorized recreation use brings some detrimental effects to the environment and the social aspect. Resource disturbance is evident in many meadows of this area. These meadows tend to be revisited yearly by the same user types with class II vehicles (jeeps and 4x4s). Past mitigation attempts with barrier placement has helped reduce some of the activity.

In the past, management activities within dispersed sites have been relatively minimal. Signing and information are only located at developed recreation sites and Forest offices. The Forest Plan directs that: “the dispersed campsites will exhibit a relatively natural appearance, even though management activities (such as timber harvest) may be highly visible nearby.”

Table 104 shows McKay project units that contain Forest Plan inventoried dispersed camping sites; except where noted, units are common to Alternatives 2, 3 and 4.

Table 104. McKay project units that contain Forest Plan inventoried dispersed camping sites.

Unit #	Proposed Activities
2	Commercial thin, precommercial thin, underburn
4	Commercial thin, precommercial thin, underburn
5	Commercial thin, precommercial thin, underburn
6	Commercial thin, precommercial thin, underburn
7	Commercial thin, precommercial thin, underburn
11	Commercial thin, precommercial thin, underburn
15	Commercial thin, precommercial thin, underburn
18	Commercial thin, precommercial thin, underburn
24	Commercial thin, precommercial thin, underburn
25	Commercial thin, precommercial thin, underburn
28	Commercial thin, precommercial thin, underburn
34	Commercial thin, precommercial thin, underburn
37	Commercial thin, precommercial thin, underburn
53	Juniper reduction, jackpot burn
81 (Alts 2 and 3 only)	Sanitation harvest, precommercial thin, underburn
90	Precommercial thin
93	Precommercial thin

Unit #	Proposed Activities
95	Precommercial thin, handpile and burn
109	Underburn
120	Underburn
141	Underburn
142	Precommercial thin
151	Juniper reduction, underburn
165 (Alt. 3 only)	Riparian thinning

Alternative 1

Use of dispersed camping sites is not expected to change. This alternative has no commercial harvest or road decommissioning and closure proposed. 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 overstocked stands could increase risk to disease, insect infestation and wildfire (see "Forested Vegetation" and "Fire and Fuels" sections in Chapter 3 of this document); if such stand-altering events occur, the recreation experience could be affected at these sites.

Alternatives 2, 3 and 4

Proposed activities would improve the long-term health of timber stands adjacent to the above camping areas; however, short-term impacts (1-3 years) to the affected camping areas from project 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 precommercial thinning treatments; smoke and blackened ground and vegetation from prescribed fire activities. Some dispersed site users may be temporarily displaced due to loss of access during project-related 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. However, dispersed camping opportunities are amply available and exceed the demand even in the high use hunting season.

Trails

Within the project area there are two Forest Service system trails, Pot Lid #836 and Green Mountain Off-Highway Vehicle #831. These trails are very different in character and use.

The Pot Lid trail is a non-motorized trail used primarily for hiking and horseback riding. It has not received trail maintenance in many years, resulting some difficulty in locating the route. Because of the lack of maintenance, visitor use has been very low which in turn has resulted in a trail with little to no mineral tread remaining. Attention to the condition of this trail has been recognized and efforts are underway to clear, brush and re-establish trail diamonds,.

The Green Mountain trail is a motorized trail intended for use by Class I vehicles (ATVs) and Class III vehicles (motorcycles); non-motorized uses are also allowed. The trail tread is well defined and approximately five feet in width. It is maintained by COHVOPS program of the Forest Service on an annual basis.

The McKay project does not propose to construct any new trail. Any damage to system trails caused by logging or burning activities would be repaired in order to maintain trails that are safe for use. Trails are maintained as needed.

Table 105 identifies trails adjacent to activity units within the McKay project (all action alternatives).

Table 105. Trails with adjacent McKay project activity units.

Trail Name	Trail Type	Segment Length (miles)	Units Adjacent to Trails	Proposed Treatment Type
Pot Lid #836	Standard/Terra Trail	6.5	27	Commercial thin
Green Mt. #831	OHV Trail	8.1	52, 88, 89	Commercial thin; handpile and burn

Alternative 1 No Action

There would be no effects to the designated standard terra trails (summer, native surface type) or their trail use in the project area. Trail maintenance activities would continue. No alteration to the surrounding vegetation would occur.

Alternative 2, 3 and 4

There is no difference between the three action alternatives as relates to trails. Recreational users would be directly affected for a short duration when an adjacent unit is being treated. Visitors would see evidence of vegetation treatments, such as slash and when burning treatments are implemented will see visible signs of past fire. In the short term, the scenic quality of the area would be affected, as visual evidence (stumps, slash, etc.) of the activities would be apparent. Users could also encounter noise, dust, smoke, and logging-related traffic, if they are present when these activities occur. In the long term, scenic quality would be enhanced as more large ponderosa pines develop and views of open, park-like stands become more frequent. Design elements have been incorporated in the project design to reduce impacts to recreational users (see Chapter 2 of this document).

Cumulative Effects

Ochoco Summit Trail System EIS:

The proposed trail system would be located east of HWY 26, approximately 15 miles east of the McKay project area and traveling further east. Off-highway vehicle (OHV) recreational trail users are drawn to trail systems that offer a full days riding potential of at least 25 miles or greater. Since the Green Mt. Trail only offers 8.1 miles of OHV trail it is anticipated that some current use would be transferred to the new trail system. A decision on the Ochoco Summit project is expected to be signed in April, 2013.

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.

Scenic Quality

The Forest Plan allocated some areas to visual management, including the corridor for Historic Summit Trail. Also Forest Roads 27 and 33 are visual management corridors as designated in the Forest Plan and are popular routes for pleasure driving. They are within close proximity to Prineville and provide an abundance of opportunities for scenic vistas, wildlife viewing, etc. Vegetation management activities that result in a natural appearance and protection of natural resources along these roads helps to provide a high quality recreational experience to forest visitors. The general emphasis in these areas is to maintain the natural-appearing character of the forest.

Historic Summit Trail (MA-F7)

Ochoco National Forest land management plan designated this historic trail as "retention" and "partial retention," and emphasized protection of the integrity of the Summit Trail. The visual management boundary will not exceed 600 feet either side of road. As stated in the Ochoco FLMP Desired Condition: "The Summit Trail will 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 will generally not dominate the landscape." **Error! Reference source not found.** identifies proposed treatments in the Summit Trail partial retention corridor, while **Error! Reference source not found.** summarizes activities proposed within the retention corridor.

Table 106. Proposed activities in Summit Trail Visual Partial Retention Corridor (all action alternatives).

Unit #	Proposed Activities	Acres within Corridor
27	Commercial thin, precommercial thin, prescribed burn	11.1
133	Prescribed burn	12.2
TOTAL		**23.2**

Table 107. Proposed activities in Summit Trail Visual Retention Corridor (all action alternatives).

Unit #	Proposed Activities	Acres within Corridor
27	Commercial thin, precommercial thin, prescribed burn	15.9
28	Commercial thin, precommercial thin, prescribed burn	47.7
29	Commercial thin, precommercial thin, prescribed burn	35.4
30	Commercial thin, precommercial thin, prescribed burn	85.4
31	Commercial thin, precommercial thin, prescribed burn	34.3
32	Commercial thin, precommercial thin, prescribed burn	24.7
33	Commercial thin, precommercial thin, prescribed burn	102.9
36	Commercial thin, precommercial thin, prescribed burn	38.3
126	Precommercial thin	1.9
129	Precommercial thin, prescribed burn	0.0
130	Thin with fire	13.1

TOTAL	399.6

FS Road 27 and FS Road 33; Visual Management Corridors (MA-F26)

Emphasis for these partial retention 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 will not exceed 600 feet either side of road. Vegetation will be manipulated but will reflect a natural forest setting.

Table 108. Proposed activities within Visual Management Corridors Partial Retention (common to all action alternatives, except where noted).

Unit #	Proposed Activities	Acres within Corridor
24	Commercial thin, precommercial thin, prescribed fire	10.2
25	Commercial thin, precommercial thin, prescribed fire	12.0
26	Commercial thin, precommercial thin, prescribed fire	58.1
25a	Precommercial thin, prescribed fire	2.5
27	Commercial thin, precommercial thin, prescribed fire	46.0
28	Commercial thin, precommercial thin, prescribed fire	16.4
34	Commercial thin, precommercial thin, prescribed fire	23.0
35	Commercial thin, precommercial thin, prescribed fire	28.2
36	Commercial thin, precommercial thin, prescribed fire	12.2
37	Commercial thin, precommercial thin, prescribed fire	37.2
39	Commercial thin, precommercial thin, prescribed fire	38.0
40	Commercial thin, precommercial thin, prescribed fire	2.2
41	Commercial thin, precommercial thin, prescribed fire	1.5
42	Commercial thin, precommercial thin, prescribed fire	16.2
43	Commercial thin, precommercial thin, prescribed fire	26.2
44	Commercial thin, precommercial thin, prescribed fire	6.4
45	Commercial thin, precommercial thin, prescribed fire	17.5
47	Commercial thin, precommercial thin, prescribed fire	15.5
48	Commercial thin, precommercial thin, prescribed fire	6.2
49	Commercial thin, precommercial thin, prescribed fire	3.0
50	Commercial thin, precommercial thin, prescribed fire	3.7
78	Precommercial thin, handpile	6.9
79	Prescribed fire	10.6
80	Precommercial thin, handpile	17.5
83	Precommercial thin	0.2
81(Alts 2 and 3 only)	Sanitation harvest, precommercial thin, prescribed fire	4.1
81a	Precommercial thin, prescribed fire	0.1
81b	Precommercial thin, prescribed fire	13.4
90	Precommercial thin	8.1
91	Precommercial thin	44.0
92	Precommercial thin	19.5

Unit #	Proposed Activities	Acres within Corridor
93	Precommercial thin	81.6
94	Precommercial thin, handpile	47.3
95	Precommercial thin, handpile	13.9
97	Thin with fire	1.2
100	Thin with fire	18.3
101	Thin with fire	15.5
102	Thin with fire	28.0
103	Thin with fire	42.4
108	Thin with fire	2.4
109	Prescribed fire	52.4
111	Precommercial thin	6.0
123	Prescribed fire	37.4
124	Precommercial thin	0.7
128	Precommercial thin, prescribed fire	8.4
130	Thin with fire	1.6
135	Prescribed fire	5.9
136	Precommercial thin	12.9
137	Precommercial thin	8.6
138	Precommercial thin	1.9
139	Precommercial thin	3.1
140	Precommercial thin	1.9
141	Prescribed fire	188.6
142	Precommercial thin	0.1
144	Prescribed fire	0.7
145	Prescribed fire	12.9
148	Prescribed fire	3.0
151	Juniper removal, prescribed fire	8.7
162 (Alt. 3 only)	Riparian thin	11.6
163 (Alt. 3 only)	Riparian thin	1.1
164 (Alt. 3 only)	Riparian thin	0.6
165 (Alt. 3 only)	Riparian thin	25.7
166 (Alt. 3 only)	Riparian thin	0.1

Alternative 1

Though the existing scenery appears natural to many Forest visitors, human activities have altered the landscape. Overstory vegetation species include ponderosa pine, western larch, Douglas-fir, and riparian species along stream corridors. There is an increasing encroachment of white fir in higher north-facing stands and juniper in lower-elevation south-facing stands. Decades of fire suppression have resulted in densely overstocked stands and increased stress on older trees. Overstocked conditions have led to increased risk of wildfire, insects and disease in some forested stands in the project area. Under Alternative 1, open park-like stand conditions would continue transitioning to dense, multi-story stands (see sections titled “Forested Vegetation” and “Fire and Fuels” in Chapter 3 of this document). While no immediate change to the landscape or foreground retention would be expected under Alternative 1, it’s anticipated that visual line of

sight would decrease as stand densities increase, and that wildfire could interrupt this trend in local areas.

Alternatives 2, 3 and 4

Management activities would occur within the scenic corridors and 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 return as the existing condition if future treatments and fire regiment are not maintained. Less alteration to the scenery would occur with the removal of smaller, understory trees.

The Forest visitor can expect to see tree stumps, hand piles, and blackened woody debris from under burning and slash piles during and immediately after implementation of project activities. Evidence of prescribed burning activities would be noticeable for 1-3 years; fuels reduction benefits would last much longer. In treated stands, field-of-view would increase within these visual corridors. With field-of-view enhanced, more topographic features may be observed. Sections of McKay and Little McKay Creeks provide excellent opportunity for views of rocky spires and cliff bands. These views maybe enhanced to the scenic traveler. Dispersed camp sites would see no change in the immediate use of the sites, but foreground and visual to roads may be exposed.

Precommercial thinning and under burning would have short term effects on scenery, such as stumps, slash, scorched vegetation and smoke. However, in the long-term, scenery would be enhanced and the vegetation would be moved to more sustainable conditions. Sufficient levels of residual trees would remain on site to meet desired conditions.

Air Quality

The Oregon Department of Environmental Quality is responsible for assuring compliance with the Clean Air Act. The DEQ monitors the emissions from prescribed fire thru the Oregon State Department of Forestry smoke management program. 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 (629-048-0200b,c). 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. The nearest SSRAs to the project area are Redmond, 20 miles to the west (into the prevailing winds), and John Day, 85 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. The nearest Class I wilderness downwind of Mckay is the Strawberry Mountain Wilderness, 85 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 Mckay 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 Mckay project area effecting Class I wilderness areas or Smoke Sensitive Receptor Areas.

Smoke from prescribed fires has occasionally pooled in the Mckay or Mill Creek valleys. 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[16] which are of the most concern to human health because they can be inhaled deeply into the lungs. Table 109 compares the production of PM 2.5 from a wildfire in Mckay unit 88 before treatment, and from a wildfire after treatment.[17] Unit 88 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 109. Smoke production, PM 2.5.

Mckay 88 High Hazard/CC 3 **Wildfire before treatment**	Mckay 88 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 discloses the affected environment and environmental consequences for wilderness areas, potential wilderness areas (PWAs), Inventories Roadless Areas (IRAs) and other unroaded or undeveloped lands.[18]

The area for each of these analyses is the approximately 25,526-acre McKay project area, where over the past several decades fire exclusion has altered natural ecological processes. Suppression of fire in these areas has helped create the stand composition and structure that is now present. In the dry upland forest, stands once dominated by open park-like stands of ponderosa pine have closed in with shade tolerant species such as Douglas-fir and grand fir. The McKay project proposes to affect a change in these conditions through vegetative treatments and prescribed burning.

The vast majority of the area, especially on lands less than 30 percent slope, has been managed in the past. This area has been harvested and roaded except within the Green Mountain Inventoried Roadless Area.

Wilderness

Affected Environment

A wilderness area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. The 17,400-acre Mill Creek Wilderness was designated by Congress through the Oregon Wilderness Act of 1984 (Public law 98-328). The entire wilderness area is within the Ochoco National Forest (MA-F3, Forest Plan pages 4-52 – 4-53). The Mill Creek

[16] NWCG Smoke Management Guide
[17] Forest Veg Simulator on CVS plot 2106234
[18] 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.

Wilderness is one of three designated Wilderness Areas on the Ochoco National Forest, and is the closest to the McKay project area. There is no designated wilderness within the project area.

Environmental Consequences – All Alternatives

The McKay project activities would have no effect on the wilderness character, including solitude, on the Mill Creek wilderness because of the distance to the nearest treatment unit. No activities would occur adjacent to or within any designated wilderness.

Inventoried Roadless Areas

Affected Environment

Inventoried Roadless Areas (IRAs) are areas 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.

All roadless area acres were allocated to various management area strategies as disclosed in the Ochoco Forest Plan FEIS, Appendix C. Current uses within the Green Mountain Roadless Area include recreation, big game production and livestock grazing.

Environmental Consequences – All Alternatives

No activities are proposed within the Green Mountain Roadless Area.

Potential Wilderness Areas

Affected Environment

Potential wilderness areas 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 purpose of identifying potential wilderness areas in the National Forest System. The National Forest System Land and Resource Management Planning Rule (currently the 1982 Rule, 36 CFR §219.17) directs that roadless areas be evaluated and considered for wilderness recommendation during the forest planning process.

Potential wilderness areas (PWAs) 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 they are not preliminary administrative recommendations for wilderness designation (Chapter 73). The inventory of PWAs does not change the administrative boundary of any inventoried roadless area (IRA).

Typically, PWAs substantially overlap, and/or are contiguous with inventoried roadless areas. PWAs may also be contiguous with designated wilderness. Some newly inventoried PWAs may be stand alone areas that were not identified as ‘roadless areas’ in Appendix C of the 1990 Deschutes 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

The McKay project was inventoried utilizing the criteria in FSH 1909.12, Chapter 71. Areas qualify for placement on the potential wilderness inventory if they meet the statutory definition of

wilderness. Areas are evaluated and are eligible for inclusion in the inventory if the area meets either criteria 1 and 3, or criteria 2 and 3 below:

1. Areas contain 5,000 acres or more.
2. Areas contain 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.
3. 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. FSH 1909.12, section 71.11 (9) states that timber harvest areas where logging and prior road construction are not evident may be included in the inventory.

For the McKay project area, information regarding past harvest and tree cutting operations and previous and existing road construction was gleaned from corporate databases to determine if areas were qualified to be included in the inventory using the criteria described above. Additionally, satellite imagery was utilized to determine if previously harvested areas and roads were present but not captured in the corporate databases. Geographic Information System analysis was utilized to identify areas with no previous tree cutting operations, including any roadside hazard tree removal or firewood cutting, and with no evidence of road building.

Inventory and Effects

The only identified polygon within the McKay area that would meet the "potential wilderness" criteria was the existing Green Mountain Roadless Area. No project activities are proposed within the roadless area.

Unroaded Areas or Undeveloped Lands

These acres of land have no history of harvest activity, do not contain forest roads, and are not designated as a wilderness area. They are areas that are unique on the landscape. These areas have values associated with them such as scenery, cultural resource values, and unfragmented habitat. These acres have no previous roads or harvest activities located in them.

The Environmental Impact Statement discloses impacts to a number of resources sensitive to the construction of new forest roads or from our system of existing roads. A road is defined and criteria and methods for inventorying a road conform to agency policy. Definitions and inventory criteria do not change project to project, Forest to Forest; they are common agency-wide.

The McKay project area has three areas outside of the Green Mountain Roadless Area that have no known harvest activities or roads. A summary of the areas and related proposed activities in displayed in Table 110.

Table 110. Potential roadless areas and proposed activities by action alternative.

Polygon #	Size (ac)	Alternatives 2 and 3			Alternative 4		
		Commercial Thin (ac)	Precommercial Thin (ac)	Thin with Fire (ac)	Commercial Thin (ac)	Precommercial Thin (ac)	Thin with Fire (ac)
1	**177**	10	1	8	1	1	8
2	**1803**	160	27		26	27	

3	**609**	10	3		10	3	

Management activities within the unroaded polygons are expected to increase forest health and reduce the risk of stand-modifying events such as insects, disease or wildfire.

Citizen Identified Unroaded Areas

In the early 2000s Oregon Wild conducted their own roadless inventory across Oregon, including the Ochoco National Forest, using inventory criteria they developed for their purposes. An initial map of Oregon Wild's unroaded areas were provided in response to the scoping letter for the proposed action for the McKay project; upon request, Oregon Wild provided a GIS shapefile to the ID team in March, 2013. This map was compared to the polygons identified by the Forest Service; the maps are very similar. Additional unroaded areas identified by Oregon Wild do have proposed activities; most of the activities are non-commercial in nature. A more thorough examination of unroaded areas will be prepared for the final EIS.

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 and 3 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 and 3 will 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 green house 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).

One public comment suggested that thinning is likely to remove more carbon than will be saved by avoiding fire and that we should consider the conclusions of Mitchell et al (2009) before attributing carbon benefits to fuel reduction. The interdisciplinary team has reviewed the paper by Mitchell et al (2009); it does not support the comment that the Canyon project is likely to remove more carbon by logging than will be saved by avoiding fire. The paper by Mitchell et al is the result of simulation exercises with three Pacific Northwest forest types: the east Cascades ponderosa pine forests, the west Cascades western hemlock-Douglas-fir forests, and the Coast Range western hemlock-Sitka spruce forests. Treatments simulated for the east Cascade ponderosa pine forests were similar to those proposed for the Canyon project (understory removal, prescribed fire, understory removal and prescribed fire). Based on a forest ecosystem simulation model, the authors suggest that fuel reduction treatments in these ecosystems consistently reduced fire severity. For the east Cascade ponderosa pine forests (representative of the Canyon project area) there was little or no trade-off incurred by managing these forests for both fuel reduction and carbon sequestration. The authors speculate that the removal of highly flammable understory vegetation led to a reduction in overall fire severity that consequently lowered overall biomass combustion, thereby allowing increased overall carbon storage.

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 Canyon 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 Canyon 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 Canyon 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 and 3 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 effect 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, pre-commercial 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 criteria 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, pre-commercial 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.

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 criteria 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. Both permanent and 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 criteria and resource protection measures would minimize these adverse effects. However, proposed activities such as road construction, commercial timber harvest, grapple piling, 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 111 summarizes other projects in the vicinity of the McKay project area.

Table 111. Projects that overlaps with the McKay project area in space and/or time.

Project/ Activity	Description	Effects in the McKay 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.	Project areas do not overlap; however, implementation of this project could reduce recreation use of the Green Mountain trail as well as illegal off-road motorized travel within the project area.	Planning; decision anticipated in April, 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.	About 609 acres of inventoried invasive plant treatment units are within the McKay project area; 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
Mill Creek Allotment Management Plans EIS (2010)	The decision reauthorized cattle grazing on three allotments, two of which have acreage within the project area. The decision included range improvements, increased requirements for livestock management, creation of stock driveways, active riparian restoration, and prescribed fire to improve upland range.	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
Mill Project Timber Sales EIS (1999)	The decision authorized a variety of activities, including timber harvest, precommercial thinning, prescribed fire, stream channel restoration, bank stabilization/headcut repair, and placement of large woody debris.	About 15 acres of Mill activities (7 acres of stand improvement harvest and 8 acres of precommercial thinning) are within the McKay project boundary.	Completed
Older vegetation management	Over 16,000 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

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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 Mckay 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 precommercial thinning occurs.

Silvicultural Treatments

Various silvicultural treatments are being proposed to meet the vegetative objectives for the area and move the landscape towards the desired ranges. 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 precommercial thinning are prescribed for the same unit. The major emphasis of the silvicultural treatments would be to:

1. Maintain existing large structure (21”+ dbh trees) and accelerate the development of additional large structure.
2. Reduce stand densities to maintain existing large trees, favor early-seral species, and reduce susceptibility to disturbance agents (insects, disease, and fire).
3. Select for species compositions that are closer to what occurred historically.
4. Increase the amount of single strata stand structure.

Commercial thinning

This prescription would be used in overstocked stands with a surplus of merchantable sized trees. Most stands contain an existing component of large trees (greater than 21 inches DBH). Current stand conditions often include multiple canopies 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 removed in commercial thinning would be sold and removed from the stand. Treatment creates immediate structure and species composition shifts to larger structures and generally earlier seral conditions because some treated stands would no longer be dominated by a dense understory and trees cut would tend to be mid and late seral species. Species diversity would be retained if it was present already but the proportion of early seral species would increase. Stands would retain some irregular or uneven-aged structure and age distribution. Existing large trees would become more vigorous due to reduced competition and the increased growth rates in smaller trees would eventually augment the number of large trees to help 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 60 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 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. The 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).

Stands selected for commercial thinning usually contain a mosaic of seral structural stages including a large proportion of pole and small size trees and dense “a” stocking conditions. Most stands selected also contain varying amounts of large structure ranging from a widespread layer to scattered groups of or individual large trees.

No live trees 21” DBH or larger would be removed in commercial thinning operations except for those which are safety hazards. Hazardous trees within Riparian Habitat Conservation Areas would be felled but not removed.

Commercial thinning prescriptions would also require that ponderosa pine with old growth characteristics be retained, regardless of size or condition. Identification of old ponderosa pine is based on tree characteristics similar to those discussed in *Identifying Old Trees and Forests in Eastern Washington* (Van Pelt 2008). These include bark characteristics, branching structure, and crown form.

Sanitation

This prescription is used when there is a risk of disease spreading from one component of a stand to another component. In this project, sanitation would be used to remove dwarf mistletoe infected overstory trees in an effort to maintain the health of the stand as a whole. Stands selected for this treatment are stocked primarily with ponderosa pine, with a lesser component of Douglas-fir and grand fir. Large overstory ponderosa pine trees, 14 to 21+ inches DBH are scattered across the stand. Within this overstory component, 75% of the ponderosa pine show visible mistletoe brooms. An understory of seedling/sapling/poles/small sawlogs is also present. The understory component is also dominated by ponderosa pine and appears generally to be free of mistletoe infection. By removing the overstory pine, the understory should be free to grow with a lower risk of infection. A follow up precommercial thinning would remove any trees with visible infection within the understory. Healthy Douglas-fir and grand fir in both the overstory and understory would be left to provide diversity as well as stocking which is not susceptible to this particular mistletoe species.

Group Selection/Commercial Thinning

The group selection system is typically used to regenerate small groups within a larger stand. This would characteristically be applied in instances where disease and/or age related stand deterioration is occurring; however it is either undesirable or unnecessary to remove the stand as a whole. In this project we are prescribing the removal of groups of Douglas-fir and grand fir from 9 inches to 21+ inches DBH, where western larch and ponderosa pine are present. The Douglas-fir in these stands is infected with dwarf mistletoe and the grand fir is commonly infected with Indian paint fungus. Removing groups of fir where larch and pine are present would reduce disease while creating conditions more conducive to regeneration by these early seral species. It is estimated that 5 percent or less of the acreage in theses stands would be treated with group selections. These treatment areas would fall mostly on north and east facing slopes, where fir is a more common component of the stand. Between the group selection treatments and on the drier sites within these stands the treatment would revert back to the above explained commercial thin prescription.

Precommercial 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 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 precommercial thinning could retain 135 or more small trees per acre. Species selection is usually performed to retain ponderosa pine and western larch or to remove species infected with or susceptible to insects/disease. Precommercial thinning can occur either following a commercial entry or as the only treatment. Trees cut during this activity would be left on site and the slash treated by a variety of fuels treatments. Where it is prescribed to thin with fire, small diameter fir and juniper trees would be targeted to be killed with an underburn operation. This treatment would result in more of a mosaic of trees across the stand. Patches of trees would likely remain in overstocked conditions.

Riparian Thinning

Precommercial thinning would occur along portions of McKay Creek. In these units, it is proposed to implement a modified precommercial thinning. Trees up to 9 inches dbh would be cut at irregular spacing. The objective of this treatment is to reduce competition on existing large diameter trees, promote and enhance the health of existing riparian plants, and to accelerate growth on existing conifers. These treatments would be designed to assure no reduction of shade to the streams below current conditions.

Hardwood Treatments

Quaking aspen, cottonwood, willow, etc. provide unique and special habitats. The small aspen or other hardwood stands in the project area are usually associated with riparian areas. Aspen develop as clones where individual trees are short-lived and replaced by sprouts from the root system. Aspen and other hardwoods are sensitive to conifer encroachment and accompanying shading, browsing by livestock and big game, and reduced water tables. Hardwood treatments involve the thinning of conifers usually up to 15 inch dbh. Trees up to 20.9 inches dbh may be cut if they are needed for placement of large wood in selected units. Most, if not all, conifers within 50 feet of a hardwood (including sprouts) would be cut. All old ponderosa pine would be retained as in commercial harvest prescriptions. Cut conifers would not be harvested but would be left on site and the slash would be manipulated to provide protection to the aspen from grazing and browsing. In select units the trees may be felled into or placed into the stream to increase large wood. Effects of the hardwood treatments have not been included in the Viable Ecosystem analysis as the scale of the treatments is too small to have any measurable effect on the landscape projections and the treatments often occur in riparian sites as opposed to uplands. Usually hardwoods occur in small clumps or patches of an acre of less. For mapping purposes the hardwood treatment units defined for this project usually encompass several patches, but not all of each unit contains hardwoods nor will it receive treatment.

Fuels Definitions and Treatments

The following fuels treatments are proposed in the Mckay project area:

Natural Fuels Underburning would reduce naturally occuring 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 precommercial 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.

Grapple Piling would occur on slopes less than 35% where thinning slash is too heavy to burn without damaging the residual stand.

Mulching (Mastication) A small tractor with a mulcher would be used to thin plantations.

Definitions

Fuels: Surface fuels consist of natural fuels (pine needles, sticks, downed trees, grass), and activity fuels (slash), which are a product of mechanical thinning. The amount of surface fuel on a site is refered to as a fuel load, and is measured in tons per acre. The greater the fuel load, the more intensely a fire can burn. Fine fuels (less than 3 inches 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).

Ladder fuels are small trees in the forest understory which provide a ladder for fire to move from the forest floor to the overstory (crown). As ladder fuels increase, the risk of crown fire 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 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 6-8 feet across and 6-8 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.

Mulching (Mastication): A small tractor with a brush mulcher would be used to thin small trees (less than 6” dbh) in plantations, and to thin juniper out of pine stands. The tractor would be similar in size to a D5 or smaller, with a ground pressure of around 5 psi. Mulching would leave an evenly distributed fuelbed less than 6” deep of finely shredded wood fiber.

Prescribed Fire: Prescribed Fire is the application of fire in specific patterns, under specific conditions, in order to produce a desired flame length, rate of spread, and fire effects. The general objectives of prescribed fire are:

- To lessen the severity, resistance to control and cost of future wildfires by reducing natural fuels (naturally occuring 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.

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 the ground on a contour, starting at the uphill end, or on the downwind 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[19], 40 - 80% of the surface area of prescribed fire units is burned; mineral soil exposure usually occurs on less than 5% of the ground, usually where downed logs are consumed.

Firelines 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, 12-24 inches feet wide. A small plow pulled by a four-wheeler or a small rubber-tired farm tractor could also be used to dig fireline on slopes under 30%. The line would be same as that dug using handtools, down to mineral soil and 12-24 inches wide.

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.[20]

The purpose of juniper reduction is to reduce the risk of high intensity wildfire, improve the vigor of native plants, improve spring flow[21], and increase forage for wildlife and livestock by using chainsaw cutting and prescribed fire to reduce juniper on XXXX acres.

Junipers to be cut are generally under 12 inches dbh, without old growth characteristics. Junipers with old growth characteristics will not be cut. Characteristics of old growth include: tree crowns are in various states of decline with sparse canopies, dead limbs, spike tops, or spreading, flattened tops; hollow trunks; bark is deeply furrowed, fibrous and reddish in color; branches are covered with lichens. No snags will be cut. Cutting will be by hand, using chainsaws.

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, the juniper stands in the southwest corner of Mckay have developed to the point where they are out-competing the native grasses needed to carry a prescribed fire under cool conditions. And, a very hot fire, wild or prescribed, would greatly increase the risk of the site being invaded by annual grasses (medusahead and cheatgrass) which would further reduce native grasses.

After the trees are cut, they will 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[22], and will remove the hazard of unburned slash on the forest boundary.

[19] Scholz, personal observations on prescribed fires on the Ochoco National Forest, 1986-2012
[20] Miller et al 2005
[21] DeBoodt, Fisher, Buckhouse, Swanson 2008
[22] Bates and Svejcar 2009. Scholz, personal observation 2012

APPENDIX B – SOIL DISTURBANCE

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)

Acreage rounded to nearest whole acre.

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
1	148	148	148	30 - 40	50	7	35	Stay on existing disturbance (skid trails, landings and roads). Till 7 acres. Meets standard.
2	111	111	111	20 - 30	50	5	25	Stay on existing disurbance. Till 5 acres. Meets standard.
3	69	69	69	20 - 30	20	3	26	Stay on existing disurbance. Till 3 acres. Meets standard.
4	29	29	29	30 - 40	10	1	37	Stay on existing disurbance only. Borders Highland Flat to south. Till 1 acre. Meets standard.
5	49	49	49	30 - 40	10	2	38	Stay on existing disurbance only. Borders Highland Flat to east. Till 2 acres. Meets standard.
6	61	61	61	30 - 40	40	3	35	Stay on existing disurbance. Borders Highland Flat to north. Till 3 acres. Meets standard.
7	80	80	80	30 - 40	50	4	35	Stay on existing disurbance.Buffer large meadow in center of unit. Till 4 acres. Meets standard.
8	13	13	13	20 - 30	25	1	25	Stay on existing disurbance (skid trails, landings and roads). Till 1 acres. Meets standard.
9	30	30	30	20 - 30	75	3	21	Stay on existing disurbance. Till 3 acres. Meets standard.
10	10	10	10	20 - 30	50	1	25	Stay on existing disturbance, no net increase over 30%. Till 1 acres. Meets standard.

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
11	21	21	21	20 - 30	100	2	21	Stay on existing disturbance, no net increase. Till 2 acres. Meets standard.
12	11	11	11	20 - 30	100	1	21	Stay on existing disturbance, no net increase. Till 1 acre. Meets standard.
13	14	14	14	20 - 30	100	1	21	Stay on existing disturbance, no net increase. Till 1 acre. Meets standard.
14	192	192	192	20 - 30	50	5	25	Stay on existing trails, no net increase over 30%. Till 5 acres. Meets standard
15	81	81	81	20 - 30	75	4	25	Stay on existing disturbance, no net increase. Till 4 acres. Meets standard.
16	118	118	118	20 - 30	100	6	21	Stay on existing trails, no net increase over 30%. Till 6 acres. Meets standard.
17	131	131	131	20 - 30	25	1	29	Stay on existing disturbance, no net increase.Till 1 acre. Meeds S&Gs.
18	44	44	44	20 - 30	100	2	25	Stay on existing disturbance (skid trails, landings and roads), no net increase. Till 2 acres. Meeds S&Gs.
19	44	44	44	20 - 30	25	1	28	Stay on existing disturbance, no net increase. Till 1 acre. Meets standard.
20	45	45	45	20 - 30	50	2	25	Stay on existing disturbance, no net increase.Till 2 acre. Meeds S&Gs.
21	57	57	57	20 - 30	50	3	25	Stay on existing disturbance, no net increase. Till 3 acres. Meeds S&Gs.
22	102	102	102	20 - 30	25	2	28	Stay on existing disturbance, no net increase.Till 2 acre. Meeds S&Gs.
23	67	67	67	20 - 30	25	1	29	Stay on existing disturbance, no net increase.Till 1 acre. Meeds S&Gs.

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
24	163	163	163	20 - 30	50	5	28	Limit new disturbance to <5%, Mitigate effects with tilling 5 acres to meet S/Gs.
25	169	169	169	20 - 30	75	5	28	Stay on existing disturbance, no net increase.Till 5 acres. Meeds S&Gs.
26	76	76	76	30 - 40	25	2	27	Stay on existing disturbance, no net increase.Till 2 acre. Meeds S&Gs.
27	124	77	124	20 - 30	50	3	25	Stay on existing disturbance, no net increase. Till 3 acres. Meeds S&Gs.
28	80	80	0	20 - 30	75	4	25	Stay on existing disturbance (skid trails, landings and roads), no net increase. Buffer wet meadow in center. Till 4 acres. Meeds S&Gs.
29	35	35	0	20 - 30	100	3	21	Stay on existing trails, no net increase over 30%. Till 3 acres. Meets standard.
30	146	146	0	20 - 30	50	5	26	Stay on existing disturbance, no net increase. Till 5 acres. Meeds S&Gs.
31	89	89	0	20 - 30	50	5	24	Stay on existing disturbance, no net increase.Till 5 acres. Meeds S&Gs
32	26	26	0	30 - 40	75	3	31	Stay on existing disturbance, no net increase. Till 2 acres. Meets standard.
33	157	157	0	30 - 40	50	5	35	Stay on existing disturbance, no net increase. Till 5 acres. Meets standard.
34	30	30	30	20 - 30	25	1	27	Stay on existing disturbance, no net increase. Till one acre. Meeds S&Gs.
35	43	43	43	20 - 30	25	1	28	Stay on existing disturbance, no net increase. Till one acre. Meeds S&Gs.
36	67	67	67	20 - 30	25	2	27	Stay on existing disturbance, no net increase. Till 2 acres. Meeds S&Gs.

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
38	74	74	74	20 - 30	75	3	26	Stay on existing disturbance, no net increase. Till 3 acres. Meeds S&Gs.
39	95	95	95	20 - 30	10	0	20 - 30	Stay on existing disturbance only. Meeds S&Gs.
40	2	2	2	20 - 30	0	0	20 - 30	Stay on existing trails, landings and roads. Meets standard.
41	2	2	2	20 - 30	0	0	20 - 30	Stay on existing trails, landings and roads. Meets standard.
42	16	16	16	20 - 30	0	0	20 - 30	Stay on existing trails, landings and roads. Meets standard.
43	30	30	30	20 - 30	20	1	28	Stay on existing disturbance, no net increase. Till one acre. Meeds S&Gs.
44	6	6	6	20 - 30	10	0	20 - 30	Stay on existing disturbance only. Meeds S&Gs.
45	18	18	18	20 - 30	10	0	20 - 30	Stay on existing disturbance, no net increase. Meeds S&Gs.
46	76	76	76	20 - 30	15	0	20 - 30	Stay on existing disturbance. No net increase. Meets standard..
47	28	28	28	20 - 30	10	0	20 -30	Stay on existing disturbance. No net increase. . Meets standard.
48	6	6	6	20 - 30	10	0	20 - 30	Stay on existing disturbance. No net increase. . Meets standard.
49	3	3	3	20 - 30	10	0	20 - 30	Stay on existing disturbance. No net increase. . Meets standard.
50	1	1	1	20 - 30	25	0	20 - 30	Stay on existing disturbance. No net increase. Meets standard.
51	126	126	126	20 - 30	40	3	20 - 30	Stay on existing trails, landings and roads. No more than 5% increase. Till 3 acres. Meets standard.

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
52	33	33	33	20 - 30	50	2	26	Stay on existing disturbance. No net increase. Till 2 acres. Meets standard
81	68 HSA	68 HSA	0	20 - 30	50	4	26	Stay on existing disturbance. No net increase. Till 4 acres. Meets standard
82	138 HSA	138 HSA	0	20 - 30	60	4	26	Stay on existing disturbance. No net increase. Till 4 acres. Meets standard
88	107	107	107	20 - 30	50	5	25	Stay on existing disturbance. No net increase. Till 5 acres. Meets standard
116a	19	19	0	20 - 30	75	1	25	Stay on existing disturbance. No net increase. Till one acre. Meets standard..
117	32	32	0	20 - 30	80	2	27	Stay on existing disturbance. No net increase over 30%. Till 2 acres. Meets standard.
118	15	15	0	20 - 30	20	0	20 - 30	Stay on existing disturbance. No net increase. Meets standard
152	17	17	17	20 - 30	60	1	25	Stay on existing disturbnace. No net increase. Buffer drainway and wet meadows in center of unit. Till one acre. Meets standard.
153	3	3	3	20 - 30	75	0	20 - 30	Stay on existing disturbance only. No net increase. Meets standard.
154	59	59	59	20 - 30	25	1	28	Stay on existing disturbance. No net increase. Till one acre. Meets standard
155	54	54	54	20 - 30	60	3	26	Stay on existing disturbance. No net increase. Till 3 acres. Meets standard
156	64	64	NT	20 - 30	75	3	25	Stay on existing disturbance. No net increase. Till 3 acres. Meets standard

Unit	Alt2 Acres Log Trmt	Alt. 3 Acres Log Trmt	Alt. 4 Acres Log Trmt	Existing Soil Disturbance (%)	Tillage Potential In %	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
157	8	8	NT	20 - 30	75	0.5	25	Stay on existing skid trails, landings and roads. No net increase over 25% . Till 0.5 acres. Meets standard.
158	140	140	NT	20 - 30	80	3	26	Stay on existing trails. No net increase over 30%. Till 3 acres. Meets standard.

HSL – Uneven-aged Management
HTH – Commercial Thinning
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