Keno Landscape Analysis
ENVIRONMENTAL ASSESSMENT (EA)
#DOI-BLM-OR-L040-2011-008-EA

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Lakeview District - Klamath Falls Resource Area

ABSTRACT:
This environmental assessment analyzes the effects of a variety of proposed treatments including commercial timber harvesting, small diameter (understory and plantation) thinning, tree planting, fuels reduction treatments, juniper treatments, road management actions, noxious weed treatment, and construction of a waterline at Topsy Recreation Site.

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FREEDOM OF INFORMATION ACT AND RESPONDENT'S PERSONAL PRIVACY INTERESTS:

The Bureau of Land Management is soliciting comments on this Environmental Assessment. Comments, including names and street addresses of respondents, will be available for public review at the above address during regular business hours. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, please be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be made available for public inspection in their entirety.

Table of Contents

1 INTRODUCTION 1
2 PROPOSED ACTION AND ALTERNATIVES 7
2.1 No Action 7
2.2 Actions Common to All Alternatives 7
2.3 Alternative 1 – Proposed Action 10
2.4 Alternative 2 13
2.5 Alternative 3 14
2.6 Alternatives Considered But Not Analyzed in Detail 15
2.7 Comparison of Alternatives 15
3 AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES 18
3.1 Introduction 18
3.2 Cumulative Actions Considered 18
3.3 Upland Forest Vegetation 19
3.4 Botany 30
3.5 Fire and Hazardous Fuels 36
3.6 Terrestrial Wildlife 39
3.7 Soils 57
3.8 Hydrology 67
3.9 Aquatic Species and Habitat 77
3.10 Grazing Management 81
3.11 Cultural Resources 82
3.12 Recreation Resources 84
3.13 Visual Resources 85
3.14 Air Quality 87
3.15 Socioeconomics 88
3.16 Greenhouse Gases 90
4 CONSULTATION 93
Endangered Species Act (ESA) Consultation 93
Tribal Consultation 94
5 LIST OF PREPARERS 94
6 BIBLIOGRAPHY 94

List of Tables

Table 1. Summary of RMP Objectives by Land Use Allocation in Keno Project Area 1
Table 2. Comparison of Alternatives (by Acreage) 16
Table 3. Differences Between Alternatives 17
Table 4: Additional Treatments Currently Proposed on BLM lands in the Project Area 19
Table 5. Distribution of Size Classes Throughout the Project Area. 20
Table 6. Land Ownership and Age Class Structure in the Keno Project Area 21
Table 7. Comparison of A. Current Species Composition (by basal area) Data with B. Historic Species Composition Data (Lieberg 1900, Twnshp 40, Range 7) 21
Table 8. Special Status Species that May Occur within the Analysis Area and Potentially Affected by the Proposed Actions 39
Table 9. Topsy Spotted Owl Historic Nest Territory Occupancy 2005-2012 41
Table 10. Spotted Owl Habitat Descriptions 41

Table 11. Available NSO Habitat within Project Area by Alternative 49
Table 12. Proposed Treatments in NSO Critical Habitat ECS –Subunit 2 51
Table 13. Summary of Effects of Action Alternatives on Special Status Species in the Project Area..... 56
Table 14. Soil Map Units and Interpretations for Management-Timber and Fuels Treatments..... 58
Table 15. Stream miles within analysis area and BLM-managed lands 68
Table 16. Percentage of Subwatershed within the Transient Snow Zone (TSZ)..... 71
Table 17. Road Densities and Stream Crossings before and after Treatment..... 75
Table 18. Native Aquatic Species Adjacent to the Analysis Area..... 78
Table 19. Non-native Aquatic Species Adjacent to the Analysis Area 78
Table 20. Harvested Volume by Alternative..... 89
Table B-1: Riparian Reserve Types and Widths from the KFRA RMP..... 111
Table B-2: Keno Project Location by Township, Range, & Section..... 116
Table B-3 - Survey & Manage Wildlife and Botany Species..... 118

List of Appendices

Appendix A: Maps

Map 1. Vicinity map of the project area…….101
Map 2. Location of proposed waterline to Topsy Recreation Site……102
Map 3. Location of medusahead rye population/proposed herbicide application……103
Map 4. Road Treatments/Transportation Management Map……104
Map 5. Forestry & Silviculture Treatments for Alternatives 1 and 3……105
Map 6. Fuels Treatments for Alternatives 1 and 3……106
Map 7. Forestry & Silviculture Treatments for Alternative 2……107
Map 8. Fuels Treatments for Alternative 2……108

Appendix B: Summary of Best Management Practices and Project Design Features……109

Appendix C: Survey and Manage……116

Appendix D: Determining Age on Uneven-aged Stands……120

Appendix E: Definition of "Old" Juniper……121

1 INTRODUCTION

The Klamath Falls Resource Area (KFRA) of the Lakeview District, Bureau of Land Management (BLM), is proposing to implement vegetation treatments and other management actions on approximately 4,100 acres in the Keno Landscape Area. The project boundary includes 14,150 acres of BLM lands within the 54,350-acre Keno Landscape Analysis project area. The project is located west of Highway 97, north of the Oregon-California border, and south of Highway 66 (see Map 1, Keno Landscape EA Vicinity Map, in Appendix A). Proposed treatments include timber sales, understory and plantation thinning, tree planting, fuels reduction treatments, juniper removal treatments, road actions, noxious weed treatment and a waterline installation for Topsy Recreation Site.

1.1 Management Direction and Conformance with Existing Plans

This project has been designed to comply with the land use allocations, management direction, and objectives of the 1995 Klamath Falls Resource Area Record of Decision and Resource Management Plan (RMP). The majority of the 4,100 acres proposed for treatment in the Keno project area (3,818 acres) are allocated as Matrix (General Forest Management Area). There are 141 acres of riparian reserves (RR), 108 acres of District Designated Reserves (DDR), and 71 acres of DDR Buffer (DDRB) lands in the proposed treatment area. Table 1 displays the acreage and summary of RMP objectives by land use allocation in the Keno project area.

Table 1. Summary of RMP Objectives by Land Use Allocation in Keno Project Area

Land Use Allocation	Approximate acres in project area (out of 4,100 proposed treatment acres)	Definition/Objectives from 1995 RMP	Page numbers in RMP
Matrix (General Forest Management Area)	3,818 acres	As stated in the RMP and Oregon and California (O&C) Lands Act of 1937, Matrix (General Forest Management Area) lands have objectives to produce a sustainable supply of timber and other forest commodities to provide jobs and contribute to community stability.	pp.22-23
District Designated Reserve (DDR)	108 acres	In District Designated Reserves (DDRs)/Late Successional Reserves (LSRs), treatments are designed to protect and enhance conditions of late-successional and old growth forest ecosystems, which serve as habitat for late-successional and old growth forest-related species including the northern spotted owl.	pp.18-22
DDR Buffer (DDRB)	71 acres	Matrix lands that surround the DDR are managed to contribute substantially to achievement of Supplemental EIS Record of Decision objectives, including provision of well-distributed late-successional habitat outside reserves; retention of key structural elements of late-successional forests on lands subjected to regeneration harvest; restoration and protection of riparian-wetland areas; and provision of a stable timber supply.	pp.23-26
Riparian Reserves (RR)	141 acres	Riparian Reserves are lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use. Goals are to meet Aquatic Conservation Strategy objectives.	pp.12-18

The project design and recommendations for implementation are contained in the RMP and in a number of other related or supporting documents including the following:

- Klamath Falls Resource Area Integrated Weed Control Plan EA (July 21, 1993).
- Range Reform Final Environmental Impact Statement (FEIS) (August 1995).
- FEIS, Vegetation Treatment on BLM Lands in Thirteen Western States (1991).
- Standards for Land Health for Lands Administered by the Bureau of Land Management in the States of Oregon and Washington (1998)
- MOU between the FWS and BLM "To Promote the Conservation of Migratory Birds"
- Record of Decision and Standard and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (2001) or fit one of the four exemptions (Pechman Exemptions) in the modified injunction in Northwest Ecosystem Alliance et al. v. Rey, Case No. 04-844-MJP (W.D. Wash.) October 11, 2006,
- Wild & Scenic Rivers Act
- Vegetation Treatments Using Herbicide on BLM Lands in Oregon FEIS (July 2010)

1.2 Purpose and Need for Action

The BLM has a statutory obligation under Federal Land Policy and Management Act (FLPMA), which directs that "[t]he Secretary shall manage the public lands in accordance with the land use plans developed by him under section 202 of this Act when they are available . . ." The KFRA RMP guides and directs management on these lands. The purpose of the Keno project is to implement actions to meet the objectives of the RMP, which include the following:

- Improve the resiliency of stands to drought, insects, and disease.
- Restore fire-dependent processes and historic stand composition and structure.
- Design one or more economically viable timber sales that help produce a sustainable supply of commercial timber products and other forest commodities to support local and regional timber-related businesses.
- Use materials from silviculture and fuels treatments to produce forest products (e.g., biomass and firewood).
- Reduce hazardous fuel loading and overstocked stands in an effort to decrease fire intensity and severity in and adjacent to the Keno Wildland Urban Interface (WUI).
- Improve riparian conditions and associated aquatic species' habitat.
- Reduce road density in the area while improving the condition of the remaining transportation system.
- Remove juniper to increase available water for preferred vegetation and wildlife species.

Other management objectives include the following:

- Apply Ecological Forestry principles (Franklin and Johnson 2010) in managing the landscape
- Meet the objectives of the 2011 Northern Spotted Owl (NSO) Recovery Plan and the Designated Critical Habitat rule (2012)

- Provide an improved, permanent source of potable drinking water to the Topsy Recreation Site that does not require handling and transport by truck and trailer.

Need

There is a need to offer commercial timber products and other forest commodities to local and regional timber-related businesses. The majority of acres in the project area are designated as Matrix (defined in the RMP as General Forest Management Area). See Table 1 for objectives on Matrix lands.

There is a need to reduce tree stocking level densities to improve growing conditions (reduce competition for water, nutrients and light) and increase the vigor of the remaining trees. Field observations and timber stand data show that many of the existing stands in the proposed project area are presently overstocked and have reduced annual growth. Trees within densely stocked stands are generally more susceptible to stress and vulnerable to attack by insects and diseases.

There is a need to reduce the overall hazardous fuel loading in the area. Throughout the 20th century, fire suppression and livestock grazing has effectively eliminated fire from the landscape. Due to this suppression, conditions have become favorable for numerous small trees, shrubs, and other vegetation to become established (Hessburg et al. 1995; Lehmkuhl et al. 1994 in USDI BLM 2003, 100). This resulting increase in surface, ladder, and crown fuels contributes to the risk of a stand replacing fire (Huff as stated in USDI BLM 2003, 100).

There is a need to protect and enhance conditions of late-successional ecosystems and a need to manage northern spotted owl habitat to promote late successional conditions in the District Designated Reserve.

There is a need to manage vegetation conditions to help attain Aquatic Conservation Strategy (ACS) objectives in the Riparian Reserves (RR). The proposed road treatments are important land management actions needed to help attain ACS objectives while ensuring that the aquatic resources are not diminished as a result of poor road management (USDI BLM 2003, p.130). The location and condition of the road network to, and within, the area can have negative land management effects on water quality and habitat quality (USDI BLM 2003, p.72).

There is a need to provide a reliable drinking water supply for the Topsy Recreation Site. Failure of existing on-site wells has caused the BLM to have to haul water to the site. Engineering data shows that the surrounding area is not suitable for additional well drilling. Therefore, there is a need to locate and access a source of potable water and obtain an easement for a waterline to traverse adjacent private landowner's property for water delivery to the recreation site.

1.3 Public Input Summary and Issue Development

A variety of efforts were made to involve the public. The project was first listed in the KFRA's Planning Update in the summer 2010 edition. A scoping letter was mailed to adjacent landowners, permittees, agencies, and other interested parties on January 27, 2012, with a Notice of public scoping published in the Herald and News on February 1, 2012. As a result of scoping, the BLM received eight emails or letters from interested parties. The interdisciplinary team reviewed the scoping responses and developed alternatives at meetings throughout 2012. Two field meetings were held with Dr. K. Norman Johnson and Dr. Jerry Franklin on April 19, 2012 and September 12, 2012 to obtain their input on the potential to apply Ecological Forestry principles in the Keno project area.

Comments, questions, and issues were raised by the public, interested individuals, groups, and BLM's interdisciplinary team. Issues are points of discussion, dispute, or debate about the environmental effects of proposed actions. Issues and concerns raised were considered in the formulation of alternatives, project design features, or environmental effects. Some comments were not related to the decision to be made, were procedural concerns, or were already decided by law, regulation, policy, or direction (such as in KFRA's RMP).

The Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations require that agencies "…identify and eliminate from detailed study the issues which are not relevant or which have been covered by prior environmental review…" (40 CFR 1501.7 (a) (3)). In some cases, an issue was eliminated from further analysis because it was not within the scope of the project, or did not meet the purpose and need. A summary of all scoping comments, as well as all the letters and emails received, can be found in the Keno Environmental Assessment (EA) project file. The summary can also be found online at http://www.blm.gov/or/districts/lakeview/plans/collaborative/keno/.

The following is a synopsis of comments, categorized by relevant issue, that were used to guide the analysis and develop alternatives or project design features for the Keno EA.

Harvest Diameter Limit

- *"Because of the variability of treatment that will be needed within the project area, [we] believe that arbitrary diameter limitations will hamper the effectiveness of this project and the stated goals."*
- *"A look at aerial photos of the areas around Klamath Falls indicates that large areas of private lands have been heavily cut-over. As a result, large trees and dense forests are in short supply. Large tree structure is in such short supply that it does not seem to make sense to remove large trees for any reason. Let the big trees sort it out and if a few snags are recruited in the process, that's another ecosystem benefit."*

Economic Feasibility

- *"The supply of merchantable sawlog material from public lands is more important now than ever before to our members. The high quality log that can be provided from the Keno area is an extremely valuable commodity and I urge you to maximize the volume per acre removed to the extent possible. In addition, the BLM manages 14,150 acres within the Keno Landscape*

area. Of those 14,150 acres about 4100 acres or 29% of the BLM lands will actually receive treatments. I encourage you to re-visit the planning area and determine if there are additional acres that can be treated under the Keno EA. The NEPA planning exercise has become so costly and so time consuming for federal agencies that it is absolutely critical that the number of acres in analysis areas treated is maximized, especially when working on a landscape scale."

- *"Presumably you will have more than one project coming from this EA in a combination of timber sales, stewardship contracts, service contracts, etc. When we review the Proposed Treatments, there appears to be quite a bit of understory density management, plantation density management and other noncommercial treatments. Please pay close attention to how these treatments are packaged. We say sales on the Klamath Falls Resource Area go no bid due to excessive costs included in the sale and are concerned that may be repeated here. Market conditions are not likely to increase significantly in the foreseeable future so paying close attention to how sales are packaged with respect to the economics will be important."*

Roads/Transportation Management

- *"While decommissioning unneeded roads is understandable and supportable we also ask that serious consideration be made for the long term implications of road removal. For example, will removal cause problems with projects that will be implemented in this same area in the future?"*
- *"Thank you for identifying the need to reduce road density in the Keno scoping notice. Please focus road closures in areas where they will have the greatest hydrological benefit. Please do not rely solely on gates and barricades to close unneeded roads as such measures often prove ineffective in the long-term. Road decommissioning, that includes hydrological and terrestrial restoration (where needed) is a much better long-term fix."*
- *"Also, we encourage the building of temporary spurs where feasible to reduce the harvest costs and more effectively treat the land base. This is especially true where existing road prisms already exist."*
- *"Please note that we remain very concerned about proposed new logging road construction. Road construction inevitably results in significant and long-term impacts to soil resources and contributes to forest fragmentation and hydrological degradation."*

Northern Spotted Owl (NSO) Habitat/Mistletoe Treatment

- *"Please ensure that the forthcoming NEPA document addresses the importance of mistletoe to spotted owl populations and their prey base. Please consider focusing your thinning activities on small-diameter ground and ladder fuels while retaining mature and late-successional forest character where it still exists."*
- *"While dwarf mistletoe has traditionally been viewed as a forest pest because of reducing [sic] in timber volume, we suggest that in areas where management goals are not strictly focused on timber production, control of dwarf mistletoe may not be justified, practical, or even desirable. Our data suggest that dwarf mistletoes may have positive influences on wildlife habitat. Consequently, we suggest that eradication efforts be reconsidered given that dwarf mistletoes have been a part of these forest ecosystems for thousands, and possibly millions, of years."*

While no specific comments were received from the public regarding northern spotted owl (NSO) nesting, roosting, foraging (NRF) habitat during scoping, this was considered a relevant issue since Critical Habitat for the northern spotted owl was designated in 2008 and finalized by the U.S. Fish and Wildlife Service on January 3, 2013. Specifics are discussed in Section 3.6 of this EA, under Terrestrial Wildlife Species.

Riparian Reserves/Hydrology

- *"The Watershed Analysis is quite clear that existing riparian reserves have been negatively impacted by past logging and road construction activities. While careful and limited thinning and road decommissioning activities may be acceptable in these reserves, it is essential that the BLM not log the remaining native stands serving as riparian buffers in this highly degraded watershed."*
- *"Hydrology has been altered in the TPLA area through reductions in base flow from drought and poor channel and riparian condition in certain areas. Peak flows have likely been increased, primarily due to the road network. The timing of peak flows may be altered due to created openings in the forest canopy on non-BLM administered lands. Sediment from roads and stream bank erosion is adversely affecting water quality..."*
- *"High road densities and high percentages of native surface roads in these watersheds. There could be short-term increases in sediment from roadbed and drainage ditch disturbance associated with road use (hauling) and maintenance activities."*
- *"Existing off-highway vehicle (OHV) use could be exacerbated by timber harvest activities and lead to increased access, potentially increasing impacts to soils, water quality, and aquatic and riparian habitat."*
- *"Logging (particularly tractor yarding) and road construction could increase soil compaction, increase bare ground cover, and alter hydrologic flow, including peak flow and low flow."*
- *"There is potential for adverse effects to water quality from increased sediment produced from disturbance associated with timber harvest activities including road construction, timber yarding, and timber hauling."*
- *"The effects of timber harvest and road construction, when combined with other past, ongoing, and reasonably foreseeable future actions on public and private lands, could potentially contribute to adverse cumulative effects to water quality and hydrologic function."*
- *"Runoff from the project area could contribute sediment and nutrients to receiving waterbodies (Klamath River) that do not meet water quality standards and are 303(d)*.."
- *"Both existing roads and new roads proposed for construction should be evaluated for long-term necessity and placement with regard to road density per square mile, location with regard to riparian reserves and stream crossings, and potential for sediment delivery to receiving 303 (d) waterbodies."*

1.4 Decision to Be Made

This environmental assessment will provide the KFRA Field Manager with current information to aid in the decision-making process. It will also determine if an Environmental Impact Statement (EIS) needs to be prepared, or if a Finding of No Significant Impact (FONSI) is appropriate.

2 PROPOSED ACTION AND ALTERNATIVES

This chapter describes the action alternatives developed to meet the purpose and need, as described in Chapter 1. It also describes the No Action Alternative and alternatives not considered in detail. Table 2 is a comparison of alternatives by acreage, and Table 3 displays the differences between alternatives.

2.1 No Action

There will be no treatment with this alternative. The no action alternative provides reviewers with a baseline to compare the magnitude of environmental effects of the action alternatives.

2.2 Actions Common to All Alternatives

Plantation Thinning, 368 acres

Plantation thinning of predominantly non-commercial sized trees in previously planted stands would be conducted on approximately 368 acres. These stands are typically younger in age than natural stands, are less variable in diameter distribution and are more evenly spaced. Plantations comprised of merchantable sized trees would be treated under a timber sale contract. Mechanical harvesting equipment would be used in these stands to cut and remove designated trees. See Maps 5 and 7 in Appendix A.

Skyline (Cable) Yarding, 150 acres

Approximately 150 acres (in unit 40-7-23-2) is proposed for skyline yarding as part of the timber sale in all three action alternatives. A cable yarding system capable of providing one end log suspension and lateral yarding capabilities would be used. Skyline yarding requires the use of steel cable for yarding, directional manual falling techniques, and corridors in place of skid trails. A complete description of this treatment can be found in the Keno EA project record.

Manual felling and bucking would be required for all skyline yarding operations. Hand cut, pile and burn slash treatments would be used to reduce hazardous fuel accumulation where needed throughout the unit. In areas of the unit with favorable slopes less than 35%, a ground-based mechanical harvesting system may be used to cut and yard timber. Mechanical harvesting systems are typically cheaper, more productive and can yard material where skyline systems cannot achieve one-end suspension.

Fire and Hazardous Fuels Treatments

Underburning is proposed on 1,131 acres of ponderosa pine-dominant stands to help restore fire-dependent processes and historic stand composition and structure. See Maps 6 and 8 in Appendix A. Underburning would also reduce potential fire severity associated with a wildfire in and adjacent to the Keno Wildland Urban Interface (WUI). Burn plans would be written and approved prior to ignitions. Specifics such as “percent consumed” and “flame lengths” would be defined in the burn plan. Burning of slash piles would occur throughout the proposed project area.

Underburning would be conducted using hand ignition methods as the primary ignition device. Fire intensity would be controlled by adjusting the ignition pattern, distance between strips, the time between strips, and the number of strips ignited at one time. Desired fire intensity would include flame lengths of six to 24 inches. Underburning would be conducted in either the spring or fall seasons, outside of limited operational periods that may be in place due to wildlife concerns. A site-specific prescription would be determined in the burn plan and be based on the management goals, desired habitat conditions of the site, vegetation type and size, and fuel loadings.

A site-specific prescription would include objectives such as: mortality of trees greater than 20" would be less than 2%, and a mosaic of burned and unburned vegetation would be created with a target of between 40% to 60% of the area left unburned. Underburns require control lines (or fire line) around the burn area. Existing control lines, such as roads, would be utilized as much as possible to minimize potential impacts associated with building new fireline. Control line would be constructed as necessary to contain the underburn. Control lines may be constructed using hand tools or a plow line that would be approximately two feet wide, and vegetation on either side of the line would be trimmed or pruned to reduce ladder fuels. If a plow is used for the line constuction, it would be pulled by an all-terrain vehicle (ATV) or small tractor. Maintenance underburning (frequent, low intensity underburns) would then be necessary to maintain the site in low fuel hazard condition. Frequency of underburns would be based on management goals, desired habitat conditions, vegetation responses, vegetation types, and other natural disturbances, such as wind throw and ice/snow damage or wildfire. It is estimated that maintenance burning throughout the project area would be on a five to 25 year rotation.

Pile burning is proposed on approximately 352 acres where material would be hand cut, hand piled, and then burned with hand-held ignition devices. Pile burning would require approved burn plans.

Conifer Planting, 161 acres

Trees would be planted by hand at appropriate stocking levels for the site on approximately 161 acres. Conifer species proposed for planting include ponderosa pine, sugar pine, Douglas-fir and incense cedar. In addition, any areas determined to be under stocked following treatment would be planted. Low density areas lacking a desired seed source may be planted, depending on the objectives of the unit. This may be applied on all treatment units in this EA, as needed (refer to maps in Appendix A).

Transportation Management

Approximately 4.3 miles of open roads are proposed for improvement. Improvement is defined as road realignment or relocation in an effort to improve hydrologic function in adjacent stream beds. Some existing roads have created poorly drained channels due to improper road location. These improved roads would remain a part of the open transportation system. Approximately 0.50 mile of existing operator spur roads would be improved to access the proposed treatments. These operator spurs were found during the reconnaissance of units. They predominantly consist of an existing road bed that is overgrown with natural vegetation. These operator spur roads have essentially closed themselves over time. After improvement for project implementation, the spur

roads would then be blocked throughout their length with project-generated slash, and water-barred where necessary in an effort to leave them closed, in an improved hydrological condition.

During transportation system analysis for the Keno project, it was determined that 10.6 miles of open roads would be proposed for closure, rather than the seven miles of road closure listed in the scoping proposal. See Map 4 in Appendix A for locations of road treatments. The objectives of road closures are to reduce and protect watershed conditions, reduce total road maintenance costs, and to reduce impacts to fish and wildlife habitat and botanical resources. Roads considered for closure were determined through an interdisciplinary process and consist of either (1) barricaded road closures, which are proposed when roads are no longer needed in the short-term but are likely needed for future forest management; or (2) gated road closures, which are used when intermittent access, or access to private land, are needed. Roads that either lack physical barriers (steep cut and fill slopes, large trees, boulders, etc.) that aid in providing adequate barricades or roads with hydrological concerns (sediment runoff, etc.) would be blocked throughout the length of the road and water-barred where necessary. Members of the interdisciplinary team would decide on this need upon project completion for the proposed road closures (within treatment areas) in an effort to ensure contractor compliance prior to leaving the area.

Water Line to Topsy Recreation Site

All three action alternatives include construction of a pipeline and associated infrastructure to source and transport potable drinking water from nearby private property to the BLM's Topsy Recreation Site. The BLM would then work with the property owners to acquire an easement and any other necessary documentation to acquire rights to the drinking water, and for the waterline to traverse their property. Approximately 9,500 feet of the pipeline would cross private property; the remaining 500 feet of its length would enter Topsy Recreation Site on BLM lands.
The BLM would secure water rights to potable water from the well of a nearby landowner to adequately provide water to the Topsy Recreation Site. The quantity of water needed at the Recreation Site is conservatively estimated at 1,000 gallons per day, from May 1 to October 1 annually. Neighboring landowners' well records show their wells producing 15 gallons per minute (gpm). The maximum water demand at the BLM Recreation Site would consume approximately 5% of the well's water yield, for a maximum of six months per year.

BLM would acquire rights-of-way (ROW) or easement(s) and any necessary permits and approvals from landowners and governing authorities, to allow construction of a buried water line from the nearby well site to the Topsy Recreation Site. The permanent easement would be 15 to 30 feet in width, and approximately 10,000 feet in length. See Map 2 in Appendix A.

BLM would install a two-inch diameter water transmission line that would run from the neighboring well to a tie-in point at the Recreation Site's existing water system. The water line installation would generally proceed along or adjacent to existing roadway alignments, within the area that was previously disturbed for road construction.

Water line construction activities would involve clearing and grading, cutting an open trench approximately three feet wide and six feet in depth, hauling and stringing the pipe, laying pipe and hydro-testing, backfilling, cleanup, and restoring disturbed areas. Topsoil would be reserved

during excavation and replaced as final backfill. The site would be reseeded with native vegetation suitable for the location. The new water system at the Recreation Site will be tested, certified, operated, and monitored in compliance with State of Oregon public drinking water regulations.

2.3 Alternative 1 – Proposed Action

The proposed action (Alternative 1) would treat approximately 4,100 acres within the 54,350-acre Keno Landscape project area, and would be implemented over a five to ten year period. The project includes the actions common to all alternatives (described above in Section 2.2), along with the following treatments: Timber Sale, Understory Thinning, Juniper Treatment, Brush Mastication, Riparian Restoration Treatments, and Noxious Weed Management.

Alternative 1 was designed to meet the purpose and need using the Ecological Forestry principles for "Dry Forests" developed by Drs. K. Norman Johnson and Jerry Franklin (2010). The Ecological Forestry objectives are described below:

- Restoration of ecologically desirable conditions on the majority of the landscape—including retention of existing trees and restoration of historic old-tree populations
- Reduced potential for large, severe wildfires and insect outbreaks, even under conditions of climatic change
- Increased resiliency – i.e., ability of disturbed forest landscapes to recover when severe disturbances do occur
- Restoration of spatial heterogeneity from the scale of small patches to large landscapes
- Increase timber harvests on Federal lands

Key elements of a restoration strategy for "Dry Forest" sites are:

- Protect and conserve all older trees (trees greater than 150 years of age), including reducing fire-risks and competitive risks to fire-resilient species
- Reduce basal areas in overstocked stands
- Increase the mean diameter of stands
- Shift composition toward more fire- and drought-tolerant species, such as ponderosa pine and sugar pine, and away from less fire- and drought-tolerant species, such as white fir
- Restore characteristic levels of within-stand spatial heterogeneity
- Manage small and intermediate tree populations to restore and maintain characteristic population levels of old and large trees
- Restore characteristic levels of ground fuels and understory vegetation, using prescribed fire where possible
- Encourage hardwood tree and shrub recovery in riparian habitats
- Retain patches of dense forest scattered across the landscape within the area of the Northwest Forest Plan (NWFP) to help conserve the northern spotted owl and its prey species
- Plan and implement restoration activities at larger landscape levels, encompassing the variety of restoration efforts that are needed within a landscape and ensuring that spatial complexity is incorporated at larger spatial scales
- Treat up to 2/3 of the landscape over time

Timber Sales

Timber sales with density management prescriptions would be used to thin trees in overstocked stands on approximately 2,587 acres. This treatment refers to thinning trees of all diameters (merchantable logs are measured as seven inch DBH (diameter at breast height, 4.5 feet from the ground) and at least 16 feet tall to a five-inch diameter top). Residual stand densities would vary across the landscape to mimic natural variability. Uneven-aged silvicultural prescriptions would be used. Following is the general harvest prescription for upland forest vegetation:

- All trees estimated to be 150 years or older will be retained from harvest. To accurately implement this, individual trees were cored for age samples. Trees of similar diameter, furrowed bark, dead/ broken tops and other characteristics (Van Pelt 2008) were considered to be over 150 years of age and would be retained.
- For uneven-aged stands, maintain a multi-strata stand structure
- Thin around large old growth trees to improve vigor and reduce hazardous fuels risk
- Thin to an average of 40 to 120 sq.ft. per acre (depending on unit) of basal area (BA)
- Generally retain trees that are full-crowned, vigorous, and disease free
- Mistletoe trees will be retained in clumps or individual wildlife trees, while scattered mistletoe trees will be targeted for removal
- Species selection priority: sugar pine (highest), Douglas-fir, ponderosa pine, incense cedar, white fir (lowest)
- Implement “skips and gaps” at multiple spatial and temporal scales to increase heterogeneity (variability in spacing and structure) at both the landscape and stand scale
- Skips are areas which are reserved from treatment. Skips would be chosen based on the presence of some unique feature (springs, seeps, special status species, and rocky outcrops) or wildlife characteristics
- Gaps are openings in the stand. Gaps would be used to create early seral habitat, to reduce density in pine stands, to reduce fir concentrations, or to address insect and disease concerns. Gaps would either be re-planted or allowed to seed in naturally, depending on whether the seed source is a preferred species (pine or Douglas-fir) and the desired amount of time that the gap will stay in the early seral stage
- The size of skips and gaps would vary widely between ¼ to 5 acres in size, and would not comprise more than 10% skips and 10% gaps in the timber sale.
- Create snags within timber sale units that are snag deficient to meet RMP guidelines three years post-treatment. A table illustrating snags per acre in each unit is located in the Project Record, along with the stand exam data.

Manual and mechanical harvesting systems would be used to cut and remove designated timber in units with slopes less than 35%. Mechanical harvesting systems are proposed for all units except portions of unit 40-7-32-2 which are over 35% slope, and are proposed for skyline yarding. This unit is explained in detail in Section 2.2, Actions Common to All Alternatives, above.

<u>Unit 40-6-35-1, District Designated Reserve</u>

Approximately 78 acres (of the 2,587 acres) of thinning will be conducted within one unit in the District Designated Reserve (DDR). The purpose of this treatment would be to thin trees to encourage the development of late successional structure. The DDR would be treated using a

different prescription from other timber sale areas. The DDR prescription would be a lighter thinning, leaving a larger residual stand component. The entire stand is about 110 acres, of which about 40 acres would be left untreated in an effort to maintain northern spotted owl nesting, roosting and foraging (NRF) habitat within the reserve. Other treatments in the DDR would include understory density management and juniper removal.

Riparian Restoration Treatments

Approximately 64 acres of timber sale and 36 acres of plantation thinning are proposed within the riparian reserve (RR). Of the 64 acres within the timber sale units, 32 acres (the outer half of the RR) are proposed for mechanical treatment and would be included in the timber sale. The inner half of the RR would be treated manually, and would not be included in the timber sale. These units are proposed in an effort to maintain and restore water quality. Density management and underburning would be used to reduce understory competition while reducing fuel hazards. This would speed the development of large trees for stream channel coarse woody debris (CWD) while maintaining stream shade requirements, sediment filtering, and stream bank stability. Stream buffer requirements would be adhered to as described in the RMP.

Understory Thin

Understory thinning, which refers to removing a percentage of small diameter trees, is proposed on approximately 297 acres. Upper diameter limits vary by unit (specific unit prescriptions located in Project Record). This material would be utilized through chipping and other means of removal. This treatment would help meet the purpose and need of this project by releasing the stand from stress associated with overstocking. Understory thinning would also reduce high fuel loads and fire intensity in and adjacent to the Keno WUI while providing commercial forest products to the local economy.

Juniper Treatment

Hand cutting, hand piling, and burning of juniper is proposed on 202 acres of juniper woodland. Juniper would be hand cut, piled, and burned according to the prescription. All juniper featuring old growth characteristics would be retained. A description of juniper old growth characteristics can be found in Appendix E.

Brush Mastication

Brush mastication would be conducted in two units on approximately 404 acres. This is a type of mechanical fuels treatment in which slash, brush, and small trees are mowed, chipped, and otherwise broken down into smaller pieces, creating a relatively dense mat of debris on the forest floor. Brush mastication is a useful tool to reduce slash, brush and small trees in areas such as plantations where prescribed fire implementation is difficult due to the relative small diameter of plantation trees, and their susceptibility to fire-related mortality.

Transportation Management

To minimize log skidding distances and associated impacts to soils and other resources, a total of 0.15 mile (approximately 795 feet) of new temporary road spur construction (reduced from 0.50 mile described in the scoping letter due to further analysis) would be constructed to access proposed treatment areas. See Map 4 in Appendix A, and best management practices (BMPs) and project design features (PDFs) for road actions in Appendix B.

Medusahead Rye Treatment

During botanical surveys for the Keno Landscape Analysis, a population of the noxious weed, medusahead rye (*Taeniatherum caput-medusae*), was discovered in unit 40S-08E-28. Under Alternative 1, the BLM would manage this 2.7-acre population of medusahead rye with a prescribed burn, followed by pre-emergent application of imazapic, then seed with native perennial grasses. Imazapic (Plateau) at 6oz/acre (0.178 pounds/acre of active ingredient imazapic) would be applied. Application method would be by backpack sprayers, and would occur in late fall to reduce potential impacts to the establishment and survival of seeded species. Map 3 in Appendix A shows the treatment area proposed for herbicide application.

2.4 Alternative 2

Alternative 2 was developed to address northern spotted owl (NSO) nesting, roosting, foraging habitat, as well as comments received during the scoping process regarding large tree retention, riparian reserves, mistletoe treatment, juniper treatment, and road construction. See Maps 6 and 8 in Appendix A for Alternative 2 treatment locations. Treatments in Alternative 2 are identical to Alternative 1 (Proposed Action) with the exception of the differences described below:

- No trees over 21” DBH will be harvested, except for white fir
- Include skips, but no gaps in the timber sale prescription
- No commercial harvest would occur within the riparian reserves
- Cut, pile, and burn juniper - also leave and scatter some tops and treat variably
- Retain all mistletoe infected trees for wildlife structure
- No treatment in all late successional forest (120 years w/structural components)
- No new road construction
- Maintain northern spotted owl nesting, roosting, foraging habitat (NRF)
- No brush mastication
- No treatment of medusahead rye

Alternative 2 maintains northern spotted owl (NSO) nesting, roosting, foraging (NRF) habitat, limits harvesting to less than 21” DBH for fire-tolerant species, and would not include tree harvest in riparian reserves or late successional habitat. The density management prescription in Alternative 2 would include unthinned skips, (thermal clumps), but would not include gaps (patch cuts). Fire-tolerant species up to 21” DBH would be thinned. White fir will be thinned throughout all diameter classes. Species preference would focus on removing white fir where it is judged to be overly abundant. Mistletoe trees would be retained.

In Alternative 2, with no brush mastication proposed, the understory brush and surface fuels would not be treated after thinning on two units totaling 404 acres. In addition, juniper thinning on 202 acres is proposed, but some tops would be lopped and scattered, rather than all of it hand piled and burned. Alternative 2 does not include new road construction, or noxious weed treatment on 2.7 acres of medusahead rye.

Alternative 2 includes treatment of approximately 30 acres of NSO dispersal habitat within the DDR. This predominantly ponderosa pine stand would be thinned to an average of 90 sq. ft/ acre of basal area. The prescription would focus on improving late successional habitat through targeting smaller trees competing with the preferred larger trees, increasing the Quadratic Mean Diameter (QMD) and thus providing more growing space and resources for larger trees to continue to grow. Disturbance agents such as Dwarf mistletoe would not be targeted for removal in an effort to retain structural diversity for wildlife habitat.

2.5 Alternative 3

Alternative 3 was developed to address comments received during the scoping process regarding the economic feasibility concerns of timber harvest in the project area. Treatments in Alternative 3 are identical to Alternative 1 (Proposed Action) with the exception of the differences described below:

- Maximize timber production through group selection in 15% of each unit
- No harvest diameter limit or age limit.
- In order to reduce costs, material less than seven inches DBH would not be thinned
- Thin to even spacing, rather than using variable density strategy
- Reduce low volume thinning over large areas
- No snags would be created
- Target mistletoe trees for removal.
- Northern spotted owl nesting, roosting, foraging habitat would not be maintained
- Medusahead rye treatment without the pre-burn, as described below

Alternative 3 would focus harvesting in areas that contain the most volume as a means to reduce the costs of the harvest. The primary prescription in this alternative is density management with 15% of each unit in gaps (patch cuts) up to five acres in size.

In all harvests under Alternative 3, conifer trees will be removed from all diameter classes 7” DBH or larger. Species preference will focus on removing white fir where it is overly abundant. In areas where the gaps are implemented, stocking will be evaluated and the openings will be planted or left to regenerate naturally, depending on surrounding seed sources. Maximized group selection will allow for the establishment of a new cohort of trees.

Under Alternative 3, the BLM would manage a 2.7 acre patch of medusahead rye (*Taeniatherum caput-medusae*) found in 40S-08E-28, unit 1 (see Map 3 in Appendix A) with only a pre-emergent application of imazapic (no pre-burn, as in Alternative 1), followed by reseeding of native perennial grasses. Imazapic (Plateau) at 6oz/acre (0.178 pounds/acre of active ingredient imazapic) would be applied by handheld backpack sprayers to treat medusahead rye. Application of imazapic would occur from late summer/early fall 2013 to reduce potential impacts to the establishment and survival of seeded species.

2.6 Alternatives Considered But Not Analyzed in Detail

Some comments, both internal and external, were considered during alternative development but were eliminated from detailed study. The following alternatives were not analyzed in detail because they were outside the scope of this EA.

Reduce Basal Area to 60
Drs. Johnson and Franklin proposed two alternative prescriptions to consider for unit 40-6-35-3. One of which would reduce the stand basal area (BA) to 60 sq. ft. However, this unit is within the District Designated Reserve (DDR). The Late Successional Reserve Assessment (LSRA) completed for this DDR, directs the KFRA to maintain 120 sq. ft. of BA. Therefore, this alternative was not analyzed in detail.

Modify Minimum Log Specifications
Comments received during scoping included requests to modify the minimum log requirements, such as the following: **"***We would ask that you reconsider your specifications for sawtimber to be 16-feet to a 6-inch diameter top. Most mills cannot handle 8-foot logs and in our particular case our preferred minimum length is 16 feet and the minimum we'll take is 12' 6". This is not just a matter of the economics but also the physical limitations of infeeds and debarkers at the mill."* Other commenters requested a minimum of 10 feet long with 8" diameter top, or 17 feet long with a 6" diameter top. The current minimum of 8 feet long with a 5" diameter top is a statewide BLM standard outlined in the BLM handbook. Therefore, the request was not carried forward for analysis because modification of the minimum log requirement would be outside the scope of this EA.

2.7 Comparison of Alternatives

Table 2 (below) displays activities and treatment acres proposed for each alternative. For the purpose of comparing alternatives, the "total acres of treatment" is shown, but these totals include overlap, where multiple treatments are proposed on the same acres. The total acres of treatment shown therefore, are higher than the actual number of project acres proposed for treatment. In some cases, the treatment acres are the same for some alternatives, but the treatment itself differs by alternative. For a comparison of treatments by alternative, refer to Table 3, which summarizes the differences between alternatives.

Table 2. Comparison of Alternatives (by Acreage)

Treatments	No Action	Alternative 1 Proposed Action (acres)	Alternative 2 (acres)	Alternative 3 (acres)
Vegetation Treatments				
Timber Sale	0	2,587	2359	2,587
Understory Thin	0	297	184	297
Plantation Thin	0	368	368	368
Plantation Thin (Riparian)	0	36	0	36
Timber Sale (Riparian) Mechanical treatment in outer half, Hand treatment in inner half	0	64	0	64
No Treatment	14,150	10,798	11,162	10,798
Tree Planting				
Conifer Planting	0	161	161	161
Fuels Treatments				
Underburn	0	1,131	1,131	1,131
Hand Thin, Pile, and Burn	0	352	150	352
Hand Thin, Pile, and Burn - scatter some tops	0	0	202	0
Brush Mastication	0	404	0	404
No Treatment	14,150	12,263	12,667	12,263
Summary				
Total Acres of Treatment * *includes overlap – acres with multiple treatments are counted more than once. A total of 4,100 acres are proposed for treatment in the project area.	0	5,400	4,632	5,400
Other Proposed Treatments				
Temporary Road Construction (feet)	0	795 feet (0.15 mile)	0	Same as Alt 1
Road Improvement (miles)	0	4.33 miles	Same for Alternatives 1, 2,3	
Roads Closed (miles)	0	10.6 miles	Same for Alternatives 1, 2,3	
Water Pipeline Construction (feet)	0	10,000 feet	Same for Alternatives 1, 2,3	
Imazapic Application in Unit 40S-08E-28 (acres)	0	2.7 acres, with Fall Rx fire	0	2.7 acres

Table 3. Differences Between Alternatives

Area or Treatment	Alternative 1 (Proposed Action)	Alternative 2	Alternative 3
Timber Sale	• Retain unthinned "skips" (similar to thermal clumps) and heavily thinned "gaps" (similar to patch cuts), 1/4 acre to 5 acres in size, in up to 10% of treated area • Skips- springs, seeps, special status species areas, rocky outcrops • Gaps – create shrub/early seral, reduce density in pine, reduce fir concentrations • Increase the stand's mean diameter • Retain dense patches across the landscape • Retain trees 150 years or older • Thin 3"- 7" DBH material where needed	• Retain skips but no gaps • Retain shade-tolerant tree species 21" DBH and greater • Retain all late successional forest (120 years old with structural components)	• Thin through all diameters • Increase timber production through maximized group selection (15% of each unit) • Minimize overall costs (timber industry costs) • Reduce low volume thinning over large areas • Do not thin material less than 7" DBH in order to reduce costs
Plantation &Understory Thinning	Thin plantations using skip and gap strategy	Thin plantations to increase vigor	Thin to even spacing. Consider waiting until commercial sized
NSO Nesting, Roosting, Foraging (NRF)	Maintain NRF in Critical Habitat units	Maintain NRF where it occurs, leave at higher density or don't underburn	Do not maintain NRF
Riparian Reserves (RR)	Thin outer half of Riparian Reserves where needed	No commercial harvest in RR	Same as Alt 1
Juniper Treatment	Hand cut, hand pile, and burn juniper in unit 40-08-28-1. Remove juniper in all other treatment areas where needed, along with first entry, or with second entry, depending on unit	Cut and leave juniper – scatter some tops and treat variably	Same as Alt 1
Fuels Treatment	Mechanical fuels treatment (brush mastication) in 2 units. Prescribed fire will be used to reduce fuels where possible	No brush mastication	Same as Alt 1
Mistletoe	Treat mistletoe only in specific areas, leave in others	Retain mistletoe trees - trees with large mistletoe brooms will not be removed	Target mistletoe trees for removal
Snags	Create snags to meet RMP guidelines 3 years post-harvest/prescribed fire	Same as Alt 1	No snags would be created
Medusahead Rye Treatment in unit 40S-08E-28	Prescribed fire (Fall burn) followed by pre-emergent application of imazapic on 2.7 acres, seeding with native perennial grasses	No treatment of medusahead rye	Application of imazapic on 2.7 acres, seeding with native perennial grasses
Temporary Road Construction	0.15 mile (795 ft.) of temporary road construction	No new road construction	Same as Alt 1

3 AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

The affected environment reflects the existing condition that has developed from all past natural events and management actions within the project area (or 5th field watershed). It is a combination of natural and human caused fires, fire suppression, road building, timber harvesting, grazing, fuel reduction treatments, and the effects of recreational use. The current condition assessed for each affected resource is a result of all past natural events and management actions. It is therefore unnecessary to individually catalog all past actions in this EA. Such detail would be irrelevant to making a rational decision among alternatives. The important value of this EA is to assess and display for the deciding official the impacts of the alternatives on those resources as they exist today, to allow a determination if the resulting project effects and/or cumulative effects are either significant or are greater than those analyzed in the RMP EIS.

Resource values that are either not present in the project area, or would not be affected by any of the proposed alternatives are: floodplains, wilderness study areas (WSAs), areas of critical environmental concern (ACECs), research natural areas (RNAs), paleontological resources, prime or unique farmlands, wild and scenic rivers, lands, and minerals. There are no known hazardous waste sites in the analysis area. For any alternative, no direct or indirect disproportionately high or adverse human health or environmental effects to minority or low income populations are expected to result from implementation of the proposed action or the alternatives.

3.2 Cumulative Actions Considered

The following overview provides a context in which to analyze the effects of the Keno Project Area. This summary of the analysis area and the future foreseeable actions provides a broad look at the analysis area, puts the project into perspective, and allows for comparison of action alternatives with the No Action Alternative (existing conditions). The Topsy/Pokegama Landscape Analysis (TPLA 1996) describes the events that contributed to the current condition such as early hunting/gathering by aboriginal inhabitants, mining, road building, agriculture and water diversions, wildfire, and timber harvest. Current timber management on the surrounding private land is more intensive and occurs on a larger scale. This management regime is expected to continue in the future. On most private lands, it is anticipated that residual vegetation will be reflective of early seral conditions and will meet pertinent state laws governing forest management practices.

Timber management activities proposed in the KFRA consist generally of density management (thinning) prescriptions and are designed to promote uneven-aged stand structure. In the future, stands throughout the Matrix allocation are expected to be selectively harvested approximately every 15 to 30 years, according to the KFRA RMP. Specific treatments currently proposed on BLM lands are listed in Table 4.

Table 4: Additional Treatments Currently Proposed on BLM lands in the Project Area

Treatment	Approximate Acres	Anticipated Year
PVJ Timber Sale EA- Density Management	790	2013/14
Keno 3 Juniper Pile Burning	60	2013/14
PVJ Timber Sale EA- Underburning	152	2013/14
PVJ Timber Sale EA- Hand cut, Pile and Burn	153	2013/14

3.3 Upland Forest Vegetation

Affected Environment

The Keno project area has a mixed conifer vegetation type with grasses, forbs, and shrubs (primarily manzanita and ceanothus) in the understory. Shrub density varies according to the amount of overstory cover and dense shrubfields generally dominate early seral habitat. The forest ranges from dense cover with down woody debris to a more open canopy with mainly grasses and shrubs in the understory. Forested lands in the proposed treatment area contain mixed species (primarily ponderosa pine and Douglas-fir, with smaller components of incense cedar, white fir, sugar pine, western juniper, Oregon white oak and California black oak). These stands are multi-aged and multi-layered. Tree ages vary from one year old seedlings to dominant overstory trees over 200 years old. From the 1950s through the 1990s, most of these stands were entered at least once for selective thinning and overstory removals. Many of the conifer-dominated stands have been selectively cut leaving an array of tree sizes and ages. There are some areas within the project area where most of the larger and older overstory trees have been harvested and the residual stands are a dense, multistoried mix of remnant trees and second growth.

The northeastern portions of the project area (approximately 400 acres) have a mixed conifer vegetation type with grasses, forbs, and small shrubs in the understory. The southeastern portion of the project area is made up primarily of clumpy ponderosa pine mixed with juniper. The eastern portions of the project area are primarily juniper shrublands. Throughout the project area there are scattered ponderosa and lodgepole pine plantations.

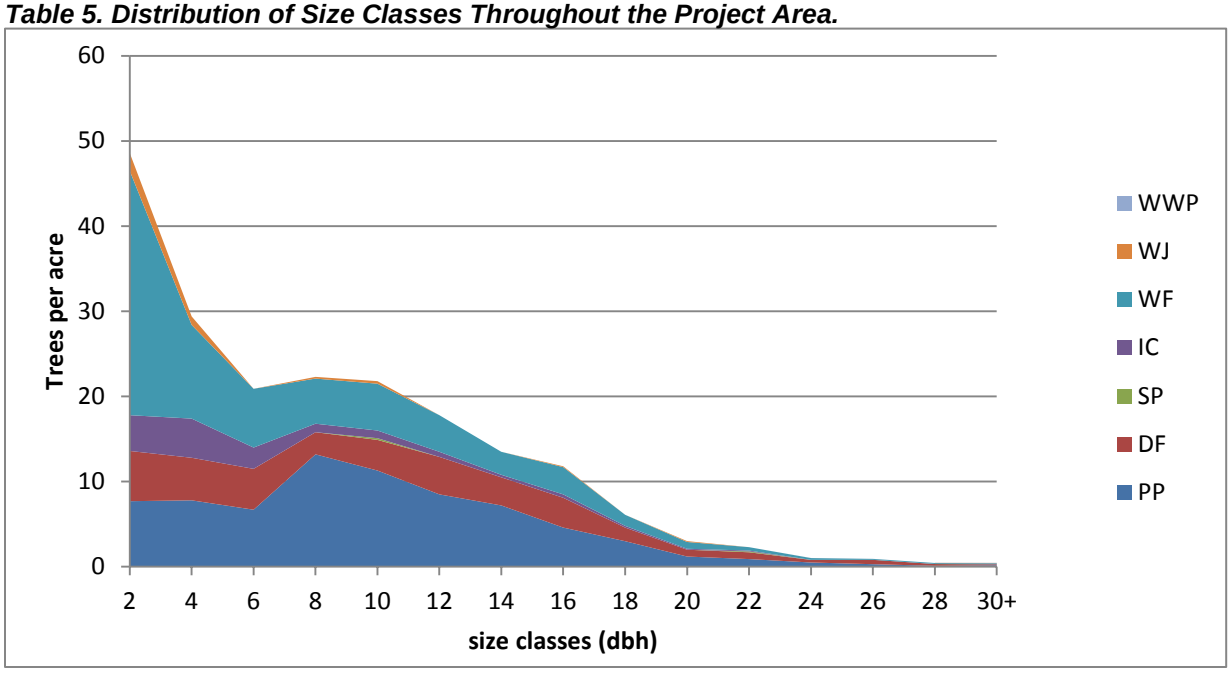
Plant associations are generally a mix of dry white fir associations at lower elevations with more moist associations occurring at higher elevations. Dry Douglas-fir associations are scattered throughout the white fir associations (Simpson 2007). White fir plant associations are often dominated by Douglas-fir and ponderosa pine in the overstory, as is largely the case in these stands. Although they may be referred to as moist in the plant association description, white fir and dry Douglas-fir plant associations are considered to be at the drier end of the plant association spectrum and are considered dry plant associations by Johnson and Franklin (2009). Plant communities in the EA project area are within those plant associations described by Hopkins (1979) for the Klamath Ranger District, Winema National Forest and by Atzet and McCrimmon (1990) for the Southern Oregon Cascade Mountain Province.

The units in the majority of the project area vary from 4000 to 5000 feet in elevation. These units are dominated by Douglas-fir and ponderosa pine and have a much lower proportion of white fir

than the units at higher elevation. The units on Hamaker and Chase mountains can vary from 5000-6300 feet in elevation. The species composition of the lower elevation units is very similar to historical species composition (Leiberg 1900) which suggests that the units at higher elevations have increased levels of white fir encroachment as a result of past management or disturbance.

Many stands are uneven-aged and have a wide variety of ages of trees in a single stand. See Appendix D in this EA for the procedure used to determine age on uneven-aged stands in Klamath Falls. Table 5 shows the species and size distribution throughout the project area. Stand metrics vary widely both between and within units. The forest stands are made up of a mosaic of clumps and gaps. Average trees per acre vary from 20 to more than 550. Average TPA for the timber sale units is 202. Average quadratic mean diameter (QMD) is 9.5 inches. Basal area (BA) varies from 0 to more than 250 sq. ft./ac. The average BA for all of the timber sale units is 89 sq. ft./ac. Average canopy cover for all timber sale units is 56%. The average total snags per acre for all of the timber sale units is 2.9 (2.5 snags less than 16”DBH and 0.3snags greater than 16”DBH). The average coarse woody debris is 119 ft/ac less than 19 ft. long and 9.5 ft./ac greater than 20 ft. long. Ages vary widely throughout the project area. Refer to Table 6 for land ownership and distribution of age classes throughout the Keno project area.

Table 5. Distribution of Size Classes Throughout the Project Area.



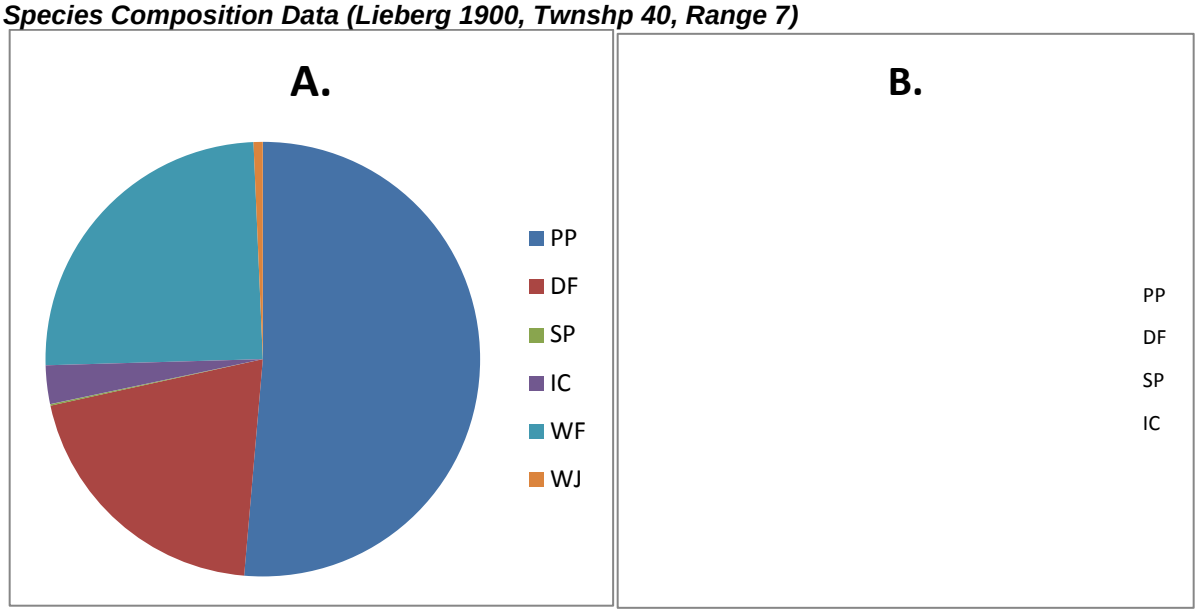
(WWP=Western white pine, WJ=Western juniper, WF= White fir, IC=Incense Cedar, SP=Sugar pine, DF=Douglas-fir, PP=Ponderosa pine)

Table 6. Land Ownership and Age Class Structure in the Keno Project Area

Owner	Age Class	Total Acres	% of BLM Land	% of Project Area	Acres Proposed for Treatment	% of Treatment area in BLM land
BLM Unforested Land		380	2%			
BLM Forested Land	0-20	835	5%		708	5%
BLM Forested Land	30-80	5696	37%		2984	20%
BLM Forested Land	90-150	6758	44%		2798	18%
BLM Forested Land	160+	1546	10%		396	3%
Total BLM Land		15217		28%		
USFWS Lands		4312		8%		
State Land		4119		8%		
Private Land		30673		56%		
Total Project Area		**54321**				

Historic vegetation in the area consisted of 55% Douglas-fir, 40% ponderosa pine, 5% sugar pine and scattered incense cedar. Some of the more western stands along the rim of the canyon had a higher percentage of ponderosa pine (60%) and sugar pine (15%), a lower percentage of Douglas-fir (22%), and 3% of a combination of both incense cedar and white fir. The southern units were historically 75% ponderosa pine and 25% Douglas-fir (Lieberg 1900).

Table 7. Comparison of A. Current Species Composition (by basal area) Data with B. Historic Species Composition Data (Lieberg 1900, Twnshp 40, Range 7)



PP=Ponderosa pine, DF=Douglas-fir, SP=Sugar pine, IC=Incense Cedar, WF= White fir, WJ=Western juniper

Table 7 displays the departure of the current species composition from the historic species composition. White fir is a much large component of the current stands than it was historically. A history of fire suppression within the project area has led to encroachment by fire intolerant species (primarily white fir). This encroachment has resulted in denser stands than those that

occupied these sites prior to European settlement. Increased stand density and ladder fuels have led to an increase in fire risk. These increases in density have also served to change the ecosystem and habitat functions from what they may have been historically.

There are a number of insects that can cause damage to both individual trees and groups of trees within these stands. Western pine beetle and mountain pine beetle are the insects most damaging to the ponderosa pine component in these stands. They affect older, stressed trees and dense second growth stands, respectively. The large pines that are affected are generally suffering from crowded growing conditions with dense stands encroaching upon the pine clumps. These crowded growing conditions often leave the pines in weakened condition and more susceptible to insect and disease mortality. Similarly, dense stands of second growth pines will stress trees and attract insects. Neither of these insects are currently at epidemic levels, however, drought conditions could cause high levels of mortality, especially in overcrowded stands. Stand density control is the most common recommendation for reducing mortality from these insects.

White fir is often attacked by the fir engraver beetle, *Scolytus ventralis*, and often suffers dieback of top branches, limiting height growth. Total mortality from the fir engraver can also occur when white fir is highly stressed during drought years, particularly on these drier, lower elevation sites. The fir engraver beetle has been responsible for substantial mortality to both white fir and Shasta red fir along the entire eastern slopes of both the southern Cascade Mountain Range and northern Sierra Nevada Mountain Range. Drought conditions in the early 1990's led to fir engraver killing over 60% of the standing volume in the Klamath basin in a four year period (Eglitis 2000). White fir stands on sites with mean annual precipitation rates below 32 inches (the majority of the project area) are more susceptible to beetle kill even if stand densities are kept very low (Cochran1998, Eglitis 2000).

Douglas-fir tussock moth can do quite a bit of damage to Douglas-fir and true firs (white fir, Shasta red fir, noble fir, sub alpine fir) on low elevation late seral stands that were traditionally ponderosa pine or on warm, dry sites (Simpson 2007). This would be typical of most of the project area. These insects are defoliaters that can cause top kill and mortality. Douglas-fir tussock moth outbreaks generally last three to four years. The best prevention of outbreaks would be species conversion to a species more appropriate for the site. Western spruce budworm is also a defoliator of the same species and often occurs coincidentally with it. They feed on new growth and can cause top kill and mortality and can affect tree growth and cause deformity. Both species may also target pines. Additional stress from defoliator damage can often lead to damage by bark beetles or root disease.

Tree pathogens are also present within the project area. Dwarf mistletoe (*Arceuthobium* spp.) is caused by a parasitic plant that attacks conifers and occurs throughout the project area. Mistletoe brooms create micro-habitat preferred by nesting northern spotted owls; at the same time, however, the disease is highly infectious in stands, deforms trees inducing bole and branch cankers that result in timber volume loss, and can kill trees. Dwarf mistletoe can be heavy in Douglas-fir and ponderosa pine and can cause both growth loss and mortality (Hopkins 1979). Young stands that are heavily infested will not develop into a large, tree dominated forest (Simpson 2007).

Root diseases such as Annosus, Armillaria, and laminated root rot are common in this area and occurred on 36% of plots examined (Simpson 2007). Annosus and Armillaria are the most common and tend to have the greatest mortality effect in stands of late successional true firs where previous management has occurred.

Western juniper is present throughout the project area, however it is more prevalent on the eastern side. Over the past 130 years, juniper has expanded into areas where it has not previously been found. This has largely been attributed to anthropogenic factors (Miller et al 2005). In response to this expansion, the BLM has worked to reduce juniper within forested conifer stands to levels designated in the RMP (RMP E-10). In stands of pure juniper, the BLM has worked to reduce juniper density in order to encourage the production of native forage species. Research studies have shown an increase in the productivity of forage species following juniper removal (Young et al. 1985; Vaitkus and Eddleman 1987; Bates et al 2000).

Further discussion of forested stands in the proposed treatment area can be found in the Topsy/Pokegama Landscape Analysis, 1996 (Forest Composition section, pp. 17-24, and Ecosystem Structure and Function section, pp. 27-34).

Environmental Consequences - Upland Forest Vegetation

Methodology

The treatments are designed to promote shade intolerant species, maintain or promote a multistoried stand, and to improve forest resiliency to fire, insects and disease by reducing stand density. Prescriptions are site specific and based on stocking guidelines taken from Cochran et al. 1994 and Cochran 1998. These stocking guidelines were recommended by the local pathologist. These guidelines will maintain the stand at a low enough density to reduce the risk of density-dependent mortality due to insects and disease, especially in the instance of a drought.

The Forest Vegetation Simulator (FVS) was used to model a 100 year period with specific treatments repeating every 30 years. The No Action Alternative does not model any treatments within the 100 year period. Three units (40-6-12-1, 40-7-17-1 and 41-7-11-1) were chosen to represent the density management treatments proposed in this EA. 40-6-12-1 is representative of some of the denser fir dominated stands in the area. 40-7-17-1 is representative of an average density management stand with a wide variety of species and tree sizes. 41-7-11-1 is representative of some of the less dense, drier pine sites. Model results will refer to these stands as dense, average and dry, respectively. This model is used to compare different treatments as applied to the same stands. It is not intended to provide accurate quantitative estimates of forest metrics, either post treatment or in the future.

No Action Alternative

This alternative would mean no immediate timber harvest in the project area.

Modeling for treatment units in the action alternatives shows that, without any treatments, an increase in volume and stand density would occur in all units. In the dense and average units, stand density increases for about 20 to 40 years and then levels off and begins to decrease. This indicates that these stand's carrying capacity would be reached in 20 to 40 years. At that time the stands begin to self-thin. In the average units, overall growth would be reduced after 20 years

as competition for common resources (water, light and nutrients) increases. In the dense units, growth begins to decline immediately. In the dry units, growth increases over time. Average stand diameter decreases in the dry stands as more small trees grow in, but at the end of the 100 year period remain essentially the same. In the average stands, stand diameter increases two inches over the 100 year period. In the dense stands, average stand diameter decreases over this time period. This is likely because the stands become so dense, that tree growth stagnates.

Modeling also indicates that over time, stands would become more and more white fir dominated. This is especially true of stands that contain white fir, as shade tolerance allows it to thrive under a thick canopy. As white fir increases in the stands, ponderosa pine decreases. This would move many of these stands further away from their historic species composition and stand structure.

Forest stands would grow denser. The stands would become more susceptible to insect and disease attacks and increasing density-dependent mortality. This is especially true in the Keno project area as it is drier than much of the resource area and therefore, more susceptible to damage agents (Eglitis et al. 2012). Mortality from insects is expected to continue, resulting in increased hazardous fuel loadings of dead material, both standing and ground level. This would potentially increase the severity of any future wildfires.

Dwarf mistletoe infected trees would be retained in all stands. This would allow the spread of dwarf mistletoe to non-infected trees and impact the development of seedlings and saplings located near infected trees. Dwarf mistletoe may also cause growth loss and mortality in host trees (Hopkins 1979). Dwarf mistletoe is likely to continue to spread throughout stands where it is present.

Stands proposed in the action alternatives for understory or plantation thinning would be especially prone to fire risk. Without treatment, ladder fuels would continue to accumulate which would lead to higher mortality in the event of a fire.

This alternative would fail to improve resiliency to drought, insects and disease, reduce hazardous fuel loading, restore fire dependent processes, restore historic stand structure and composition and utilize materials from treatments to produce forest commodities.

Cumulative Effects of No Action Alternative

Considering the 5th field watershed scale, the greatest vegetation change would be, and has been, on private lands. Industrial forestry (private land) objectives involve shorter rotations resulting in a higher percentage of early seral habitat. Even-aged management on private lands usually results in young stands of seedlings, saplings and pole-sized material, typically ponderosa pine. Over time, these stands generally develop into a mosaic of even-aged ponderosa pine stands distributed over the landscape with scattered natural second growth. Although some of the BLM units have been previously thinned, BLM forest lands in the area would continue as relatively dense stands, with increased mortality from bark beetle attack, resulting in an increased amount of forest fuels. The risk of stand replacing fires on these lands would also continue to increase.

Alternative 1 - Proposed Action

Alternative 1 incorporates the principles of Ecological Forestry. The objectives are to increase within stand heterogeneity, resiliency, and average stand diameter while producing forest products. The primary prescription in the timber sales for these units would be density management with unthinned "skips" (ranging in size up to five acres) and "gaps" (ranging in size up to five acres, similar to patch cuts). The size of the skips and gaps would vary widely, and treatment would range from heavy thinning to small openings surrounding selected species, seral conifer clumps, or individuals. The percentage of the skips and gaps would be approximately 10% (each) throughout the sale area, but would vary by unit.

In all harvests, conifer trees would be removed from all diameter classes (with the exception of most trees 150 years or older). This would leave a residual stand with less density and a variety of diameter classes. Species preference would focus on removing white fir where it is overly abundant. This would restore species composition to historic levels, leaving a residual, uneven-aged stand with trees of a variety of species and sizes.

In areas where the gaps are implemented, stocking would be evaluated, and the gaps would be planted with conifers or left to regenerate naturally, depending on surrounding seed sources. The openings created by the gaps would allow for the establishment of a new cohort of trees. The combination of density management and group selection would create a more heterogeneous stand structure. Likewise, leaving unthinned skips would ensure a more heterogeneous residual stand.

According to the Forest Vegetation Simulator (FVS) model, stand density and volume would fluctuate with each harvest (every 30 years) over a 100-year period. These regular harvests keep the stands below recommended stocking and stand density levels. These levels are recommended in order to keep the stands from exceeding its carrying capacity and to reduce the danger of large scale mortality loss as a result of insects that favored stressed trees. Residual volume increases over time in the dense stands, remains constant in the average stands and is reduced slightly in the dry stands. Stand density stays fairly constant over time for the dry stands and the average stands, but decreases over time in the dense stands. This decrease in stand density (with an increase in volume in the dense stands) indicates that larger trees are taking the place of many smaller trees.

Growth would decrease in the dense stands, stay constant in the average stands, and increase in the dry stands. Again, this indicates that over time, more larger trees would develop in the denser stands and more younger trees would develop in the dry stands. Lower growth in the dense stand may also be due to Alternative 1 retaining a higher density (120 BA in Alternative 1 as compared to 80 BA in Alternative 3).

In Alternative 1, average stand diameter would increase slightly (one inch DBH) in the average stands, decrease slightly in the dry stands (two inches DBH), and increase in the dense stands by eight inches DBH over the 100 year period.

Mortality in the stands would be reduced with every harvest and then would increase over time until the next harvest. The highest levels of mortality in the dry and average stands under this

alternative are only 30 to 40% of the mortality for the No Action Alternative. Mortality in the dense stands are slightly higher than the other stands (45% of the No Action Alternative). This is also higher mortality than Alternative 3. This can be attributed to the higher density retained in the dense stands in Alternative 1. Regular harvests reduce the risk of mortality within the stands and allow that mortality to be captured and used as forest products.

The highest volume per acre over time would come from the average stands, although these stands would have the lowest initial volume per acre. The highest initial volume per acre would come from the dense stands, despite the higher residual basal area.

These metrics indicate that Alternative 1 would provide larger tree growth in the denser stands, smaller tree growth in the dry stands, and a sustainable level of various sizes of trees in the average stands.

Some dwarf mistletoe infected trees would be retained in all stands. Dwarf mistletoe would be retained in clumps or in large single trees in which the dwarf mistletoe brooms create desired wildlife structure. Scattered dwarf mistletoe infected trees would be removed. In areas where dwarf mistletoe is retained, this would allow the spread of dwarf mistletoe to non-infected trees and impact the development of seedlings and saplings located near infected trees. It may also reduce growth and cause mortality in infected trees (Hopkins 1979). In areas where dwarf mistletoe is eliminated, it is likely that spread to other trees would be reduced. Dwarf mistletoe is likely to continue to spread throughout stands where it is present, however these areas would be reduced by the removal of scattered dwarf mistletoe infected trees.

Plantation and understory thinning would be performed under Alternative 1, which would lead to a reduction in ladder fuels and stand density. This would lower the mortality levels, as compared to the no action alternative, in the event of a fire.

Creating large (less than 16” dbh) snags in the timber sale units would reduce the number of large, live overstory trees. These are generally young small diameter stands that are deficit in large snags (see Table 5 for distribution of size classes). The snag guidelines were generated with older stands in mind. In these stands if snags are determined to be deficient, snags will be created from what is available within the stand. These snags may not meet the 16” diameter guidelines, however they would represent the trees available in the stand.

This alternative would improve resiliency to drought, insects and disease, reduce fuel loading, restore fire-dependent processes, restore historic stand structure and composition and utilize materials from treatments to produce forest commodities.

Cumulative Effects of Alternative 1

The Topsy/Pokegama Landscape Analysis (TPLA) (1996) describes the events that contributed to the current condition such as early hunting/gathering by aboriginal inhabitants, mining, road building, agriculture and water diversions, wildfire, and timber harvest. Forested vegetation zone descriptions can be found on pages 17-34 in the TPLA.

Potential future harvesting and fuels treatments on BLM lands within the watershed (see Section 3.2, Cumulative Actions Considered) would have similar impacts on the timber stand density and canopy closure as described for Alternative 1. These types of actions were analyzed for the Matrix and Riparian Reserve land use allocations in the KFRA RMP Final Environmental Impact Statement (FEIS) (Biological Diversity 4-24 to 4-32, Ecosystem Health 4-32 to 4-33, Vegetation Management 4-35-4-4). Thinning of timber stands would affect the relative abundance of tree species in a stand, but would not affect the overall diversity of species across the landscape. Lower levels of stand density and the use of prescribed fire would result in higher vigor of individual plants and an increase in community and ecosystem stability. Density management proposed under the RMP would contribute to the improvement of forest resiliency. The potential future actions mentioned would be within the range of effects described in that FEIS analysis. Potential future recreation and road actions would have little to no effect on upland forest vegetation.

The effect of Alternative 1 on BLM lands, combined with future actions on private lands would result in no change in age or seral classification of stands on BLM lands within the watershed. Generally, the seral classification of BLM lands would remain mid to late seral as the structural and functional composition of the stands would be maintained after treatment. As stated above, the greatest change in vegetation would likely occur on private lands with an increased percentage of early seral habitat.

Alternative 2

This alternative maintains northern spotted owl (NSO) nesting, roosting, foraging (NRF) habitat, limits harvesting to less than 21” DBH for fire-tolerant species, would not target dwarf mistletoe infected trees for removal, and would not include tree harvest in riparian reserves or late successional habitat. The density management prescription in Alternative 2 would include unthinned skips, but would not include gaps.

In Alternative 2, fire-tolerant species up to 21” DBH would be thinned. White fir would be thinned in all diameter classes. This would leave a residual stand with less density and a variety of diameter classes. Species preference will focus on removing white fir where it is judged to be overly abundant. This would restore species composition to historic levels. The residual stand would be an uneven-aged stand with trees of a variety of species and sizes.

Initially, the diameter limit would not make much difference in stand structure when compared with Alternatives 1 and 3. Because most of these stands are very young, the majority of the trees (98%) are less than 21” DBH (See Table 5 for distribution of size classes). As the stands age, however, focusing harvest on the smaller trees would create a single layer of large trees as opposed to a variety of sizes and layers as described in Alternatives 1 and 3.

Under this alternative, the stands that would be represented by the “dense” stand are reserved from harvest. As a result, the environmental consequences to these stands would be similar to what is described in the No Action Alternative.

The FVS model shows that stand density and volume would fluctuate with each harvest (every 30 years) over a 100 year period. These regular harvests keep the stands below recommended stocking and stand density levels. These levels are recommended in order to keep the stand from exceeding its carrying capacity and to reduce the danger of large scale mortality loss as a result of insects that favored stressed trees. Volume increases over time in all the stands. Stand density stays constant in the average stands. Stand density in the dry stands decreases slightly over time. Growth decreases in all of the stands, likely because the younger trees that would have higher growth rates are removed in each harvest.

Average stand diameter would increase for all of the stands, but the average stands would show the lowest increase at about seven inch DBH over the 100-year period. This is less of an increase in stand diameter than is shown in Alternative 3, but more than is shown in Alternative 1. Dry stands increase almost 26" over a 100-year period. This dramatic increase is due to the smaller trees being eliminated (over 100 years) from the stand leaving only the larger trees.

Mortality in the stands would be reduced with every harvest and then would increase over time until the next harvest. The highest levels of mortality in the stands under Alternative 2 are 30 to 40% of the mortality that would occur under the No Action Alternative. Mortality is similar to Alternatives 1 and 3 for the average stands. Mortality in the dry stands would be lowest in Alternative 2, likely because most of the potential mortality is captured in the harvests.

Alternative 2 would produce the lowest total volume per acre for the dry and average stands. Alternative 2 would produce a lower volume than Alternatives 1 and 3 because 18% of the treatment units would not be treated with a density management prescription. Likewise, of the units that are proposed for treatment under this alternative, many of the units are prescribed a higher basal area to maintain NRF habitat. This would also result in a lower overall volume for this alternative when compared to Alternatives 1 and 3.

The effects on 18% of the proposed units left untreated under this alternative would be similar to those under the No Action Alternative.

Dwarf mistletoe infected trees would be retained in all stands. This would allow the spread of dwarf mistletoe to non-infected trees and impact the development of seedlings and saplings located near infected trees. Dwarf mistletoe may also cause growth loss and mortality in host trees (Hopkins 1979).Dwarf mistletoe is likely to continue to spread throughout stands where it is present.

Alternative 2 includes plantation and understory thinning, which would lead to a reduction in ladder fuels and stand density. This would lower the mortality levels, as compared to the No Action Alternative, in the event of a fire.

Creating snags in the timber sale units would have similar effects to those described in Alternative 1. This alternative would improve resiliency to drought, insects and disease, reduce fuel loading, restore fire dependent processes, and utilize materials from treatments to produce forest commodities on all the units treated. In the long term, this alternative would fail to restore historic stand structure as the diameter limits would create stands that are primarily a single story

of large trees rather than a multi storied, uneven-aged structure as would be maintained in Alternatives 1 and 3. The 18% of acres not treated under this alternative would fail to meet all of the goals described under the purpose and need section.

Cumulative Effects of Alternative 2

Overall, the cumulative effects of the treated acres in Alternative 2 would be similar to Alternative 1. The cumulative effects on the untreated acres reserved from harvesting and prescribed fire would more closely resemble the cumulative effects of the No Action Alternative. Potential future harvesting and fuels treatments on BLM lands within the watershed would have similar impacts on the timbered stand density and canopy closure as described for Alternative 1 and would be within the range of effects described in the FEIS (referenced above). Potential future recreation and road actions would have little to no effect on upland forest vegetation.

Alternative 3

This alternative attempts to focus harvesting in areas that contain the most volume as a means to reduce the costs of the harvest. The primary prescription in this alternative is density management with 15% of the stands in gaps of up to five acres in size.

In all harvests under Alternative 3, conifer trees would be removed from all diameter classes. This would leave a residual stand with less density and a variety of diameter classes. Species preference would focus on removing white fir where it is judged to be overly abundant. This would restore species composition to historic levels. The residual stand would be an uneven-aged stand with trees of a variety of species and sizes.

In areas where the gaps are implemented, stocking would be evaluated and the openings would be planted or left to regenerate naturally depending on surrounding seed sources. Group selection would allow for the establishment of a new cohort of trees. The combination of density management and group selection would create a more heterogeneous stand structure than density management alone.

Stand density and volume would fluctuate with each harvest (every 30 years) over a 100-year period. These regular harvests would maintain the stands below recommended stocking and stand density levels. These levels are recommended in order to keep the stand from exceeding its carrying capacity and to reduce the danger of large scale mortality loss as a result of insects that favor stressed trees. Over the 100-year time period, stand density would be reduced in the average and dense stands. In the dry stands, stand density would increase over time, but overall residual volume would be reduced as more large trees are removed.

In Alternative 3, growth would decrease slightly in the average and dense stands, but would increase in the drier stands. Average stand diameter would increase eight to ten inches in the average and dense stands, but would stay constant in the dry stands.

Mortality in the stands would be reduced with every harvest and then would increase over time until the next harvest. The highest levels of mortality in the stands under this alternative are 30 to 40% of the mortality that would occur under the no action alternative. In comparison to the other alternatives, this alternative results in the lowest levels of stand mortality. Regular harvests

would reduce the risk of mortality within the stand and allow that mortality to be captured and used as forest products.

The highest volume per acre over the 100-year period would be harvested from the average stands, although these stands would also yield the lowest initial volume. The highest initial volume would come from the dense stands.

All dwarf mistletoe infected trees would be harvested in all stands. This would slow the spread of dwarf mistletoe to non-infected trees and reduce the impact on the development of seedlings and saplings located near infected trees. Dwarf mistletoe is likely to continue to spread more slowly throughout stands where it is present in Alternative 3 when compared to Alternatives 1 and 2.

Plantation and understory thinning would be performed under this alternative which would lead to a reduction in ladder fuels and stand density. This would lower the mortality levels, as compared to the No Action Alternative, in the event of a fire.

This alternative would improve resiliency to drought, insects and disease, reduce fuel loading, restore fire dependent processes, restore historic stand structure and composition and utilize materials from treatments to produce forest commodities.

Cumulative Effects of Alternative 3

Overall, the cumulative effects of the treated acres in Alternative 3 would be similar to Alternative 1. Potential future harvesting and fuels treatments on BLM lands within the watershed would have similar impacts on the timbered stand density and canopy closure as described for Alternative 1 and would be within the range of effects described in the FEIS (referenced above). Potential future recreation and road actions would have little to no effect on upland forest vegetation.

3.4 Botany

Special Status Plant Species (Survey and Manage and Bureau Sensitive)

Affected Environment and Methodology

Vascular and Nonvascular Plants
Botanical surveys completed in the field season of 2012 covered approximately 4,000 acres in the Keno EA treatment units. No special status or survey and manage vascular or nonvascular plant species were found.

Fungi
Fungi surveys were conducted in stands over 180 years old in the spring of 2012 over 17 acres of the proposed project area. These surveys yielded no special status or S&M fungi found after completing two seasons of surveys. Based on the Pechman's exemptions of 2006, additional seasons of fungi surveys will not be completed because the treatment proposed in this unit is

only a fuels treatment. Since there were no special status species of any plant or fungi found within the Keno project units during 2012 surveys, no further analysis is needed in this EA. The complete analysis of the botanical resources is located in the Keno EA project record.

Noxious Weeds

Several populations of noxious weed species are located on BLM lands within the project area. Weed populations are mostly located in roadside habitats or past harvest units, and are primarily associated with physical disturbance. The following noxious weeds were found in the project area during botanical surveys:

Medusahead rye (*Taeniatherum caput-medusae*), two sites, approximately 3.2 acres
Klamath weed (*Hypericum perforatum*), two sites, approximately 500m²
Scotch thistle (*Onopordum acanthium*), one site, approximately 1m²
Canada thistle (*Cirsium arvense*), three sites, approximately 55m²
Diffuse knapweed (*Centaurea diffusa*), one site, approximately 30m²

The Oregon Department of Agriculture (ODA) Noxious Weed Control Policy and Classification System for 2012 classifies these five species as "B" designated weeds which are weeds of economic importance that are regionally abundant, but may have limited distribution in some counties. The following description of medusahead impacts is from the Oregon Department of Agriculture website (http://oregon.gov/ODA/PLANT/WEEDS/profile_medusaheadrye.shtml): "*Found in virtually every county in the state, medusahead rye demonstrates its negative qualities best on the east side of Oregon where it out-competes other grasses by extracting the majority of moisture well before perennial grasses have begun to grow…Medusahead rye changes the temperature and moisture dynamics of the soil, greatly reducing seed germination of other species, and creating fuel for wildfires.*"

Environmental Consequences - Noxious Weeds

No Action Alternative

Under the No Action Alternative, the BLM would not implement new management actions that could result in ground disturbance, changes in canopy cover, or importation of noxious weed seeds or plant parts into the Keno EA project area. Therefore, implementing the No Action Alternative would result in no direct or indirect impacts to noxious weeds.

By not treating the medusahead rye in unit 40S-08E-28, the 2.7-acre population would continue to spread out from this small population into more public and private land, creating a larger population. Medusahead exhibits characteristics that allow it to suppress native perennial species. It germinates in late winter and begins growth before the perennial species, thus using available moisture in the upper soil layers. Medusahead litter is also high in silica and has a slow decomposition rate that allows it to build up over time and suppress native plants (Bovey et al. 1961). The result is often a dense monoculture of medusahead (George 1992). This buildup of litter also increases the potential fire frequency to the detriment of native perennials (Torell et al. 1961, Young 1992, Milton 2004). It also decreases biodiversity, reduces livestock forage

production, and degrades ecological function of native plant communities (Davies and Svejcar 2008).

Cumulative Effects of No Action

Past activities in the Keno project area that have likely contributed to the introduction and spread of noxious weeds on both private and public lands include road building and vehicular traffic, timber harvest, livestock grazing, wildfire, agriculture, rural land development, mining, and recreational activities. In addition, weeds spread through natural processes such as transportation by wind, water, birds, or animals.

These human-caused activities and natural processes will continue to present risks of introducing new and spreading existing noxious weed populations in the watershed. While there is a potential for continuous influx of noxious weeds due to those activities, the BLM has an ongoing program of inventory and treatment of noxious weeds within the Keno project area. Treatments in the past few years have focused on quarries and road systems. Treatments in those areas and new areas discovered in 2012 are funded for 2013.

Added to past, present, and foreseeable future actions, implementing the No Action Alternative would not contribute additional cumulative effects to noxious weeds in the Keno project area beyond existing conditions because no new activities would occur that create risks of introducing or spreading them.

Effects Common to All Action Alternatives

The proposed water source and pipeline construction, road decommissioning, and planting of conifers would be the same in all three action alternatives.

Water Source and Pipeline Construction

Noxious weeds could be introduced or spread by equipment used for the water source restoration. Weed seeds or other plant parts could be brought into the project area by vehicles or equipment coming from infested sites outside the project area. If noxious weed populations are present at or adjacent to the water sources, weed seeds or parts could be spread at the site during the work or transported to different areas when the equipment moves to another location. Weed seeds or plant parts could also be transported to another location and result in the establishment of new populations if present in material removed from the water sources.

Soil disturbance would occur when water sources are cleaned out or soil rearranged to provide better water containment. The newly disturbed soil provides favorable conditions for noxious weeds to become established. Removing overhanging vegetation could also create favorable environmental conditions for new infestations by providing increased space and light for noxious weeds. Seed could blow in or be carried in by animals or vehicular traffic and become established in the recently disturbed sites.

To prevent importing noxious weed seeds to the pump from other areas, heavy equipment would need to be cleaned to remove all plant parts and seeds prior to coming to work in the project area. If noxious weed populations are discovered at a water source from which soil is removed, the

areas where it is deposited would be monitored for a minimum of three years to detect and treat noxious weeds. Drinking water sources would also be monitored after construction is complete to detect and treat noxious weeds.

Road Closures
The majority of roads proposed for closure have not been driven for a number of years. However, they may contain noxious weed populations. Equipment would be required to be cleaned prior to moving into the area to reduce the risk of introducing or spreading weeds (see PDFs in Appendix B). Over the long term, closing the roads would reduce the path along which weeds can travel in the Keno project area.

Planting conifers
Planting conifers causes minor soil disturbance, which can leave areas vulnerable to noxious weed establishment. Most species of noxious weeds prefer disturbance and are shade-intolerant, however, so planting conifers would aid in the prevention of future populations of noxious weeds to be established.

Alternative 1 – Proposed Action

Timber harvest and the associated road work and hazardous fuels treatments could introduce or spread noxious weeds within the project area unless PDFs are applied. Management activities which disturb the soil and remove existing vegetation leave areas open for possible invasion by noxious weeds.

Noxious weed seeds or plant parts could be transported from infested areas outside the project area to non-infested areas within the project area on equipment or vehicles used for timber harvest or road work. Vehicles or equipment could spread seeds or plant parts while traveling in and out of the project area along the haul routes or between units during timber harvest operations.

Activities that disturb the soil create favorable conditions for establishment of noxious weeds. Noxious weeds possess biological characteristics that allow them to quickly occupy disturbed sites by germinating, developing, and producing abundant seeds. Mechanical harvest would create a risk of spreading weed seeds or plant parts into the harvest units if equipment is exposed to noxious weed populations prior to being unloaded or if noxious weed populations are present in the units. Noxious weed populations have been documented along roads going through the units.

Road construction would also create disturbed areas that favor establishment of noxious weeds. In Alternative 1, approximately 795 feet of temporary spur roads would be constructed. Landings are also areas highly vulnerable to noxious weeds because vegetation is removed, soil is compacted, and traffic moves continuously in and out.

Removing vegetation leaves areas open for establishment and occupation by noxious weeds. The more open an area, the more susceptible it is to invasion by a variety of noxious weeds that occur in the units. In Alternative 1, timber harvest would remove some overstory trees and leave a

lower percent canopy. These stands would be vulnerable in the short term to invasion by noxious weeds that are shade intolerant.

In the short term (approximately 1 to 5 years), proposed timber harvest activities within the project area could result in a reasonable probability of introducing or spreading noxious weeds. However, the rate at which weeds could potentially spread as a result of these activities cannot be predicted due to the indistinguishable causal effect of other activities and factors.

Implementing PDFs (see Appendix B) would reduce the risk of introducing noxious weeds into the project area. These measures are the recommended weed prevention strategies in the action plan developed by the western states BLM weed coordinators, with review and input by 30 individuals from agricultural research services, state agencies, universities, weed societies, and weed advisory councils with backgrounds in weed prevention and control (Bureau of Land Management 1996, 35-40).

Herbicide Application

Alternative 1 includes noxious weed treatment in unit 40S-08E-28. The BLM would manage this 2.7-acre population of medusahead rye with a prescribed burn, followed by pre-emergent application of imazapic, then seed with native perennial grasses.

Effects of Prescribed Burn

Prescribed burning, when used in combination with herbicide application, is an effective management tool for the control of noxious weeds. Medusahead rye has been shown to be reduced after prescribed burning as a stand-alone treatment (Kyser et al. 2008). However, using prescribed burning prior to imazapic application shows a significant decrease in medusahead rye (Sheley et al. 2007, Davies 2010), due to the removal of thatch left over from prior growing years (Kyser et al. 2007). Prescribed burning the 2.7 acre unit infested with medusahead rye would remove the thatch layer and allow for the herbicide to penetrate the pre-emergent seed. Prescribed burning should not negatively impact the existing native plant community, as it has been used to revitalize perennial grasses by encouraging more above-ground growth (Rau et al. 2008, Blank et al. 1994). This benefits native wildlife species dependent on sagebrush ecosystems (Connelly et al. 2004). Burning in semi-arid environments can result in increased available nutrients and reduce competition for resources from woody species (Sturgis 1993) and increase abundance of perennial herbs (Cook et al. 1994).

Effects of Imazapic

The proposed herbicide, imazapic (BLM-approved trade name: Plateau), and its impact to vegetative communities are as follows: Treating with Plateau would have moderate risk to no risk to the health of upland vegetation (National Veg. FEIS pp. 4-49 and 53). Applications of 6oz/acre (0.178125 pounds/acre of active ingredient imazapic) would be below the maximum rate of 0.1875 pounds/acre analyzed by the Oregon Veg. FEIS (CH 3, pp. 60) and National Veg. FEIS (Appendix C-9) authorized to treat infested sites (Oregon Veg. FEIS C-9). Risk to the health of terrestrial and Special Status plants at this application rate from direct spray would have moderate risk; offsite drift, low risk (Special Status spp.) and no risk (terrestrial); surface runoff, no risk; and wind erosion, no risk. It has been observed that fall applications with 6oz/acre Plateau would further reduce the risk from moderate to low from direct spray on non-target plant

species because these plants are dormant (Davies 2010; Davies and Sheley 2011). Plateau would reduce medusahead rye and allow existing native plants or seeded areas the opportunity to compete for available resources such as water, nitrogen and other nutrients, and re-establish the site once occupied by this invasive noxious weed.

Native Plant Seeding
Within the proposed herbicide application area (see Map 3 in Appendix A), the proposed action to seed native perennial grasses provides the highest likelihood that perennial vegetation would establish and persist to carry out ecological processes. If establishment is successful, there would be green plants through much of the growing season. This breaks up the uniform fuel conditions created by invasive annual grasses that typically become dry and flammable by the end of June. Thus, even in poor production years, there would be plants present to protect the soil. While medusahead rye produces a dense ground cover in good years, following several years of poor production, the soil can be nearly bare. Sheet erosion occurs under the medusahead rye thatch layer. The seeded species create more structure than a medusahead rye-dominated community. Successful seeding of the selected species would interrupt the transition to an invasive annual grass-dominated community, introduce a longer green period through the growing season, provide more habitat values than an invasive annual grass community, and allow plant succession to occur. In comparison to a medusahead rye-dominated community, establishment of native plants would be on a faster successional trajectory towards a healthy native plant community.

Alternative 2

Potential direct and indirect effects of timber harvest, road work, and treatment of post-harvest slash would be similar in Alternative 2 as those described in Alternative 1. One difference would be that NRF and late successional habitat would not be treated, amounting to 24% of untreated units, with a lower risk of noxious weed invasion in those units.

Alternative 2 does not include medusahead rye treatment in unit 40S-08E-28. There would not be a prescribed burn, imazapic application, or native perennial grass seeding on the 2.7 acre population of medusahead rye. Medusahead would then spread out from this small population into more public and private land, creating a larger population.

The impacts and risks of introducing or spreading noxious weeds in the project area would be the same in Alternative 2 as described in Alternative 1 for haul routes, mechanical harvest, road construction, landings, brush mastication, underburning, and road improvement. The same PDFs would also be applied to reduce the risk of introducing or spreading noxious weeds.

Alternative 3

Potential direct and indirect effects of timber harvest, road work, and treatment of post-harvest slash would be similar to those described in Alternative 1 except that the canopy cover would be reduced to 60-80% on slightly more acres, but the total acres treated would be similar to Alternative 1 and 2. The same PDFs would also be applied to reduce the risk of introducing or spreading noxious weeds.

Herbicide Application
In unit 40S-08-28, Alternative 3 includes only herbicide treatment and seeding with native perennial grasses (no prescribed burn) to treat the 2.7 acre population of medusahead rye. The effects of imazapic herbicide application and native grass seeding would be similar to those described in Alternative 1. Without a prescribed burn prior to imazapic application, however, the herbicide may not reach the medusahead seed effectively. Imazapic would be absorbed by fewer medusahead seed and allow for more medusahead seed to germinate. This may become costly if repeat treatments may be needed each year, and more imazapic treatments may be needed overall.

Cumulative Effects for All Action Alternatives

Past, present, and anticipated future activities in the Keno project area would be the same as those described in the No Action Alternative. These human-caused activities and natural processes will continue to present a risk of introducing new noxious weeds and spreading existing populations.

Added to past, current, and future activities, the proposed timber harvest, planting conifers, waterline construction, fuels treatments, and related road work may add cumulative effects to noxious weeds in the project area, but the use of PDFs would reduce the risk of these effects. The risk of introducing or spreading noxious weeds as a result of activities proposed in Alternative 1, 2, or 3 is low to moderate if weed treatments continue to be funded. The risk of increasing weeds as a result of implementing Alternative 2 would be lower compared to that in Alternative 1 or 3 because the total acres impacted, acres of mechanical harvest, and miles of road construction and road improvement are fewer in Alternative 2. The major difference is that no harvest in NRF and late successional habitat in Alternative 2 would leave 26% of units untreated, and less of a risk of exposure to noxious weed invasion. However, the lack of herbicide treatment on medusahead rye in Alternative 2 would allow the spread from this small population into more public and private land. The application of PDFs would reduce the risks that activities in any of the action alternatives would add cumulative effects to noxious weeds in the Keno Treatment unit area.

It is anticipated that ongoing activities on private lands and activities over which the BLM does not have control will continue to create situations in which noxious weeds could be introduced and spread. On-going treatments and monitoring by the BLM and continued collaboration with outside groups increase the chances of containing or reducing noxious weed populations in the watersheds and the project area.

3.5 Fire and Hazardous Fuels

Affected Environment and Methodology

Within the project boundary, there was an average of six fires per year based on fire start data from 1967 to 2011. The primary cause of these fires was lightning and the majority of fires are extinguished by initial attack firefighters while they are less than ¼-acre in size. Currently, fuels in the project area can generally be described as moderate load conifer litter and moderate load dry climate shrub. Under 90th percentile weather conditions, this fuel model could have surface flames lengths up to nine feet, based on outputs from BehavePlus (5.0.5) modeling. 90th

percentile weather conditions for the project area are based on historical records obtained from the nearby Parker Mountain remote area weather station (RAWS) observations from June 1st to October 1st (typical fire season) between 1995 and 2012.

Based on Landfire Data (2008), the majority of fuels within the project area are categorized as Fire Regime I, Condition Class II. Fire Regime I can be described as conditions where historically, fires occurred every 0 to 35 years, and were generally of low to mixed severity. Condition Class II indicates that fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals. This departure could result in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from historical range.

Over 50% of the Keno WUI analysis area is covered under the Keno Rural Fire Department's Community Wildfire Protection Plan for Keno, Oregon and surrounding areas, making it a high priority for fuels reduction treatments.

Environmental Consequences – Fire and Hazardous Fuels

No Action

Under the No Action alternative, both surface fuels and ladder fuels would increase over time, which would increase fire intensity, flame length, and rate of spread in the event of wildfire. Fuel models could change from primarily a moderate load conifer litter and moderate load dry climate shrub to a fuel model that could be described as timber litter containing small downed logs and a high load, dry climate shrub. This would increase potential flame lengths under 90th percentile weather conditions to over 28 feet.

Alternative 1 – Proposed Action

Fuels treatments identified in Alternative 1 include underburning, brush mastication, and hand thinning, hand piling and pile burning. Underburning is proposed on approximately 1,131 acres following thinning treatments. Thinning will reduce ladder fuels and decrease the continuity of the overstory trees. Underburning will consume existing and activity-generated surface fuels. Underburning would occur in those stands that are pine-dominated, rather than those stands that are fir-dominated. The combination of these treatments would result in lower flame lengths, fire intensity, and rate of spread during a wildfire. There is one unit that is approximately 62 acres where only underburning is proposed in a stand that had been previously thinned. Brush mastication is proposed in two units totaling approximately 404 acres. Thinning would occur first, followed by brush mastication. Brush mastication is proposed (rather than underburning) due to the high brush component and smaller diameter of the trees in these two units. Smaller diameter trees tend to be less fire resilient and brush mastication would not expose these trees to underburning while still reducing surface fuel height. Smaller diameter trees would not be targeted during brush mastication, however some small trees in the brush may be taken.

There are two units where hand thinning, piling, and pile burning are proposed. One of those units is a juniper woodland unit, totaling approximately 202 acres. This unit is surrounded by private property and residence. This treatment would thin juniper trees in a mosaic pattern to

reduce fuel continuity and fuel loading. After hand thinning, the residual trees will be hand piled and burned under conditions that are favorable for smoke dispersion. The second unit (approximately 150 acres) is proposed for cable logging, followed by hand piling and pile burning to reduce primarily activity-generated slash. However, some existing surface fuels and small diameter trees may also be hand thinned and piled under Alternative 1.

Approximately 404 acres of plantation thinning are not proposed for follow-up fuels treatments due to low surface fuel loading. Thinning itself will reduce ladder fuels and fuel continuity.

Approximately 2,587 acres are proposed for thinning throughout all size classes (except trees determined to be greater than approximately 150 years old) which would reduce ladder fuels in the understory. Brush mastication was not proposed in these acres due to limited surface fuels. Underburning was not proposed in these units since they have a high component of fire intolerant white fir.

Current fuels can be described as moderate load conifer litter and moderate load dry climate shrub. Under 90th percentile weather conditions, this fuel model could have surface flames lengths up to nine feet. After treatments proposed in Alternative 1, surface and ladder fuels would be reduced and the resulting fuel model would be described as a moderate load conifer litter where flame lengths under 90th percentile weather conditions would be reduced to an average of two feet.

Alternative 2

Alternative 2 differs from Alternative 1 in that there would be no brush mastication proposed in two units totaling 404 acres. The understory brush and surface fuels would not be treated after the thinning occurred. In the juniper woodlands unit (approximately 202 acres), juniper thinning would occur but some tops would be left on the surface rather than hand piled and burned. The slash would be left on the ground which would create increased surface fuels. This would contribute to higher surface flame length and rate of spread in the unit which is surrounded by private property and residences. The additional surface fuels would increase potential fire effects for approximately three to five years until the needles fell form the branches. After the needles fall off the branches, the branch skeletons would remain, and there would be less fine fuels to carry fire and the slash would not have as much of an increased effect on flame length and rate of spread.

Current fuels can be described as moderate load conifer litter and moderate load dry climate shrub. Under 90th percentile weather conditions, this fuel model could have surface flames lengths up to nine feet. After treatments proposed in Alternative 2, surface and ladder fuels would be reduced in all areas treated and the resulting fuel model would be described as a moderate load conifer litter where flame lengths under 90th percentile weather conditions would be reduced to an average of two feet. Under Alternative 2, there would be 404 less acres treated with brush mastication than in Alternative 1. The fuel model for those 404 acres would remain the same as the current fuels description since surface and ladder fuels would not be treated on those areas and over time, the fuel model on these 404 acres would change to a fuel model that could be described as timber litter containing small downed logs and a high load, dry climate

shrub. This would increase potential flame lengths under 90th percentile weather conditions to over 28 feet.

Alternative 3

The fuels treatments in Alternative 3 are the same as those proposed in Alternative 1, so the effects of those treatments would also be the same.

Cumulative Effects

Past fuels treatments and currently proposed fuels treatments on Federal and private lands adjacent to the project area, in addition to this project, contribute favorably to reducing hazardous fuels in much of the Keno WUI project area by reducing potential fire behavior.

3.6 Terrestrial Wildlife

Affected Environment

This section focuses on species considered special status species that may be affected from management activities. These will include species listed under the Endangered Species Act (ESA - listed, proposed and candidate species), species listed under the BLM special status species policy as Bureau Sensitive, species listed as Survey and Manage (USDA/USDI 2001), and land birds classified as Species of Concern (USDI FWS 2008a) by the U.S. Fish and Wildlife Service (FWS). Table 8 is a list of terrestrial wildlife species that may be affected and were considered in the analysis for this EA. For a list of other species and a description of their habitat that may occur in the proposed project area, refer to the 1994 Klamath Falls Resource Area FEIS (pages 3-37 to 3-41). A complete list of BLM Special Status Species that occur on the Lakeview District, Klamath Falls Resource Area may be found at: http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy.

Table 8. Special Status Species that May Occur within the Analysis Area and Potentially Affected by the Proposed Actions

Common Name	Scientific Name	Status*	Key Habitat Association within the KFRA	Comments
Northern Spotted Owl	*Strix occidentalis caurina*	Federally Threatened	Foraging- Mature/Late Successional Mixed Conifer Nesting – Mature/Late Successional Mixed Conifer	One historic nest territory within analysis area
White-headed Woodpecker	*Picoides albolarvatus*	BLM Sen. FWS BCC	Forging - Large Ponderosa Pine Nesting – Large Snags	May occur in the analysis area
Lewis's Woodpecker	*Melanerpes lewis*	BLM Sen. FWS BCC	Foraging – Open Woodlands Nesting – Large Snags	May occur in the analysis area
Northern Goshawk	*Accipiter gentilis*	None	Foraging -Mature Mixed Conifer Nesting – Mature Mixed Conifer	Three known nest territories occur within analysis area. One within timber sale unit.
Great Gray Owl	*Strix nebulosa*	S&M	Mature Conifer –Nesting Meadow Habitat - Foraging	Surveys completed – No detections
Osprey	*Pandion halieatus*	None	Large live or dead tree – Nesting Open Water -Foraging	Two known osprey within proposed treatment units

Common Name	Scientific Name	Status*	Key Habitat Association within the KFRA	Comments
Bald Eagle	*Haliaeetus leucocephalus*	BLM Sen.	Mature Conifer Tree – Nesting Open Water - Foraging	Seven Nest Territories within Analysis Area (three of those within Bear Valley National Wildlife Refuge)
Flammulated Owl	*Otus flammeolus*	FWS BCC	Foraging - Open Mixed Conifer Nesting – Snags Roosting –Dense thickets	Has been documented in the analysis area
Pacific Fisher	*Martes pennanti*	BLM Sen. Federal Candidate	Mature complex mixed conifer forest	Habitat is very fragmented; not conducive to Fisher presence.
Pallid Bat	*Antrozous pallidus*	BLM Sen.	Roosting – Primarily caves, rocks but may use large snags	May occur in the EA analysis area
Fringed Myotis	*Myotis thysanodes*	BLM Sen.	Roosting – Primarily caves, rocks but may use large snags	May occur in the EA analysis area
Evening Fieldslug	*Deroceras hesperium*	BLM Sen., S&M	Moist forest in low vegetation, litter, debris, rocks. Priority habitat is considered forested habitat within 30 m (98 ft.) of perennial water (USDA/USDI 2003).	No priority habitat within proposed units. No surveys required-
Crater Lake Tightcoil	*Pristiloma arcticum crateris*	BLM Sen., S&M	Moist to wet sites such as riparian areas, near springs, wetlands and mountain meadows. Priority habitat is considered forested habitat within 10 m of perennial water (USDA/USDI 2003).	No priority habitat within proposed units. No surveys required-
Chase Sideband	*Monadenia chaceana*	BLM Sen., S&M	Talus and rock slides in and adjacent to conifer and oak woodlands. It may be found within 30 m (98ft.) of rocky areas, talus deposits and in associated riparian areas in the Klamath physiographic province (USDA/USDI 2003).	Pre-disturbance surveys completed within most of the proposed units - no sites located. On approximately 545 acres, priority habitat was identified and will be buffered and avoided. This resulted in 21 acres identified and will be removed from habitat-disturbing activity..

* Status: FWS BCC – U.S. Fish and Wildlife Service Birds of Conservation Concern 2008; BLM Sen. – Species considered by the Bureau of Land Management as a sensitive species; Federally Threatened – Species listed under the Endangered Species Act as Threatened; S&M – Species listed in the 2001 ROD classified as Survey and Manage.

Threatened and Endangered Species (T&E)

Northern Spotted Owl (*Strix occidentalis caurina*) - Federally Threatened

The northern spotted owl is the only federally listed species that may be affected from the proposed project. The project area includes one historic spotted owl nest territory (Topsy MSNO - 2388). The nests were located on private industrial forest lands directly adjacent to BLM lands. The site was discovered in 1991 and was monitored by the BLM and private lands company continuously through 2009. The site was occupied from 1991- 2006 with either a pair or single owl for those sixteen years. The BLM conducted a commercial thinning harvest (Slim Chicken Timber Sale – Biological Opinion 1-10-02-F-162) between 2004-2006 within the core and home range of the Topsy owl site. The private landowners also conducted commercial thinning within the core and home range in 2008. The nest site was unoccupied in 2007, 2008, and 2009 (Table

9) and the territory was classified as "abandoned" by the Oregon Department of Forestry (Anne Maloney ODF, personal communication, August 2012) and the core and home range were harvested in 2010 and 2011 by the privately owned industrial forest company (Chris Sokol JWTR, personal communication, February 2013). In February 2013, the FWS concurred with the classification of "abandoned" for the Topsy NSO site due to the limited amount of habitat available. Therefore, the Topsy NSO site will not be discussed further in this EA.

Table 9. Topsy Spotted Owl Historic Nest Territory Occupancy 2005-2012

NSO Territory	2005	2006	2007	2008	2009	2010	2011	2012
Topsy	Single	Single	3 Visits None	3 Visits None	3 Visits None	Not Surveyed	6 Visits None	6 Visits None

None- No owls detected
Single- Single adult detected

Spotted Owl Surveys

Surveys were conducted within suitable spotted owl habitat in the project area to meet the 2011 NSO survey protocol. Six visit surveys were conducted in 2011 and 2012. No spotted owls were detected.

Table 10. Spotted Owl Habitat Descriptions

Nesting/Roosting Habitat (NR): Stands for nesting and roosting are generally characterized by: (i) Moderate to high canopy closure (60 to over 80 percent), (ii) Multilayered, multispecies canopies with large (20–30 in (51–76 cm) or greater (dbh) overstory trees, (iii) High basal area (greater than 240 ft^2/acre (55 m^2/ha), (iv) High diversity of different diameters of trees, (v) High incidence of large live trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence), (vi) Large snags and large accumulations of fallen trees and other woody debris on the ground, and (vii) Sufficient open space below the canopy for northern spotted owls to fly (USDI FWS 2012).
Foraging Habitat (F): Stands for foraging habitat are generally characterized by: (i) Stands of nesting and roosting habitat; (ii) Stands composed of Douglas-fir and white fir/Douglas-fir mix; (iii) Mean tree size greater than 16.5 in (42 cm) quadratic mean diameter; (iv) Increasing density of large trees (greater than 26 in (66 cm) and increasing basal area (the total area covered by trees measured at breast height) increases foraging habitat quality; (v) Large accumulations of fallen trees and other woody debris on the ground; and (vi) Sufficient open space below the canopy for northern spotted owls to fly (USDI FWS 2012).
Dispersal Habitat (D): Stands for dispersal habitat are generally characterized by: (a) Habitat supporting the transience phase of dispersal, which includes: (i) Stands with adequate tree size and canopy closure to provide protection from avian predators and minimal foraging opportunities; in general this may include, but is not limited to, trees with at least 11 in (28 cm) dbh and a minimum 40 percent canopy closure; and (ii) Younger and less diverse forest stands than foraging habitat, such as even-aged, pole-sized stands, if such stands contain some roosting structures and foraging habitat to allow for temporary resting and feeding during the transience phase. (b) Habitat supporting the colonization phase of dispersal, which is generally equivalent to nesting, roosting, and foraging habitat as described above, but may be smaller in area than that needed to support nesting pairs (USDI FWS 2012).
Nest Patch: High quality habitat around the nest site. An important attribute for site selection for spotted owls. Typically a 300 meter radius around the nest site which equates to approximately 70 acres (USDI FWS 2008).
Core Area: Area that provides the important habitat elements of nest sites, roost sites and access prey. This area is delineated for this analysis by a ½ mile radius circle (approximately 500 acres) around the last known nest site.
Home Range: Extent of area used by a pair of spotted owls for annual survival. This area is delineated for this analysis by a 1.2 mile radius circle (approx. 2,894 acres) around the last known nest site.

Spotted Owl NRF and Dispersal Habitat within Project Area
The project area is on the eastern edge of the spotted owl range and suitable spotted owl habitat is limited in the area. Approximately one-quarter (13,500 acres) of the project area is outside Northwest Forest Plan boundary and outside the range of the NSO. The limited amount of nesting, roosting and foraging (NRF) spotted owl habitat in the project is in part due to the dry open ponderosa pine and mixed conifer stands that occur in the southern and eastern portion of the project area. The current limitations on NRF habitat are also due to past management on both public and private lands. There are 3,599 acres of BLM Lands classified as NRF within Keno EA Area and only 1% (240 acres) of that is actually nesting habitat. Although the acres of NRF were not calculated on private, state, and other federal lands there is less than an additional 10 % of the forested habitat that is currently NRF based on 2011 National Agriculture Imagery Program (NAIP) Imagery.

Spotted Owl Designated Critical Habitat
Critical habitat was originally designated in 1992 for the spotted owl (USDI FWS 1992). In 2008, the U.S. Fish and Wildlife Service revised this designation (USDI FWS 2008c). In both instances, no critical habitat occurred within the Keno project area. In 2012, the FWS issued a final rule for revised critical habitat for the northern spotted owl (USDI FWS 2012). Under the final rule, portions of the Keno EA area were designated as critical habitat for the northern spotted owl. Regulations from Section 7(a) (2) of the Endangered Species Act (ESA) require consultation where a proposed discretionary action is likely to destroy or modify designated critical habitat.

The East Cascades South Critical Habitat Unit (ECS; unit 8) contains 526,815 acres and is divided into three subunits. A portion of one of the subunits, ECS subunit 2, is within and adjacent to the Keno EA area. ECS subunit 2 was designated primarily for its north-south connectivity to other critical habitat subunits, but was also designated for its demographic support in an area of sparse federal land and sparse high quality nesting habitat (USDI FWS 2012).

The KFRA portion of ECS subunit 2, also known as the Klamath River Canyon, is dominated by California white oak and Oregon black oak with patches of mixed conifer and ponderosa pine stands. ECS 2 contains approximately 90,012 acres of which approximately 1,158 acres of ECS subunit 2 are within the Keno EA area. There are approximately 320 acres of ECS subunit 2 within proposed treatment units, and approximately 258 acres of that are within proposed Keno timber harvest units.

A landscape evaluation of the KFRA portion of ECS subunit 2 showed that NRF and dispersal habitat is limited and not well distributed. There are approximately 5,744 total acres within the KFRA portion of the subunit and 65% of the habitat is considered non-habitat; the majority (76%) of that is not habitat capable. There are approximately 968 acres (17%) of NRF habitat and 1040 (18%) of dispersal habitat within the subunit. Most of this is on the edges and northern portion of the Klamath River Canyon, making the connectivity function of this ECS subunit questionable. This provides minimal opportunity to improve habitat conditions or provide for connectivity for spotted owls, let alone provide for nesting owls, which is the secondary function of this ECS subunit 2.

Spotted Owl Populations within the Southern Oregon Cascades Demographic Study Area
The latest population trend from Forsman et al (2011) for the spotted owl indicates that the spotted owl population continues to decline across its range. There was strong evidence that populations on seven of the 11 study areas declined, and the remaining four study areas were classified as "stationary," meaning they could not conclude these populations were declining. The Southern Oregon Cascades Demographic Study Area (SOC) was one of those four classified as stationary. Annual rates of population decline were most precipitous on study areas in Washington and northern Oregon. There was strong indication for declining adult survival on 10 of 11 study areas; declines were most evident in Washington and northwest Oregon. The SOC was declining in adult survival and fecundity (Forsman E. et al 2011).

The 2011 SOC annual report also suggests that the number of spotted owl sites occupied is declining. The number of sites occupied for those sites surveyed was below 50% for the first time in 2008 since the surveys began. In 2011, the percentage of sites where spotted owls were detected dropped to 38% on the study area, and represented an 8% decrease from 2010. This was the lowest percentage recorded during the study (unpublished report USDA/USDI 2011).

The KFRA is within the Southern Oregon Cascades province, adjacent to the demographic study area. The KFRA owl monitoring data was used in the population meta-analysis for the SOC Demographic Study Area, so the population trends within the SOC would be representative.

Barred Owls
Surveys for spotted owls have been conducted annually within the KFRA since 1990. Until 2002, the barred owl was only rarely detected within the KFRA. Since that time, the barred owl has regularly been detected in the Resource Area. Presently, there are five spotted owl territories that are now known to be occupied by barred owls. Several other barred owl detections within known spotted owl territories have also occurred. The SOC Demographic annual report for 2008 showed that the annual percentage of historic territories with both spotted owls and barred owls, or barred owls alone, has increased from 8.6 to 21.9% since 1997. Kelly et al (2003) reported that occupancy of spotted owls was significantly lower in the presence of barred owls. The latest publications continue to show the impacts that barred owls are having on occupancy rates of spotted owls found within the SOC Demographic Study Area (Dugger et al 2011). There is a strong association between barred owl detection rates and spotted owl extinction rates. These two species are competitors and the barred owl is currently displacing spotted owls from historical breeding territories. This study also showed the strong barred owl habitat effects on occupancy dynamics of spotted owls, and provided evidence of interference competition between the species. Spotted owl occupancy rates decreased when barred owls were detected regardless of the habitat configuration of a territory. Extinction of spotted owl territories was lowest in areas where old forests were most abundant and colonization was highest in forests of less fragmentation. These effects increase the importance of conserving large amounts of contiguous, old forest habitat to maintain northern spotted owls in the landscape (Dugger et al 2011).

The detections of barred owls within the KFRA occurred during spotted owl surveys. It is likely that the full number and influence of barred owls within the KFRA has not been realized, since systematic surveys for barred owl has not occurred. Based on the current trends, it is likely that spotted owls will continue to be displaced or negatively affected by barred owls within the

KFRA. The barred owl has not been detected within or adjacent to the proposed project prior to the development of this EA.

Special Status Species (Bureau Sensitive, Survey and Manage, and Birds of Conservation Concern)

White-headed Woodpecker (WHWP) – White-headed woodpecker habitat occurs within the project area. No systematic surveys have been conducted but the potential for species presence is likely. The WHWP is associated with open ponderosa pine forests or mixed conifer with ponderosa pine as a dominant species (Marshall et al 2003). They forage on ponderosa pine seed and insects, and use large snags (greater than 20") for nesting (Marshall et al 2003). The forested stands within the proposed project area contain this habitat.

Lewis's Woodpecker (LWP) – Lewis's woodpecker habitat occurs within the project area. No systematic surveys have been conducted, but the potential for species presence is likely due to the documentation in the Klamath River Canyon. The LWP is associated with open oak woodlands, open ponderosa pine, and oak woodland mixed. Their diet is focused on insects in the spring and summer and acorns in the fall and winter. Nest sites are often associated with streams or open water where insects are abundant (Marshall et al 2003). They use both pine and oak cavities for nesting. The oak are typically live trees, while the ponderosa pine are typically larger snags (greater than 20"). The LWP typically nests in snags with cavities excavated by other woodpeckers. This means that the snags are usually in a greater extent of decay.

Great Gray Owl (GGO) – Bull and Henjum (1990 as stated in USDA/USDI 2004) found the great gray owl preferred to nest in mature or older stands with open understory and dense overstory. The birds tend to select nest sites in forests near meadows or other openings that have sufficient prey. The proposed project area contains areas that meet the definition for nesting habitat. Great gray owl surveys were initiated in 2011 and completed in 2012 to meet the Survey and Manage species requirements. No GGO detections occurred during these surveys.

Bald Eagle – There are seven known bald eagle nest territories within the proposed project area. There are three within the Bear Valley National Wildlife Refuge and the remaining three on BLM lands. None of the nest sites are within the proposed units. One nest site is adjacent to a proposed unit.

Northern Goshawk – Northern Goshawks are widely distributed in most forest types. Within the KFRA, the goshawk is generally associated with mature conifer stands and uses habitat similar to that of the northern spotted owl. Northern goshawk platform stick nests are typically built in large trees within a 20 to 40 acre dense patch of trees (Marshall et al 2003). Their foraging areas are quite large, approximately 5,000 acres, comprised of a forest mosaic including large trees, snags and down wood. These areas must support a wide range of suitable prey (Marshall et al 2003).

The goshawk is currently not considered a sensitive species by the BLM and is not listed as a bird of conservation concern by the FWS for this region. However, there are three known goshawk nest territories (Topsy, Chicken Hills, Gave Chase) within the Keno EA area. The nest

trees have been identified and marked for protection. A no harvest buffer (RMP 1995 pg. 38) will be placed around the nest tree to maintain the nest stand characteristics. A seasonal restriction near the nest site will also be implemented to limit disturbance during the critical nesting period if the nest or an alternate nest is in use.

Osprey
The osprey is well distributed on all continents in temperate and tropical area. Forages primarily on fish and nests are usually located within 2 miles of water with accessible fish populations (Marshall et al 2003). Two nest trees occur within proposed treatment units. The nest trees have been identified and marked for protection. A seasonal restriction near the nest site will also be implemented to limit disturbance during the critical nesting period if the nest or an alternate nest is in use (KFRA ROD pp. 34).

Flammulated Owl - The flammulated owl is a cavity-nester highly associated with open ponderosa pine forests, but is also found in mixed conifer stands with ponderosa pine as a component (Marshall et al 2003). This is apparently due to the lepidopteran (moths and/or butterflies) prey species that are associated with this type of forest. No systematic surveys have been conducted but there is potential for species to be present in the project area. Two areas (Topsy, Chicken Hills) within the EA planning area have had multiple detections of flammulated owls during past surveys for other owls.

Pallid Bat and Fringed Bat - Surveys (Cross and Kerwin 1995) on the west-side of the KFRA have documented the fringed myotis and pallid bats in similar habitat to that of the proposed project. Limited radio–tracking studies in southwestern Oregon have shown the fringed myotis to roost in trees, particularly snags. The pallid bat was captured in areas that had large conifers, including ponderosa pines. Radio-tracking in Jackson County has shown that the species uses such trees for roost sites (Cross and Kerwin 1995).

Crater Lake Tightcoil and Evening Field Slug (*Pristiloma arcticum crateris* and *Deroceras hesperium*) – Both species are associated with perennial water and priority habitat is within 30 m of perennial water. Both species are classified as Survey and Manage and BLM Sensitive. Surveys were conducted to protocol (USDA USDI 2003) on the majority of the proposed project area, and no sites were located. In proposed project areas that were not surveyed, priority habitat was delineated and those areas will be buffered from ground-disturbing activities. This will meet the 2001 ROD requirements. Therefore, these species will not be assessed further in this document.

Chase Sideband – (*Monadenia chaceana*) – is a terrestrial snail usually found within 30 meters of rocky areas, talus deposits, and in associated riparian areas. Areas of herbaceous vegetation in these rocky landscapes adjacent to forested habitats are preferred (USDI/USDA 2003). It can, however, be associated with large wood in forested habitats where little rock is located (unpublished USDA/USDA Conservation Assessment 2005). Surveys were conducted to protocol (USDA USDI 2003) on the majority of the proposed project area and no sites were located. In proposed project areas that were not surveyed, priority habitat was delineated, and those areas will be buffered from ground disturbing activities. This will meet the 2001 ROD requirements. Therefore, these species will not be assessed further in this document.

Pacific Fisher - The KFRA was surveyed for forest carnivores (Canada Lynx, Wolverine, Pacific Fisher and American Marten) in 1998-2001 including the Topsy/Pokegama Landscape Area. Photographic bait stations were set up systematically throughout the resource area using Zielenski's protocol (Zielenski and Kucera 1995). The American marten was the only target species located during these surveys. No special status species were located during these surveys. The fisher is listed as a Federal Candidate species and its current range is thought to be limited to two populations in Oregon, the Southern Cascade Mountains and the Siskiyou Mountains of southwestern Oregon, which does not include the KFRA (Aubry and Lewis 2003). The proposed project is very fragmented and does not provide suitable habitat for the Pacific fisher. Therefore, impacts to the Pacific fisher will not be analyzed further in this document.

Environmental Consequences- Terrestrial Wildlife Species

Threatened and Endangered Species - Northern Spotted Owl

Methodology

For the spotted owl habitat analysis, several assumptions were made to determine the effects of the proposed actions on northern spotted owl (NSO) suitable and dispersal habitat. These assumptions are as follows:

- Timber harvest prescriptions on similar forest stands from previous sales would result in similar habitat qualities after harvest within the proposed project. Post-harvest stand exams (USDI BLM, 1999-2011) have supported this assumption with respect to canopy closure, tree density, snag density, and stand structure.
- Timber harvests that maintain snags, coarse woody debris, multi- age stands, greater than 120 basal area (BA) with the majority of the BA in the overstory would maintain canopy closure greater than 60% and would maintain spotted owl foraging habitat. This is based on pretreatment stand exam data for the Keno project area indicating stands categorized as NRF had > 120 BA.
- If multiple treatments (i.e., commercial timber harvest, submerchantable thinning, and prescribed fire) were conducted within NRF habitat on the same acres, the loss of the structural components resulting from the additional treatments may reduce the quality of habitat and downgrade the habitat to dispersal habitat.
- Pre-commercial, hand thinning, and prescribed burning would maintain nesting, roosting, foraging (NRF) and dispersal habitat based on the structural components and canopy closure left after treatment. This is based on past treatments that have been conducted in similar habitat that resulted in the maintenance of NRF and dispersal habitat.
- The habitat classified as dispersal pre-project would remain dispersal post-harvest. Post-harvest stand exams from previous timber harvest on similar habitat have supported this assumption. On average, if a stand is thinned to 75-80 BA, the resulting canopy closure has been approximately 50% thereby meeting the definition of dispersal habitat.

Effects Common to All Alternatives

For all alternatives, including No Action, there will be no direct effects to territorial/resident spotted owls from proposed activities. The project area has been surveyed to protocol (USDI

FWS 2011) and no spotted owls were detected. None of the proposed actions will have any effect on the current population due to the lack of owls within the project area. The spotted owl habitat within the Keno EA landscape is fragmented and does not provide large contiguous blocks of NRF habitat that would support spotted owl reproduction.

Proposed brush mastication and prescribed underburning would maintain the current levels of NRF and dispersal habitat throughout the Keno project area. Both may reduce the quality of foraging habitat within the project in the short-term (less than 10 years) due to the reduction of understory shrubs and potential loss of downed wood. But both treatments would maintain the multi-story structure within the NRF habitat and maintain canopy closure when implemented in conjunction with the project design features (PDFs -Appendix B) for both treatments. Both types of treatments are designed to leave a mosaic of treated and non-treated areas within the proposed units, thereby retaining diversity and providing a continued prey base for spotted owls that may be dispersing through the area.

A dispersal habitat analysis was conducted using the 50-11-40 rule. The analysis is based on quarter townships where 50% of the quarter township has trees 11” DBH or larger and a 40% canopy closure on average. The BLM habitat was based on the KFRA spotted owl habitat layer. The private, state, and other federal lands were estimated by NAIP imagery. Only two of the eight quarter townships within the Keno landscape exceeded these parameters and both were only slightly above 50%. This is an indicator that current habitat conditions are not favorable for spotted owls due to the lack of habitat connectivity within the analysis area. Dispersal habitat is currently limited within the project area but is expected to increase in the long-term on the public lands and remain low on the private industrial forest lands. The No Action and all action alternatives would continue to maintain the current connectivity levels at the quarter township scale. No dispersal habitat would be downgraded from proposed treatments.

There is potential for disturbance to dispersing owls that may move through the area from proposed actions. Timber harvesting, timber hauling, fuels treatments, and road construction or decommissioning may all require heavy equipment, chainsaws, and large vehicles that produce high levels of noise. Spotted owls are susceptible to disturbance from human-caused activity (Delaney et al 1999), especially during critical periods in the nesting season. The project area does not have resident spotted owls due to current habitat conditions. It is reasonable to assume that those spotted owls that move through the project area would avoid those areas where disturbances occurred and would not be adversely affected from those activities.

The proposed juniper cutting, piling and burning, and the imazapic chemical application in alternative 1 and 3 would have no effect to spotted owls or any other special status species considered in this analysis. The areas of treatment are outside the range for these species.

The proposed water pipeline would have no effect on spotted owls or spotted owl habitat. The pipeline is not proposed within or adjacent to any nest stand, is not within NRF or dispersal habitat or designated critical habitat.

Spotted Owl Recovery Plan

The 2011 Revised Spotted Owl Recovery Plan contains over 30 recovery actions (RA), some of which are applicable to the Keno EA proposed projects and some which are not. RA 10 and RA 32 are the only two recovery actions that will be considered for the Keno EA project area.

Recovery Action 10 – "Conserve spotted owl sites and high value spotted owl habitat to provide additional demographic support to the spotted owl population."

The recovery plan states that "For federal lands, create an interagency scientific team to use the latest and best available habitat modeling information and other data to identify these high value areas (USDI FWS 2011 pp. III 43-45)." As of the development of the Keno EA, this interagency scientific team has not been identified nor the modeling completed to identify this high value habitat. To address this recovery action in the absence of the team, the Service included interim guidance described in the revised recovery plan.

Interim Guidance

"In the interim time period while the above team process is formalized and carried out, we (the Service) recommend the following process be followed. When planning management activities, Federal and non-federal land managers should work with the Service to prioritize known and historic spotted owl sites for conservation and/or maintenance of existing levels of habitat. The prioritization factors to consider are reproductive status and site condition. The site conservation priorities for reproductive status are (1) Known sites with reproductive pairs; (2) Known sites with pairs; (3) Known sites with resident singles; and (4) Historic sites with reproductive pairs, pairs, and resident singles, respectively."

"The priority for site condition is sites currently with >40% suitable habitat in the provincial home range (*e.g.*, 1.3 mile radius) and >50% suitable habitat within the core home range (*e.g.*, 0.5 mile radius). This prioritization provides a guide to evaluate the relative impacts of management actions, and conservation of sites that provide the most support to spotted owl demography. When implementing this interim process, land managers and the Service should utilize professional judgment as to the best available site-specific data (collectively across years, if appropriate)" (USDI FWS 2011 pp. III 44-45).

The BLM biologists worked with the FWS and followed the interim guidance issued to prioritize spotted owl sites. The Topsy spotted owl site is the only territory within the Keno project area. This site was not considered a priority site for conservation because it is unoccupied, has a low amount of habitat available in the core area and home range, the site is classified as abandoned by both the State and the FWS, and the majority of the home range is private industrial forest land and management on those lands is not conducive to growing and maintaining NSO habitat in the future. Therefore, under all alternatives, the proposed treatments within the home range and core areas that are designed for ecological purposes and to enhance habitat conditions would be consistent with Recovery Action 10.

Recovery Action 32- "Because spotted owl recovery requires well-distributed, older, and more structurally complex multi-layered conifer forests on Federal and non-federal lands across its range, land managers should work with the Service as described below to maintain and restore

such habitat while allowing for other threats, such as fire and insects, to be addressed by restoration management actions. These high-quality spotted owl habitat stands are characterized as having large diameter trees, high amounts of canopy cover, and decadence components such as broken-topped live trees, mistletoe, cavities, large snags, and fallen trees"(USDI FWS 2011 pp. 67).

The KFRA worked with the FWS to describe RA 32 stands. These high-quality forest stands are a subset of nesting/ roosting habitat and are defined by having large diameter trees for nesting, canopy closure that exceeds 70%, large coarse woody debris, snags, and a multi-storied stand. There are only 47 acres of nesting/roosting habitat proposed for treatment. Based on the stand exam data and field review of the units, there is no habitat proposed for treatment that currently meets the high-quality standard for RA 32. Therefore, all proposed actions would be consistent with Recovery Action 32.

No Action Alternative

Under the No Action Alternative, the NRF and dispersal habitat within the project would be maintained in its current state for the short-term (less than 40 years). Growth of trees within stands would remain slow due to density and the forest stands currently classified as NRF would maintain that status for the next 20 to 40 years without a major disturbance (wildfire or insect or disease outbreak) influence. Over time, the forest stands within the project area with no treatment would trend towards more fir-dominant as succession of firs continues. This would be beneficial to spotted owls, especially for those stands moving towards a Douglas-fir dominated stand. Long-term (more than 40 years) forest stands would see decline through natural mortality thinning due to density-related issues from insect and disease or drought (see vegetation section). This may result in the reduction of habitat in the long-term without treatment. Under the No Action Alternative, the project area overall would continue to provide dispersal and foraging habitat on a limited basis for spotted owls that may move through the project area.

Northern Spotted Owl Designated Critical Habitat

Under the No Action Alternative, there would be no direct effect to designated critical habitat. The habitat currently classified as foraging and dispersal habitat would continue to serve those functions. The primary constituent elements (PCEs) as described in the final rule that comprise critical habitat (stand type, nesting-roosting habitat, foraging habitat, and dispersal habitat) would not be affected from the No Action Alternative.

Table 11. Available NSO Habitat within Project Area by Alternative

Available NSO Habitat Pretreatment	Available NSO Habitat (acres)	Acres Treated		Available NSO Habitat Post Treatment (acres)			
		Alt 1&3	Alt 2	No Action	Alternative 1	Alternative 2	Alternative 3
Nesting/Roosting	240	47	47	240	201	240	193
Foraging	3359	605	411	3359	3058	3359	2984
Dispersal	5331	1865	1865	5331	5671	5331	5753

Alternative 1 – Proposed Action

Under Alternative 1, the NRF and dispersal habitat within the project would be reduced. Although there are no nesting owls within the project area, there are approximately 652 acres

(Table 11) of NRF habitat that would be entered with vegetation treatments (prescribed burn, slashbuster, timber harvest, understory thinning). Of those proposed treatments, 581 acres of NRF would be entered via a timber sale or understory thinning.

The removal of some trees infected with mistletoe in this alternative would reduce future nesting structure for the spotted owl and reduce habitat structure used by its prey. The bushy tailed woodrat and northern flying squirrel (key prey species) both are highly associated with mistletoe brooms (Lemkuhl et al 2006; Lemkuhl et al 2006 (a)). Mistletoe brooms also are important nest structure for spotted owls especially in younger stands where large live trees and snags are not available. Retention of patches of mistletoe infected trees and large single trees would mitigate the effects of both future nesting habitat and prey habitat (Lemkuhl et al 2006; Lemkuhl et al 2006 (a)). Alternative 1 would also continue to promote future spotted owl nesting and prey habitat by retaining the source for future trees to be infected.

Based on past timber sales and understory thinnings in similar habitat, it is estimated that the prescription (60-120 BA retention) in Alternative 1 would downgrade NRF habitat to dispersal habitat on 340 acres (Table 11). This reduction in habitat would be due to canopy closure loss that would reduce the habitat to dispersal (40-60% canopy closure). The loss of canopy not only effects prey availability, it also increases the risk of predation to spotted owls. The remaining acres (241) proposed for silvicultural treatments, would maintain foraging habitat by leaving 120 BA in the treated portion of the stand, while leaving up to 10% “skips” (untreated patches) and 10% “gaps” (heavily thinned patches, similar to patch cuts or group selection) throughout the proposed units. Alternative 1 would also retain more trees approximately 150 years old and maintain a mix of unique structural trees (dead-tops, fork-tops, snags, mistletoe clumps) on the landscape. This would leave a diverse stand with a minimum of 60% canopy closure.

Northern Spotted Owl Designated Critical Habitat

Under Alternative 1, there would be direct effects to critical habitat. There are approximately 320 acres within critical habitat that would be treated with timber harvest or prescribed fire (five treatment units; 62 acres of prescribed fire, 258 acres of timber harvest). Of these 320 acres, 170 acres are classified as NRF habitat, 106 acres are classified as dispersal habitat, and the remaining is classified as non-habitat.

There are approximately 112 acres of NRF habitat that would be thinned to 120 BA and maintained as foraging habitat (see Table 12). Approximately nine acres of NRF habitat contained in one proposed unit will be thinned to 90 BA, which would result in the downgrading of this NRF to dispersal habitat. Ten acres of NRF habitat are proposed for prescribed under burning and would be maintained as NRF habitat post-treatment. The 106 acres of dispersal habitat would be maintained as dispersal habitat.

Alternative 1 would have minimal impacts to NSO critical habitat. The acres of critical habitat entered equate to approximately 5% of the total acres available within the KFRA portion of ECS subunit 2, but less than 1% of the total acres within ECS subunit 2. Only nine acres would be downgraded to dispersal habitat, which is less than1% of the KFRA portion of the available NRF habitat. Therefore, the actions proposed under Alternative 1 would not have adverse effects to NSO critical habitat.

Table 12. Proposed Treatments in NSO Critical Habitat ECS –Subunit 2

Unit #	Total Acres	Total Acres of NRF	Alt 1 Treatment	Alt 1 Maintain NRF (Y/N)	Alt 2 Treatment	Alt 2 Maintain NRF (Y/N)	Alt 3 Treatment	Alt 3 Maintain NRF (Y/N)
40-6-01-1	28	28	Thin to 120 BA	Y	No treatment	Y	Thin to 80 BA	No
40-6-12-1	51	45	Thin to 120 BA	Y	No Treatment	Y	Thin to 80 BA	No
40-6-35-1	108	78	Thin 50% NRF to 120 BA	Y	No Treatment of NRF	Y	Thin to 120 BA	Y
40-6-35-3	71	9	Thin to 75 BA	No	No Treatment	Y	Thin to 60 BA	No
40-6-35-2	62	10	Prescribed Underburn	Y	Prescribed Underburn	Y	Prescribed Underburn	Y
ESA Determination to CHU –ECS Subunit 2			"Not Likely to Adversely Affect"		"Not Likely to Adversely Affect"		"Likely to Adversely Affect"	
Total Acres	320	170						

Alternative 2

Under Alternative 2, the spotted owl NRF and dispersal habitat within the project would be maintained. Although there are no nesting owls within the project area, there are approximately 458 acres of NRF habitat (Table 11) that would be entered with vegetation treatments (prescribed burn, slashbuster, timber harvest, understory thinning). Of those proposed NRF acres that would be entered, 387 acres would be treated with timber sales or understory thinning, and 58 acres with prescribed under burning. Under this alternative, NRF stands would be treated via timber harvest or prescribed fire but not both on the same acres. This would ensure that NRF habitat can be maintained in the short-term while still providing some long-term benefits.

The retention of all dwarf mistletoe trees would maintain current levels of prey habitat and spotted owl nesting habitat. Alternative 2 would also continue to promote future spotted owl habitat by retaining the dwarf mistletoe source for future trees to be infected.

Alternative 2 is designed to maintain spotted owl foraging and dispersal habitat for the spotted owl where it currently exists. Proposed units that are currently considered lower quality foraging habitat (on the fringe of being classified as dispersal habitat) are not included in Alternative 2. This would result in 194 acres of NRF habitat being dropped from timber harvest treatment in this alternative. The 458 acres that are still proposed for treatment would be treated to maintain NRF habitat by leaving 120 BA in the treated portion of the stand, while leaving 10-15% "skips" (untreated patches) throughout the proposed units. This alternative would also retain all trees greater than 21" with the exception of white-fir and maintain those unique structural trees (dead-tops, fork-tops, snags, dwarf mistletoe clumps) on the landscape. This would leave a diverse stand with a minimum of 60% canopy closure. Although there are no resident owls in the project area, this alternative would provide a more diverse stand for spotted owls dispersing through and provide future nest structure in stands when compared to Alternatives 1 and 3.

Northern Spotted Owl Designated Critical Habitat
Under Alternative 2, there would be direct effects to critical habitat. Approximately 163 acres would be entered with silvicultural treatment (30 acres) and prescribed under burn (133acres) treatments. There are approximately 19 acres (nine acres silvicultural units, ten acres under burn) of NRF habitat within these units (Table 12).

The underburn prescription is designed to be conducted under moist conditions (see PDFs-Appendix B) to create a mosaic of burned and unburned within the unit. This, along with the retention of the canopy closure, would maintain the NRF and dispersal habitat where it currently exists within the unit.

There are approximately 30 acres of dispersal habitat that would be thinned to 90 BA to improve stand vigor and reduce the risk of insect and disease outbreaks brought on from density issues. This stand would remain as dispersal habitat post-harvest; thinning to a 90 BA would maintain canopy closure between 40-60% and therefore, maintain the stand as dispersal habitat.

Alternative 2 would have minimal impacts to critical habitat. The acres of critical habitat treated equate to approximately 1% of the total acres available within the KFRA portion of ECS subunit 2. Therefore, the actions proposed under Alternative 2 would not have adverse effects to critical habitat.

Alternative 3

Under Alternative 3, the NRF within the project would be reduced. Although there are no nesting owls within the project area there are approximately 652 acres of NRF habitat and 1,865 acres of dispersal habitat (Table 11) that would be entered with vegetation treatments (prescribed burn, brush mastication, timber harvest, understory thinning, planting). Of those proposed treatments, 581 acres of NRF would be entered via a timber sale or understory thinning.

The removal of all dwarf mistletoe trees in Alternative 3 would reduce current and future nesting habitat for the spotted owl. This would also reduce habitat structure used by its prey, especially in younger stands when large live trees and snags are not available for nesting and prey habitat. Under Alternative 3, the units with a prescription that would retain 60-80 BA would result in the downgrading of NRF habitat to dispersal habitat on approximately 422 acres (Table 11). For the remaining units that retained a 120 BA or greater, those units would be maintained as NRF habitat. The remaining NRF acres proposed for treatment (230 acres) would maintain foraging habitat by retaining a diverse structure with up to 15% in “gaps” throughout the proposed units, and retain a canopy closure that exceeds 60%. The dispersal habitat treated would be maintained by retaining canopy closure greater than 40%.

Northern Spotted Owl Designated Critical Habitat
Under Alternative 3, there would be direct effects to critical habitat. There are approximately 320 acres within critical habitat that would be treated with silvicultural thinning or prescribed fire (five treatment units; 62 acres prescribed fire, 258 acres timber harvest). Of these 320 acres, 169 acres are classified as NRF, 106 acres are classified as dispersal habitat, and the remaining is classified as non-habitat. There are approximately 81 acres of NRF habitat contained in three

proposed units that would be thinned to 80-90 BA. This thinning would result in the downgrading of 81 acres of NRF to dispersal habitat. The remaining 78 acres would be thinned to 120 BA but maintained as foraging habitat (Table 12). Ten acres of NRF habitat are proposed for prescribed under burning and would also be maintained as NRF habitat post-treatment.

The down grading of 81 acres of NRF habitat to dispersal equates to approximately 8% of the total available NRF habitat within the KFRA portion of ECS subunit 2. This downgrade of NRF habitat is substantial with respect to the available NRF habitat within the KFRA portion of ECS subunit 2. Due to the limited amount of NRF habitat within this portion of the subunit, the reduction of NRF habitat would diminish even further the ability of the this portion of the subunit to function as intended. Based on the percentage of habitat downgraded within the KFRA portion of subunit 2, the BLM would make a "Likely to Adversely Affect" determination under ESA to critical habitat for Alternative 3. However, considering the entire subunit, the overall downgrade of 81 acres of NRF habitat to dispersal would equate to less than 1% (.002) of the available NRF habitat (34,968 acres). Therefore, based on the available acres within the ECS subunit 2, Alternative 3 would continue to provide north/south connectivity between subunits as described in the final rule.

Cumulative Effects for All Alternatives

The project area is on the eastern edge of the spotted owl range with 13,500 acres (out of 54,350 acres) of the project area outside the range of the spotted owl. For all the alternatives, past management (primarily timber harvest) on public and private lands in this "checkerboard" landscape has resulted in a very limited amount of suitable (NRF) and dispersal habitat within the project area. Only 27% (3,599 acres) of the BLM lands within the project area are classified as NRF and the other public and private lands within the project area have less than an estimated 10% that would qualify as NRF and dispersal habitat. Only 40% (5,331 acres) of the BLM lands currently functions as dispersal habitat. The acres classified as NRF are widely scattered and severely limit the opportunity for owls to nest within the project area. The surrounding private industrial forest lands are predominately in early seral condition, planted with ponderosa pine seedlings and saplings, and based on past management, are not expected to provide spotted owl habitat in the future.

A dispersal habitat analysis was conducted using the 50-11-40 rule. Only two of the eight quarter townships within the Keno Landscape exceeded these parameters and both were only slightly above 50%. This is another indicator that current habitat conditions are not favorable for spotted owls due to the lack of habitat connectivity within the analysis area. Dispersal habitat will likely increase in the long-term on the public lands within the project area, but likely will remain low on the private industrial forest lands.

The lands within the project area are on the eastern portion of the range for the spotted owl. Additionally, the BLM lands within the Keno project area are predominantly classified as Matrix lands and are intended to provide a sustainable supply of timber (see Section 1.1, Table 1 for the RMP objectives by land use allocation). The private industrial forest lands will continue to be harvested for timber production. The "checkerboard" ownership of lands within the project area will continue to make it difficult to provide enough contiguous habitat to support nesting spotted owls. The cumulative effects from past actions have left the current landscape unsuitable for

spotted owls. The proposed alternatives and foreseeable projects would not change the current trend on both public and private lands and would continue to limit the ability for owls to occupy the landscape or move through the project area.

Non-Listed Special Status Species (Bureau Sensitive, Survey and Manage, Birds of Conservation Concern)

Effects Common to All Alternatives

None of the proposed Alternatives would have a measurable effect positive or negative on overall population numbers for the special status species considered in this assessment. All of these species are well distributed across their range and the amount of habitat being affected from proposed actions would not result in a measurable change to their overall populations.

The proposed juniper cutting, piling and burning, and the imazapic chemical application would have no adverse effects to the special status species considered in this EA. The area proposed for treatment is not essential habitat for these species, and they would typically not be found within this habitat. For other non-special status species within the proposed imazapic treatment area, imazapic has been shown to not be highly toxic to most terrestrial wildlife species (BLM FEIS 2010). "Mammals are more susceptible during pregnancy and larger mammals are more susceptible than small mammals. Imazapic has low toxicity to honeybees. No adverse short-term exposure risks to birds were noted for imazapic, but some chronic growth reduction was noted. None of the risk categories for susceptible or non-susceptible shows any ratings that exceed the level of concern" (BLM FEIS 2010).

The proposed water pipeline would also have no adverse effects on any of these special status species. The proposed water line would not modify their nesting, foraging or roosting habitat. Seasonal restrictions (PDFs – Appendix B) would provide protection from disturbance during critical nesting periods for bald eagles and ospreys adjacent to proposed activities.

White-headed Woodpecker

The white-headed woodpecker is typically associated with open ponderosa pine, or mixed conifer stands dominated by ponderosa pine (Marshal et al 2003). Considering the fragmented habitat and the relatively large home range needed in fragmented habitat, it is likely the white-headed woodpecker is scarce within the project area and the watershed. In fragmented habitat, the home range for a white-headed woodpecker is approximately 130 acres (Altman B. 2000).

The proposed treatments under all three action alternatives would remove some trees that add to the suitable habitat for these species, especially in the ponderosa pine-dominated stands. Ponderosa pine snag retention and green tree retention guidelines (PDFs -Appendix B) would maintain foraging and nesting habitat for these species (Bull et al 1990 as cited in Marshal et al 2003, Altman B. 2000). No existing snags are planned to be cut unless required for safety. This would protect and maintain snag habitat near the current level. Thinning would continue to promote larger ponderosa pine trees in the stand, which would benefit the white-headed woodpecker (Altman B. 2000). These woodpeckers use larger (greater than16") snags, along

with dead-top and heart rot live trees for their nesting structure (Marshal et al 2003). Alternatives 1 and 3 would be most beneficial to the white-headed woodpecker by opening up the mixed conifer and pine stands to promote larger pine in the long-term (Altman 2000). Future snag development would be altered due to the thinning of the stand in the short-term. However, based on FVS modeling projections for the proposed project as well as similarpast timber sale modeling, snag development would continue to meet the RMP guidelines of 2.5 snags per acre after 10 years. The proposed prescribed burning has the potential to remove large snags used for nesting by the WHWP. The greatest potential for loss of snags is likely following the first entry of prescribed fire after a long fire-free period (Bagne et al 2007). In the Bagne study, as much as 43% of the ponderosa pine snags were lost during initial prescribed fire activity. Some snags were created as well, reducing the overall loss of snags to 12%. However, since snags are limited in the area, loss of large snags may be detrimental to those species that rely on them for nesting.

Finally, there is potential for loss of woodpecker reproduction if harvesting or fuels treatment activities occur during the nesting season. Some nests and nest structure could be removed during implementation or disturbance near the nest site could result in nest failure.

Lewis's Woodpecker (LWP)

The LWP is associated with open oak woodlands and open ponderosa pine forests (Marshall et al 2003). The LWP forages on insects during the summer months but relies heavily on acorns in the fall and winter. It nests in both oak and pine tree cavities. Due to the limited amount of large oak and larger pine in the project area nesting habitat is limited.

The proposed alternatives would maintain current nesting habitat for the LWP. Ponderosa pine snag retention and green tree retention guidelines (PDFs - Appendix B) would maintain foraging and nesting habitat for these species (Bull et al 1990 as cited in Marshal et al 2003, Altman B. 2000). No existing snags are planned to be cut unless required for safety. This would protect and maintain snag habitat near its current availability. Alternatives 1 and 3 would provide the most benefit to the Lewis's woodpecker by opening up the stands and ponderosa pine development (Altman 2000). Prescribed fire that resulted in scattered or patchy tree mortality within the stand would also benefit the Lewis's woodpecker by providing an increase in foraging habitat (Altman 2000).

Flammulated Owl

All proposed alternatives would maintain current nesting structure and foraging habitat by maintaining a similar level of snags (PDFs –Appendix B) and providing green tree retention for future snags. All the proposed alternatives are designed to retain and promote large ponderosa pine. Alternative 2 would provide the most beneficial effects to flammulated owls by retaining the larger ponderosa pine, creating an open understory and retaining some dense patches of forest for roosting habitat.

If the species is present within the project area, there is potential for loss of reproduction if harvesting occurs during the nesting season (April – July). Some nest structure could be lost or disturbance near the nest site could result in nest failure. Daytime activities associated with the proposed project may disturb some nesting and foraging sites, but only in the short-term for the duration of harvest and fuel treatment activities.

Pallid Bat and Fringed Myotis
Both these species may occur in the project area, although they are strongly associated with caves, mines or rock crevices. The fringed myotis are sometimes found using cavities in snags as roosts (Cross and Kerwin 1995). Weller (2001) found that the fringed myotis using snags switched roost areas often, and did not show strong site fidelity as previously shown with other roost substrate. Snags typically used by fringed myotis are usually greater than 24 inches DBH and taller than 45 feet (Weller 2001).

No snags are planned to be harvested in the proposed action unless required for safety. The snag retention guidelines would maintain current snags and the green tree retention would provide for future roosting structure (PDFs - Appendix B). Snag monitoring on past timber harvest on BLM lands have consistently shown that snag retention guidelines have been met and snags are well distributed within the watershed (BLM APS 1999, 2002). Under the proposed alternatives, short-term disturbance could push individuals from snags or thickets. These disturbances would have a short duration and overall would have minimal impacts to the species. The existing snag and green tree retention levels (PDFs, Appendix B) would be sufficient to meet the needs of both species.

Table 13. Summary of Effects of Action Alternatives on Special Status Species in the Project Area

Common Name	Alternative 1	Alternative 2	Alternative 3	Comments
White-headed Woodpecker	Snag and green tree retention measures would maintain population	Snag and green tree retention measures would maintain population	Snag and green tree retention measures would maintain population	All three Alternatives would be beneficial to promote long-term habitat needs.
Lewis's Woodpecker	Snag and green tree retention measures would maintain population. Prescribed burning would provide more foraging opportunities	Snag and green tree retention measures would maintain population. Prescribed burning would provide more foraging opportunities	Snag and green tree retention measures would maintain population. Prescribed burning would provide more foraging opportunities	Alternatives 1 and 3 would be most beneficial to promote long term habitat needs.
Northern Goshawk	"No harvest" buffer and seasonal restriction will maintain nesting opportunities at the nest site	No harvest occurs within the nest stand. Nest site would remain intact.	No harvest buffer and seasonal restriction will maintain nesting opportunities at the nest site	No harvest occurs within the nest stands under Alternative 2 and the No Action Alternative. Both of these would maintain nesting habitat at its current levels. Alternatives 1 and 3 would provide nesting habitat at a lower level. Alt 3 would remove all potential mistletoe nesting platforms
Osprey	Protection of the nest tree and a seasonal restriction will maintain nesting opportunities	Protection of the nest tree and a seasonal restriction will maintain nesting opportunities	Protection of the nest tree and a seasonal restriction will maintain nesting opportunities	All three alternatives would maintain the nest trees and continue to provide future potential nest trees

Common Name	Alternative 1	Alternative 2	Alternative 3	Comments
Bald Eagle	Potential disturbance neutralized by seasonal restrictions	Potential disturbance neutralized by seasonal restrictions	Potential disturbance neutralized by seasonal restrictions	One nest has potential for disturbance from proposed activities. FWS Bald Management guidelines will be implemented (PDFs). Current nest stands, trees, and foraging habitat will not be affected.
Great Gray Owl	No Effect	No Effect	No Effect	Surveys completed – No great gray owls detected.
Flammulated Owl	Snag and green tree retention measures should maintain population	Snag and green tree retention measures would maintain population	Snag and green tree retention measures should maintain population	Alternative 1 would be most beneficial to promote long-term habitat needs; followed by Alternative 3
Pacific Fisher	No effect	No effect	No effect	Area unoccupied - Habitat unsuitable for Pacific Fisher.
Pallid Bat	Snag and tree retention measures would maintain population	Snag and tree retention measures would maintain population	Snag and tree retention measures would maintain population	All proposed alternatives meet the habitat needs in the short and long term.
Fringed Myotis	Snag retention measures should maintain population	Snag retention measures should maintain population	Snag retention measures should maintain population	All proposed alternatives meet the habitat needs in the short and long term.
Evening Fieldslug	No Effect	No Effect	No Effect	Surveys completed - No sites located
Crater Lake Tightcoil	No Effect	No Effect	No Effect	Surveys completed - No sites located
Chase Sideband	No Effect	No Effect	No Effect	Surveys completed – No sites located. Priority habitat removed and buffered from project area

3.7 Soils

Affected Environment

Soils in the project area were derived primarily from andesite, basalt, and ashy deposits of the High Cascade Province. Hamaker and Chase Mountains, twin volcanic peaks, dominate the landscape. Elevations range from about 4,000 along the Klamath River Canyon Rim to over 6,500 feet at the top of Hamaker. With the exception of a few steeper areas, most of the landscape is less than 35 percent slope. The geologically young parent material, coupled with the cold climate, has produced soils in early or intermediate stages of development (Natural Resources Conservation Service, 1993).

NRCS soil surveys of southern Klamath and Jackson Counties identify 15 soil map units (or types) in the project area (SCS, 1985 and 1993). Within the treatment units, there are 11 soil types of greater than 20 total acres. Soil map units of the forested sites consist primarily of the Pinehurst, Greystoke, Pokegema, and Woodcock soils. These deep, well-drained soils formed from volcanic ash or mudflows and exhibit thick dark surface layers, otherwise known as horizons. They are differentiated by the amount of rock fragments throughout the soil profiles.

The soil types are further distinguished by subsurface temperatures; in this case, a function of elevation and/or slope orientation. The Pinehurst and Greystoke soils are found on the lower elevation or south-facing slopes, whereas the Pokegema and Woodcock soils are associated with high elevation or colder sites.

Potential forestland productivity varies among the soil types. When evaluated for site index and potential volume of wood fiber, productivity tends to be lowest on the south-facing Pinehurst and Greystoke units for both Douglas-fir and ponderosa pine. The flat and north-facing Pinehurst and Greystoke soil types rate higher for forestland productivity. The highest site index and wood fiber volumes for Douglas-fir and ponderosa pine typically occur on the Pokegema and Woodcock soils (NRCS, 1993).

Soils found on the juniper treatment unit are the very stony loams of the Dehlinger and Lorella soil types. The deep, well-drained Dehlinger soils are present on north-facing steep slopes. The climax plant community is dominated by a variety of tall shrubs. In contrast, the south-facing Lorella soils are shallow and contain a high amount of clay in the subsoil. The climax native vegetation on Lorella soils is primarily western juniper, with about 15 percent canopy cover (SCS, 1985).

Fragile slope gradient and groundwater soils (defined in the 1995 KFRA ROD/RMP, page D-12) are present in the project area. Fragile soils have been identified within riparian reserves and juniper units proposed for manual treatments.

When moist, all soils in the project area exhibit a low resistance to compaction. Likewise, the hazard of forming deep ruts is severe in most of the soils, with the exception of the very stony loams in the juniper treatment units. In their natural state, the soils allow water to move freely into and through the profile, creating a slow to medium potential for runoff when thoroughly wet. The hazard of erosion, from both roads and off-road areas following disturbance activities trends from slight to moderate. Soils with a high erosion hazard and rapid runoff potential typically occur on very steep slopes and comprise a minor component (9%) of the project area. Table 14 displays the soil map units and characteristics relevant to project analysis. Units comprising less than 20 acres were included with similar soils for the purpose of this analysis. A soil map is available in the project record.

Table 14. Soil Map Units and Interpretations for Management-Timber and Fuels Treatments

Map Unit	Soils	Erosion Hazard (water)	Compaction Resistance	Rutting Hazard	Runoff Potential	Fire Damage Susceptibility	Acres
Less than 12% slopes							
145C	Pinehurst-Greystoke complex	Slight	Low	Severe	Slow	Low	1346
147C	Pokegema-Woodcock complex	Slight	Low	Severe	Slow	Low	628
12 to 35% slopes							
79E	Greystoke-Pinehurst complex, north slopes	Moderate	Low	Severe	Medium	Low	170
80E	Greystoke-Pinehurst complex, south slopes	Moderate	Low	Severe	Medium	Low-Mod	704
204E	Woodcock-Pokegema complex, north slopes	Moderate	Low	Severe	Medium	Low	649

Map Unit	Soils	Erosion Hazard (water)	Compaction Resistance	Rutting Hazard	Runoff Potential	Fire Damage Susceptibility	Acres
205E	Woodcock-Pokegema complex, south slopes	Moderate	Low	Severe	Medium	Low-Mod	209
35 to 55% slopes							
78F	Greystoke stony loam	High	Low	Severe	Rapid	Moderate	30
202F	Woodcock stony loam, north slopes	High	Low	Severe	Rapid	Moderate	60
203F	Woodcock stony loam, south slopes	High	Low	Severe	Rapid	Moderate	44
Soil Map Units and Interpretations for Management-Juniper Treatments							
15E	Dehlinger very stony loam, 15 to 65% north slopes	Moderate	Low	Slight	Medium	High	118
50E	Lorella very stony loam, 2 to 35% south slopes	High	Low	Mod	Rapid	High	74

Source: Soil Survey of Jackson County Area, Oregon. 1993.

The Topsy-Pokegama Watershed Analysis (1996) describes an area where natural and human activities have created a mosaic of disturbance patterns across the landscape. Soils in open areas tend to exhibit more physical alteration due to logging and grazing activities, whereby soils in forest clumps experience less physical disturbance. When the forest floor is removed, soil productivity is subsequently diminished by loss of nutrient capital from the decomposing organic matter of the surface or "O" horizon.

Forest management activities have the potential to alter or reduce the soil surface by causing compaction, displacement, increased runoff, and accelerated erosion. Soil disturbances such as these can result in nutrient loss and reduced site productivity. The 1995 ROD/RMP specifies objectives and practices to maintain or improve soil productivity. To meet those objectives, best management practices (BMPs) have been established limiting soil detrimental conditions to no more than 20 percent of the total acreage within an activity area (see Appendix B). "Detrimental soil conditions" are defined in terms of detrimental compaction, displacement, and creation of adverse cover conditions. With the exception of displacement, quantitative specifics and thresholds of detrimental soil condition variables are outlined in the ROD, page D-11. For this analysis, the Region 6 U.S. Forest Service threshold for displacement is referenced, defined as the loss of 50 percent of the "A" horizon (surface layer) from an area of 500 square ft. (FSM 2520, R-6 Supplement No. 2500-98-1).

Management actions most likely to impact soils are timber harvest, road building, and fuels reduction activities. Various types of harvest have occurred over the last 50 years, with many forested areas entered two or more times. Historically, yarding techniques were primarily ground-based, and site prep methods commonly included tractor piling, scarification, ripping, and broadcast burns. Although operations likely occurred during wet soil conditions, the extent to which soil productivity has been affected by management activities in the watershed has not been quantified. More recently, hazardous fuels management has included prescribed fire and mechanical methods (shrub mastication) for hazardous fuels reduction treatments.

Previous attempts to measure detrimental soil conditions have been conducted on the on KFRA. Compaction monitoring studies assessed soil disturbance and changes in bulk density following

timber harvest activities. Results concluded that soil disturbance was at or near compaction levels considered detrimental. However, quantifiable increases in soil bulk density could not be determined. Subsequent studies suggest continued soil monitoring utilizing methodology other than bulk density sampling.

Pre-activity soil monitoring was conducted in the project area during 2011 and 2012. KFRA staff used the USDA Forest Soil Disturbance Monitoring Protocol (FSDMP) in sections 15 and 23 to quantify physical soil attributes that could influence site sustainability and hydrologic function. Additionally, a rapid assessment methodology was applied in sections 3, 7, 17, 21, and 35 to qualitatively evaluate existing soil and ground surface conditions. Both protocols interpreted soil conditions based on ocular observations made along random soil monitoring transects. Field investigations revealed detrimental conditions ranged from 20 to 29 percent of the sample points using the FSDMP. Some of the monitoring transects were located in units of very steep slopes; all transected areas had been identified as former brush mastication treatment units. Existing detrimental conditions in proposed treatment units 40-7-23-2 and 40-7-15-3 exceeded RMP limits.

Treatment units where the rapid assessment method was utilized displayed a broader range of variability, with 1 to 15 percent of the sample points showing adverse departure from natural soil conditions. Discrepancies in results between the two methodologies may be attributed to the qualitative nature of the methodology, variability of soil types throughout the units, and/or diversity of treatment history. Complete monitoring results are available in the project file at the KFRA.

Data collected verified that most of the stands were impacted by former management activities and showed evidence of previous entries. A network of skid trails and cutting lanes crisscrossed many units. The data indicated most of the detrimental soil conditions were attributed to past timber harvest activities that resulted in topsoil displacement and mixing. Soil displacement is the loss of surface horizons (forest floor and mineral topsoil) by a combination of harvesting disturbance and mechanical site preparation, and is an indicator of soil organic matter and nutrient loss (Dumroese, et al, 1996). When topsoil is displaced or moved offsite, soil productivity is diminished, and the displaced topsoil is more susceptible to erosion by water or wind.

About eight percent of the sample points recorded detrimental compaction and rutting features. Compaction can adversely affect site productivity by increasing the density of a soil. A compacted soil is characterized by increased runoff, which generally increases erosion rates and affects organisms living within the soil. Compaction reduces or impedes water infiltration, which affects plant production and composition. Soil compaction can potentially alter the water-holding capacity of a soil and reduce plant growth. Rutting also influences soil hydrologic function. Soils in the bottom of ruts are typically compacted and sealed; along the shear edge the soil is often dried out. Ruts can concentrate surface water flow and transport sediment offsite, thereby increasing the potential for erosion (Halvorson et al., 2001).

Erosional features including soil pedestals, rills, or sediment deposition comprised a minor component of the landscape. Erosion is an active, natural geologic process, and typically occurs

at naturally low rates when soils are protected by vegetation and organic litter layers. Accelerated erosion above the natural background erosion rate is the primary concern, and is usually associated with disturbances or events that reduce vegetative cover, displace organic surface layers, or reduce soil porosity through compaction (NRCS, 1996). 2011 and 2012 monitoring studies support this assertion, attributing the low incidence of erosion across the landscape to the gentle to moderate slopes, low recorded presence of compacted soils, and small percentage of exposed surface soil. Due to the lack of structural development however, soils derived from volcanic ash can erode at accelerated rates above the geologic erosion rates when water becomes channeled on disturbed sites such as road surfaces, recreation trails, and logging facilities. The steep Greystoke and Woodcock, or shallow Lorella soils are particularly vulnerable to soil erosion. If the surface layers of these soils are removed by water or wind, the productivity loss can extend well beyond implementation of management activities.

Environmental Consequences - Soils

Methodology

The baseline used for the potential effects analysis was the existing condition described previously. For each alternative, an analysis was conducted to assess the effects of proposed management actions on the soil resources. Information used in the analysis about soils and the effects on soils from various management actions was compiled from field investigations, soil survey inventories, GIS data, literature review, and consultation with various resource professionals. The analysis represents best estimates of impacts based on expertise and professional judgment.

To identify the level of effects and compare the consequences between alternatives, prospective acres of disturbance and soil productivity were used as indicators for the soils impact analysis. “Acres of disturbance” are the acres of surface-disturbing activities and treatments that could potentially affect soil productivity. Ground disturbance is the primary indicator used to assess impacts on soil resources. Ground-disturbing activity that could lead to loss of ground cover or vegetation, reduction of topsoil, or in any way decrease site productivity would be an indicator of adverse effects to soils.

Soil productivity is the capability of a soil to sustain plant growth under a specified set of conditions (Hausenbuiller 1977). Former management treatments, human activities, and naturally occurring events can influence site productivity. Activities that reduce soil stability, alter site hydrology, or diminish nutrient cycling processes could result in decreased productivity. Soils within the project area were analyzed for potential impacts of various management actions on soil productivity.

The magnitude of impacts or effects ranges from negligible to moderate. Negligible effects on soil productivity would be at or below the level of detection, whereby moderate effects would be readily apparent, result in changes of soil character, and would likely require mitigating measures to offset adverse effects.

No Action

Under this alternative no soil-disturbing treatments would be implemented. Detrimental soil conditions from timber harvest and fuels treatment activities would not increase above existing levels. The No Action Alternative would have the least adverse effects of all the alternatives on soil productivity. Additional soil impacts such as compaction, rutting, or displacement would not occur. Units where detrimental conditions exceed RMP limits would continue the recovery process towards improved productivity. Upward trends in soil and site productivity could be expected, not only in the areas above the RMP threshold, but throughout the project area.

Conversely, under the No Action Alternative, hazardous fuel reduction and weed treatment activities would not occur. Fuels would continue to accumulate and the spread of noxious weeds would persist through natural processes. The lack of adequate periodic fuel treatments would likely result in more intense and widespread wildfires. Indirect effects would be a greater potential for soil nutrient loss due to volatilization and the formation of a hydrophobic (water-repellant) surface following a wildfire event. Fire results in the loss of cover and, on steeper slopes, renders the soil more susceptible to surface erosion. A stand-replacing wildfire could have long-term adverse effects on the soil resource, negating any improvement in productivity realized by implementing the No Action Alternative.

With the exception of the 2.7 acre site identified for imazapic application, the absence of weed treatments would have negligible effects on soils in the project area overall. Within the 2.7 acres however, the lack of herbicide treatments would likely facilitate the spread of noxious weeds. Invasive plants can have dramatic effects on soil productivity due to changes in soil characteristics such as nutrient and water availability, organic matter in the soil, diversity and abundance of soil biota, and soil water holding capacity. Invasive plants can also increase the soil surface exposed to wind or water erosion, change fire frequency, and produce toxic chemicals that affect soil organisms (Malaby, 2011).

Actions and Effects Common to Alternatives 1, 2, and 3

- Conifer planting
- Road closures and improvements
- Pipeline construction for Topsy Campground drinking water source

The planting of conifer species is proposed in unit 41-7-17-1. The soils on 161 acres of the treatment unit are primarily soil map unit 145C, the Pinehurst-Greystoke complex on less than 12 percent slopes. Localized soil impacts from planting activities are expected to be short term and minor due to the gentle slopes, deep loamy soils, and minimal ground disturbance from foot traffic and hand planting equipment. In the long term, beneficial effects of planting this unit can be anticipated, including increased nutrient cycling, improved soil surface stability, and in some cases, decreased compaction from new root penetration.

All alternatives propose closing approximately 10.6 miles of roads and undertaking road improvements on 4.3 miles of roads. Studies have shown that forest roads are a source of sediment production, with the road surface being the main source of erosion and sediment

generation (Croke and Hairsine, 2001). Road improvement activities can cause minor sedimentation and erosion. Road maintenance activities are expected to result in minimal short-term adverse soil impacts in localized areas. Although all roads within the project area will continue to yield some amounts of sediment, Croke found that sediment concentrations in road runoff were much lower on abandoned roads than on well-used ones, and abandoned roads were minor sources of sediment (Croke, 1999). It is anticipated that road closures would have moderate long-term beneficial effects on soil resources. A complete discussion of sediment production and deposition can be found in the hydrology report.

Approximately 10,000 feet of water pipeline for the Topsy Campground would be constructed under all action alternatives. Pipeline construction activities typically cause soil displacement and compaction. Assuming a four-foot wide installation footprint, ground-disturbing impacts from pipeline construction are anticipated to be about 40,000 square feet, or close to one acre. Effects on soil resources would be short-term, localized, and negligible.

Alternative 1- Proposed Action

Implementing the activities described in Alternative 1 would result in some detrimental soil impacts. Historically, vegetation treatments were accomplished in the project area with ground-based mechanized equipment, which would likely be used in future operations. Use of heavy equipment for timber sales, thinning activities, and brush mastication operations has the potential to cause isolated areas of compaction and topsoil displacement, creation of adverse surface conditions, and diminished site productivity. Soil compaction would most likely occur on skid trails and landings, whereby tractors and skidders make multiple passes over a designated area. The use of mechanical harvesters normally results in a greater area of ground disturbance, particularly soil displacement, since they are not confined to skid roads.

In an attempt to quantify soil disturbance caused by mechanical harvester operations, KFRA timber staff evaluated GIS and GPS data from the neighboring Grenada East timber sale. Results of the analysis suggest the extent of soil disturbance from conventional ground-based logging methods typically ranges from 5 to 12 percent (KFRA staff, 2004). Other studies assert the total degree of residual detrimental soil disturbance remaining after all ground-based timber harvest activities varies from 15 to 21 percent (Megahan, 1986; Landsberg, 2003; Deschutes National Forest, 1995-1999). Discrepancies in data are presumably due to the fact that the KFRA analysis did not consider soil disturbance apart from skid trails, landings, and temporary road construction, whereby outside studies accounted for all disturbances from timber harvest activities. Exclusive to units 40-7-23-2 and 40-7-15-3, the 2012 soil monitoring data shows 15 to 21 percent soil disturbance, which more accurately reflects post-harvest conditions within the project area.

It is expected that effects of Alternative 1 on soil resources would be less, in both extent and magnitude, than the impacts of conventional vegetation management prescriptions. This is due in part to “Ecological Forestry” prescriptions that not only exclude patches of ground from harvest treatments, but also remove less volume of wood compared to alternative 3. Fewer acres treated and less volume extracted equates to less soil impacts. It is important to note that a smaller number of acres treated may not equate to an equal reduction in soil disturbance (e.g., 10 percent

fewer acres retained in “skips” may not reduce total soil disturbance by 10 percent). There may not be a one-to-one reduction in soil impacts because the potential exists for additional maneuvering to avoid designated skips and retain older trees. Furthermore, soil disturbances would be magnified in a few units requiring a second entry.

The precise extent and magnitude of potential detrimental soil conditions resulting from vegetation treatments remains unknown. With the exception of specific units described in the following discussion, extensive areas of detrimental soil conditions are not likely to occur under implementation of Alternative 1. Short-term minimal effects would be alleviated by application of PDFs and BMPs, which require utilization of existing roads, skid trails, and landings (see Appendix B). Soil moisture limits preclude operations during the wet season. With properly implemented PDFs and BMPs, detrimental soil conditions are expected to remain below threshold limits established by the 1995 RMP.

Treatment unit 40-7-23-2 was identified in the NRCS soil survey as 204E Woodcock-Pokegema complex on 12 to 35 percent slopes. However, GIS layers and field monitoring confirmed a predominance of slopes greater than 35 percent. As such, skyline cable logging is proposed in this unit to facilitate timber harvest. Typically, soil disturbance resulting from cable yarding systems is primarily limited to the narrow (approximately 10-foot wide) yarding corridors. Landsberg studied the effects of thinning and partial cuts by various yarding systems. He found that skyline cable yarding disturbed about 7 percent of the site, with 7 percent soil displacement and less than 1 percent compaction (Landsberg, 2003). It is anticipated that cable logging in this unit would result in minimal short-term adverse soil impacts.

Soil monitoring identified timber sale units 40-7-23-2 (a steep slope unit discussed in the preceding paragraph) and 40-7-15-3 as above RMP limits for detrimental soil conditions. To minimize soil impacts and ensure compliance with RMP objectives and goals in these units, applicable BMPs are recommended and listed in Appendix B.

Manual thinning of junipers (unit 40-8-28-1) and timber (unit 40-7-27-1) are expected to have no measureable impact on the soil resource, except when followed by pile burning. Depending on the size, intensity, and duration, burning slash piles could damage the soil. Piled slash burns hotter than underburning. Soils below the burned piles can incur loss of organic matter, changes to physical properties such as structure and water-repellency, and exhibit increased erosion rates. Soils throughout the project area are highly susceptible to forming a water-repellent surface layer. Applicable PDFs that would be implemented are listed in Appendix B.

To alleviate potential detrimental effects, burned areas will remain small and interspersed throughout the units. Burning will only occur when the soil surface is very moist or wet. The threshold for detrimentally burned conditions occurs when the mineral soil (below the duff or litter layer) is oxidized to a red color; the next half-inch is blackened due to charring of organic matter.

To eliminate ladder fuels, brush mastication treatments are proposed in units 40-7-15-1 and 40-7-35-1. Mastication or mowing of slash can create varying amounts of soil disturbance depending upon machine operator techniques and how fuels are distributed within a treatment unit. The

forest floor and topsoil can easily be displaced, especially where equipment makes small-radius turns (Napper et al, 2009). The proposed brush mastication units correspond to the productive Pokegema/Woodcock soils, both of which are well-suited to mechanical site prep on the gentler slopes. To document extent and magnitude of soil impacts, pre-and post-treatment soil monitoring is recommended in units identified for mastication treatments.

Low-intensity underburns would have minimal effects on soil properties. Typically, cool broadcast burns have a slight short-term positive effect of increasing available nutrients, with a slight negative effect three to five years post burning, due to decreases in nitrogen. Soil productivity is expected to improve due to the positive flush of post-treatment nutrients.

Construction of 0.15 (approximately 795 feet) miles of new temporary road is expected to have minimal adverse effects on soil resources. Roads create a permanent disturbance footprint of three to four acres per mile for a bladed 14-foot road width (McCarty, personal communication, 2011). These figures calculate a soil disturbance footprint of approximately 0.6 acres.

Manual thinning in the riparian reserves is expected to have no measurable adverse effects on the soils within the treatment units. To avert potential resource damage, additional BMPs specific to these fragile groundwater soils would be implemented and are included in Appendix B.

Application of imazapic following prescribed fire is proposed on treatment unit 40-8-28. Prescribed burning of 2.7 acres of medusahead sites is likely to have minimal direct effects on soils. Burning would result in light to moderate mosaic burns that remove medusahead litter and kill some of the shrubs. Studies of herbicide effects on soils indicate there is no evidence of loss of soil productivity. Generally, either no effects or short-term effects have been found at concentrations likely to occur from typical application rates. Similar to other treatment methods, direct effects to soils could include small amounts of compaction and disturbance during implementation of herbicide treatments, and indirect effects could result from changes in plant composition and vegetative cover. In the long term, treatments could improve soil conditions by removing invasive plants and restoring native vegetation on the site (USDA Forest Service, 2011).

Alternative 2

Alternative 2 proposes fewer acres of ground-disturbing activities than what is described in Alternative 1. Implementation of Alternative 2 would result in less adverse effects on soil resources because fewer acres would be treated, and no thinning would occur in Riparian Reserves. Fewer mechanical treatments and lower overall volume would result in less soil disturbance than would occur under Alternative 1. Short-term minimal adverse effects such as soil displacement and compaction are expected within treatment units. However, in the long term, implementation of Alternative 2 would maintain or improve soil productivity and meet the objectives of the RMP to a greater degree than either Alternative 1 or Alternative 3.

With the exception of the brush mastication treatments, fuel treatments implemented in Alternative 2 would be the same as Alternative 1. Therefore, the effects of fuels treatments on soil resources would mirror the effects of the Alternative 1 in all units except 40-7-15-1 and 40-

7-35-1. No fuels mastication is planned in this alternative; hence overall adverse soil impacts would be considerably reduced in the identified units, and slightly less overall.

The manual thinning and retaining on site of junipers (unit 40-8-28-1) is expected to result in minimal ground disturbance which would be primarily due to foot traffic. Likewise, adverse impacts on soil resources and productivity would be minimal due to juniper treatments.

Unlike Alternative 1, Alternative 2 does not include other ground-disturbing activities such as thinning in the Riparian Reserves, new road construction, nor would imazapic treatments occur. Although minimal, fewer ground-disturbances would result in fewer impacts on soils and site productivity than would occur under Alternative 1. The absence of imazapic treatments however, would facilitate the spread of noxious weeds. Invasive plants can have dramatic effects on soil productivity due to changes in soil characteristics such as nutrient and water availability, organic matter in the soil, diversity and abundance of soil biota, and soil water-holding capacity. Invasive plants can also increase the soil surface exposed to wind or water erosion, change fire frequency, and produce toxic chemicals that affect soil organisms.

Alternative 3

Adverse effects to the soil resource under implementation of Alternative 3 are projected to increase above that of Alternatives 1 or 2. Slightly fewer acres would be treated, but more importantly, greater wood volume would be removed. Unlike Alternative 1, Alternative 3 does not include silvicultural prescriptions to retain older trees or provide for skips. Under this alternative, there is no diameter limit. Conceivably, more ground would be disturbed by harvest operations than that of Alternatives 1 or 2.

Ground disturbances would be similar to those described for Alternative 1. However, it is likely that soil disturbances and potential detrimental conditions would be greater in magnitude than either Alternatives 1 or 2. The degree of soil impacts would be attributed to the greater harvest volume proposed with implementation of Alternative 3. It is anticipated that vegetation treatments would result in localized effects on soil resources. Depending upon factors such as properly implemented BMPs, operator skills, and site conditions, the long-term adverse soil impacts could range from minimal to moderate.

Hazardous fuels and juniper treatments implemented in Alternative 3 would be the same as Alternative 1. Therefore, the effects on soil resources would be the same. Alternative 3 includes imazapic treatments for weeds. Application of imazapic is proposed on treatment unit 40-8-28. Studies of herbicide effects on soils indicate there is no evidence of loss of soil productivity. Generally, either no effects or short-term effects have been found at concentrations likely to occur from typical application rates. Similar to other treatment methods, direct effects to soils could include small amounts of compaction and disturbance during implementation of herbicide treatments. Indirect effects could result from changes in plant composition and vegetative cover. In the long term, treatments could improve soil conditions by removing invasive plants and restoring native vegetation on the site.

Cumulative Effects

It is recognized that former management treatments, human activities, and naturally occurring events have resulted in various degrees of soil disturbance within the project area boundaries. A majority of the project units have been previously entered for management activities. Since the year 1998, a minimum of eight BLM timber sales operated within currently proposed project boundaries. An array of fuels treatments, including underburning, brush mastication, and pile and burning have been performed in most units. Roads, both aggregate and native-surfaced, cross many of the units. Cumulative effects of management actions on soil resources are evident throughout the project area. As a consequence, soil productivity has been impacted to various degrees.

Detrimental soil conditions likely resulted from prior activities. Presently, detrimental conditions exceeding the standards in the KFRA ROD/RMP have been documented in units 40-7-23-2 and 40-7-15-3, as described previously in this report. To ensure the cumulative effects of additional treatments meet soil protection thresholds and productivity objectives, additional mitigations listed in Appendix B would be required for those units.

For all management units, treatments would continue to be implemented during the summer months (June-October) when soils are least susceptible to damage. Winter logging over snow or with frozen ground conditions would be a recommended option whenever feasible. Ongoing monitoring to measure soil and forest floor conditions would assure that effects on soils are within the RMP standards and are minimized by appropriate measures when needed.

Future activities anticipated within the project area include, but are not limited to: timber sales, vegetation and fuels treatments, grazing, dispersed recreation, road construction and maintenance, and watershed improvement projects. Wildfires have occurred and continue to occur throughout the watershed. Most of these actions were analyzed in previous EAs. Continued implementation of PDFs, BMPs, and monitoring would ensure compliance with soil resource management objectives in the RMP.

3.8 Hydrology

Affected Environment

Watershed Overview—Geology, climate, and streamflow

The Topsy Pokegama Landscape Analysis (TPLA 1996) provides general water resources background information for the project area. The project area includes a portion of that landscape analysis area on the east side of the Upper Klamath River. The Keno Project is located in the Upper Klamath River sub-basin upstream of Irongate Dam. The affected watersheds include small, upper portions of four small to medium sized drainages entering the Klamath River canyon, Lower Klamath Lake subwatershed, and Butte Valley (a closed basin). There are portions of seven sub-watersheds and four watersheds in the Keno Project Area.

The climate is characterized by mild wet winters and hot dry summers with relatively low average precipitation compared to other areas of western Oregon. Average annual precipitation ranges from approximately 13 inches to 35 inches near the top of Hamaker Mtn. Winter

precipitation in the higher elevations usually occurs as snow, which ordinarily melts during the spring runoff season from April through June. Rain predominates in the lower elevations with a mixture of rain and snow occurring between approximately 3,500 feet and 5,000 feet in what is referred to as the transient snow zone (TSZ). Rain-on-snow runoff events originate in this zone and can trigger floods and road damage. Summer rainstorms occur occasionally and are usually of short duration and high intensity. These types of events are usually limited in coverage but can result in increased erosion and sediment deposition. The geology of the project area is volcanic in origin. The drainages are dominated by lava flows of basaltic andesite, basalt, and andesite (TPLA 1996).

Streamflow Characteristics

Surface Water

Surface water in the Keno Project Area includes streams, ditches, springs, wetlands, and reservoirs. Streams in the project area are classified as perennial, intermittent with seasonal flow (long duration intermittent), intermittent with ephemeral flow (short duration intermittent), and dry draws with ephemeral flow. Streams categorized as perennial or intermittent on federal lands are required to have Riparian Reserves as defined in the Northwest Forest Plan (USDA and USDI 1994). Dry draws do not require Riparian Reserve designation because they lack the combination of a defined channel and annual scour and deposition (USDI 1995). Streams on private forest lands are managed according to the Oregon Forest Practices Act. Stream types on BLM-managed lands were identified through site specific stream inventories in 2010 and 2011. For this analysis, the site potential tree lengths used for establishing Riparian Reserves are 120 for the Keno analysis Area. Table 15 summarizes stream miles within each 5th and 6th field Hydrologic Unit Code (HUC) (Watershed and Sub-Watershed). Mileages include perennial and intermittent streams.

Table 15. Stream miles within analysis area and BLM-managed lands

Subwatershed (Huc 12)	Watershed (Huc 10)	Analysis Area Stream Miles			BLM Stream Miles		
		Perennial	Intermittent	Total	Perennial	Intermittent	Total
Modoc Gulch - Butte Valley	Butte Valley	0.48	4.55	10.83	0.00	1.37	4.64
Pleasant Valley	Butte Valley	0.00	17.96	27.62	0.00	5.39	8.97
Rock Creek - Klamath River	John C Boyle Reservoir - Klamath River	0.11	12.58	16.15	0.00	3.05	4.16
Big Bend - Klamath River	John C Boyle Reservoir - Klamath River	0.02	11.32	16.49	0.02	4.92	7.04
John C Boyle Reservoir	John C Boyle Reservoir - Klamath River	0.07	4.24	19.52	0.00	1.30	6.61
Lake Miller	Lower Klamath Lake	1.63	14.45	55.87	0.41	0.06	2.63
Klamath Strait Drain	Lower Klamath Lake	0.00	0.00	0.00	0.00	0.00	0.00
Keno Reservoir - Klamath River	Lake Ewauna - Klamath River	0.26	6.67	25.37	0.00	0.16	0.57

The major factors influencing both water quantity and quality within the analysis area where harvest is to occur include soil conditions, canopy cover, roads/trails, and riparian grazing impacts (TPLA 1996). Reduced canopy cover within the upper forested portion of the drainages that are less than historical can alter the amount and timing of streamflows. This may result in increased channel erosion and morphological changes to the stream channels. Roads, OHV trails, and logging can accelerate erosional processes and result in increased turbidity and sedimentation. Grazing along streams and within meadows can elevate stream temperatures and accelerate erosion by reducing streamside shade and altering channel form and process. These impacts are discussed in more detail below.

Watershed Conditions

Roads and Trails

Road systems impact the natural hydrologic routing pattern by intercepting subsurface flow paths and increasing the drainage efficiency. Increasing the drainage efficiency can exacerbate the frequency and magnitude of peak flows and cause increases in sediment delivery to streams (Jones and Grant 1996). For the Keno analysis area, there is currently an average of approximately 3.62 miles of road per square mile. GIS analysis shows that approximately 83% are native surface roads. There are 2.29 stream crossings (intermittent and perennial streams) per square mile, (see Table 17) in the project area.

Widespread logging on private and BLM lands has occurred during the last 20 years. The dominant logging method on private and public lands in the project area is ground-based machine cutting and ground skidding, using a network of skid trails and landings. Increased compaction and soil bulk density can reduce soil infiltration rates, accelerating run-off rates, and increasing overland flow (see Section 3.7, Soils). On private lands, these skid trails and landings are often ripped and replanted. The legacy (remnant) effects of compaction are unknown at the watershed scale across ownerships.

Research supported by local and regional field evaluations have consistently found roads, native surfaced roads in particular, to be the primary source of accelerated erosion in managed forest watersheds (Reid and Dunne, 1984: Luce and Black, 1999). Roads impact aquatic systems through both chronic and episodic erosion. Chronic erosion is where material is detached and transported to streams via the road surface and drainage structures such as cross drains and inboard ditches. This occurs in response to precipitation events throughout the year. Episodic erosion usually occurs as a result of intense rainfall and rain-on-snow events within the transitional snow zone. Large failures often occur as a result of culvert plugging, stream diversion and fillslope landslides. In addition, where road densities are high, concentration and routing of stormwater may result in increased peak flows. Both road density and the number of stream crossings are gross indicators of the level of road impacts in watersheds. Although road density is a useful indicator, it should be noted that not all roads impart similar effects. For instance, the magnitude of impacts from roads on steep slopes is different than those from roads located on flat terrain. Roads located near streams and road stream crossings are responsible for the majority of sediment delivered to channels. Within the analysis area, some roads are located within Riparian Reserves. In addition, some native surface roads are open during the rainy

season. This type of use can render drainage features ineffective and result in concentrated flow and increased erosion.

Although some road work has been accomplished, some crossings are susceptible to failure through culvert plugging and stream interception. Other road segments are unsurfaced, steep, lack adequate drainage, or are located within close proximity to streams. Lack of road maintenance or improper road maintenance by all jurisdictions within the analysis area has increased sediment production or the potential for sediment production. OHV use is occurring in the watershed as well. OHV trails with hydrologic connectivity impact water quality in a similar fashion as roads. OHV trails often utilize old road beds and skid trails, or are established through repeated off-road travel, or are illegally constructed. They exist on the landscape irrespective of sensitive soils, adequate drainage, or proximity to watercourses, and are also responsible for increased sediment production.

Based on recent field observations, conditions are highly variable and site specific.

Most of the roads in the analysis area are native surfaces and stream crossings consist of unimproved low water crossings or improved crossings with no recent maintenance. Road densities in the analysis area (3.62 miles per square mile, see Table 17) are the same as road densities in the watershed as a whole (3.62 mi/ sq.mi., TPLA 1996).

Canopy Cover and Transient Snow Zone

The effect of large contiguous areas of open canopy on peak flows has not been specifically studied in this watershed (TPLA 1996). It has been documented that western Cascade watersheds that are 30 to 40% vegetatively unrecovered can realize substantial increases in two to five year return peak flows as well as increases in flow volumes (Grant et al 2008). These effects are likely to be additive with other watershed disturbances, such as road interception, rather than compounding or magnified (Jones 2000). Substantial changes in the two to five year return peak flows can alter the channel shape and induce channel bank erosion and down-cutting (Ziemer et al 1991). If peak flows have been enhanced in this watershed, it is likely that stream channels have already adjusted (enlarged). Historically, geomorphic processes that shape landscape and channel geometry are triggered by large, infrequent storm events. In recent times, these events can be characterized by warm, moist storms that result in high intensity, long duration rainfall. The results can be intensified when rainfall occurs on an established snowpack.

The percent of a watershed in the transient snow zone (TSZ), for the Keno Analysis area (roughly an elevation band between 3,500 and 5,000 feet), can indicate elevated risk of adverse impacts. Approximately 80% of the Keno area is in the TSZ. These impacts can be accelerated by modifications to forest canopy cover, roads, and other disturbance features. Drainages where TSZ compromises greater than 25% of the drainage area are of hydrologic concern, particularly where large openings such as clearcuts exist. Drainage areas in the analysis area have greater than 25% in the TSZ (Table 16). Large areas of vegetation removal in the TSZ are of particular concern due to alterations of the streamflow regime and the potential for resultant increased peak flow magnitudes (Christner and Harr 1982).

Table 16. Percentage of Subwatershed within the Transient Snow Zone (TSZ)

Subwatershed (Huc 12)	Watershed (Huc 10)	Acres in TSZ	Total Acres	Percentage of Subwatershed in TSZ
Modac Gulch - Butte Valley	Butte Valley	1769.71	1974.89	89.61
Pleasant Valley	Butte Valley	3474.79	5215.63	66.62
Rock Creek - Klamath River	John C Boyle Reservoir - Klamath River	8230.59	8487.77	96.97
Big Bend - Klamath River	John C Boyle Reservoir - Klamath River	5499.60	7511.94	73.21
John C Boyle Reservoir	John C Boyle Reservoir - Klamath River	6575.97	7654.59	85.91
Lake Miller	Lower Klamath Lake	10818.87	15979.25	67.71
Klamath Strait Drain	Lower Klamath Lake	11.81	11.81	100.00
Keno Reservoir - Klamath River	Lake Ewauna - Klamath River	7224.08	7485.07	96.51

Modifications of canopy cover in a watershed, particularly in the TSZ, that result in less than historical conditions, either through fire or timber harvest, may affect the timing and volume of stream flow. An assessment of percent canopy cover is also useful in determining potential cumulative effects of the proposed activities. In the analysis area, the Ecoregion Description (TPLA) lists historic canopy closure as 30%, with the exception of the oak woodland. An analysis of percent canopy cover of forested land at the 6th field HUC was conducted. This scale is where detectable changes in peakflows would likely occur.

Different levels of harvest in watersheds have demonstrated variable effects on peak flows (Wemple et al. 1996; Harr and Rothacher 1979). When less than 25% of a watershed is harvested, no detectible change in peak flows has been observed (Stednick 1996). It should be noted that the majority of literature available regarding the relationship between harvest and flow has focused on clear cut harvesting, many in areas that removed close to 100% of the overstory canopy. For this analysis, any area where 30% or greater of the forested acres is less than 30% canopy cover, it is assumed to be hydrologically unrecovered, and responds similarly to a clearcut. This is particularly true if a large percentage of the drainage is located within the TSZ. None of the TSZ canopy cover values within the Keno Project drainages reflects a value that may elevate the potential to alter timing and increase the potential for peakflows.

An aerial photo reconnaissance of the Big Bend –Klamath River sub-watershed was performed to assess whether there exists an elevated risk of peak flow effects from additional disturbances. This subwatershed has the greatest potential for change under the action alternatives because it has the highest acreage proposed for timber sale harvest (1,100 acres). The analysis procedure included performing canopy cover estimates via ocular estimation for all land within the subwatershed that are on the south side of the Klamath River (the sub-watershed includes drainages outside the analysis area on the north side of the Klamath River that would have no effect on the analysis area). The results of the analysis were that approximately 26% of the area is in Equivalent Clearcut Area (ECA) condition (i.e. approximately 74% canopy cover overall). Areas that were naturally un-forested were not included in the analysis. Additionally, management units were interpreted at a scale of 10 to 400 acres based on observable management consistency, and assessed as to whether they were greater or less than 30% ECA.

Overall, for the approximately 7,000 acres of forested area assessed, approximately 25% was in a 30% or greater ECA condition.

Recent research indicates that effects from peak flows, although of concern, should be confined to a relatively distinct portion of the network where channel gradients are less than approximately 2.0% slope and streambeds are composed of gravel and finer material. Furthermore, data supports the interpretation that if peak flow increases do occur, they can only be detected in flows of moderate frequency and magnitude. Beyond that, they are likely not detectable (Grant et al. 2008). This suggests that if increases in peak flows occur, they are unlikely to result in adverse effects to the higher gradient channels located within the analysis area. Also, that peak flows are only detectable in smaller storm events with return periods of 6 years or less, where channel forming processes are minor in effect. Most of the stream channels in the analysis are greater than 2% slope suggesting that peak flow effects, if they occur would be limited in extent.

Water Quality

Limited information is available on existing water quality conditions in the analysis area. Intermittent streams in the analysis area have the potential to deliver sediment and associated nutrients to receiving waterbodies including 303(d) listed waterbodies, such as the Klamath River. (The Clean Water Act requires each state to compile a 303(d) list of threatened or impaired waters that do not meet water quality standards). The roads network has the potential to route sediment if it is not designed and maintained to minimize hydrologic connectivity to streams.

Environmental Consequences - Hydrology

No Action

There would be no direct effects which would result from selection of the No Action Alternative. The current conditions in the Keno Analysis Area, which are the result of past actions not related to the proposed Keno project, would persist. All current conditions and trends would continue as specified in the Affected Environment discussion. Namely, roads with poor drainage and lack of maintenance, or improper maintenance, would continue to deliver water and sediment to streams. Likewise, in certain stream reaches, roads located along and crossing stream channels would continue to contribute sediment to stream channels. Some routine maintenance and repair of roads would likely occur.

On BLM-administered lands, over time, vegetation recovery within Riparian Reserves would mediate steam temperatures (to the limited extent that this would occur in only intermittent streams) and provide for increased wood recruitment to stream channels. There would be no changes in percent of area in non-recovered (less than 30 percent canopy cover) openings, areas of compacted soil, road densities, percent of area in roads, or number of stream crossings. There would therefore be no changes to the magnitude and frequency of peak flows beyond those which may already be occurring.

In the long-term, climate change projections indicate that the West and Pacific Northwest are likely to experience continued warming and increased precipitation, along with more extreme wet and dry years (Furniss et al. 2010). As a result, hydrologic changes, particularly the changes in snowpacks and runoff patterns, are among the most prominent and important consequences. Declines in snow water equivalent occurring in low and mid-elevation sites may result in earlier spring flows and lower late-season flows. Average annual streamflows are also expected to decrease. Flood severity is expected to increase because increased inter-annual precipitation variability would cause increased runoff in wet years and increased rain-on-snow probability in low-elevation snowpacks.

Under the No Action Alternative, given the right conditions, the lack of vegetation and fuels treatments may increase the likelihood of a high-intensity wildfire over part or all of the area. If so, it could alter the surface water and groundwater regime. Immediately after a severe fire, the loss of vegetation would make more groundwater available for streamflow, and summer flows would likely increase. However, the absence of vegetation may also result in an increased risk of higher peak flows, increased erosion, and water quality impacts. Burned areas would also become more susceptible to weed infestations which would negatively impact hydrologic function.

Medusahead Rye Treatment

Not treating the identified medusahead population would have the effect of continued reduced hydrologic function. This weed infestation reduces infiltration and reduces protection from erosion provided by native perennial plant cover. This effect would be magnified if the population were to spread and increase in aerial coverage or spread to new areas.

Alternative 1 - Proposed Action

Alternative 1 proposes various treatments of timber sales, new road construction and improvements, prescribed burning, and non-commercial thinning. In addition, depending on post-harvest conditions, timber sale harvest units could be followed up by silvicultural treatments that would entail hand thinning, piling, and burning.

A total of 0.15 miles of new temporary road construction, none of which is within Riparian Reserves, is proposed. All road renovation and new construction would occur on BLM-administered land. Road maintenance, including spot rocking, would occur. All road construction, improvement, and log hauling would be restricted to the dry season (see PDFs as described in Appendix B).

All vegetation treatments would maintain an overstory and mosaic of understory vegetation. At least 30 to 50% canopy cover would be maintained in harvest units. There would be no increase of forested area with canopy cover less than 30% within the Keno Analysis Area, including the TSZ. Therefore, none of the Project Area would cross the threshold which may result in an increase in peak flows. Detailed analysis with tables that show acres harvested in each watershed and subwatershed for the proposed treatments are available in the Keno EA project file.

In order to maintain long term site productivity, silvicultural treatments would likely occur over a period of several years, distributing activity over time. These activities would not appreciably decrease canopy cover, as only small diameter vegetation would be cut and piled. Sediment levels due to roads, past harvest, and other disturbances is the primary focus of concern. In addition to road construction and improvement, Alternative 1 includes log hauling and associated minimal road maintenance. This could include minor ditch cleaning (if necessary), road blading, and maintenance of drainage features. Log truck traffic, especially on unsurfaced roads, loosens the road surface and makes that material available for transport to stream channels. In 2011, the BLM conducted a review and update of BMPs to provide direction regarding road maintenance practices and road-related actions. The intention was to minimize or prevent sediment delivery to waters of the United States in compliance with the Clean Water Act and its revisions. All applicable road construction and road improvement BMPs as described in Appendix D of the 1995 RMP (as modified by IM-OR-2010-074) will be utilized in this project. Examples include sidecasting material, undercutting cutslopes, improper disposal of material, and unnecessary disturbance within riparian reserves. For a link to this list of BMPs, see Appendix B of this EA.

With implementation of Alternative 1, hauling and road maintenance activities are expected to result in short term increases in sediment and turbidity. Luce and Black (1999) found no significant increase in erosion when only the road surface was treated; however, statistically significant erosion occurred when road ditches were bladed. Luce and Black (2001) observed an 87% decrease in erosion and sediment transport from roads in years one and two following road maintenance activities. With implementation of BMPs and properly conducted maintenance activities, these increases are expected to be minor. Transport of sediment at low flows is unlikely. If transport occurs during high flows, which is likely, the introduced sediment would become an immeasurable fraction of the total sediment load, and would not be detectable at downstream locations.

Road construction has the potential to increase sediment production, as well. No new road construction would occur in Riparian Reserves, nor would any of the new roads have hydrologic connectivity to streams. None of the new temporary roads would involve any stream crossings. With proper installation of drainage features, any fine sediment mobilized from road construction would likely be filtered by vegetation and assimilated into the forest floor before reaching aquatic habitat. New road construction would temporarily increase road density and the compacted area attributed to roads in the Analysis Area drainages. However, the 10.6 miles of road closure would offset new construction and ensure a net reduction in road density (see Table 17 for road densities before and after Proposed Action treatments in the Keno watersheds). Roads closed that have potential for negative hydrological effects would be hydrologically disconnected (stormproofed) from the surface water stream network, and would therefore have low potential to capture and route stream runoff. Assuming system roads used for hauling are properly upgraded and maintained, there could be short-term increases in sediment delivered to streams during runoff events, but there would likely be overall improvements in road surface, drainage features, and a reduction in overall open road density. These road system improvements would move watershed conditions towards attainment of ACS objectives for improving hydrologic function and reducing sediment delivery to streams.

Table 17. Road Densities and Stream Crossings before and after Treatment

	Road Density (miles/square mile)	**Road Density within Riparian Reserves** (miles/square mile)	**Perennial and Intermittent Stream crossings/square mile**
Existing Condition	3.62	5.91	2.29
After Keno Project proposed actions	3.35	4.96	2.20

Skid trails and landings would contribute to the overall increase of hydrologically unrecovered area, but would be treated following applicable BMPs (for example properly spaced water bars on slopes) to minimize erosion potential. Stream crossings and landings would be placed to avoid impacts to stream and riparian areas to the extent practical.

Water Quality

Erosion and runoff from road systems, skid trails, and landings are the primary source for water borne nutrient transport to listed water bodies including the Klamath River in the Keno Analysis Area watersheds. Because the proposed actions would minimize road and harvest activity in RR, there will be a low likelihood of sedimentation or runoff entering stream channels.

Medusahead Rye Treatment

Fall prescribed burning and herbicide (imazapic) application PDFs would minimize impacts to existing vegetation and water quality. Impacts would be minimized because the treatment site is not near or adjacent to perennial or intermittent streams, ponds, or reservoirs. Impacts could occur, however, in ephemeral streams or where there is surface runoff immediately following application. Herbicides are usually picked up in stream flow by the first storm large enough to create flow in the channels. The 2007 National Vegetation FEIS pp. 4-28, Table 4-9 quantifies the off-site movement potential for imazapic. Groundwater leaching potential ranges from low to high while surface water runoff is low. Even if an herbicide has runoff or leaching potential, the likelihood of it reaching a water body also depends on site characteristics. For the proposed treatment site, groundwater levels are likely greater than 100 feet below the ground surface (based on nearby local domestic well log information) and precipitation is low. Therefore, the overall potential for that herbicide to reach groundwater before degrading would be very low (2001 National Veg. FEIS, pp. 4-26). These site characteristics of the proposed project area, coupled with current buffer protections, would help to minimize accidental direct application or drift at concentrations high enough to impair water quality.

Risk to non-target riparian vegetation associated with herbicide use would be low or non-existent due to the location of the proposed treatment. The proposed method of hand treatment decreases the risk for accidental direct spray or drift onto non-target species. As long as standard operating procedures for stream buffering and chemical application are followed, there would be no measurable risk to water resources and wetlands/riparian areas.

Benefits to riparian and aquatic environments would occur from the upland treatments designed to establish native perennial grasses, shrubs, and forbs. Once adequate perennial native vegetation is established, the potential for erosion would be reduced. In general, underburning would improve the effectiveness of the herbicide application and as such, would be more

effective in improving hydrologic function of the watershed as the site becomes re-vegetated with desirable species.

Water Supply Line Installation
Construction activity associated with water line installation would result in minor disturbance and may create erosion hazards during trenching and filling activities. Following applicable BMPs for erosion control would mitigate potential impacts to water quality and sedimentation. This same action is common to all action alternatives, so the effects would be the same for Alternatives 1, 2, and 3.

Alternative 2

Alternative 2 proposes slightly fewer timber sale units and would overall have slightly less ground-disturbing activities than Alternative 1, and therefore, slightly less hydrologic impact from ground disturbance and road use. Short-term adverse effects such as road use and compaction would be slightly lower under this alternative than Alternatives 1 or 3. No new road construction or fuels mastication is planned in this alternative; therefore, these areas would likely remain hydrologically recovered.

The manual thinning and retaining on site of junipers (unit 40-8-28-1) is expected to result in minimal ground disturbance and therefore, runoff and erosion impacts would be minimized. Compared to the No Action Alternative, Alternative 2 could enhance hydrologic function in the long-term if the resulting juniper cutting meets objectives for increased shrub and bunchgrass cover.

In Alternative 2, baseflows would likely remain unaffected as the magnitude of vegetation removal would not significantly reduce transpiration. Since there is no harvest proposed within Riparian Reserves in Alternative 2, stream temperatures would not be affected because there is no change to the vegetation currently providing shade. The project would allow attainment of the Aquatic Conservation Strategy (ACS). An assessment of the ACS Objectives can be found in the Keno EA project file.

Medusahead Rye Treatment
As stated in the No Action Alternative, not treating the identified medusahead population would have the effect of continued reduced hydrologic function to the extent that this weed infestation reduces precipitation infiltration and reduces protection from erosion provided by native perennial plant cover. This effect would be magnified if the population were to spread and increase in aerial coverage or spread to new areas.

Alternative 3

Adverse effects under implementation of Alternative 3 are projected to increase above that of Alternatives 1 or 2. Potentially more ground would be disturbed by harvest operations than that of Alternatives 1 or 2.

Fuel and juniper treatments implemented in Alternative 3 would be the same as Alternative 1, so the effects on hydrologic resources would be the same. In the long term, there would be slightly

more acres remaining in a hydrologically unrecovered condition and therefore runoff may increase slightly in the TNZ compared to Alternatives 1 or 2.

Medusahead Rye Treatment
Alternative 3 includes imazapic treatments for weeds. However, because no pre-burning of the existing medusahead rye thatch is proposed, the treatment may not be effective at controlling this population. If that is the case, the effects would be expected to be similar to the No Action Alternative and Alternative 2 (no treatment). Alternatively, for effective treatment, more chemical and potentially multi-year applications would be required.

Cumulative Effects - All Alternatives

As described in the affected environment, impacts from roads, OHV use, clearcut logging, and water diversions have altered watershed processes. It is expected that reasonably foreseeable future actions, including rotational harvest on commercial timberlands that maintain forest conditions in an early to mid-seral condition (USDI 1995), and land disturbance attributed to development of private lands, will continue at the past rates. Activities on BLM lands will likely continue to focus on commercial thinning for forest health and fuels reduction projects. Some recovery is expected to occur as previously harvested areas within Riparian Reserves improve shade and large wood recruitment. Overall, none of the action alternatives would reduce canopy cover below critical thresholds (less than 30 percent) or result in appreciable increases in ground disturbance. These would be the primary catalysts that may trigger synergistic responses. The proposed project does not appreciably decrease canopy cover within the TSZ that may result in peak flow increases. The elevated risks to peak flows from this potential reduction in canopy cover exist regardless of the treatments proposed in the action alternatives. Recent research supports the interpretation that if peak flows increase, they can only be detected in flows of moderate frequency and magnitude and not in extreme storm events. Beyond that, they are likely not detectable (Grant et al. 2008). This suggests that if increases in peak flows occur, they are unlikely to result in adverse effects to the higher gradient channels located within the analysis area. Also, that peak flows are only detectable in smaller storm events with return periods of 6 years or less, where channel forming processes are minor in effect.

3.9 Aquatic Species and Habitat

Affected Environment

The analysis area has extremely limited perennial water and aquatic species habitat. There is only one perennial waterway that contains habitat for fish and other aquatic species within or directly adjacent to the analysis area. The Upper Klamath River is outside, yet adjacent to the analysis area. Two distinct reaches of the Upper Klamath River will be addressed in the following discussion; John C. Boyle Reservoir and the Bypass Reach.

J.C. Boyle Reservoir is essentially the Upper Klamath River backed up by J.C Boyle Dam and regulated for power generation by Pacificorp. Habitat for aquatic species favors those that prefer a fluctuating, reservoir-like system and therefore, is more suitable for non-native aquatic species. This reach does, however, support some robust populations of native aquatic species (see Tables 18 and 19).

The Bypass Reach can be described as the reach of the Upper Klamath River between the J.C. Boyle Dam and the J.C. Boyle substation or powerhouse. A significant amount of the river flow is diverted at the dam into a flume/canal system which in turn is used to generate power at the substation. Therefore, the Bypass Reach is generally low flow and regulated by flow from the dam. Habitat in this reach favors species that prefer a more riverine-like system, and therefore a mostly native aquatic species assemblage. This reach also supports some non-native aquatic species. The following tables list aquatic species documented within the two aforementioned Upper Klamath River reaches.

Table 18. Native Aquatic Species Adjacent to the Analysis Area

Common Name	Scientific Name	Status	Distribution
Western toad	*Bufo boreas*	None	Present in Bypass Reach and J.C. Boyle Reservoir
Klamath smallscale sucker	*Catostomus rimiculus*	None	Widely distributed in the Bypass Reach and present in J.C. Boyle Reservoir.
Klamath largescale sucker	*Catostomus snyderi*	None	Widely distributed in J.C. Boyle Reservoir and Bypass Reach
Shortnose sucker	*Chasmistes brevirostris*	Federally Endangered*	Present in Bypass Reach and J.C. Boyle Reservoir
Marbled sculpin	*Cottus klamathaensis*	None	Present in Bypass Reach and J.C. Boyle Reservoir
Slender sculpin	*Cottus tenuis*	None	Present in Bypass Reach
Pacific giant salamander	*Dicamptodon tenebrosus*	None	Widely distributed in Bypass Reach
Tui chub	*Gila bicolor*	None	Widely distributed in J.C. Boyle Reservoir and present in Bypass Reach
Lamprey species	*Lampetra sp.*	None	Present in J.C. Boyle Reservoir and Bypass Reach
Klamath redband trout	*Onchorhynchus mykiss*	None	Widely distributed in Bypass Reach and present in J.C. Boyle Reservoir
Klamath speckled dace	*Rhinichthys osculous*	None	Widely distributed in Bypass Reach
*Federally Endangered or Threatened – Those species listed under the Endangered Species Act as Endangered or Threatened			

Table 19. Non-native Aquatic Species Adjacent to the Analysis Area

Common Name	Scientific Name	Status	Distribution
Brown bullhead	*Ameiurus nebulosus*	Gamefish	Widely distributed in J.C. Boyle Reservoir
Goldfish	*Carassius auratus*	Invasive	Widely distributed in J.C. Boyle Reservoir
Pumpkinseed sunfish	*Lepomis gibbosus*	Gamefish	Widely distributed in J.C. Boyle Reservoir
Bullfrog	*Lithobates cateisbiana*	Invasive	Widely distributed in J.C. Boyle Reservoir and present in Bypass Reach
Largemouth bass	*Micropterus salmoides*	Gamefish	Widely distributed in J.C. Boyle Reservoir
Yellow perch	*Perca flavescens*	Gamefish	Widely distributed in J.C. Boyle Reservoir and present in Bypass Reach
Fathead minnow	*Pimephales promelas*	Invasive	Widely distributed in J.C. Boyle Reservoir and present in Bypass Reach
Black crappie	*Pomoxis nigromaculatus*	Gamefish	Widely distributed in J.C. Boyle Reservoir

Environmental Consequences - Aquatic Species and Habitat

Aquatic species and habitats in the project area would be affected to the extent that hydrologic regimes of streams are altered by reduction in stream shading, ground disturbance and road use (see Hydrology section). If ground disturbances (compaction, vegetation removal, loss of duff/organic layer, and increased road use) act in combination to increase the magnitude of peak runoff events, negative effects on aquatic species from streambank erosion, higher than normal nutrient concentration, and sedimentation would be expected.

The proposed projects would maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species. Implementation of any of the alternatives with the application of the identified and appropriate BMPs and PDFs are expected to minimize short term impacts to aquatic resources and Riparian Reserves/Riparian Management Areas (See Appendix B for PDFs and BMPs). In the long term, restored and/or maintained riparian forest stand health would be anticipated to maintain, protect and restore aquatic resources and Riparian Reserves/Riparian Management Areas.

No Action

Under the No Action Alternative, there would be no ground disturbing effects of sedimentation or increase in road-related sediment inputs due to increased levels of road use and maintenance.

In general, overstocked areas in Riparian Reserves/Riparian Management Areas would remain at an elevated risk for stand-replacing wildfire. If a stand-replacing wildfire were to occur, negative effects on downstream aquatic species and their habitat could include loss of canopy shading, negative impacts on water quality due to higher than normal nutrient concentrations in soil adjacent to the stream, and sedimentation. Conifer growth in overstocked stands adjacent to streamside areas would continue to be suppressed, reducing forest health, long-term stream shading, and large wood recruitment. Overstocked stands in the Riparian Reserves would maintain mostly uniform age/size and species distributions until shade-tolerant tree establishment and/or natural mortality (either chronic or catastrophic) allowed understory development. This type of development would contain a simplified size and age class stand structure, and is not typical of late succession stand characteristics. Late seral stand characteristics in riparian areas allow for many benefits to streams and aquatic species including channel stability/complexity, large wood contributions, and nutrient recycling.

Cumulative Effects of No Action Alternative

Indirect cumulative impacts associated with current watershed conditions identified in the affected environment section will continue to occur if the No Action Alternative is selected.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

Due to the use of riparian buffers along the Upper Klamath River, there are no perennial, and/or fish-bearing streams/waterbodies within or directly adjacent to the following proposed treatment units in the analysis area. There are intermittent/ephemeral drainages within or adjacent to these units, but specific project design features (PDFs) are in place to minimize impacts. Implementing the PDFs (Appendix B) is expected to mitigate effects on downstream aquatic species to levels

analyzed in the 1995 KFRA RMP and FEIS. Along the Upper Klamath River, a 300-foot Riparian Reserve buffer would be applied, and along intermittent non-fish bearing streams, a 120-foot buffer would be established. The trees in this buffer account for nearly all stream shading and contribution of coarse woody debris (CWD) entering the aquatic system

Riparian Restoration Treatments

The proposed riparian restoration treatments in Alternatives 1 and 3 would reduce stand densities, increasing average tree diameter, and potentially increase species diversity. As the treated stands age, ecosystem processes consistent with old-growth stands would begin to evolve, including CWD recruitment regimes, where trees would fall into the stream channel and riparian zone at a variable rate. This would provide the streams/riparian areas with a variety of size, species, and decay classes of CWD, which is critical in providing aquatic species habitat and channel stability and complexity.

There are no perennial or fish-bearing streams within or adjacent to the proposed riparian treatment units. There are intermittent/ephemeral drainages associated with these units, and specific PDFs are in place to minimize impacts. Implementing the PDFs in Appendix B is expected to mitigate effects on downstream aquatic species to levels analyzed in the 1995 KFRA RMP and FEIS.

By following guidelines set by the 1995 KFRA RMP PDFs, no substantial detrimental impacts to fisheries resources are expected to occur as a result of water temperature from streamside shade reduction or peak/base flow alterations from stream channel alterations caused by the proposed mechanical and manual riparian treatments.

The proposed actions are consistent with the objectives for Riparian Reserves and the Aquatic Conservation Strategy (ACS) in the 1995 KFRA RMP and would not prevent or retard attainment of any of the ACS objectives in the long term (USDI BLM 1995, pgs. 7-8).

Underburning /Prescribed Fire

Implementation of PDFs in Appendix B is expected to mitigate impacts of fuel treatments within the proposed project area. Objectives of fuels treatments within riparian reserves are: protection of vegetation and soils from catastrophic fire, (including overhead canopy for stream shading); restoration of riparian areas to the potential natural community for the site; and retention and protection of CWD and overhead cover for stream function and aquatic habitats. Ignition of prescribed fire is restricted depending on topography, distance to stream, ignition methods, and fuel moisture as defined in Appendix B. Ignition limitations are designed to prevent negative impacts to aquatic habitat, such as introducing chemicals into streams and protecting riparian vegetation and canopy cover.

Water Line to Recreation Site

This action would not occur near any perennial and/or fish-bearing waterway. Therefore, there would be no impact to aquatic species or their habitat. PDFs would be implemented to reduce impacts of this development to intermittent and ephemeral streams.

Prescribed burn and Herbicide Application
There are no perennial or fish-bearing streams within or adjacent to the proposed riparian treatment units, however there are intermittent/ephemeral drainages associated with these units. The herbicide imazapic would be applied and aquatic species are not affected by this chemical (Fickenscher, 2013). Nonetheless, specific PDFs are still in place to negate any potential impacts.

Cumulative Effects of All Action Alternatives
Because other activities including future harvesting, fuels treatments, recreation and road actions are either already approved or potentially would be approved in the future, both direct and indirect cumulative impacts would potentially include increased sediment delivery to streams from road surfaces and ditch lines during hauling operations. These types of cumulative actions are analyzed in the FEIS (at 4-89 to 4-91). As discussed in the Hydrology section, potential increases in sediment delivery due to hauling would be small, and would not be expected to have a detrimental effect on aquatic species.

3.10 Grazing Management

Affected Environment

Livestock
There are three BLM-administered livestock grazing allotments with the analysis area. These are the Chase Mountain, Chicken Hills, and Dry Lake Allotments.

The Chase Mountain Allotment has approximately 8,823 acres of public land and is located in the northern 2/3 of the analysis area. Within the allotment boundaries are approximately 19,680 acres of private lands which are grazed in common with the public lands. The active grazing preference for the allotment is 195 Animal Unit Months (AUMs). The intermingled private lands allow for an additional 239 AUMs of exchange-of-use grazing. The designated season-of-use is May 1 to August 13. This allotment has been rested from active livestock grazing since 1993. The private lands within the allotment are considered the base property for the BLM grazing lease. The owners of the base property have chosen not to graze their property, and the BLM has allowed the adjacent public lands to also be rested from grazing.

The Chicken Hills Allotment has approximately 3,422 acres of public lands and another 1,800 acres of intermingled private lands within the allotment boundaries. The active grazing preference is 80 AUMs with an additional 180 AUMs of exchange-of-use grazing for the private lands. The season-of-use for the allotment is May 15 to September 15.

The Dry Lake Allotment has approximately 145 acres of public lands and 3,800 acres of adjacent private lands. The active grazing preference is 10 AUMs with an additional 440 AUMS of exchange-of-use grazing for the private lands. The season-of-use for the allotment is May 1 to June 30.

The proposed juniper treatment area in T40S, R14E, Sec. 21 and 28 is not part of a livestock grazing allotment.

Wild Horses
The analysis area is not part of a BLM wild horse Herd Management Area (HMA). The Pokegama HMA is located to the west of the analysis area with the Klamath River being the east boundary of the HMA. Environmental Consequences - Grazing Management

No Action

Under the No Action Alternative, there would be no effect to livestock grazing. There would be no impacts to livestock forage species within the analysis area.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

Under all of the action alternatives, there would be minimal effects to livestock grazing. Livestock primarily utilize forage species outside of forested areas in meadows or other openings in the analysis area. Any treatments that reduce trees could increase the understory vegetation in those areas, including grass species that livestock utilize for forage. This could result in a minor positive increase in the forage available to livestock.

Cumulative Effects

Under any of the action alternatives, a reduction in trees could result in an increase in understory grass species which would result in a minor increase in forage available to livestock.

3.11 Cultural Resources

Affected Environment

Native American use of the area spans many millennia. The region was most likely used by the Modoc, Klamath, and/or Shasta peoples. The proposed project area held many attractions, such as root crops, berries, and game animals, for Native Americans. Archaeological Evidence within the Klamath River Canyon, marking the western boundary of the project area, documents at least 10,000 years of Native American presence (Beckham 2006).

Dispute persists surrounding the extent of aboriginal territories, so it is uncertain as to which tribal territory the area fell into at the time of Euro-American contact. The claimed territorial boundaries of the Takelma of the Upper Rogue River, the Shasta of northern California, and the Klamath fall across the project area (Ray 1963, Follansbee and Pollock et. al. 1978, and Silver 1978). It is probable that the plateau was used by all three tribes (Beckham 2006, Follansbee and Pollock et. al. 1978, Silver 1978). Common among all these tribes were winter pit houses, hunting and fishing of small animals and gathering of acorns and various root crops (Burnside 1990).

Historic contact between the Native American tribes and Euro-Americans began around the 1820s and culminated with the Klamath Lake Treaty of 1864 in which lands around the project area were ceded to the United States by the Klamath Tribes (Minor et al. 1979). The Klamath Tribes consist of the closely related Klamath, Modoc, and Yahooskin peoples.

Euro-American exploration near the analysis area began in 1843 when a band of "free trappers" led by Old Bill Williams, explored the Lost River region. Euro-American settlement did not occur until 1875. Homesteaders pursued sheep and cattle ranching within the area of analysis. The first Euro-American exploration within the region was conducted by Peter Skene Ogden under the employment of the Hudson's Bay Company in 1827. On January 24, 1827, Ogden's party camped on the Klamath River. They spent several days trapping on the river and its tributaries before heading west through the Siskiyou Mountains. The first Euro-Americans to cross the plateau was the McLeod party in 1829. Alexander Rodrerick McLoad led a Hudson's Bay Company brigade across the area in route from the Rogue River Valley to the Sacramento. The next significant crossing occurred in 1846 by the Scott-Applegate party while scouting for a new emigrant trail, later known as the Applegate Trail Valley (Beckham 2006).

In 1867, President Ulysses S. Grant signed legislation to create a land-grant subsidy for the construction of the Oregon & California Railroad (O&C RR). The grant allowed the O&C RR Company to select off-numbered sections from the public domain for the construction of the railroad through valuable timbered lands. The O&C RR violated the terms of their grant, leading to Oregon land fraud trials in 1904 (Beckham 2006). The result of the trials was that some of the lands were revested to the United States.

It is noted by Martin Frain, early settler to this area, that the geographical name for this area, "Chicken Hills," was given because a man was traveling the Topsy Road, with his wagon loaded down, and a crate of chickens fell from his load, resulting in chickens running about the hills. The Topsy Road has been a major transportation corridor for goods and people to the Klamath Basin from Yreka, CA since 1851 (Beckham 2006).

Additional information about cultural resources in the analysis area may be found in various overviews of the history and prehistory of the region (Anderson 1994, Beckham 2006, Follansbee and Pollack 1978, Minor 1979, Ray 1963, and Spier 1930).

Environmental Consequences - Cultural Resources

A file search was performed at the KFRA and utilizing the online State Historic Preservation records, the results of this review showed the project area was partially inventoried by earlier surveys. A survey covering the remaining portion of the project area occurred in the summer of 2012. All known sites within the proposed project area will be avoided by project activities.

No Action

Selection of the No Action alternative would allow for increased risk of high severity fire leading to potential increased site disturbance through consumption of cultural resources.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

Sites would be identified and avoided by activities. Fuel loads would also be decreased around sites, which would diminish the possibility of wildfires affecting sites. Under Alternative 2, where some juniper would be scattered, there is a potential, if the scatters are left near a cultural site, to increase the threat of wildfire adjacent to these sites during the first three to five years post implementation when branches still have needles present. No scattering of juniper would

occur within a cultural site however; therefore, ultimately the larger risk of wildfire activities at sites within the project area would be reduced.

Cumulative Effects

Cumulative effects from any of the action alternatives are expected to be negligible, except in the event of a large scale wildfire, or if operators do not comply with avoidance measures.

3.12 Recreation Resources

Affected Environment

The analysis area provides opportunities for dispersed recreation activities such as hunting, fishing, camping, off-highway vehicle (OHV) driving, sightseeing, winter sports on Hamaker Mountain, and road and mountain biking. OHV use of the area occurs in a dispersed manner, both on open roads, as well as on logging skid trails, closed roads and abandoned roads, and cross country where the terrain is traversable. OHV use in the area may occur at a higher rate due to the close proximity of Sportsmen's Park, a Klamath County developed recreation facility that has a Motocross track and trails for All Terrain Vehicle (ATV) use.

BLM recreation facilities with some level of development include the Topsy Recreation Site on the shore of Boyle Reservoir, and the network of forest roads. Topsy Recreation Site features a 15-site campground, boat ramp, and day use sites. Drinking water is currently hauled to Topsy from Sportsmen's Park. This is due to two previous wells onsite at Topsy failing to produce usable potable water. Hauling water has provided the minimum quantity of water to operate the Recreation Site; however, it has caused some user dissatisfaction, and has curtailed water available for functions such as watering landscaping.

The analysis area currently receives light dispersed recreation use, occurring throughout the year. Visitation at Topsy is light to moderate most of the use season, with occasional periods of high use on summer and holiday weekends.

For additional information about recreation resources in the analysis area, reference the Topsy-Pokegama Landscape Analysis. For general information about recreation throughout the BLM-KFRA, refer to the Klamath Falls RMP/ROD.

Environmental Consequences - Recreation Resources

No Action

Under the No Action Alternative, no impacts to existing recreation resources and activities would be expected. The area would continue to receive light dispersed recreation use throughout the year. Topsy Recreation Site would continue to receive potable water by hauling from a nearby Recreation Site by truck/trailer. The current situation of limited potable water and potential for decreased visitor satisfaction would continue. OHV use of the area would continue.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

Vegetation Treatments
Under all action alternatives, only temporary, minor disruption to recreational uses would occur during treatment activities. Short-term disturbances to recreationists from truck traffic, equipment noise, dust, and smoke associated with treatment activities would be expected.

Road Closure
Under all action alternatives, a total of 10.6 miles of road would be closed. This project would close numerous short sections of road, the longest single section being 0.85 miles in length. As the current average road density in the analysis area is 3.62 miles of road per square mile, the proposed closure actions would not significantly alter or diminish the opportunity to OHV drive, nor the vehicular access to the vast majority of the land in the analysis area.

The road closure would restrict access to some undeveloped/primitive camping areas.

Drinking Water Pipeline
The proposed project to secure all necessary easements and permits to allow construction of a buried 10,000-foot water pipeline would provide a stable, secure source of drinking water to the Topsy Recreation Site. Drinking water would no longer have to be trucked in on a regular basis, and a more plentiful supply of water would be available for both recreationists onsite and for administrative use to manage the Recreation Site.

Cumulative Effects

Cumulative effects from all action alternatives are expected to be negligible, except in the event of a large scale wildfire or widespread insect-caused mortality that would dramatically affect the recreation setting and opportunities. Potential future timber harvesting, fuels treatments, and road actions on BLM lands would cause minor temporary impacts to recreationists, but would be typical and expected for a managed forest area.

3.13 Visual Resources

Affected Environment

The BLM has a basic stewardship responsibility to identify and protect scenic values on public lands. This is accomplished through the Visual Resource Management (VRM) program. Through this program, all BLM lands are inventoried and managed in specific VRM classes. BLM lands within the analysis area contain a variety of landforms and scenic/aesthetic qualities. BLM lands in the analysis area are managed under the following VRM classes:

VRM Class II: All of the BLM lands within the viewshed of the upper Klamath River. VRM Class II management objectives are for low levels of change to the characteristic landscape. Management activities may be seen, but should not attract attention. While there are no VRM Class II lands within the analysis area, it should be noted that the entire western boundary of the area is bounded by the VRM Class II zone in the Klamath River Canyon.

The entirety of the analysis area is managed as VRM Class III. Management objectives for VRM Class III are to manage for moderate levels of change to the characteristic landscape, caused by project activities. Management activities may attract attention but should not dominate the view of the casual observer. Visually, the landscape appears as a typical dry side Cascade forest, varying from enclosed, shady views of coniferous forest to more open views of distant forested mountains and flats. The terrain tends to be rolling and gently sloping to flat. Over 50% of the land in the project area is private forestland. In some areas, recent clear cutting of private forestlands adjacent to BLM managed land has created openings with strong linear contrast between clear cuts and forested areas.

For additional information about scenic resources in the analysis area, refer to the KFRA RMP/ROD, pages 43-44, and RMP maps 2-5.

Environmental Consequences - Visual Resources

No Action

Visual resources on BLM-managed land would remain unchanged, except for gradual changes as the stands age and additional trees die from insects and disease. No short term effects on visual resources would be expected. However there may be greater likelihood of widespread insect mortality and catastrophic fire, which would greatly affect visual resources until a mid- seral stage forest cover is reestablished. Potential management activities on intermingled private land holdings would continue to affect the overall character and appearance of the landscape.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

Under all action alternatives, proposed treatment activities would have minimal negative impacts to visual resources. The use of various forest thinning prescriptions, juniper removal, underburning, slashbusting, and riparian restoration work would serve to add complexity, vegetative diversity, and variety to the forested landscape. Maintaining an uneven-aged, multi-strata stand structure and reducing competition and stress to reserve trees, would maintain the overall appearance of the landscape in the project area. The viewshed, especially on private timber lands, is altered from pre-timber harvest conditions. Generally, viewsheds that are noticeably altered can be further modified with less adverse visual impacts than viewsheds with little or no noticeable alterations.

Long-term visual resources within the analysis area would likely be positively impacted by proposed forest treatments, riparian area thinnings, and follow-up prescribed fire activities. These activities would reduce the potential for catastrophic wildfire within the treated areas.

Cumulative Effects

Cumulative effects of the action alternatives combined with all other actions are expected to be negligible, except in the event of a large scale wildfire or widespread insect caused mortality, which would drastically alter visual resources. Future potential actions such as timber harvest, hazardous fuels treatments, recreation improvements, and road actions would be designed to meet VRM class III management objectives.

3.14 Air Quality

Affected Environment

Air quality is a sensitive issue in the Upper Klamath Basin primarily because of the recent designation of part of Klamath County as nonattainment for PM2.5 (particulate matter 2.5 microns). This area of non-attainment is located approximately seven miles northeast of the Keno Project Area. Potential air quality consequences are important for the preservation of high quality visual values for the region. National Ambient Air Quality Standards (NAAQS) were established by the 1970 Clean Air Act, and subsequent amendments to protect the public health and welfare from adverse effects associated with the presence of pollutants in the ambient air. In 2006, EPA revised the 24-hour NAAQS for PM2.5 downward from 65 to 35 µg/m3. If the particulate matter for NAAQS is exceeded, the EPA is required to designate the area as a "non-attainment" area.

Air pollutants are emitted from a variety of sources in the Basin including woodstoves, open burning, industrial plants, and internal combustion engines. Woodstoves contribute greatly to particulate matter during the winter. Agricultural and forestry burning operations are substantial sources in the spring and fall. With the emphasis on reducing risk of wildfire, fuels reduction projects using prescribed fire are also a common source of pollutants that can contribute to reduced air quality. This is a Class II airshed, with the closest Class I airshed, Mountain Lakes Wilderness, located approximately 13 miles to the northwest. To comply with air quality standards and minimize impacts to either the non-attainment area of Klamath Falls or the nearby Class I airshed, the KFRA reports to the Oregon Department of Forestry (ODF) an estimate of the tonnage it expects to consume for each proposed burning project. Burn days are selected in coordination with the ODF Smoke Management to minimize the probability of smoke impacting these sensitive areas.

Environmental Consequences - Air Quality

Methodology

The following assumptions are made for smoke emissions, based on modeling using FOFEM (a first order fire effects model) and CONSUME (a smoke emissions estimation program).

- Underburning: 364 lbs PM2.5 / acre
- Wildfire: 522 lbs PM2.5 / acre
- Biomass Plant: 5 lbs PM2.5 / acre
- Hand Pile burning: 95 lbs PM2.5 / acre

This air quality analysis has assumed that acres treated by timber sales, understory and plantation thinning will require some hand piling and burning of residual slash. Since thinning would be done using whole tree yarding, it is anticipated there would be limited slash left on the ground, so these emission estimates would result in an over-prediction of smoke production.

No Action

This alternative would not directly produce any PM2.5. However, the potential for subsequent wildfires that would produce large quantities of PM2.5 would continue to increase as surface and ladder fuels accumulate. A single 1,000-acre wildfire would result in approximately 261 tons of PM2.5, which would occur under unknown dispersal conditions, in a short period of time, and quite likely affect one or more smoke sensitive receptors.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

For all action alternatives, the proposed under burning would take place on 1,131 acres, which would produce a total of approximately 205 tons of PM 2.5. The number of acres of hand pile burning would be 202 acres, which would produce a total of approximately 10 tons of PM 2.5. Both hand pile burning and under burning would occur under favorable weather conditions to maximize smoke dispersion. These treatments are most likely to be implemented over the course of two years.

Cumulative Effects

It is anticipated that regional emissions would remain at the current level, and that these actions would have a short-term additive effect, lasting for several days at a time. It is likely that other prescribed burning in the region would take place concurrently, which is mitigated through the smoke management process described in the Affected Environment section above.

3.15 Socioeconomics

Affected Environment

This EA primarily analyzes the effects of multiple forest health treatments, including commercial timber harvest, biomass removal, and hazardous fuels reduction. This section of the EA will focus on analyzing the socioeconomic environment of the Keno Project Area.

The “checkerboard” landscape within this project area encompasses a diverse multitude of resource uses by the general public, interest groups, private landowners and public and state agencies. Public use includes hunting, fishing, boating, camping, ATV/UTV and snowmobile use, four wheel/off-road vehicle use, and general scenic driving. The majority of private land is owned by JWTR and is managed primarily for timber production. Public lands in the area are mostly managed by the BLM, Oregon Department of Forestry (ODF), and U.S. Fish and Wildlife Service (Bear Valley National Wildlife Refuge). Public land in this area is characterized as multiple resource management, including timber, water, grazing, wildlife habitat, and recreation. Most of the proposed forest health treatments within this analysis area are located within O&C designated lands, which are lands directed to produce a sustainable supply of timber resources.

The Allowable Sale Quantity (ASQ) of timber that KFRA is expected to produce from O&C lands is 5.9 million board feet (MMBF). This EA is expected to produce between 4 and 6 MMBF. It is estimated that one (1) MMBF creates or retains 11 forest sector jobs (defined as the part of Oregon’s economy derived from forests), meaning this project would create or retain

between 44 and 66 jobs in the forest sector. The project area is located within Klamath County, a rural economy that depends heavily on local natural resources for economic stability. Currently, Oregon's forest sector makes up about 7% of Oregon's economic base, roughly $12.7 billion. This equates to roughly 76,000 jobs and about $5.2 billion in income. In Klamath County specifically, the forest sector makes up about 25% of the county's economic base. Federal forestlands make up 60% of Oregon's forest land base and only 12% of Oregon's harvested volume. Currently, federal eastside Oregon forestlands produce about 0.5 billion board feet (BBF) annually (Oregon Forest Resources Institute, 2012 Forest Report).

Environmental Consequences - Socioeconomics

No Action

The No Action Alternative would affect local businesses primarily dependent upon the production of forest products, as no timber harvesting or fuels treatments of smaller material would be completed. Based upon the assumption above that for every one MMBF of timber harvested, 11 jobs are generated; approximately 44 to 66 jobs either locally or within the timber processing community would be negatively impacted if this alternative is chosen. Employment related to biomass reduction, as described in the next section, would also be negatively impacted. The No Action Alternative should not result in any detectable socioeconomic change in regards to recreation uses. Hunting and other recreational uses are expected to continue at present levels regardless of this alternative or the action alternatives. The Topsy drinking water pipeline would not be constructed, meaning the Topsy recreation site would continue to see potential decreased visitor satisfaction due to limited potable water.

Alternative 1 (Proposed Action), Alternative 2, Alternative 3

The socioeconomic impacts of the proposed project would differ between alternatives, primarily due to differences in volume harvested. Alternative 3 would yield the most volume with maximized group selection, no skips, no diameter limits and no maintaining of NRF or adherence to NSO critical habitat guidelines. Alternative 2 would yield the least amount of volume due to diameter limits, retaining skips and no gaps, no treatment of Riparian Reserves, and no commercial treatment in NRF or critical habitat. Alternative 1 would yield less volume than Alternative 3 primarily due to the inclusion of skips and retaining a higher basal area in some units. Table 20 below shows differences in average volume harvested between alternatives. Estimates were taken from FVS based on one cutting cycle.

Table 20. Harvested Volume by Alternative

Harvested Volume by Alternative	
Alternative	**Estimated Total Volume (MMBF)**
No Action	0
Alternative 1	4-6
Alternative 2	2-3
Alternative 3	7-9

Based on volume estimations, alternative 1 would create approximately 50 jobs. Alternative 2 would create approximately 28 jobs. Alternative 3 would create approximately 88 jobs. Differences in volume between alternatives occur due to:

1) Increase in gaps from alternative 1 to alternative 3
2) Inclusion of skips in alternative 1 and 2
3) Difference in acres in alternative 2
4) Difference in basal area retained between alternatives

Additional employment may become available from chipping and biomass operations derived from timber sale slash, pre-commercial forest treatments and juniper removal. Chipping operations require specialized equipment other than logging equipment, and are therefore typically subcontracted, providing additional employment opportunities. The number of jobs created would depend on the amount of material removed (measured in tons), which is undetermined at this point. However, based on previous BLM biomass contracts, it is estimated that pre-commercial forest health treatments, including understory thinning and plantation thinning, would create employment for approximately three people for five months.

Cumulative Effects

The local area processes a considerable amount of timber. Timber harvested from the proposed actions would only be a small percentage of that volume. However, processing facilities are dependent upon a stable, sustainable, and reliable supply of timber. Continual delays such as litigation of timber sales on Federal lands have decreased the stability of a sustainable supply. The cumulative effects of this instability are partially responsible for permanent closures of processing facilities and the corresponding loss of jobs. Although private timberlands supply much of the present demand for timber, some of the present forest industrial infrastructure is dependent upon a sustainable supply of timber and other forest products from Federal lands. While each timber sale harvested may offer a short duration of the above mentioned employment, cumulatively a steady supply of timber sales are expected to result in longer, more reliable employment. Additional employment opportunities would result from above mentioned biomass operations that would utilize residual landing debris as well as biomass operations of pre-commercial forest treatments.

3.16 Greenhouse Gases

Affected Environment

Climate change is a phenomenon that has been occurring on earth for approximately the past four billion years. The climate has cooled and warmed as evidenced by ice ages, warm periods, changing sea levels and distribution of vegetation and human populations. Currently, there is general consensus that the climate is warming with various warmer and colder periods for the past 10,000 or so years (Singer, F. S. and Avery, D. T. 2008.). Greenhouse gases (GHG), carbon dioxide in particular, may be contributing to the warming. Uncertainty about the nature, effects, and magnitude of the greenhouse gases and global climate change interrelationship is evident in a wide range of conclusions and recommendations in the literature reviewed.

The spatial scale for analysis of carbon, greenhouse gases and climate change is global, not local, regional, national, or continental because climate change is inherently a global issue and carbon cycling is only an issue as it relates to contributing to greenhouse gases as they potentially contribute to climate change. The U.S. Geological Survey, in a May 14, 2008 memorandum to the U.S. Fish and Wildlife Service, summarized the latest science on greenhouse gases and concluded that it is currently beyond the scope of existing science to identify a specific source of greenhouse gas emissions or carbon sequestration, and designate it as the cause of specific climate impacts at a specific location (USGS 2008).

Climate change may affect the condition of local forests through changes in temperature and precipitation patterns. Vegetation ranges may change in both elevation and associations between plants. These changes are difficult to predict and current climate and vegetation models vary widely on what changes are expected.

The proposed project area is a very small part of a global carbon cycle. Generally, as forests grow, trees, other vegetation, and soils accumulate carbon from the atmosphere (CO2). The carbon is stored in all vegetative parts including leaves, roots, stem, tree boles, and soils. The faster the vegetation grows, the more carbon it stores. For vegetation, the carbon remains stored, or sequestered, until the plant dies and decomposes, is consumed by fire-releasing carbon back into the atmosphere, is utilized for forest products, or burned for energy. In any analysis of carbon sequestration, GHG emissions, and forest management, it is important to note that results depend greatly on the forest type, forest location on the planet, the origin and type of forest soils, past management, and whether the harvested product is manufactured into a long-lasting wood product used for energy.

Environmental Consequences – Greenhouse Gases

No Action

Under the No Action Alternative, continued forest growth would result in an increase in stand volume, which equates to an increase in storage of carbon. Carbon dioxide emissions associated with stand treatments and other management actions would not occur. However, continued forest growth could also result in excessive stocking levels which, in turn, could result in decreased growth rates and associated decreased carbon storage. Further, excessive forest and woodland growth can also contribute to fuels build-up that can make intense wildfires more likely in drier landscapes east of the cascades. These hotter, faster moving wildfires could result in immediate emissions of large amounts of the carbon currently stored in living and dead biomass. Such releases would be expected to be temporary if the stands were regenerated, and would subsequently be expected to begin growing and sequestering carbon again.

Alternative 1 (Proposed Action), 2, and 3

All of the action alternatives include timber sales, thinning of stands, biomass utilization, and use of fire to reduce fuels. All of these activities would release carbon into the atmosphere through a variety of mechanisms including burning of fossil fuels by heavy equipment, vehicles and power tools, decomposition of slash and forest products, and possible burning of slash and forest residue. For example, assuming a log transport carbon emission factor of 0.0214kg CO2/ M3/km, hauling 5 MMBF from the project area to Klamath Falls is assumed to release

approximately 34.5 tonnes (tonne = metric ton, equal to 1,000 kilograms) of CO2 round trip (Carbon Balance and Management, 2009).

Up to 2,696 acres of mixed conifer stands would be commercially treated within the planning area. These stands currently average 13.5 MBF per acre, and are estimated to store an average of 31 tonnes of carbon per acre in merchantable standing trees, including plantation material (FVS output). Removal of material is expected to produce approximately 2 MBF per acre, which would equate to about 8 tonnes of carbon per acre removed from the presently standing biomass. This equates to approximately 21.5 tonnes removed from all commercial density management units. Trees that are harvested would cease to sequester carbon, while slash created and left on site by the harvest would begin to decompose. Many of the wood products removed would retain carbon in fairly stable materials such as lumber, plywood, hardboard, and posts and poles. Overall, these stable materials would be expected to retain the majority of their sequestered carbon for up to 100 years (Sierra Pacific Industries 2007). Other products, such as hog fuel material for biomass facilities and firewood, would be expected to be burned and release carbon fairly quickly. As noted above, any residual forest residue including limbs, leaves, needles, cull logs left on site, and those not yarded to the landing would also begin to decompose and release carbon. Pre-commercial thinning activities, including understory and plantation thinning, were not modeled for greenhouse gasses, but it can be assumed that a similar trend would be found in carbon removal and emissions from these treatments. The overall amount of biomass however, would be far less than found in commercial thinning units.

The treatment of forest fuels, primarily logging slash and existing hazardous fuel accumulations, would accelerate carbon emissions compared to natural mortality and decay processes. Burning slash piles and underburning timber stands would contribute CO2 directly to the atmosphere. If it is assumed that underburning emits approximately 37,098 lbs./acre of carbon dioxide (BLM 2008), then the total emissions expected from the proposed actions would be 20,960 tonnes (37,098 lbs./acre x 1,130 acres). The amount of slash openly burned would be reduced if forest residue (landing slash) is chipped or ground and used for energy production. Depending upon the biomass energy generating facility, the amount of PM10, CO, NMOC, CH4, NOx, SOx emissions could be substantially less than any open pile burning (Placer County Air Pollution Control District, 2008). However, the reduced emission of carbon dioxide through carbon storage in wood products could be offset by the burning of the additional fossil fuels to yard, chip, transport, and process the material. Utilizing biomass to produce electricity would potentially preclude the need to generate electricity with other fossil fuels.

The 20 to 40% of the stand on the landscape that would be harvested would immediately cease to sequester carbon. However, the remaining 60 to 80% of the residual trees should experience increased growth rates and carbon sequestration rates as a result of less crowded growing conditions. Forest growth, and therefore carbon sequestration amount, varies with species, elevation, soils, treatment prescriptions, etc. Depending on the stand type and treatment intensity, models show that it would take up to ten years to return to pre-harvest levels of carbon storage in the area being analyzed. Assuming a 30-year rotation (entry) on stands modeled, carbon storage would see a slight reduction after each harvest, although carbon storage levels would not be reduced to current levels throughout the modeled time period, 2110 (FVS output). This increase in carbon storage may be attributed to increased growth rates of residual trees and ingrowth of new cohorts.

Cumulative Effects

The primary factors leading to the expectation of global warming are substantial increases in atmospheric carbon dioxide, nitrous oxide, methane, chlorofluorocarbons, and other trace gases. The BLM's proposed land management activities in this analysis area would primarily only affect the amount of carbon dioxide in the atmosphere. The action alternatives would have direct impacts related to harvest of growing trees and release of greenhouse gases through burning of forest residue and fossil fuels, and through equipment emissions. Emissions from the proposed actions, including underburning and pileburning, removal of carbon through commercial thinning, and equipment usage (log transport), would be approximately 21,016 tonnes of CO2. Greenhouse gas emissions, regardless of the action alternative, would be minor as compared to emissions on a large geographic scale, since they only constitute 0.000003081% of 2010 U.S. emissions, which were 6,822 million tonnes of CO2 (www.epa.gov). Therefore, while analyzing each of the action alternatives would yield different results; the differences would not be significant based on the overall scale of the project.

4 CONSULTATION

Endangered Species Act (ESA) Consultation

A determination of "May Affect, Not Likely to Adversely Affect" was made by the BLM for the Northern Spotted Owl (NSO) and NSO designated critical habitat. Surveys were conducted in suitable habitat within the project area for the NSO, and there were no detections. There is only one historic NSO site within the project area, and it was deemed "abandoned" by Oregon Department of Forestry (ODF) and the U.S. Fish and Wildlife Service (FWS) due to the site history and the limited amount of habitat available within the core and home range. NSO designated critical habitat would be affected from proposed activities, but only nine acres of NRF habitat would be downgraded to dispersal, and the treatments would not change the connectivity or demographic function for which it was designated.

Pre-treatment the NRF habitat within project area is scattered in small parcels and patches and does not provide large enough blocks of habitat to provide for resident owls. Although the treatments in the Keno project will downgrade NRF habitat to dispersal habitat on 316 acres, the treatments proposed and the reduction of habitat will not substantially change the current conditions of not supporting resident owls. The amount and configuration of the NRF habitat within the project area will not support resident or nesting spotted owls pre or post treatment.

The actions (juniper cutting, piling and burning, imazapic treatments) that are proposed outside the range of the spotted owl, and the Topsy water pipeline, tree planting, road improvements and closures that do not reduce spotted owl habitat quantity or quality, would not affect spotted owls. Therefore, the BLM has made a "No Effect" determination for these actions on spotted owls.

The NSO was the only listed species affected from proposed activities, and NSO critical habitat was the only designated critical habitat that would be affected from proposed activities. Therefore a "No Effect" determination was made by the BLM for all other listed species and designated critical habitat.

Tribal Consultation

Tribal consultation has been on-going with the Klamath Tribes since March of 2012, and no concerns have been expressed, given the protection of cultural resources and best management practices are followed, and BLM collaborates with the tribe relating to traditional plants within the project areas to reduce impacts to harvest locations.

5 LIST OF PREPARERS

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Terry Austin	Writer-Editor/Planner

6 BIBLIOGRAPHY

Altman, Bob. 2000. Conservation Strategy for Landbirds of the East Slope of the Cascade Mountains in Oregon and Washington. Oregon-Washington Partners in Flight. June 2000. 131pp.

Anderson, Merle. Interview with William D. Yehle. Bureau of Land Management. Brookings, Oregon. December 20, 1994. (m/s on-file Klamath Falls Resource Area, Klamath Falls, OR.)

Aubry, K., and J.C Lewis. 2003. Extirpation and reintroduction of fishers (Martes pennanti) in Oregon:implications for their conservation in the Pacific states Biological conservation Volume 114, Number 1,November 2003, pp. 79-90(12).

Atzet, Thomas and L.A. McCrimmon, 1990. Preliminary Plant Associations of the Southern Oregon CascadeMountain Province. USDA Forest Service Pacific Northwest Region, Siskiyou National Forest.

Bart, J. 1995. Amount of suitable habitat and viability of northern spotted owls. Conservation Biology 9 (4): 943-946.

Beckham, Stephen Dow. 2005. Upper Klamath River Canyon of Oregon and California: Historical *Landscape Study.* Department of the Interior, Bureau of Land Management, Klamath Falls, Oregon.

Bingham, B. B., and B. R. Noon. 1997. Mitigation of habitat "take": Application to habitat conservation planning. Conservation Biology 11 (1): 127-138.

Bovey, R.W., D. LeTourneau., L.C. Erickson. 1961. The chemical composition of medusahead and downy brome. Weeds 9:307-311.

Bull, E. L., A. L. Wright, and M. G. Henjum. 1990. Nesting Habitat of Flammulated Owls in Oregon. Journal of Raptor research 24:52-55

Bureau of Land Management (BLM), June 2, 1995. KFRA Resource Management Plan (RMP) Record of Decision (ROD) or (KFRA RMP/ROD). Klamath Falls Resource Area, Klamath Falls, Oregon.

Bureau of Land Management (BLM), June 1996. Topsy/Pokegama Landscape Analysis. Klamath Falls Resource Area, Klamath Falls, Oregon.

Bureau of Land Management. 2003. Late Successional Reserve Assessment for the Klamath Falls Resource Area. 105 pp. Unpublished Report.

Bureau of Land Management. July 2010. Vegetation Treatment Using Herbicides on BLM lands in Oregon. Final Environmental Impact Statement. Volume 1. BLM/OR/WA/AE-10/077+1792.

Burnside, Carla. 1990. *Cultural.* Final Eligibility and Suitability Report for the Upper Klamath Wild and Scenic River Study. United States of the Interior, Bureau of Land Management, Klamath Falls, Oregon.

Cochran P.H., 1998. Examples of Mortality and Reduced annual Increments of White Fir Induced by Drought, Insects, and Disease at Different Stand Densities. Pacific Northwest Research Station PNW-RN-525.

Cochran P.H. , J.M. Geist, D.L. Clemens, Rodrick R. Clausnitzer and David C. Powell, 1994. Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington. Pacific Northwest Research Station PNW-RN-513.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L.Cody, J.P.Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, and L. Sztukowski. 2004. Unpublished report. Scientific evaluation of the status of the Northern Spotted owl. Sustainable Ecosystem Institute, Portland, Oregon.

Croke, J.; Wallbrink, P.; Fogarty, P.; Hairsine, P.; Mockler. S.; McCormack, B.; Brophy, J. 1999. Managing sediment sources and movement in forests: the forest industry and water quality. Cooperative Research Centre for Catchment Hydrology.

Cross, Stephen P. and Anthony E. Kerwin 1995. Unpublished Report. Survey of Bats and Their Habitats in the Winema National Forest and the lakeview District BLM (Klamath Falls Resource Area) in 1994. Dept. of Biology . Southern Oregon State College. Ashland, OR.

Delaney, D.K., T.G. Grubb, P. Beier, L.L. Pater, and M.H. Hildegard Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63:60-76.

Dugger, K.M., F. Wagner, R.G. Anthony, and G.S. Olson. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. Condor 107:863–878.

Dugger, K. M., S. Andrews, E. Fleigel, L. Friar, T. Phillips, and F. Wagner. 2012. Demographic Characteristics and Ecology of Northern Spotted Owls (Strix occidentalis caurina) in the Southern Oregon Cascades. Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon. (Unpublished annual report. Includes data through the 2011 breeding season)

Dugger, K.M., R.G. Anthony, and L.S. Andrews. 2011. Transient dynamics of invasive competition: Barred Owls, Spotted Owls, habitat and the demons of competition present. Ecological applications, 21(7):2459-2468.

Dumroese, Deborah Page; Abbott, A; Rice, R. 2009. Forest Disturbance Monitoring Protocol, Volumes I and II; US Department of Agriculture Forest Service; Gen. Tech. Report WO-82b

Dumroese, Deborah Page, Jurgensen M., and Terry T., 2010. Maintaining Soil Productivity during Forest or Biomass-to-Energy Thinning Harvests in the Western United States. WEST. J. APPL. FOR. 25(1) 2010.

Eglitis, A., H.M. Maffei, and M.L. Simpson 2012. Pest Risk Assessment for Stands Managed for the Northern Spotted Owl. BLM-Lakeview District-Klamath Falls Resource Area.

Environmental Protection Agency website, www.epa.gov

Fickenscher, Johanna. May 2013. Personal communication. KFRA BLM Botanist.

Forsman, E.D., R.G. Anthony, K.M. Dugger, E.M. Glenn, A.B. Franklin, G.C. White, C.J. Schwartz, K.P. Burnham, D.R. Anderson, J.E. Nichols, J.E. Hines, J.B. Lint, R.J. Davis, S.H. Ackers, L.S. Andrews, B.L.Biswell, P.C. Carlson, L.V. Diller, S.A. Gremel, D.R. Herter, J.M. Higley, R.B. Horn. J.A. Reid, J. Rockweit, J.P. Schaberl, T.J. Snetsinger, S.G. Sovern. 2011. Demographic Trends of northern Spotted owls, 1985-2008. Studies in Avian Biology no. 40.

Franklin, A.B., Anderson, D.R., Gutierrez, R.J., and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs, 70(4): 539-590.

Franklin, J.F. and K.N. Johnson. 2009. Restoration of Federal Forests in the Pacific Northwest: Strategies and Management Implications. Unpublished manuscript.

Franklin, J.F. and K.N. Johnson. 2010 (November). Applying Restoration Principles on the BLM O&C Forests in Southwest Oregon. College of Forestry, Oregon State University. 9 pp.

Franklin, J.F. and K.N. Johnson. 2012 (February). *Southwest Oregon Secretarial Pilot Projects on BLM Lands: Our Experience So Far and Broader Considerations for Long-term Plans.* College of Forestry, Oregon State University. 85 pp.

Follansbee, Julia A. and Nancy L. Pollock. 1978. *Cultural Resources Overview: Jackson-Klamath Planning Unit*. Cultural Resources Consultant. Report prepared for the United States Department of the Interior, Bureau of Land Management.

George, M. R. 1992. Ecology and management of medusahead. University of California Range Science Report 23:1–3.

Harr, R.D., Nichols, R.A., 1993. Stabilizing Forest Roads to Help Restore Fish Habitats: A Northwest Washington Example. Fisheries; 18: 18-22

Healey, et al. 2009. *Changes in timber haul emissions in the context of shifting forest management and infrastructure.* Carbon Balance and Management. 4:9.

Holt, Catharine. 1946. *Shasta Ethnography.* Anthropological Records Vol. 3, No. 4. pp. 299-349. University of California Press, Berkeley and Los Angeles, CA.

Hopkins, W.E. 1979. Plant Associations of South Chiloquin and Klamath Ranger Districts-Winema National Forest. USDA FS PNW R6-ECOL-79-005.

Kelley, E.G., E.G. Forsman, and R.G. Anthony. 2003. Are barred owls displacing spotted owls? Condor, 105:45-53.

Landsberg, Johanna D., Miller, R.E., Anderson, H.W., and Tepp J.S., 2003. Bulk Density and Soil Resistance to Penetration as Affected by Commercial Thinning in Northeastern Washington. Pacific Northwest Research Station. Research Paper PNW-RP-551.

Leiberg, J. B. 1900. Twenty first Annual Report of the USGS to the Secretary of the Interior 1899 – 1900. Washington Government Printing Office. Pages 209 - 498.

Lehmkuhl, John F., K.D. Kistler and J.S. Begley. 2006a. Bushy-tailed Woodrat Abundance of Dry Forest in Eastern Washington. Journal of Mammalogy, 87(2):371–379, 2006.

Lehmkuhl, John F., K.D. Kistler, J.S. Begley and J. Boulanger. 2006b. Demography of Northern Flying Squirrels Informs Ecosystems Management of Western Interior Forests. Ecological Applications, 16(2), 2006, pp. 584–600.

Maloney, Anne. August 2012. Personal Communication. Oregon Department of Forestry. Status of Topsy owl site.

Marshall, D.B., M.G. Hunter, and A. L. Contreras (eds.). 2003. Birds of Oregon – A general reference. Oregon State University Press, Corvallis, Oregon.

McCarty, Brian. February 2011. Personal communication. KFRA BLM Transportation Specialist.

Megahan, Walter F., n.d., Effects of Silvicultural Practices on Erosion and Sedimentation in the Interior West – A Case for Sediment Budgeting. Intermountain Forest and Range Experiment Station, USDA Forest Service. Boise, Idaho

Miller,R.F., J.D. Bates, T.J. Svejcar, F.B. Pierson, L.E. Eddleman 2005. Biology, Ecology and Management of Western Juniper (*Juniperus occidentalis*). Oregon State University Technical Bulletin 152.

Minor, Rick, Stephen Dow Beckham and Kathryn Anne Toepel, 1979. *Cultural Resource Overview of the BLM Lakeview District, South-Central Oregon: Archaeology, Ethnography, History.* University of Oregon Anthropological Papers No. 16, reprint by Coyote Press.

Napper, Carolyn; S. Howes; D. Page-Dumroese. 2009. Soil Disturbance Field Guide. US Department of Agriculture Forest Service, National Technology & Development Program. 1940 Inventory & Monitoring

Oregon Forest Resources Institute, 2012 Forest Report.

Placer County Air Pollution Control District, TSS Consultants, Feb. 8, 2008.

Ray, Vern F. 1963. *Primitive Pragmatists: The Modoc Indians of Northern California.* University of Washington Press, Seattle, Washington.

Sierra Pacific Industries Timber Harvest Plan (THP), California Environmental Quality Analysis (CEQA), 2007.

Silver, Shirley. 1978. Shastan Peoples. *Handbook of North American Indians,* Vol. 8, *California.* Robert F. Heizer, ed., pp. 211-224. Washington, D.C.: Smithsonian Institution.

Simpson, M. 2007. Forested Plant Associations of the Oregon East Cascades. USDA FS PNW Technical Paper R6-NR-ECOL-TP-03-2007.

Singer, Fred S. and Avery, Dennis T. 2008. Unstoppable Global Warming: Every 1,500 Years. Rowan and Littlefield Publishers, Inc. Blue Ridge Summit, Pennsylvania, 278 pages.

Sokol, Chris. February 2013. Personal Communication. JWTR. Harvest of private lands around Topsy owl site.

Spier, Leslie. 1930. Klamath Ethnography. University of California Publications in American *Archaeology and Ethnology*, Volume 30. University of California Press, Berkeley.

Torell,P.J., L.C.Erickson, R.H.Haas. 1961.The medusahead problem in Idaho.Weeds 9:124–131.

USDA Forest Service, Deschutes National Forest Soil Monitoring Reports, 1995-1999. Unpublished study.

USDA Forest Service, 2011. Fremont-Winema Invasive Plant Treatment Final Environmental Impact Statement. Fremont-Winema National Forest.

USDA Soil Conservation Service, 1985. Soil Survey of Klamath County, Oregon Southern Part

USDA Soil Conservation Service, 1993. Soil Survey of Jackson County Area, Oregon

USDA USDI 2000. U.S. Department of Agriculture-Forest Service and U.S. Department of Interior-Bureau of Land Management (USFS and BLM). Final Supplemental Environmental Impact Statement For Amendments to the Survey & Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. November 2000. http://www.blm.gov/or/plans/surveyandmanage/files/10-2001_fseis_v1_ch1-4.pdf.

USDA USDI 2001. U.S. Department of Agriculture-Forest Service and U.S. Department of Interior-Bureau of Land Management (USFS and BLM). 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents within the range of the Northern Spotted Owl.

USDI Bureau of Land Management, 2004. GIS skid trail disturbance assessment. KFRA staff.

USDI, Fish and Wildlife Service (FWS), 2002. “Birds of Conservation Concern 2002”. U.S. Fish and Wildlife Service, Portland, OR.

USDI, Fish and Wildlife Service (FWS), 2011. Revised Recovery Plan for the Northern Spotted Owl (*Stix occidentalis caurina*). U.S Fish and Wildlife Service. Portland, Oregon *xvi.* +258pp.

USDI, Fish and Wildlife Service (FWS), 2012. Designation of Revised Critical Habitat for the Northern Spotted Owl. Federal Register / Vol. 77, No. 233 / Tuesday, December 4, 2012; U.S Fish and Wildlife Service. Portland, OR

USGS (US Geological Survey). 2008. *The Challenges of Linking Carbon Emissions, Atmospheric Gas Concentrations, Global Warming, and Consequential Impacts*. Memorandum from Mark D. Myers, Director, US Geological Survey to Director, Fish and Wildlife Service. May 14, 2008.

Van Pelt, Robert 2008. Identifying Old Trees and Forests in Eastern Washington. Washington State DNR, Land Management Division, Ecosystem Services Section.

Zielenski, W. and T. Kucera 1995. American Marten, Fisher, Lynx, and Wolverine: Survey Methods for Their Detection. USDA Forest Service General Technical Report PSW GTR-157.

List of Appendices

Appendix A: Maps

Map 1. Vicinity Map of the Project Area
Map 2. Location of Proposed Waterline to Topsy Recreation Site
Map 3. Location of Medusahead Rye Population/Proposed Herbicide Application
Map 4. Road Treatments/Transportation Management Map
Map 5. Forestry & Silviculture Treatments for Alternatives 1 and 3
Map 6. Fuels Treatments for Alternatives 1 and 3
Map 7. Forestry & Silviculture Treatments for Alternative 2
Map 8. Fuels Treatments for Alternative 2

Appendix B: Summary of Best Management Practices and Project Design Features

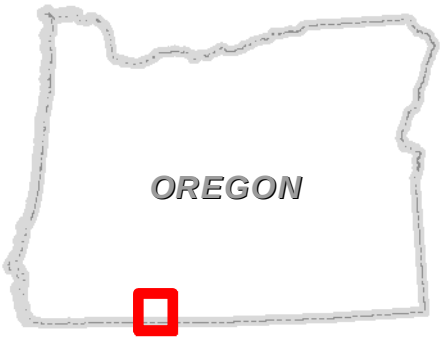
Appendix C: Survey and Manage

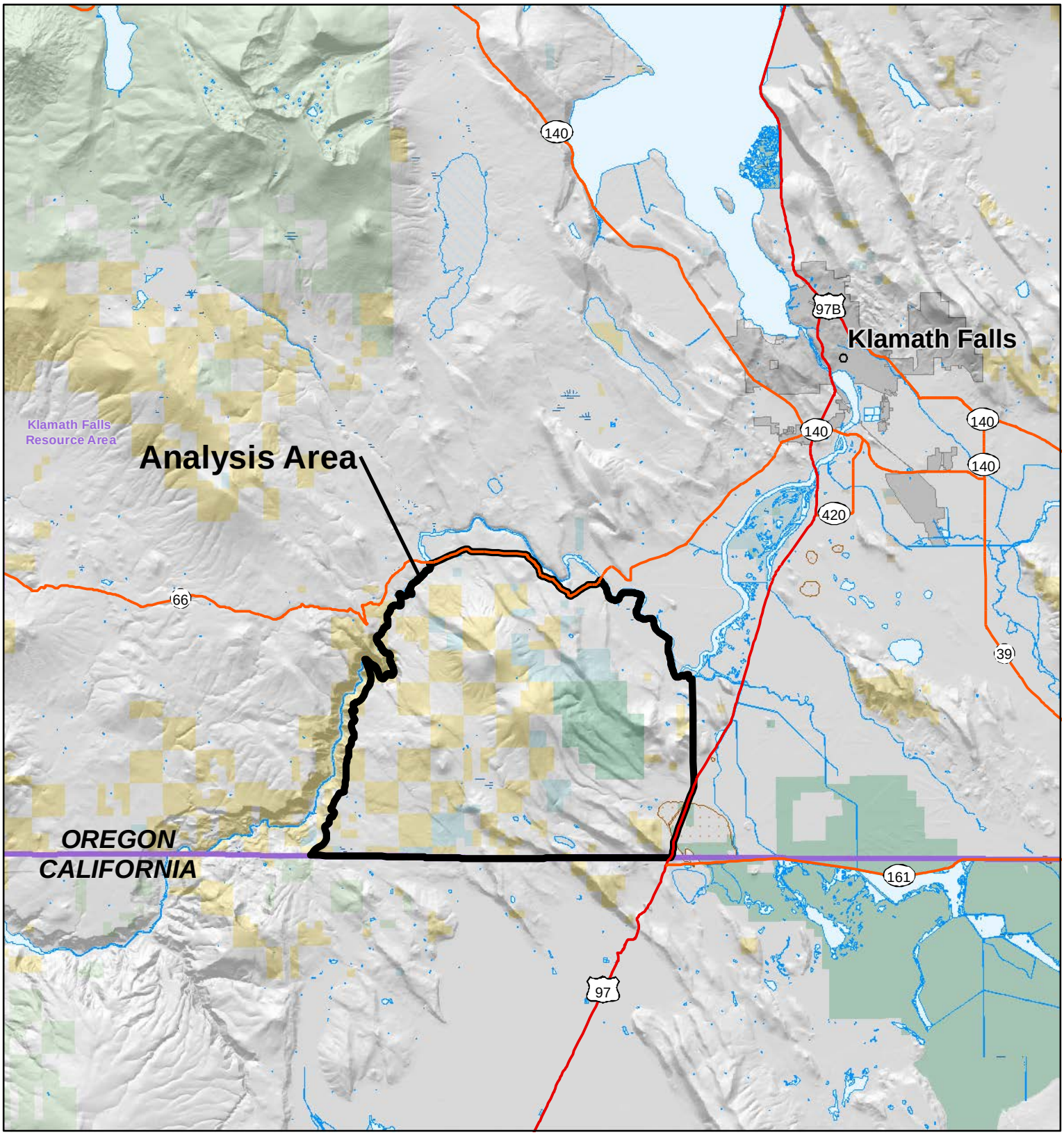
Appendix D: Determining Age on Uneven-aged Stands

Appendix E: Definition of "Old" Juniper

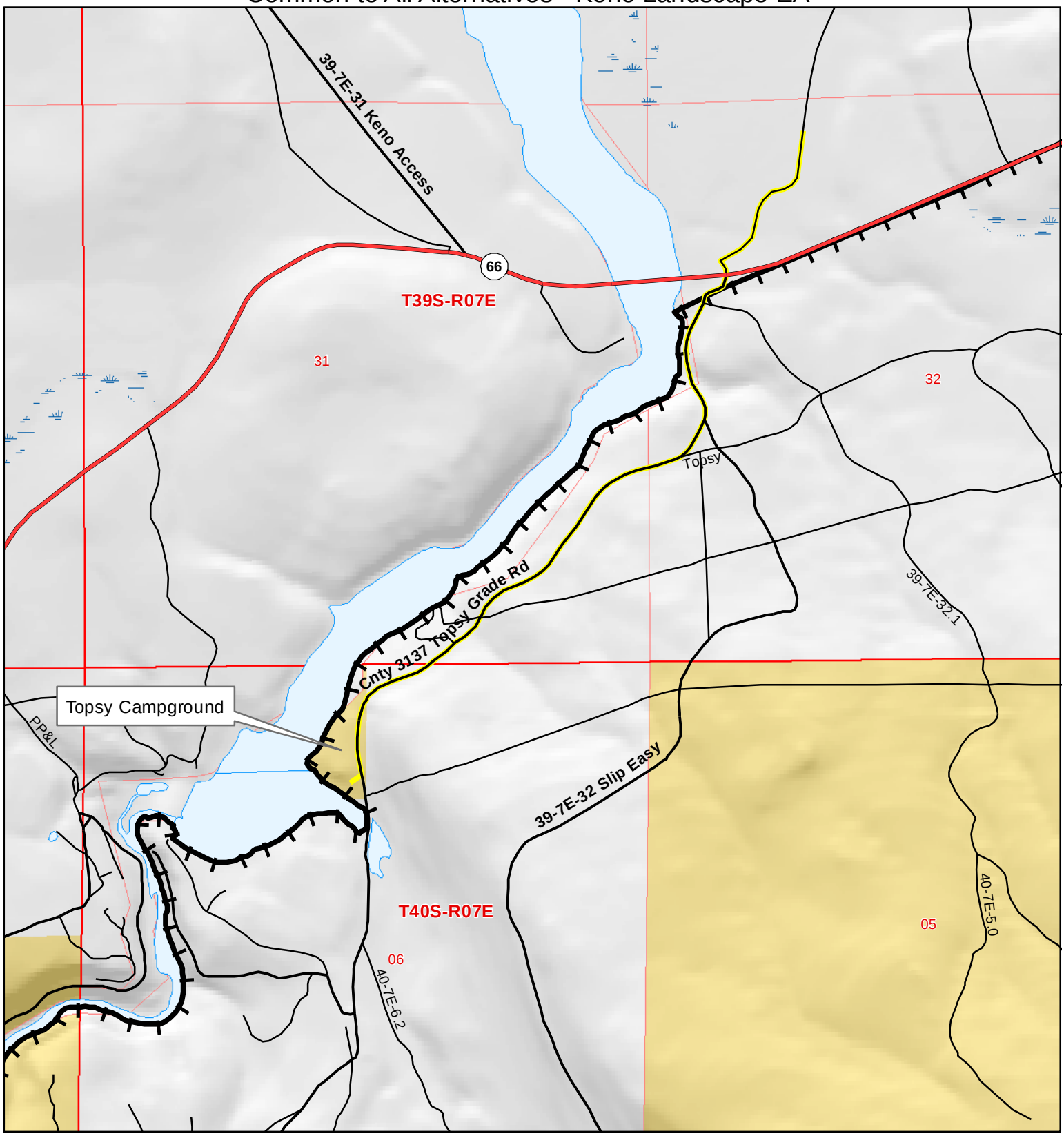
Keno Landscape EA Vicinity Map

Klamath Falls Resource Area
Lakeview District - Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541) 883-6916





Proposed Waterline Installation
Common to All Alternatives - Keno Landscape EA



Feet
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Proposed_Waterline
Keno EA Analysis Area
Highway
Major road
Intermediate road
Minor road
BLM
Private Lands

Klamath Falls Resource Area
Lakeview District - Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

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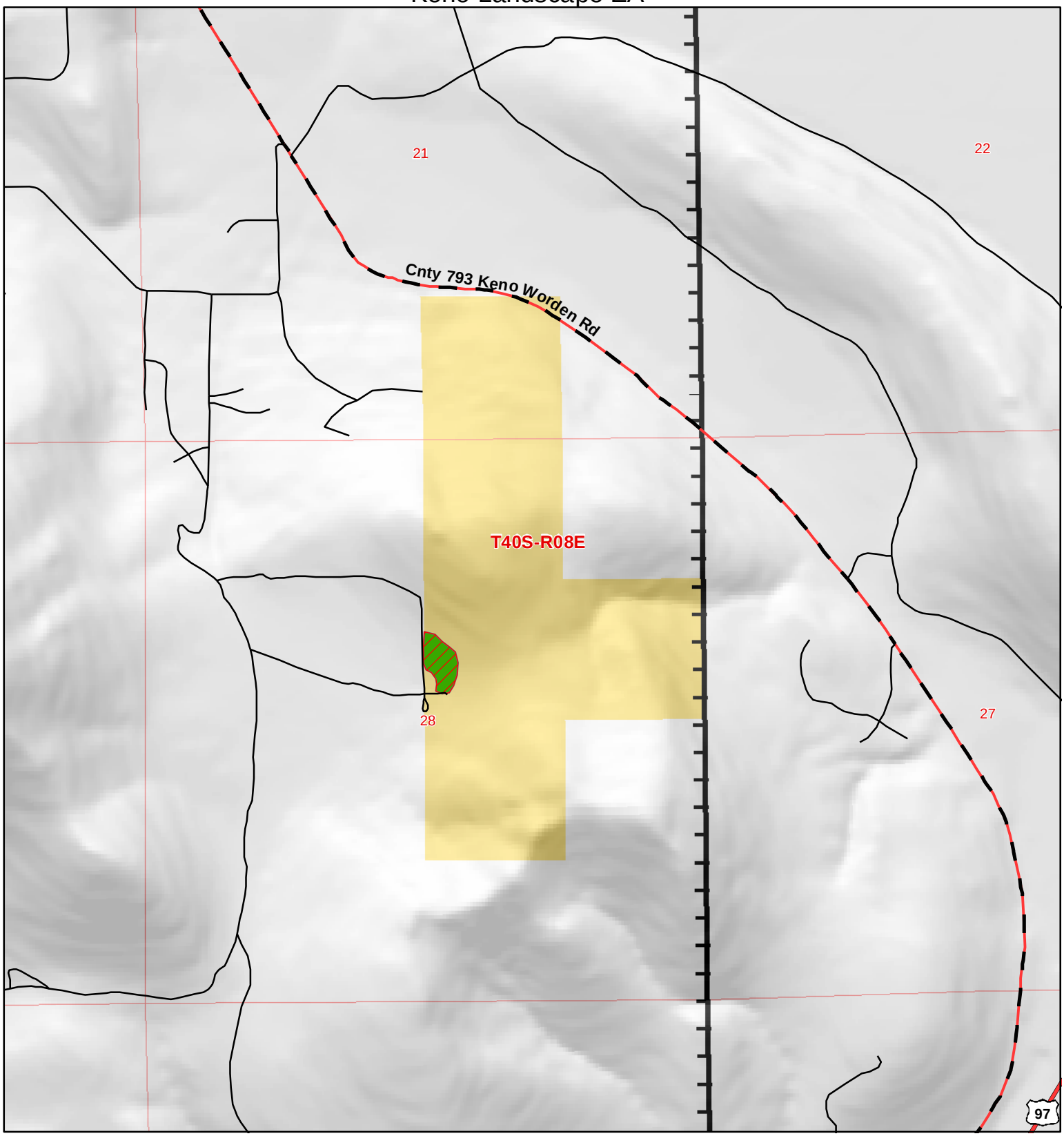
Medusahead Rye
Keno Landscape EA



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Proposed_Herbicide_Area
Keno EA Analysis Area
BLM
Private Lands
Highway
Major road
Intermediate road
Minor road

Klamath Falls Resource Area
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(541)883-6916

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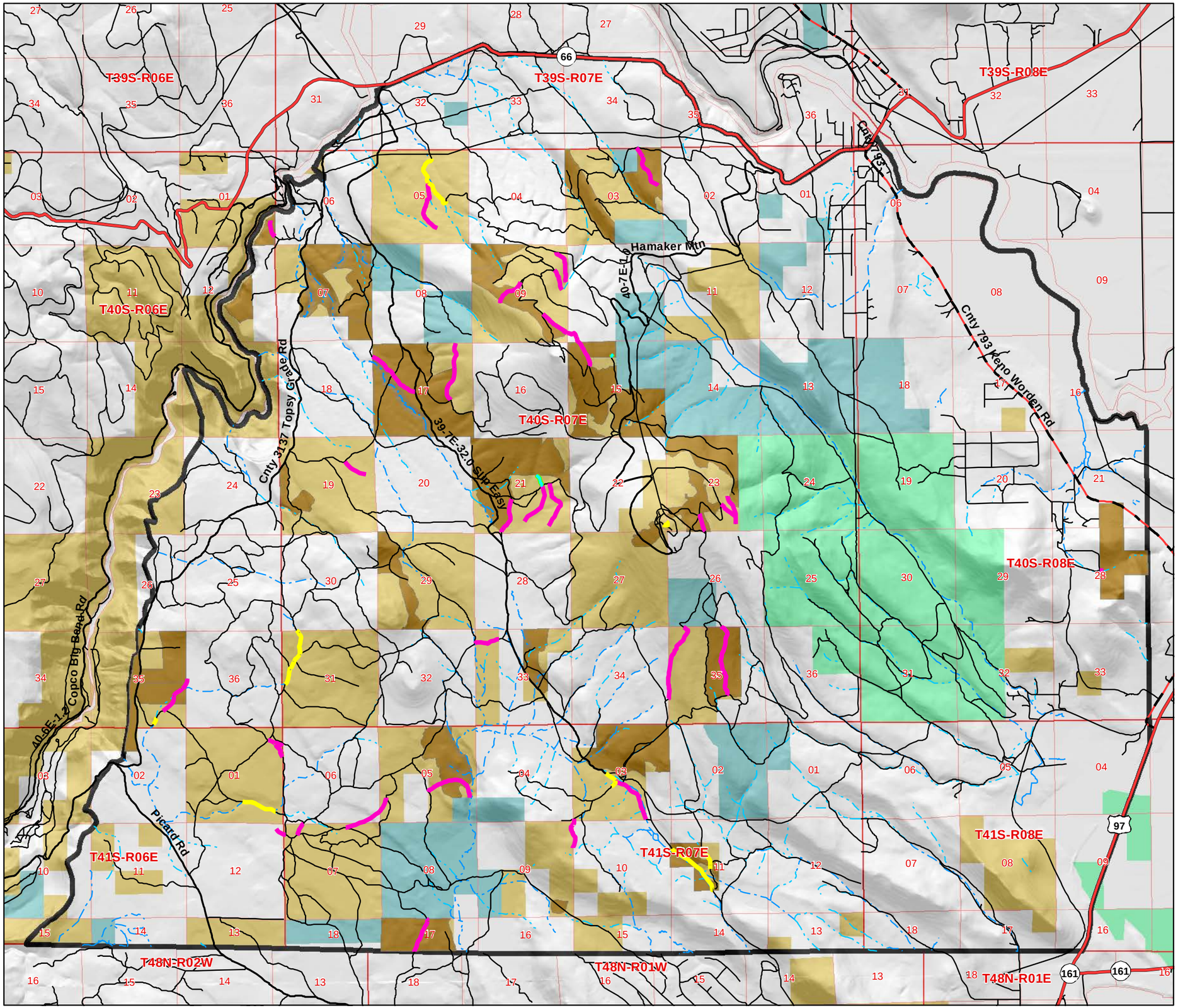
Road Treatments
Common to All Alternatives
Keno Landscape EA



Klamath Falls Resource Area
Lakeview District
Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

Road Improvement- 4.33 mi.
New Temporary Road - 0.15 mi.(T40S R7E S15&21)
Road Closure- 10.6 mi.

Reference Themes

- Keno EA Analysis Area
- Highway
- Major road
- Intermediate road
- Minor road
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Forestry and Fuels Treatment Units
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- State Lands
- Private Lands

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1 in = 1 miles

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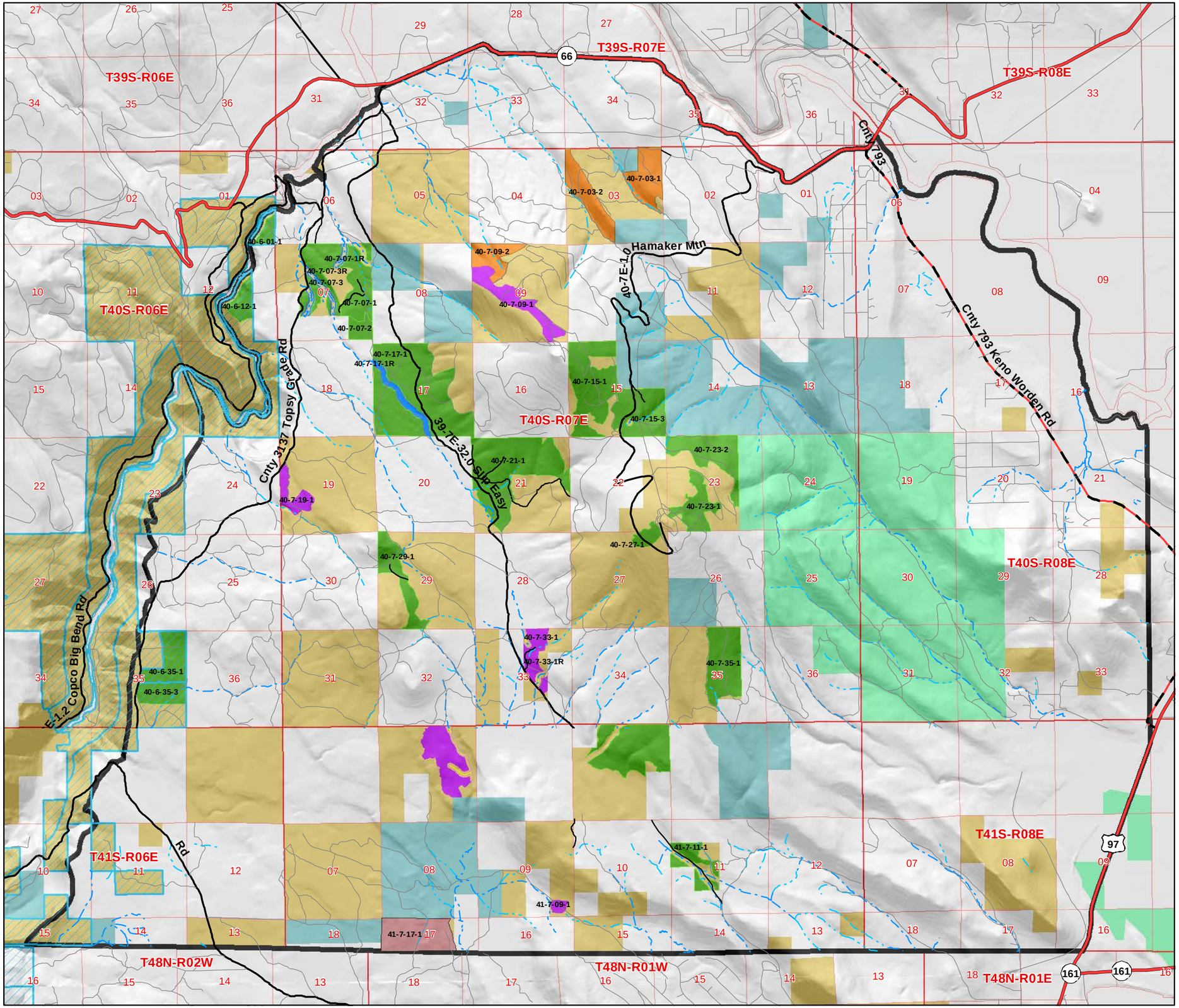
Forestry & Silviculture Treatments
Alternatives 1 & 3
Keno Landscape EA



Klamath Falls Resource Area
Lakeview District
Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

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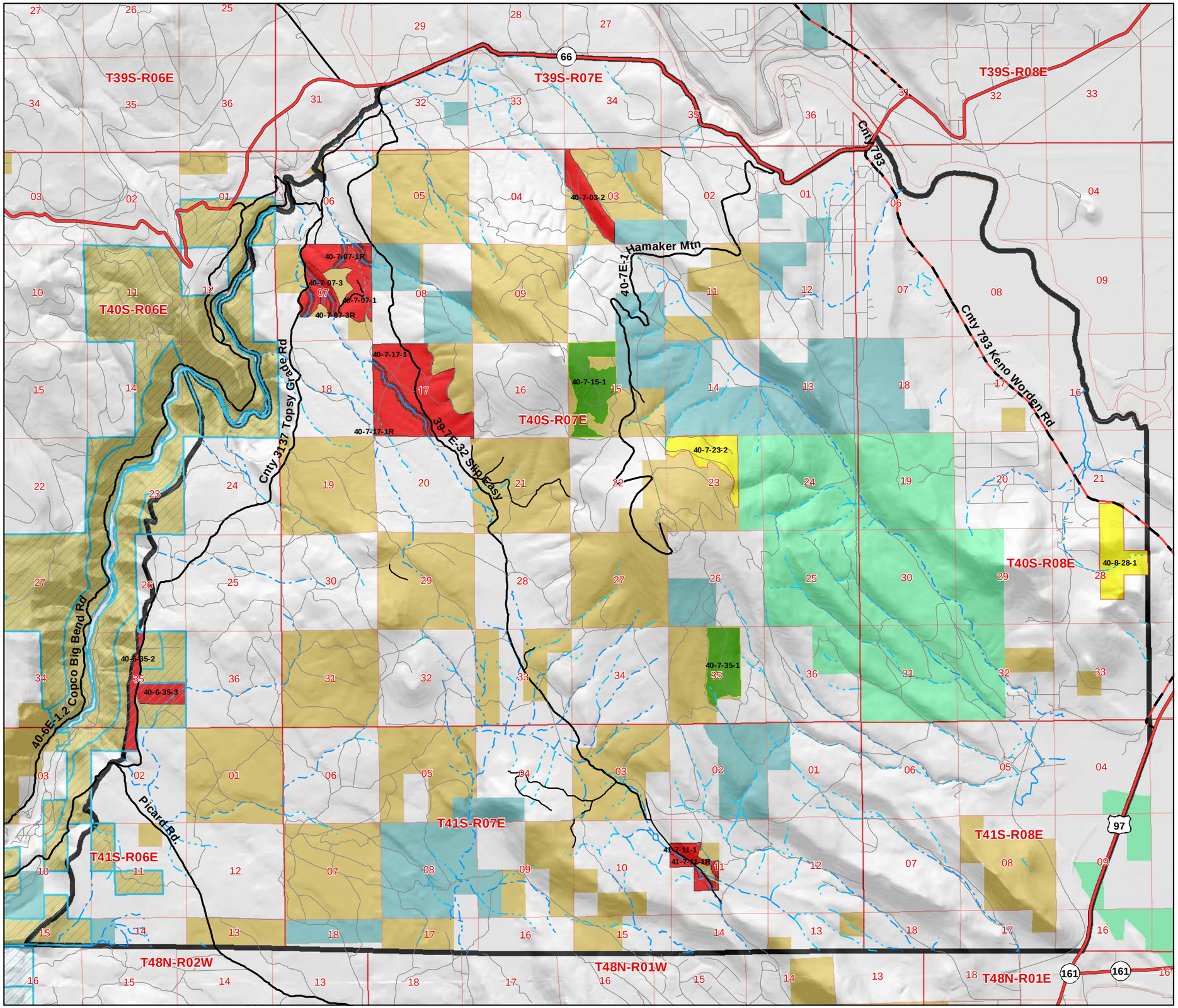
Fuels Treatments
Alternatives 1 & 3
Keno Landscape EA



Klamath Falls Resource Area
Lakeview District
Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

Fuels Treatment Units Alt 1&3

- Hand Thin, Pile, and Burn - 352 ac.
- Brush Mastication 404 ac.
- Underburn - 1131 ac.

Reference Themes

- Keno EA Analysis Area
- Northern Spotted Owl Critical Habitat 2012
- Highway
- Major road
- Intermediate road
- Minor road
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- State Lands
- Private Lands

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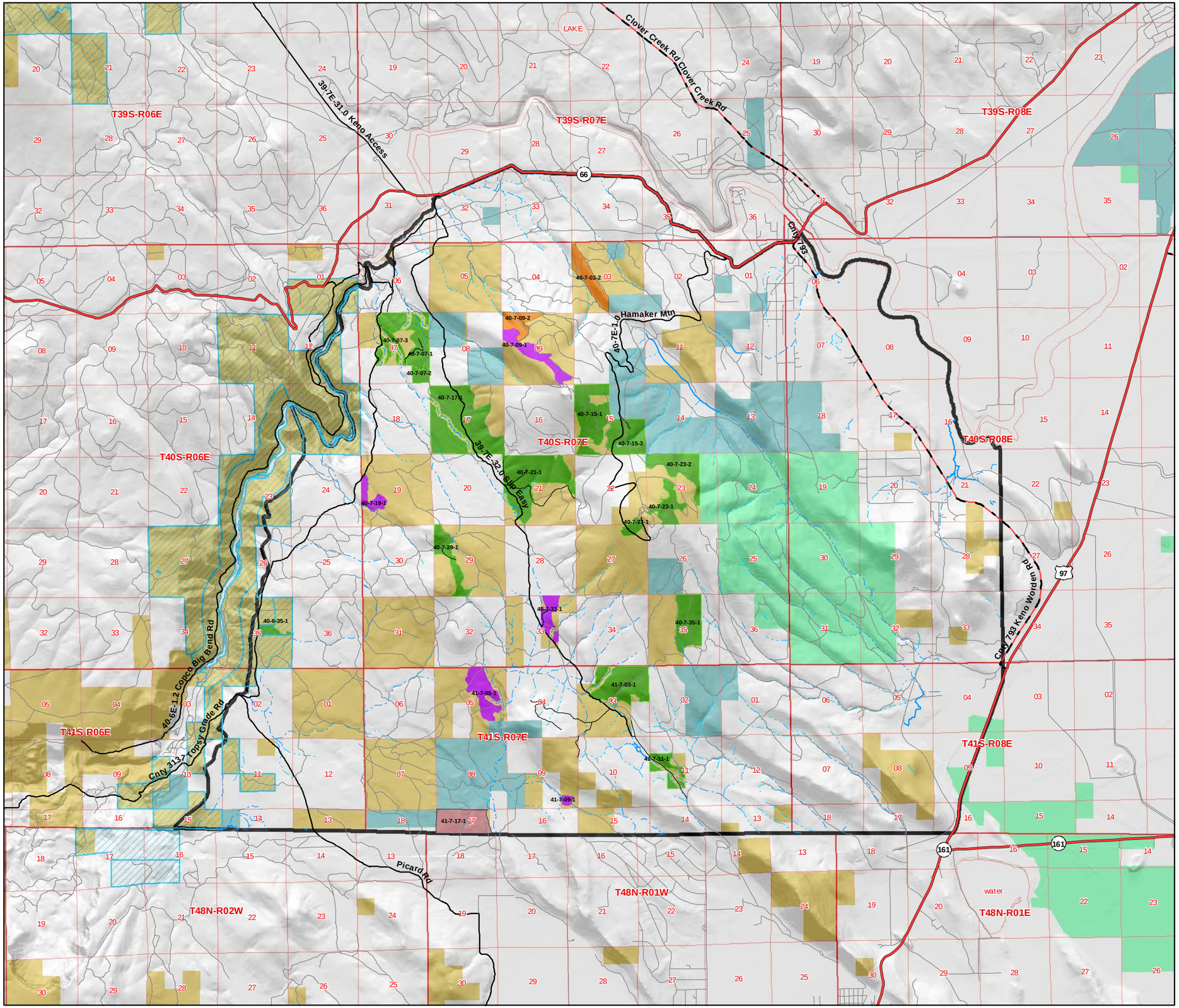
Forestry & Silviculture Treatments
Alternative 2
Keno Landscape EA



Klamath Falls Resource Area
Lakeview District
Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

Forest Treatment Units Alt 2

- Timber Sale - 2359 ac.
- Understory Thin - 184 ac.
- Plantation Thin - 368 ac.
- Conifer Planting - 161 ac.

Reference Themes

- Keno EA Analysis Area
- Northern Spotted Owl Critical Habitat 2012
- Highway
- Major road
- Intermediate road
- Minor road
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- State Lands
- Private Lands

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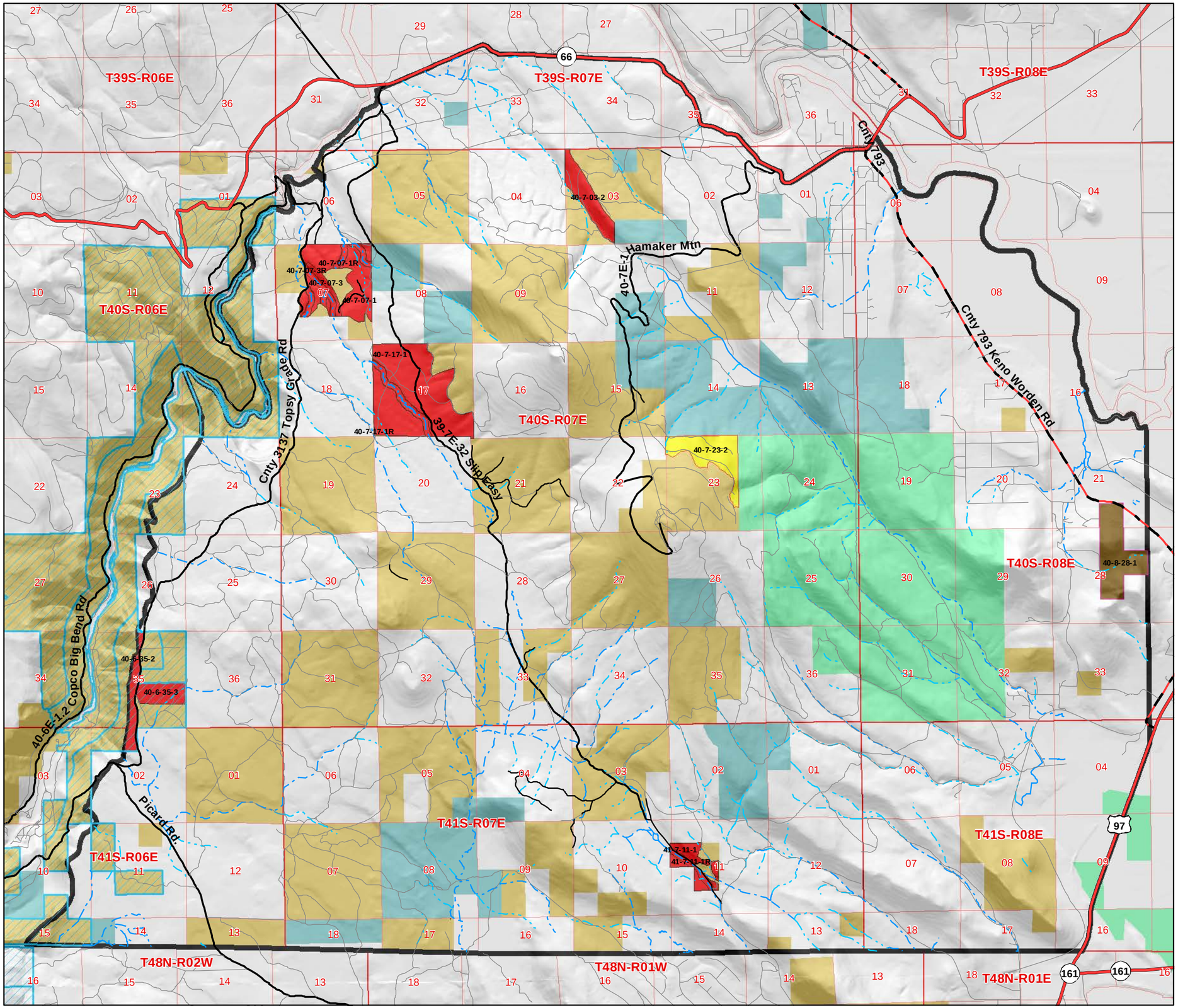
Fuels Treatments
Alternative 2
Keno Landscape EA



Klamath Falls Resource Area
Lakeview District
Bureau of Land Management
2795 Anderson Ave. #25
Klamath Falls, Oregon 97603
(541)883-6916

Fuels Treatment Units Alt 2

- Hand Thin, Pile, Burn, and Scatter Some Tops - 202 ac.
- Hand Thin, Pile, and Burn - 150 ac.
- Underburn - 1131 ac.

Reference Themes

- Keno EA Analysis Area
- Northern Spotted Owl Critical Habitat 2012
- Highway
- Major road
- Intermediate road
- Minor road
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Bureau of Land Management
- U.S. Fish and Wildlife Service
- State Lands
- Private Lands

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APPENDIX B: Summary of Best Management Practices and Project Design Features

Appendix D of the RMP (pages D1-D46) describes the Best Management Practices (BMPs) that are "designed to achieve the objectives of maintaining or improving water quality and soil productivity and the protection of riparian-wetland areas." BMPs are defined as methods, measures, or practices selected on the basis of site-specific conditions to ensure that water quality will be maintained at its highest practicable level (D-1, Appendix D, RMP). In addition to BMPs that focus on water quality and soil production, the interdisciplinary team also developed project design features (PDFs) with the objective of meeting other resource goals The list below is not an exclusive list of BMPs or PDFs for the Keno landscape EA, it is a list of thosethat the interdisciplinary team found to be most pertinent for the action alternatives.

Roads

The KFRA RMP (1995) was updated in 2011 to improve BMPs in order to reduce sediment delivery from BLM roads in Oregon, as per Instruction Memorandum No. OR-2011-074. The BMPs in this list, R 001 through R 101, will be applied during the Keno EA project implementation. The complete list can be viewed on the BLM website at:
http://www.blm.gov/or/districts/lakeview/plans/files/BMPPlanMaintMemo1995_120109.pdf

Soil Resources

- Use corrective measures to return as much displaced topsoil and organic matter as possible to its original location. Excessive rutting would be corrected by backblading, without creating additional disturbance. (Correct disturbance footprint to less than 20% of area).
- Low-disturbance yarding equipment is recommended.
- Where operations utilize forwarder harvester or shovel/loader, create an adequate layer of green slash (limbs, tops and small boles) by the harvesting or felling process to limit bare soil exposure. A desired depth of such material would be 12 to 18 inches of loose slash.
- Retain minimum effective ground cover amounts to prevent erosion from ground-disturbing activities. Vegetative retention and establishment is 45-60% in the first year and 60-75% in the second year on disturbed sites of high erosion hazard (RMP, D-11).
- Burning will only occur when the soil surface is very moist or wet.
- Limit detrimental soil conditions to less than 20 percent of the total acreage within the activity area. Use current soil quality indicators to monitor soil impacts. Sites where the 20 percent standard is exceeded will require treatment, such backblading or seeding.
- To protect riparian areas, soil resources, and water quality while limiting erosion and sedimentation to nearby streams and drainages, logging operations will not be conducted during the wet season (typically October 15 to May 1).
- Limit mechanical cutting and yarding operations to periods when the soil moisture is below 20 percent at a six inch depth. Even lower soil moisture levels are preferable on fragile soils.
- Winter logging activities will be allowed when sufficient snow or frozen ground are present. This is normally when snow depths average twenty (20) inches or greater, or when the ground is froze to a depth of six (6) inches.

- To protect soil resources and water quality, unsurfaced roads will be restricted from hauling during periods of high soil moisture (greater than 20 percent at a six inch depth) unless waived by authorized personnel.
- Residual slash will be placed upon skid trails upon completion of yarding.
- Avoid placement of skid trails in areas with potential to collect and divert surface runoff, such as the bottom of draws and ephemeral drainages.
- Retain and establish adequate vegetative cover in accordance with RMP BMPs to reduce erosion.
- Retain enough small woody (dead and down) material to sustain soil nutrients. See RMP BMPs for specifications. In ponderosa pine forest land, nine tons per acre of duff and litter (approximately ½ inch deep).
- Cable yarding and restricted use of mechanized equipment is required on slopes that are greater than 35 percent.
- Construct fireline by hand on slopes greater than 35 percent.

Additional Soils BMPs for Units 40-7-23-2 and 40-7-15-3

- Winter logging activities will be required when sufficient snow or frozen ground are present. This is normally when snow depths average twenty (20) inches or greater, or when the ground is froze to a depth of six (6) inches.
- Backblade and seed areas of mechanical disturbance, including landings and skid trails.
- Conduct post-harvest soil disturbance monitoring to validate BMP implementation and effectiveness.

Additional BMPs for Fragile Groundwater Soils (KFRA ROD, page D-12):

- Commence rehabilitation promptly, by seeding or planting of native species or species that will quickly establish desired ground cover conditions; and
- Block unsurfaced roads to prohibit motorized vehicle use upon completion of riparian thinning activities.

Hydrology & Riparian Reserve Treatments

Timber Harvest

- Delineate Riparian Reserve widths as described in the RMP (pg F-8, ROD pgs C-30 to 31). Refer to Table B-1 below.
- For understory vegetation treatments within older, multi-age stands within Riparian Reserves, delineate “no-cut” buffers along stream channels and wetland areas. No-cut widths will be 20 foot on each side of non-fish bearing stream channels and wetlands.
- For vegetation treatments within Riparian Reserves, limit the use of mechanical equipment to the outer one-half of the Riparian Reserve (except for designated skid trail crossings, roads, or yarding corridors).
- Existing landings and roads within Riparian Reserves will be used only when replacing them with landings and roads outside the Riparian Reserves would result in greater overall disturbance to the Riparian Reserve or water quality.

- Avoid placement of skid trails and landings in areas with potential to collect and divert surface runoff such as the bottom of draws and ephemeral drainages.
- Harvest/treatment methods that would disturb the least amount of soil and vegetation (yarding over snow or frozen ground, limiting activities to the dry season, pulling line to each tree, and minimizing skid trails) will be used in the Riparian Reserves. The 20-foot radial arm on the mechanical harvester will be used to reach toward the boundary line of Riparian Reserves wherever possible.
- Thin to a higher basal area (100-160 square feet per acre), favoring larger trees for shading and removing competing conifers around dominant pines.
- No new permanent roads will be constructed within Riparian Reserves (except where construction or re-alignment of short road segments allows obliteration of longer road segments within Riparian Reserves).
- Yarding/skidding corridors that pass through Riparian Reserves will be designated prior to project implementation, will have a minimum spacing of 300 feet and be oriented perpendicular to streams, will have minimal relative slope, and will be revegetated following project implementation (as needed).
- Stream crossings will be selected at stable, naturally armored locations or will be armored with slash before being used as a corridor.
- Use of existing roads and landings within Riparian Reserves will be reviewed by the appropriate members of the Klamath Falls Resource Area interdisciplinary team and recommendations made to the authorized officer.

Table B-1: Riparian Reserve Types and Widths from the KFRA RMP

Riparian Reserve Type	Reserve Width (for each side of streams/wetlands)
Fish-bearing streams	At a minimum, the reserve width will include: ▪ Slope distance equal to the height of two site potential trees (240 feet); or, ▪ The stream channel and the area extending to the top of the inner gorge; or, ▪ The area extending to the outer edges of riparian vegetation; or, ▪ The 100-year floodplain; or, ▪ The extent of unstable or potentially unstable areas, whichever is greatest.
Perennial non-fish-bearing streams and Intermittent (seasonal) non-fish-bearing streams; Constructed ponds and reservoirs; and Wetlands greater than one acre	At a minimum, the reserve width will include: ▪ Slope distance equal to the height of one site potential tree (120 feet); or, ▪ The stream channel (or waterbody/wetland) and the area extending to the top of the inner gorge; or, ▪ The area extending to the outer edges of riparian vegetation; or, ▪ The 100-year floodplain (for streams) or the extent of seasonally saturated soil (for waterbodies and wetlands); or, ▪ The extent of unstable or potentially unstable areas, whichever is greatest.
Wetlands less than one acre and Unstable or potentially unstable areas	At a minimum, the reserve width will include: ▪ The wetland and the extent of seasonally saturated soil; or, ▪ The area extending to the outer edges of riparian vegetation; or, ▪ The extent of stable or potentially unstable areas, whichever is greatest.
Lakes and natural ponds	At a minimum, the reserve width will include: ▪ Slope distance equal to the height of two site potential trees (240 feet); and, ▪ The body of water or wetland and the area to the edges of riparian vegetation; ▪ The extent of seasonally saturated soil; ▪ The extent of unstable or potentially unstable areas; whichever is greatest.
Springs	Reserve widths vary according to the size of the associated wetland (see above).
*A site-potential tree is defined as the average maximum height of the tallest dominant trees (200 years old or more) for a given site class. In the Keno project area, the site potential tree height was determined to be 120 feet.	

Treatments in Riparian Reserves:

- No ripping, piling, or mechanical site preparation (except for designated skid trail crossings, roads, or yarding corridors) would occur in Riparian Reserves.
- A no-mechanical-entry spacing for treatments will occur from the natural topographic break to the edge of the riparian area within the Riparian Reserve. In areas where a topographic break is not evident, the following guidelines would be implemented: On perennial, intermittent, and/or fish bearing streams with slopes less than 20%, a 25-foot no entry buffer would be established from the edge of the riparian area, and on slopes greater than 20%, a 50-foot no entry buffer would be established from the edge of the riparian area. In wetland areas, a 50-foot no entry buffer would be established from the edge of the riparian area.
- Stream crossings will be designated prior to project implementation, will have a minimum spacing of 300 feet and be oriented perpendicular to streams, will have minimal relative slope, and will be revegetated following project implementation (as needed). Stream crossings will be selected at stable, naturally armored locations or will be armored with slash before being used as a corridor.

Ignitions within Riparian Reserves:

- Ignition of broadcast fires will not occur within a minimum of 50 feet from the stream channel within the Riparian Reserves. The specific distance for lighting fires within the RR will depend on topography, habitat, ignition methods, and fuel moisture.
- Ignition line location nearest the stream will be based on topography and ignition methods and will be sufficient to protect water quality, CWD, and stream overhead cover. There will be no ignition of CWD directly touching the high water mark of the stream, or of CWD that may be affected by high flows. Where there is thick vegetative cover that extends out from the stream, ignition lines will be located in the forest stand, away from the stream.
- Ignition lines near large open meadows, associated with the stream channels will be located at the toe slope above the meadow elevation as much as possible to protect meadow vegetation.
- Increased ignition spacing from the stream will occur when igniting fuels on the lower end of the window of moisture content to protect CWD and overhead cover components.

Roads and temporary fire trail access in Riparian Reserves:

Use of existing roads and landings within the RR will be reviewed and approved by the resource advisor.

Streamside pumping sites:

- Pumping on small streams will not reduce the downstream flow of the stream by more than half the flow.
- Avoid the construction of temporary pump chances; when necessary, use temporary plastic dams to create chances and remove these dams when not actively pumping.
- All pumping located on fish-bearing streams must have a screen over the intake to avoid entrainment of small fish.
- Pump intake must be suspended near the thalweg (deepest/highest quantity of flow) of the stream. Avoid placing pump intakes on the substrate or edges of the stream channel.

Post Riparian Reserve treatments for access roads and temporary fire trails:

- Install drainage dips, or water bars, in accordance with RMP BMPs to reduce surface run-off.
- A layer of duff (average of ½ inch after final burn) will be retained to protect soil from erosion during the wet season (typically October 15 to May 1).
- Seeding or other methods of soil stabilization will be applied prior to the wet season to reduce surface erosion.
- Design blockages (close or decommission) upon completion of treatments to minimize non-authorized use of roads and trails within treatment areas.
- Place residual slash on trails upon completion of mechanical treatments.

Wildlife Terrestrial Species

Snag Retention/Creation

- In alternative one and two; In timber sale units retain approximately 2.5 snags per acre with one snag per acre a minimum diameter at breast height (DBH) of 16," or largest available based on the mean diameter of trees and the development of the stand(RMP/ROD, Page 26-27; USDA USDI 2001 ROD).
- Create snags within timber sale units to meet RMP guidelines three years post-treatment (timber harvest and prescribed fire).

Coarse Woody Debris (CWD)

In timber sale units, approximately one hundred and twenty (120) linear feet of down logs per acre will be retained. Logs shall be greater than or equal to sixteen (16) inches in diameter and sixteen (16) feet long (RMP/ROD, Page 22).

Seasonal Restrictions, Wildlife

Seasonal restrictions will be required where the following wildlife species are actively nesting: bald eagle, northern spotted owl, northern goshawk, osprey, and special status species. Seasonal restrictions for specific species can be found on pages 231-240 of the KFRA FEIS.

Nesting Areas

Protect nesting areas as described on page 38 of KFRA RMP.

For units adjacent to or containing northern spotted owls or Nesting, Roosting, Foraging (NRF) habitat:

- Burn prescriptions will require proper fuel moisture and atmospheric conditions so that adequate large woody debris will be retained for prey habitat. General objective for burn would be to create a mosaic of burned and unburned habitat in the unit to maintain some habitat for prey production.
- In nesting, roosting, foraging (NRF) habitat, maintain visual screening along open roadways to minimize disturbance. In northern spotted owl NRF habitat, maintain the understory structure by retaining a diversity of the sub-merchantable understory conifer trees (Douglas - fir, white-fir, sugar pine, cedar, ponderosa pine). In mechanical treatment areas, this would be done by site-specific designs described in the individual task orders.

- During prescribed fire activities, the overall objective is to create a mosaic of burned and unburned areas. Ignition techniques and pull back on smaller trees may also be used to maintain the understory structure.
- Retain untreated areas ranging from ¼ acre to five acres ("skips" or thermal clumps) within the treatment units to provide diversity for wildlife.
- During prescribed fire activities, create a mosaic of burned and unburned areas to maintain a diversity of species and age classes of understory vegetation.
- Maintain habitat connectivity and corridors.

Noxious Weeds

- Pressure wash vehicles and equipment that will travel off system roads prior to entry onto BLM-managed lands. This will remove loose seeds, grease, plant parts, and dirt that may contain viable noxious weed seeds, thereby reducing potential introduction of new noxious weeds into the project area and into newly disturbed sites.
- If the job site includes a noxious weed infestation, require cleaning of all logging and construction equipment and vehicles prior to leaving the job site.
- Seed landings and skid trails with native plant materials. This will introduce native vegetation to the site prior to noxious weed seed recruitment, and allow native plants an advantageous jump-start in re-establishment, reducing the risk of noxious weed infestation.
- Monitor the project area 1-3 years after harvest is complete and treat noxious weeds as detected in areas that were disturbed by project implementation.
- Road graders used for road construction or maintenance would grade towards any known noxious weed infestations. If no good turn around area exists within one half mile that would allow the operator to grade towards the noxious weed infestation, then the operator would leave the material that is being moved within the boundaries of the noxious weed infestation.

Cultural Resources

- Follow procedures for cultural protection and management outlined in the KFRA ROD/RMP (page 43), and protect identified sites by buffering.
- In accordance with guidelines and directives in the Klamath Falls Resource Area RMP, BLM regulations, and the National Historic Preservation Act, areas not included in previous archaeological surveys will be surveyed before any ground-disturbing action is undertaken.
- If subsurface cultural resources are unearthed during operations, activity in the vicinity of the cultural resource will cease and a BLM representative notified immediately. Pursuant to 43 C.F.R. 10.4 the holder of this authorization must notify the authorized officer, by telephone, with written confirmation, immediately upon the discovery of human remains, funerary items, sacred objects, or objects of cultural patrimony. Further, the project leader/operator/permittee/etc. must stop activities in the vicinity of the discovery and protect it for 30 days or until notified to proceed by the authorized officer. The holder will be responsible for the cost of evaluation and any decision as to proper mitigation measures that are made by the authorized officer (BLM).
- The project leader/operator/permittee/etc. is responsible for informing all persons associated with this project that they will be subject to prosecution for knowingly disturbing Native American Indian shrines, historic and prehistoric archaeology sites, or for collecting artifacts of any kind, including historic items and/or arrowheads from Federal lands pursuant to the

1906 American Antiquities Act (P.L. 59-209; 34 Stat. 225; 16 U.S.C. 432, 433), the Archaeological Resources Protection Act of 1979 (P.L. 96-95; 93 Stat. 721; 16 U.S.C. 47Oee as amended), and/or other federal laws.

Visual Resources

- Maintain scenic quality as follows, within and adjacent to existing and potential recreation sites, concentrated recreation use areas, Special Areas, along the access roads leading to the west portion of section 31, and all but the SE corner of section 7 (within the VRM class II area), and along Oregon State Highway 66:
  - Retain a variety of size classes of trees including large ponderosa pine, Douglas fir and incense cedar
  - Small (hand) piles of slash dispersed for firewood gathering
  - Avoid large landings/log decks, obvious skid trails, and minimize ground disturbance near major roads.
  - Mechanical shearing and chainsaw cutting of small trees will be done as close to ground level as practical, to reduce negative visual impacts.
- Minimize use of tree marking paint on trees identified for harvest or retention.
- Minimize number of skid trails and amount of ground disturbance
- Minimize damage to residual trees through careful timber falling.
- Use multiple prescribed fire treatments over time to maintain the desired character of the landscape, and to limit the level of change at each treatment so that it does not attract the attention of the casual observer.
- Design vegetation and fuel treatment areas to have feathered, irregular edges and shapes. They should mimic naturally appearing shapes, forms, and textures of the surrounding landscape.
- All treatments will meet appropriate Visual Class objectives specified in the KFRA ROD/RMP (page 44).

Recreation Resources

- Ensure that purchaser signs haul routes to alert recreationists to log truck traffic in the area.
- Highway flaggers may be needed to warn traffic along Highway 66 of operations per ODOT requirements.
- Ensure that dust abatement and frequent grading occurs on haul routes, especially near more popular recreation areas such as Topsy campground, access to the upper Klamath River, or other parking/staging areas as identified by the outdoor recreation planner.

APPENDIX C – Survey and Manage

2001 ROD Compliance Review: Survey & Manage Wildlife and Botany

Environmental Analysis File
Lakeview District BLM – Klamath Falls Field Office

Project Name: Keno EA
Date: 04/26/13

Prepared By: Steve Hayner (wildlife), Johanna Fickenscher (botany/fungi/lichens and bryophytes)

Project Type: Timber harvest; road maintenance, closures, construction; prescribed burning; mechanical and manual thinning, conifer planting.

Table B-2: Keno Project Location by Township, Range, & Section

Township	Range	Section
39S	06E	07, 31, 32
40S	06E	1, 6, 12, 35
40S	07E	3, 5, 6, 7, 9, 15, 17, 19, 21, 22, 23, 27, 29, 31, 33, 35
40S	08E	21, 28
41S	06E	1, 2
41S	07E	3, 5, 6, 7, 9, 11, 17

S&M List Date: January, 2001

Species listed below were compiled from the 2001 Record of Decision and include those vertebrate and non-vertebrate wildlife and non-vascular and vascular botanical species whose known or suspected range includes the Klamath Falls Resource Area according to the protocols listed below. There is one known site for Category B, D, E, and F species within the project area.

- Survey Protocols for Survey and Manage Strategy 2 Vascular Plants Version 2.0 (December 1998)
- Management Recommendations for Survey and Manage Lichens Version 2.0 (March 2000)
- Natural History and Management Considerations for the Northwest Forest Plan Survey and Manage Lichens Based on Information as of the Year 2000 (USDA Forest Service R6-NR-S&M-TP-03-03 2003). Survey Protocols for Survey and Manage Category A & C Lichens in the Northwest Forest Plan Area Version 2.1 (2003)
- 2003 Amendment to the Survey Protocol for Survey and Manage Category A and C Lichens Version 2.1 (2003)
- Survey Protocols for Survey and Manage Component 2 Bryophytes Version 2.0 (1997)
- Survey and Manage Protocols Protection Buffer Bryophytes 2.0 (1999)
- Handbook to Strategy 1 Fungal Species in the Northwest Forest Plan (PNW-GTR-476 October 1999), and Handbook to Additional Fungal Species of Special Concern in the Northwest Forest Plan (PNW-GTR-572 January 2003)

- Survey Protocol for the Great Gray Owl within the Range of the Northwest Forest Plan v3.0 (Jan. 2004)
- Survey Protocol Aquatic Mollusk Species From the Northwest Forest Plan Version 2.0 (Oct. 1997)
- Survey Protocol for S&M Terrestrial Mollusk Species v 3.0 (Feb. 2003).

Statement of Compliance

The Keno project is consistent with the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines, as incorporated into the Klamath Falls District Resource Management Plan and is consistent with court orders relating to the Survey and Manage mitigation measure of the Northwest Forest Plan

On December 17, 2009, the U.S. District Court for the Western District of Washington issued an order in *Conservation Northwest, et al. v. Rey, et al.*, No. 08-1067 (W.D. Wash.) (Coughenour, J.), granting Plaintiffs' motion for partial summary judgment and finding a variety of NEPA violations in the BLM and USFS 2007 Record of Decision eliminating the Survey and Manage mitigation measure.

Judge Coughenour deferred issuing a remedy in his December 17, 2009 order until further proceedings, and did not enjoin the BLM from proceeding with projects. Plaintiffs and Defendants entered into settlement negotiations that resulted in the 2011 Survey and Manage Settlement Agreement, adopted by the district court on July 6, 2011.
The Ninth Circuit Court of Appeals issued an opinion on April 25, 2013, that reversed the District Court for the Western District of Washington's approval of the 2011 Survey and Manage Settlement Agreement. The case is now remanded back to the District Court for further proceedings. This means that the December 17, 2009, District Court order which found National Environmental Policy (NEPA) inadequacies in the 2007 analysis and records of decision removing Survey and Manage is still valid.

Previously, in 2006, the District Court (Judge Pechman) had invalidated the agencies' 2004 RODs eliminating Survey and Manage due to NEPA violations. Following the District Court's 2006 ruling, parties to the litigation had entered into a stipulation exempting certain categories of activities from the Survey and Manage standard (hereinafter "Pechman exemptions").

Judge Pechman's Order from October 11, 2006 directs: "Defendants shall not authorize, allow, or permit to continue any logging or other ground-disturbing activities on projects to which the 2004 ROD applied unless such activities are in compliance with the 2001 ROD (as the 2001ROD was amended or modified as of March 21, 2004), except that this order will not apply to:

A. Thinning projects in stands younger than 80 years old (emphasis added);

B. Replacing culverts on roads that are in use and part of the road system, and removing culverts if the road is temporary or to be decommissioned;

C. Riparian and stream improvement projects where the riparian work is riparian planting, obtaining material for placing in-stream, and road or trail decommissioning; and where the stream improvement work is the placement large wood, channel and floodplain reconstruction, or removal of channel diversions; and

D. The portions of project involving hazardous fuel treatments where prescribed fire is applied. Any portion of a hazardous fuel treatment project involving commercial logging will remain subject to the survey and management requirements except for thinning of stands younger than 80 years old under subparagraph a. of this paragraph."

Following the District Court's December 17, 2009 ruling, the Pechman exemptions still remained in place. I have reviewed the Keno Project in consideration of both the December 17, 2009 partial summary judgment and Judge Pechman's October 11, 2006 order. Because the project meets the provisions of the last valid Record of Decision, specifically the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (not including subsequent Annual Species Reviews), and on one treatment unit conducts hazardous fuel treatments where prescribed fire is applied without commercial logging, I have made the determination that this project meets Exemption D of the Pechman Exemptions (October 11, 2006 Order).Therefore, it may still proceed to be offered for sale even if the District Court sets aside or otherwise enjoins use of the 2007 Survey and Manage Record of Decision since the Pechman exemptions would remain valid in such case. Details of the project surveys are described below:

Based on the survey results, there are no known sites of Survey & Manage species that require management within the analysis area. Therefore, based on the information (Table B2) regarding the status of surveys for Survey & Manage wildlife species and the results of those surveys, it is my determination that the Keno EA complies with the provisions of the *2001 Record of Decision and Standard and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measure Standards and Guidelines* (2001 ROD).

Table B-3 - Survey & Manage Wildlife and Botany Species

Species	S&M Category	Survey Triggers			Survey Results			Site Management
		Within Range of Species?	Contains Suitable habitat?	Project may negatively affect species or habitat?	Surveys Required?	Survey Date Month/ year	Sites Known or Found?	
Vertebrates								
Great Gray Owl (Strix nebulosa) [1]	A	Yes	Yes	Yes	Yes	2011 2012	0	N/A
Mollusks								
Chace Sideband (Monadenia chaceana) [2]	B4	Yes	Yes	Yes	Yes	Fall 2011 Spring 2012	0	N/A
Crater Lake Tightcoil (Pristiloma arcticum crateris) [3]	B4	Yes	No	No	No	N/A	0	N/A

Species	S&M Category	Survey Triggers			Survey Results			Site Management
		Within Range of Species?	Contains Suitable habitat?	Project may negatively affect species or habitat?	Surveys Required?	Survey Date Month/ year	Sites Known or Found?	
Evening Fieldslug (Deroceras hesperium) [4]	B4	Yes	No	No	No	N/A	0	N/A
Oregon shoulderband (Helminthoglypta hertieni) [2]	B4	No	No	No	No	N/A	0	N/A
Fluminicola no. 3	A	Yes	No	No	No	N/A	0	N/A
Fluminicola no. 1	A	Yes	No	No	No	N/A	0	N/A
Vascular Plants								
Cypripedium fasciculatum[5]	C	Yes	Yes	Yes	Yes	7/2012	0	N/A
Cypripediium montanum[5]	C	Yes	Yes	Yes	Yes	7/2012	0	N/A

[1]Pre-disturbance surveys for great gray owls are required since there is suitable nesting habitat within the project area. The required habitat characteristics of suitable habitat include: (1) large diameter nest trees, (2) forest for roosting cover, and (3) proximity [within 200m] to openings that could be used as foraging areas (Survey Protocol for the Great Gray Owl within the range of the Northwest Forest Plan v3.0, January 12, 2004). Surveys for the great gray owl were conducted 2004 protocol designed to meet the 2001 Survey and Manage Standards and Guidelines. Survey protocol used was "Survey protocol for the Great Gray Owl within the Range of the Northwest Forest Plan (2004)." No great gray owl detections were detected within the Keno Analysis area.

[2] Equivalent-effort pre-disturbance surveys are required for the Chace Sideband (Survey Protocol for S&M Terrestrial Mollusk Species v3.0, 2003). The chace sideband is associated with open talus or rocky areas in forested habitat. Vegetation types include dry conifer/hardwood forest as well as oak communities (unpublished USDA/USDA 2005). The Oregon shoulderband was removed from the Resource Area survey list in 2002 under the Annual Species Review process due to the change in the known and suspected range. No Chace sideband snails were located in the Keno project area. Some treatment units were not surveyed but the habitat for the chace sideband was delineated and buffered. Approximately 21 acres of habitat will be removed from habitat disturbing activity to maintain the microsite characteristics.

[3]Suitable habitat for the Crater Lake tightcoil is "perennially wet situations in mature conifer forests, among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 meters of open water in wetlands, springs, seeps and riparian areas…" (pg. 43, Survey Protocol for S&M Terrestrial Mollusk Species v3.0, 2003). No habitat for the Crater Lake tightcoil snails occurs within any proposed treatment units.

[4]The evening field slug's range was extended to include the KFRA in March 2003 (pg. 2 and 3 2002 Annual Species Review and Appendix A pg32. Survey Protocol for S&M Terrestrial Mollusk Species v3.0, 2003). This species may be found in perennial moist situations in mature conifer forests or meadows amongst rushes, mosses and other surface vegetation or under rocks or woody debris within 10 m of open water in wetlands, springs, seeps, and streams. No habitat for the evening field slugs occurs within any proposed treatment units.

[5]Surveys for Cyperpidium fasciculatum and Cypripediium montanum were conducted in 2012 within the project area. No sites were found.

[6] No habitat for Fluminicola no. 1 and 3 occurs within any of the treatments units or will be affected from the proposed actions. The pebblesnail is generally found in bodies of water with gravel-boulder substrates and moderate flow. It prefers cold, oligotrophic water with high dissolved oxygen content. It is typically found in springs and avoids areas with dense macrophyte beds.

Some project areas proposed for treatment under this EA have not been specifically surveyed for S&M terrestrial mollusks. The terrestrial mollusk protocol (USDA/USDI 2003) identified priority habitat for surveying for specific species. Using this protocol the Bureau of Land Management (BLM) identified priority habitat for the species, and will avoid the habitat to prevent impacts. Priority habitats have been identified, buffered and removed from the proposed vegetation treatments that would be considered habitat disturbing (i.e. timber harvest). This methodology to identify habitat and avoid disturbance meets the intent of the 2001 S&M ROD by assuming occupancy within priority habitat and protecting its microsite characteristics.

All other proposed actions that are not considered habitat disturbing (USDA/USDI 2003) would be compliant with the Standards and Guidelines in the 2001 S&M ROD or survey and manage project exemptions and habitat protection would not be required. Habitat disturbing activities are defined as those disturbances likely to have significant negative impact on species habitat, its life cycle or life support requirement (USDA/USDI 2001). The projects listed as non-habitat disturbing are those listed because they are not considered habitat for the S&M terrestrial mollusks.

Appendix D – Determining Age on Uneven-aged Stands

Procedure for determining age on uneven-aged stands in Klamath Falls

- Collect stand exam data as described in the Ecosurvey handbook. This will include separating the trees in each plot by layer based on height. The Ecosurvey handbook specifies that layer 2 be "on average less than 2/3 the average height of the top layer".
- Bore a representative tree of each layer at each plot to determine average layer age.
- When Forest Operations Inventory (FOI) unit has been completed determine the basal area made up by each layer in each plot and average them.

Plot 1	**Plot 2**	**Plot 3**
50 sq. ft. layer 1	20 sq. ft. layer 1	100 sq. ft. layer 1
70 sq. ft layer 2	100 sq. ft layer 2	20 sq. ft layer 2
10 sq. ft layer 3	10 sq. ft layer 3	0 sq ft layer 3

Average basal area/layer	
1	57
2	63
3	7

- The age of the stand will be assigned as the layer with the greatest BA for the stand. In this case the average age of layer 2 would be assigned to the entire FOI unit.

Appendix E – Definition of "Old" Juniper

Old Juniper refers to juniper that likely originated in the "presettlement" period, before 1870. It is assumed that these trees are growing on sites that they are adapted to, since they began growing there under "natural conditions" when natural processes (including lightning fires) determined vegetation patterns. Older junipers are usually found in rocky areas where vegetation is sparse and natural fire frequency is low. Some typical characteristics of older juniper are the following:

- Crown is flat, rounded, broad at top, or irregular (as opposed to the more pointed tops of younger trees)
- Spike top
- Numerous dead branches
- Branches covered with a coarse, bright yellow-green lichen (*Letharia*, or wolf lichen)
- Large diameter lower branches
- Large diameter trunk relative to height
- Trunk has spirally-twisted bark, deep furrows
- Hollow trunk

It is rare for an older juniper to have all of the above features, but more commonly will have at least three or four. Also, older juniper are not always the largest trees; on drier, rocky sites, they can be short, stubby, gnarly trees. In addition, junipers with cavities and or wood rat middens (adjacent to or in tree) shall be retained.