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Final Environmental Impact Statement

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Eddy Gulch Late-Successional Reserve Fuels/Habitat Protection Project

Salmon River and Scott River Ranger Districts
Klamath National Forest
Siskiyou County, California

Pathway to a healthy future

Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Final Environmental Impact Statement, Klamath National Forest

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Abstract: The *Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Final Environmental Impact Statement* (EIS) documents the analysis of the no-action alternative and two action alternatives.

Purpose and Need. The purpose of the project is to protect late-successional habitat used by the northern spotted owl and other late-successional-dependent species, to protect communities, and create safer emergency access routes. The project is needed to reduce excessive fuel hazards, where recent surveys for this project determined that 73 percent of the entire LSR would support active or passive crown fires.

Alternative A: No Action. This alternative is the continuation of the current level of management and public use—this includes road maintenance, dispersed recreation (hunting, fishing, camping, and hiking), mining, and watershed restoration projects and a 7,200-acre modeled wildfire.

Alternative B: Proposed Action. Alternative B proposes 25,969 acres of landscape-level treatments to protect late-successional habitat and communities. Within those acres, 16 Fuel Reduction Zones (FRZs), totaling 8,291 acres, would be constructed to increase resistance to the spread of wildfires to adjacent watersheds. The 8,291 acres include 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels. The proposal includes 17,524 acres of Prescribed Burn Units (Rx Units) located outside the FRZs to increase resiliency to wildfires and protect habitat for the NSO and other wildlife species that are dependent on late-successional forests. There would be 44 miles of Roadside (RS) treatments along emergency access routes treated in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (154 acres) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes.

Alternative C: No New Temporary Roads Constructed. Approximately 1.03 miles (5,443 feet) of new temporary roads would not be constructed. As a result, no fuel-reduction treatments in 99 acres would occur in portions of seven M Units, which reduces the M Units to 832 acres. There would be 822 fewer acres treated in Rx Units because no treatment would occur in a portion of two M Units. The inability to treat the 921 acres would result in vulnerable areas that could allow wildfires to escape to other areas of the LSR.

Public and agency reviewers provided the Forest Service with their comments during the 45-day review period for the draft EIS (the review period ran from July 24 through September 8, 2009). Edits were made to the final EIS (and related resource reports) based on public and agency comments. No changes were made to the two action alternatives (Alternative B: Proposed Action or Alternative C: No New Temporary Roads Constructed), and no additional action alternatives were developed.

Public and agency comments, and Forest Service responses to comments, can be found in Section B.2 of Appendix B of this final EIS. Full copies of public and agency comment documents are contained in Section B.3 of Appendix B.

Summary

Background

Prior to European settlement the Klamath Mountains experienced frequent (every 12–19 years) mixed-severity fires. The highest-intensity fires occurred on the upper third of slopes and on south and west aspects, while the lowest-intensity fires occurred on the lower third of slopes and on north and east aspects. The result was that ridgetops and south and west aspects had scattered remnants of older trees among a matrix of younger stands, while the lower third of slopes and east and west aspects supported stands characterized by large-diameter trees with a multilayered closed canopy, snags, and downed logs (late-successional habitat) (Taylor and Skinner 1998; Skinner et al. 2006).

Settlement of the area and an effective fire-exclusion policy have significantly modified the fire regime and forest structure. The number of acres burned by small fires on the Salmon River and Scott River Ranger Districts has declined steadily since 1930, while the number of large fires that escaped initial attack increased between 1970 and 1999. Studies have determined that 67 percent of the Eddy Gulch Late-Successional Reserve (LSR) is characterized as Fire Regime Condition Class 3, where the fire regime has been significantly altered from its historical range, and there is a high risk of losing key ecosystem components (Creasy 2008).

A total of 23 northern spotted owl (NSO) activity centers have been identified within the boundary of the Eddy Gulch LSR (20 of which are in or overlapping the project Assessment Area), and 62 percent were occupied during the most recent surveys (2008). A 7,200-acre wildfire (as modeled under Alternative A—no action) could destroy or significantly degrade multiple NSO activity centers. The Salmon River Community Wildfire Protection Plan (CWPP) identified several wildland-urban interface (WUI) areas adjacent to communities, municipal watersheds at risk, and emergency access routes where excessive fuels should be reduced in the Eddy Gulch LSR. The CWPP is consistent with the *Healthy Forests Restoration Act*, and that Act requires the Forest Service to consider CWPPs in project planning. Climate change could directly affect the current distribution of plants and wildlife as a result of warmer temperatures, and could also dry forest fuels earlier and extend the fire season, resulting in more frequent fires.

Purpose and Need

The purpose of the Eddy Gulch LSR Project is to protect late-successional habitat used by the NSO (*Strix occidentalis caurina*) and other late-successional-dependent species, to protect communities, and create safer emergency access routes. The project is needed to reduce excessive fuel hazards, where recent surveys for this project determined that 73 percent of the entire LSR would support active or passive crown fires. Two objectives were developed for the project based on current conditions in the Assessment Area.

Objective 1: Habitat Protection—Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.

Need for Action (Existing Conditions). The Eddy Gulch LSR Project is needed to reduce excessive fuel hazards to protect and conserve late-successional habitat. Current conditions have created the following problems:

1. Due to policies that required the control of all fires and excluded fire from the ecosystem, there have been changes in stand structures, including higher densities of ground and ladders fuels such as brush, small trees, and shade-tolerant tree species.

2. Most of the mid- and late-successional conifer stands in the Assessment Area are choked with small trees (less than 10 inches diameter at breast height [dbh]). Additionally, tree mortality will continue to increase in response to current competition for resources and warmer temperatures, which contribute to higher fuel loads.

3. Fire modeling, using current conditions, indicates that under 90th percentile weather conditions

    - flame lengths during a wildfire would be from 11 to 20 feet, contributing to crown fire behavior;

    - the rate of fire spread would range between 30 and 60 feet per minute, affecting the ability of suppression crews to contain fires; and

    - 73 percent of the entire Eddy Gulch LSR (61,900 acres) would experience active/passive crown fires that would reduce or destroy habitat suitability for the NSO (including designated critical habitat) and other late-successional-dependent species.

Objective 2: Community Protection—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

Need for Action (Existing Conditions). The Eddy Gulch LSR Project is needed to reduce wildfire risk to communities by reducing fuel hazards and provide people with safe passage by reducing fuel hazards along emergency access routes that occur in the Eddy Gulch LSR.

1. Current fuel conditions are increasing the wildfire risk to residents, property, infrastructure, and municipal watersheds. Communities near the LSR would be at risk of high losses.

2. During a wildfire, emergency access routes (described in the Salmon River CWPP) may not be safe or passable because fuel loading and hazard trees along 60 miles of specifically identified road segments could potentially block primary escape routes in the event of a wildfire—this would compromise the safety of local residents who would need to evacuate ahead of the fire and potentially prevent firefighters from reaching the fire area to initiate and sustain suppression activities.

3. Vegetation treatments are needed to reduce fuel loading and continuity and to provide strategic locations where firefighters can safely work. Current conditions would be unsafe for firefighters because there are no fuelbreaks in place to serve as safe areas from which to fight fires, and fires would have the opportunity to grow very large.

4. In the event of a wildfire, much of the vegetation and ground cover would be removed from seven municipal watersheds, which would affect water quality for local residents who depend on these areas.

Alternative Development

Alternative A: No Action

The no-action alternative complies with Council on Environmental Quality regulations for implementing the *National Environmental Policy Act* (40 Code of Federal Regulations [CFR] 1502.14(d)). It is not a baseline condition but rather a description of future circumstances without implementation of the Eddy Gulch LSR Project. The no-action alternative is described in this environmental impact statement as continuation of the current level of management and public use—this includes road maintenance, dispersed recreation (hunting, fishing, camping, and hiking), mining, watershed restoration projects, and a simulated 7,200-acre wildfire, where a majority of the fire was characterized by a stand-replacing crown fire. The time frame for analysis is considered to be 20 years. Given the fuel hazard in the Eddy Gulch LSR and current predictions of climate change, it is assumed at least one wildfire will escape initial attack during the 20-year period and burn under 90th percentile weather conditions (defined as 10 percent of the days in the historical weather database that had lower fuel moisture and higher wind speeds compared to the rest of the days). An analysis of a wildfire for three days that escaped initial attack in the Eddy Gulch LSR Project Assessment Area indicates that fire would burn 7,200 acres. Of those 7,200 acres, 1,355 acres (19 percent) would be surface fire; 5,065 acres (70 percent) would be passive crown fire; and 780 acres (11 percent) would be active crown fire. These crown fires would result in extensive tree mortality, approaching 100 percent, over 81 percent of the total burned area.

Alternative B: Proposed Action (Forest Service Preferred Alternative)

Alternative B proposes to treat 25,969 acres of landscape-level treatments in the Eddy Gulch LSR Project Assessment Area to protect late-successional habitat and communities. Of the 25,696 acres proposed for treatment, 8,291 acres would be in Fuel Reduction Zones (FRZs); 17,524 acres would be in Prescribed Burn Units (Rx Units); and 154 acres would be in Roadside (RS) treatments along emergency access routes that do not pass through an FRZ or Rx Unit.

Fuel Reduction Zones

Alternative B proposes to construct 16 FRZs totaling 8,291 acres to increase resistance to the spread of wildfires to adjacent watersheds. The 8,291 acres include 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels. The FRZs would be strategically located on ridgetops to increase resistance to the spread of wildfires. The FRZs would be wide enough to capture most short-range spot fires, and ground, ladder, and crown fuels would be reduced so as to change crown fires to surface fires within the treated areas. The FRZs would provide safe locations for fire-suppression personnel to conduct fire-suppression actions during 90th percentile weather conditions, and they would serve as anchor points for additional landscape-level fuel treatments, such as underburning.

- **M Units in FRZs**. Forty-two M Units, totaling 931 acres, would be treated in the FRZs consistent with the range of natural variation. A “Designation by Description” prescription with variable spacing would be used to retain the largest trees generally within 14–28 feet of the next adjacent largest conifer tree. Tree removal would thin from below, removing trees 8–28 inches diameter at breast height (dbh). No trees larger than 20 inches dbh would be removed in M Unit 8, M Unit 24, M Unit 31, and M Unit 43 to retain large trees in NSO habitat. Additional emphasis would be given to retaining desired conifer species and all hardwoods. Post-treatment canopy cover would range from 32 to 50 percent. Snags and coarse woody debris would be reduced, where needed, to ensure firefighter safety; however, Standards and Guidelines in the Klamath National Forest Land and Resource Management Plan (Klamath LRMP) would be achieved on a landscape level. Tractor yarding would occur on 361 acres and cable yarding on 570 acres. Following completion of thinning, all slash in tractor units would be piled and burned, and all slash in cable units would be lopped and scattered and broadcast burned. Slash and other ground fuels would be removed to achieve post-treatment flame lengths of less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Crown base heights would be 8–15 feet to minimize crown fires.

- **Fuel Reduction Areas in FRZs**. The "fuel reduction areas" in FRZs are areas outside of M Units and total 7,383 acres. Ground and ladder fuels (conifer trees up to 10 inches dbh) would be masticated on 3,184 acres on slopes less than 45 percent. Prescriptive burning, outside of M Units, would be used on 5,107 acres on slopes greater than 45 percent. Mortality of intermediate, dominant, and codominant trees would not exceed 10 percent in a burn block; however, mortality may be higher in plantations and in areas with forest fuel concentrations, which could result in small openings—all openings will not exceed 10 percent of any unit. Post-treatment flame lengths would be less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Crown base heights would be 8–15 feet to minimize crown fires.

  Plantations would be thinned to a 20-foot by 20-foot spacing, using mastication on slopes less than 45 percent. On slopes greater than 45 percent, plantations would be prescribed burned, except in eight strategic plantations in five FRZs where hand thinning, pruning (maintaining 60 percent canopy cover), and pile and burn would be necessary to maintain the integrity of the FRZs. Those treatments would occur on 56 acres in FRZ 2, 17 acres in FRZ 3, 28 acres in FRZ 5, 49 acres in FRZ 9, and 9 acres in FRZ 14.

Prescribed Burn Units

- Alternative B proposes 11 Rx Units, totaling 17,524 acres to increase resiliency to wildfires and protect habitat for the NSO and other wildlife species that are dependent on late-successional forests. The units range in size from approximately 250 to 4,300 acres and would be generally located between the FRZs. Most of the Rx Unit treatments would occur on south-facing aspects where fuels dry faster, and treatments would support the role of the FRZs. The Rx Units were designed and located in areas containing U.S. Fish and Wildlife Service priority protection areas, which include clusters of NSO Activity Centers or are important to maintain connectivity in the LSR. Broadcast burning, ignited by hand or with "ping pong" balls from a helicopter, would be used to remove ground and small ladder fuels (less than 4 inches dbh) and to achieve post-treatment flame lengths of less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Implementation of prescribed burns would not be consistent across each Rx Unit, but rather small patches of heavier fuels would be maintained in burn areas, mimicking the range of natural variation that was created by the pre-European fire regime. Prescribed burning would result in some mortality of intermediate, dominant, and codominant trees. Mortality would be highest in the smaller intermediate trees, and total mortality would not exceed 10 percent in a burn block. Most mortality would occur to individual trees scattered throughout the entire burn area; however, small openings may also occur where groups of 3 to 5 trees could be killed when high concentrations of surface fuels occur. Mortality would be lower in mid-successional and late-successional stands where trees are larger, the bark is thicker, and the branches are higher on trees. The sum of all openings in a burn unit would not exceed 10 percent of any unit. Snags and coarse woody debris densities would be consistent with Standards and Guidelines contained in the Klamath LRMP. Roads, topographic features, and hand-cut control lines would control prescribed fire size. Existing landings would be used if burning is ignited from a helicopter. Burns may be accomplished when air quality, weather, and fuel moisture conditions could be met.

Roadside Treatments Along Emergency Access Routes

The RS treatments are proposed along 60 miles of emergency access routes; 44 of the 60 miles would receive the same treatment as the FRZ or Rx Unit the route passes through. The following are the RS treatments proposed along 16 miles (approximately 154 acres) of emergency access routes that do not pass through FRZs or Rx Units:

- RS 1 treatments would consist of hand thin and pile burn of trees up to 6 inches dbh on slopes greater than 45 percent (43.1 acres).
- RS 2 treatments would involve mastication to remove trees less than 10 inches dbh on slopes less than 45 percent (40.6 acres).
- RS 3 treatments are in Riparian Reserves and would only consist of mastication, hand thin, and pile burn (69.5 acres).

Generally, the RS treatments would occur along the following roads:

- National Forest System (NFS) Road 39 from County Road 1CO2 up to the northeast corner where it intersects the boundary of FRZ 15;
- NFS Road 40N61 (Whites Gulch) from the intersection with Road 39 to the county road; and
- the south side of NFS Road 40N54 from the intersection of the county road east to the intersection of 40N35.

All hazard trees would be identified and removed in accordance with Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (USFS 2005). To maintain the canopy cover requirements listed in the Salmon River CWPP, only small fuels within 50 feet of the road would be removed.

Proposed Temporary Roads and Landings

The construction of new temporary roads and the use of former logging access routes are proposed to access treatment units.

- Approximately 1.03 miles (5,433 feet) of new temporary roads would be used to access all or portions of seven M Units. All of these temporary roads would be closed (ripped and mulched, as needed) following thinning.
- Approximately 0.98 mile (5,177 feet) of former logging access routes would be re-opened (vegetation removed and bladed) to access all or portions of five M Units. These routes would be water-barred and closed immediately after thinning is completed.
- Five short spurs, each less than 100 feet long, would be bladed for tractor or cable yarding operations in two units.
- Existing landings will be used. The interdisciplinary team considered using whole-tree yarding to reduce slash treatments, but it would require larger landings and additional clearing and was therefore not considered further.
- Existing skid trails will be used. There may be short sections of skid trails that could be over 35 percent slope and that use the scarps (the steeper slope) to connect one flat bench to another flat bench. Please refer to the Soil RPMs in Section 2.9.4 below.

Alternative C: No New Temporary Roads Constructed

Alternative C responds to public concerns regarding the environmental and economic effects of constructing new temporary roads. Alternative C is similar to the Proposed Action but approximately 1.03 miles (5,443 feet) of new temporary roads identified in the Proposed Action would not be constructed. As a result, no fuels treatments would occur in portions of seven M Units. This reduces the total acres of treatments in M Units from 931 under Alternative B to 832 under Alternative C. Fuels treatments could not be carried out in those M Units because of excessive treatment costs, high existing dead crown fuel loadings, and potential heat damage to the overstory if these untreated units were prescribed burned.

- The FRZs would continue to total 8,291 acres; however, 99 acres in M Units would remain untreated. The total number of acres treated by tractor yarding would remain at 361 acres, but the acres of cable yarding would be reduced from 570 under Alternative B to 471 under Alternative C.
- Reducing the 99 acres of M Units treated would also reduce the number of acres treated in two Rx Units (an 822-acre reduction) because excessive fuels remaining in M Units would preclude safely burning portions of the two Rx Units. Thus, approximately 921 acres would still be susceptible to a crown fire. The inability to treat the 921 acres would result in vulnerable areas that could allow wildfires to escape to other areas of the LSR.

Decision to be Made

The Responsible Official (decision maker) for this action is the Klamath National Forest Supervisor. The decision maker will consider how well each alternative meets the objectives (purposes) of the Eddy Gulch LSR Project and addresses the significant issue described below. The decision maker will decide whether to implement an action or take no action. After the final EIS is completed, a Record of Decision will then be issued and will contain the rationale for the decision and a discussion of any applicable mitigation measures (referred to as "resource protection measures" in this final EIS).

Public Involvement

Collaboration and Scoping

Planning for this project was initiated in September 2007. Extensive collaboration meetings were held in local communities in and adjacent to the Eddy Gulch LSR between September 2007 and March 2008. The Notice of Intent to prepare the draft EIS for the Eddy Gulch LSR Project appeared in the *Federal Register* on April 1, 2008. The Notice of Intent described the purpose and need for the project and summarized the Proposed Action. The scoping letter (in the form of a project newsletter) was mailed to the approximate 1,200 members on the project mailing list. A project website (www.eddylsrproject.com) was developed to help keep people informed about the project and to make fact sheets, newsletters, meeting announcements, and other documents (such as the draft and final EISs) easily available.

Meetings and conversations were held with the United States Fish and Wildlife Service and National Marine Fisheries Service (both agency offices are located in Yreka, California) to gather suggestions and comments about the project.

Significant Issue. Public and agency comments received during collaboration and scoping efforts identified only one significant issue, which was in regard to construction of new temporary roads to access some of the treatment units. Alternative C was developed in response to public concerns regarding the environmental and economic impacts of constructing new temporary roads.

Draft EIS Review Period

The 45-day review period for the draft EIS ran from July 24, 2009 to September 8, 2009. Seven comment documents were received, and most comment documents identified individual concerns. Responses were developed for 68 individual comments. The exact words of each respondent were used rather than summaries of the person's words to ensure accuracy and objectivity. Public and agency comments, and Forest Service responses to comments, can be found in Section B.2 of Appendix B of this final EIS. Full copies of public and agency comment documents are contained in Section B.3 of Appendix B.

Comparison of Alternatives

Table S-1 provides a comparison of the three alternatives.

Table S-1. Comparison of alternatives by project objectives, resource indicators, and effects on resources.

Indicators (By Project Objective)	Alternative A (No Action)	Alternative B (Proposed Action)	Alternative C (No New Temporary Roads Constructed)
Objective 1: Habitat Protection			
Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.	Late-successional habitat would be threatened by wildfires	Large portions of late-successional habitat would be protected from wildfires	Fewer acres of late-successional habitat would be protected from wildfires
• Acres that are (1) resistant to the spread of, or (2) resilient to the effects of a wildfire	(1) 0 acres (2) 2,890 acres	(1) 8,291 acres (2) 17,524 acres	(1) 8,192 acres (2) 16,702 acres
• Percent of fire type (1) surface or (2) crown fire in the entire LSR	(1) 27 percent (2) 73 percent	(1) 77 percent (2) 23 percent	(1) 75 percent (2) 25 percent
• Percent of NSO habitat in the LSR adversely affected by wildfire	100 percent of NSO core areas	50 percent of NSO core areas	55 percent of NSO core areas
• Conifer stands resemble historic range of conditions	2,890 acres	Treatments will move 25,815 acres of conifer stands in the direction of historic range of conditions	Treatments will move 24,894 acres of conifer stands in the direction of historic range of conditions
Objective 2: Community Protection			
Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.	Communities and municipal water supplies would be threatened by wildfires	Treatments would reduce the threat from wildfires to communities and municipal water supplies	Treatments would reduce the threat from wildfires to communities and municipal water supplies
• Acres of WUI treated	0 acres	800 acres	800 acres
• Miles of emergency access routes treated	0 miles	60 miles	60 miles
• Acres of FRZs (fuelbreaks) constructed	0 acres	8,291 acres	8,291 acres
• Important infrastructure protected	None	Repeater site, Eddy Gulch Lookout, campgrounds	Campgrounds
• Acres of municipal watersheds treated	0 acres	9,850 acres	9,850 acres
• Changes in emissions	29,300 tons of PM_{10}, $PM_{2.5}$, and carbon monoxide emitted from a wildfire	80 percent reduction in emissions	80 percent reduction in emissions

Chapter 1: Purpose and Need for Action

Chapter 2: Proposed Action and Alternatives

Chapter 3: Affected Environment and Environmental Consequences

Chapter 4: Consultation and Coordination

Chapter 5: Acronyms, Glossary, Literature Cited, and Index

Figures

Tables

Appendices

Appendix A: Maps

Document Structure

The preparation of this *Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Final Environmental Impact Statement* is in compliance with Council on Environmental Quality regulations (40 Code of Federal Regulations 1500-1508) for implementing the *National Environmental Policy Act* and with other relevant federal and state laws and regulations. This final environmental impact statement (EIS) discloses the direct, indirect, and cumulative effects that would result from the Proposed Action and alternatives. This document is organized into five chapters:

- *Chapter 1. Purpose and Need for Action*. This chapter explains why the Eddy Gulch Late-Successional Reserve (LSR) Project is needed and summarizes current and desired conditions in the LSR. This chapter also summarizes public collaboration efforts and the scoping process that took place for the project.

- *Chapter 2. Proposed Action and Alternatives*. This chapter provides a detailed description of the no-action alternative (Alternative A), the Proposed Action (Alternative B), and an alternative to the Proposed Action (Alternative C). Alternative C was developed based on a significant issue raised by the public during collaboration meetings and the scoping process. This chapter describes the resource protection measures that would be employed to mitigate adverse effects.

- *Chapter 3. Affected Environment and Environmental Consequences*. This chapter describes the existing conditions (affected environment) for 16 resource topics. The treatments and activities that make up the Proposed Action stem from the need to shift existing conditions toward desired conditions. This chapter describes the environmental effects that would occur from taking no action (Alternative A) or from implementing Alternative B or C.

- *Chapter 4. Consultation and Coordination*. This chapter contains the list of preparers for this final EIS and describes the agency and tribal consultation that occurred.

- *Chapter 5*. This chapter contains the acronym list, glossary, literature cited, and index.

- *Appendix A*. This appendix contains the maps referenced in this final EIS.

- *Appendix B*. Public and agency comments on the draft EIS and Forest Service responses to comments.

- *Appendix C*. Klamath National Forest Hazard Tree Policy Safety Provisions on National Forest System Roads

The project record contains additional documentation and data that support the planning and analysis process for this project. The project record is located at the Klamath National Forest Supervisor's Office, 1312 Fairlane Road, Yreka, CA, 96097-9549, 530.842.6131.

This final EIS, the individual resource reports, and the biological assessments / biological evaluations are available for review on the project website: http://www.eddylsrproject.com.

Chapter 1
Purpose and Need for Action

Welcome

You are now in the "Purpose and Need for Action" chapter. Here are the topics you can read about.

Chapter 1. Purpose and Need for Action

SUMMER 2008—another season marked by hot, dry conditions and a staggering number of wildfires in northern California. The spring and summer of 2008 were the driest recorded in northern California. The persistence of moderate to severe drought conditions across parts of the West have aided in perpetuating a region of extreme fire potential.

The 2008 fire season in the Klamath National Forest began in mid-June. The lightning storm during the weekend of June 21–22, 2008, was an epic event that started more than 3,000 fires in California and kicked off the fire season much earlier than usual (R. Moore, Regional Forester). The following is an excerpt from a June news release from the Klamath National Forest:

> **Yreka, CA (June 24, 2008).** The evening of June 19 was very busy for Klamath National Forest firefighters as they launched initial attacks on 23 fires that began with lightning strikes during the storms that moved through the area. The fires occurred forestwide. There were four starts on the Happy Camp Ranger District, 16 between the Salmon/Scott Ranger Districts, and three on the Goosenest Ranger District.
>
> On June 20 Klamath fire managers turned over the Happy Camp fires to the Southern Oregon and Northern California (ORCA) incident management team, due to the size, complexity and expected duration of those fires.

That was just the beginning—additional fires ignited and continued to burn into August.

> **Fact:** July began with a number of wildfires in 12 states, most notably California and Arizona. By the middle of the month, many of the fires raging across northern California remained largely uncontained. As July came to a close, a dozen large fires continued to burn in northern and central California.
>
> **Fact:** As August came to a close, 21 large fires were burning in 11 states, primarily northern California, southern Oregon, and southern Idaho. By mid-October, over 200,000 acres burned on the Klamath National Forest.

(http://www.ncdc.noaa.gov/oa/climate/research/2008/fire08.html) and (KNF pers. comm. 2008)

There is nothing that can be done to prevent weather-related fire starts, but there are many actions that can be taken to reduce their severity. The Klamath National Forest is proposing the Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project (Eddy Gulch LSR Project) on the Salmon River and Scott River Ranger Districts to provide protection against, and to reduce the number of acres that would be burned by large stand-replacing wildfires.

1.1 Introduction

1.1.1 Project Location

The Eddy Gulch LSR is on the Salmon River and Scott River Ranger Districts, Klamath National Forest, Siskiyou County, California (see Map A-1). (Note: All maps for this final environmental impact statement [EIS] are located in Appendix A.) The LSR is located mostly west of Etna Summit, south of North Russian Creek and the town of Sawyers Bar, east of Forks of Salmon, and north of Cecilville. The LSR is about 61,900 acres in size, making it one of the largest LSRs on the Klamath National Forest. The LSR encompasses much of the area between the North and South Forks of the Salmon River, as well as the headwaters of Etna Creek. Elevations range from 1,100 feet to about 8,000 feet. The terrain is generally steep and dissected by sharp ridges and streams. There are a few private inholdings in the LSR and along the main Salmon River and other stream corridors adjacent to the LSR.

The legal description for the Eddy Gulch LSR includes the following (all Mount Diablo Meridian):

T38N, R11W, Sections 2-5, 8-10, and 17-19
T38N, R12W, Sections 1-3, 9-16, and 22-24
T39N, R10W, Sections 2-10, 15-21, and 29-31
T39N, R11W, Sections 1-18, 20-29, and 32-36
T39N, R12W, Sections 11-14, 23-25, and 36
T40N, R10W, Sections 3-5, 8-11, and 13-35
T40N, R11W, Sections 24-27 and 34-36
T41N, R10W, Sections 2-5, 8-17, 20-24, 26-29, and 31-34
T42N, R10W, Sections 28-29 and 32-35

1.1.2 Background

The northern spotted owl (NSO) (*Strix occidentalis caurina*) was listed as threatened in 1990, and the Northwest Forest Plan (USDA, USDI 1994a) identified standards and guidelines and allocated lands for LSRs by amending federal land management plans within the range of the NSO. The “federal land management plan” for the forest is the *Klamath National Forest Land and Resource Management Plan* (Klamath LRMP) (USFS 1995). LSRs, in combination with other land allocations and standards and guidelines, were established to maintain a functional, interactive, late-successional and old-growth forest ecosystem. They were designed to serve as habitat for late-successional and old-growth-related species, including the NSO. The Klamath National Forest prepared a forestwide LSR assessment (*Klamath National Forest Forestwide Late-Successional Reserve Assessment*) (USFS 1999), which describes resources and issues in LSRs on the forest and presents a management strategy for attainment of LSR goals and objectives.

Prior to European settlement, fires ignited by lightning or native Americans were a frequent and effective source of disturbance that shaped forest stands in the Eddy Gulch area. These fires occurred every 8–16 years and did not burn uniformly but had a mixed severity, with the highest intensity on ridgetops and the lowest intensity on the lower third of the steep slopes. As a result, fuels were frequently reduced, mature forest cover was scattered on the ridgetops, and stands on the lower third of the slopes were characterized by large, well-spaced trees (Taylor and Skinner 1998). Gold was discovered in about 1850 in the area that is now the Eddy Gulch LSR. Over the next four to five decades, miners removed much of the vegetation in the vicinity of the mining activities for tunnel timbers and structures and often burned the rest to expose the mineral resource (examples would be the lower portion of Whites Gulch and areas around Black Bear Ranch). The mining-related activities resulted in fewer old trees scattered throughout the landscape and fewer stands over 130 years of age.

With the creation of the Klamath National Forest shortly after the turn of the century, and the emphasis on fire suppression beginning about 1910, not only have forests returned to much of the potential forest land in the LSR, but most stands contain many more young trees and other understory vegetation (along with limbs, logs, and other understory fuels) than would be present under historical conditions. These stand conditions provide habitat for certain late-successional-forest-related species, but conversely, they also place at least portions of the LSR and surrounding areas, including local communities, at risk of high-intensity, large-scale fires (a primary concern) and high levels of insect mortality. The LSR experiences about five fire starts per year that require suppression action, either initiating in the LSR or spreading into the LSR from surrounding areas. Late-successional habitat, watershed health, private property values, and public safety are the major concerns about wildfire in the LSR.

1.1.3 Terms

Throughout this final EIS, acres presented will be identified (or apparent from context) as applying to one of the following areas:

Eddy Gulch LSR — the entire 61,900-acre LSR.

Assessment Area — the 37,239-acre portion of the Eddy Gulch LSR west of Etna Summit where various treatments are proposed. All inventoried roadless areas that occur in the LSR were excluded from planning efforts and are therefore not part of the Assessment Area.

Treatment Unit — the acres proposed for some type of on-the-ground treatment under a particular alternative.

Analysis Area — the area around treatment units considered in the effects analysis (the analysis area may be larger than the LSR Assessment Area). The analysis area varies by resource.

The following sections list the project objectives, the underlying purpose and need for taking action, legislation and policy direction for the objectives, and measurement indicators. The measurement indicators are used to describe, quantify, and compare how well the Proposed Action and alternatives (including no action) would meet the project objectives and address issues.

1.1.4 Concerns for the Eddy Gulch LSR

Concern—the high amount of fuels present. Policies requiring the control of all fires have excluded fire from the landscape, resulting in changes to stand structures and higher densities of ground and ladder fuels such as brush, small trees, and shade-tolerant tree species. The successful implementation of these policies has removed the historic role of fire as a thinning agent (USFS 1995,

1999) and mechanism for regulating the volume of ground fuels. The increased accumulations of dead and down woody material and organic debris (duff and litter) have led to larger and more intense wildfires in the Klamath Mountains. These intense wildfires have the potential to permanently damage soil, degrade watersheds, and remove a high proportion of all vegetation over large areas, thereby slowing natural recovery and increasing impacts. The primary concern is what the results of current (2008) fire modeling show—that under 90th percentile weather conditions and using current heavy fuel loads, 73 percent of the LSR would experience active/passive crown fires, which could potentially reduce or destroy habitat suitability for the NSO and other late-successional-dependent species. But, of greatest importance during these severe fire events is the threat to human life and property.

Concern—loss of high-quality NSO habitat. The forestwide LSR assessment (USFS 1999) determined that, of the 45,220 acres in the Eddy Gulch LSR capable of supporting late-successional forest conditions, 42 percent of the acres were late-successional and 37 percent were mid-successional. These stands support more than the forestwide LSR assessment goal of 20 NSO pairs, as well as a variety of other late-successional-forest-related species. However, recent data from the LSR indicate the NSO population has not increased for several years (USFWS 2008). The major concern in the LSR is this habitat being destroyed by large high-intensity fire (USFS 1999). Indeed, the loss of high-quality NSO habitat to wildfires in the Klamath Mountains during the past decade has been troublesome (USFWS 2008).

Concern—damage to communities and municipal watersheds. Cecilville and Sawyers Bar, two communities near the Eddy Gulch LSR, were listed in the *Federal Register* (2001) as communities at risk from a wildfire. The Klamath National Forest was a signatory agency to the approved Salmon River Community Wildfire Protection Plan (CWPP) (SRFSC 2007). Additionally, Black Bear Ranch and Rainbow cooperative fire plans (SRFSC 2002; SRFSC 2003) have been prepared. These plans include recommendations to reduce fuel hazards in the wildland-urban interface (WUI) in seven municipal watersheds and to provide for safe ingress and egress by reducing fuel hazards along emergency access routes that occur in the Eddy Gulch LSR.

Crown fires could substantially damage communities at risk, remove vegetation, and degrade municipal watersheds. Crown fires could prevent the use of emergency access routes required to evacuate local residents and allow suppression crews to enter the area. Additionally, there are no fuelbreaks that would allow suppression crews to safely work to control the spread of a wildfire.

1.1.5 Climate Change

Growing bodies of knowledge have described recent climate changes, and new policies by developed nations are acknowledging that our climate is changing. However, climate change is not a recent phenomenon. For example, temperatures were below the modern mean (defined as 1928–1988 A.D.) for nearly the entire period from 1450 to 1850 A.D. (Graumlich 1993). Although some intervals of this period were wet (1550–1650 and the early to mid-Eighteenth Century), others were remarkably dry (including 1834–1883 A.D., which was the fifth-driest 50-year period of the past millennium). Stine (1996) provides additional evidence for a cool and dry climate prior to 1850 and concludes that the first half of the Twentieth Century was the third wettest period in the last 1,000 years.

Diaz (2002) described changes in physical systems, especially water regimes, as climates change in the modern period: "Glaciers are retreating, snowpacks are melting earlier, and runoff is less, leaving the Mediterranean-based Sierra Nevada summers effectively longer and drier." Extensive modeling of the effects of climate change has been completed for the state of California (http://www.climatechange.ca.gov/). Unless changes in existing policies are implemented, there is a general consensus that increased concentrations of carbon dioxide will contribute to future increases in temperature. The effects of these climate changes on precipitation patterns in California are not as clearly understood (Lenihan et al. 2006); however, there is agreement that increased temperatures will result in less precipitation arriving as snow and an earlier melting of the snow that does accumulate.

In response to these climate changes, it is predicted that during this century, mixed-evergreen forests (Douglas-fir associations, madrone, and ponderosa pine–black oak) will expand their range (due to warmer temperatures) and replace lower-elevation conifer forests. The warmer temperatures will also result in replacement of subalpine and alpine communities with other communities (Lenihan et al. 2006). Warmer temperatures will dry forest fuels sooner in the year, resulting in longer fire seasons, larger fires, and more acres burned (Lenihan et al. 2006; Westerling and Bryant 2006). In some areas conifer forests will be replaced by shrub associations, and where fire frequencies increase in shrub associations, they will be replaced by grasslands (Lenihan et al. 2006). This could result in a reduction in conifer tree vegetation, the dominant vegetation in the Eddy Gulch LSR, and an increase in mixed-evergreen forests.

In response to these changes, resource managers should consider adaptive strategies that incorporate activities that increase *resistance* to change (forestalling impacts or protecting valued resources) and activities that increase *resilience* to impacts (improving the capacity of ecosystems to return to a desired condition after disturbance) (Millar et al. 2007). Fuelbreaks can effectively increase resistance to the spread of wildfires by modifying fire behavior; they also serve as safe areas for suppression crews to work. Large-scale reductions in ground fuels can modify wildfire behavior and reduce the loss of vegetation, rendering those areas more resilient to change and allowing them to return to their ecosystem function faster than untreated areas.

1.2 Environmental Impact Statement Goal and Project Objectives

1.2.1 Environmental Impact Statement Goal

The overall goal of the Eddy Gulch LSR Project EIS is to present an ecosystem-based approach for ensuring the safety of persons and communities and protecting and conserving conditions of late-successional-forest ecosystems, which serve as habitat for late-successional-associated species.

1.2.2 Importance of Defining Project Objectives

Objectives are specific statements of purpose that support the goals an alternative must meet, to a large degree, for the planning and environmental analysis process to be considered a success. Meeting objectives to a large degree is part of what makes an alternative "reasonable." Objectives also support the purpose of a project and help resolve the need for action.

The proposed action must meet the minimum proposal objectives (fulfill the need) and must be environmentally acceptable. Likewise, any alternatives that are developed must meet the minimum proposal objectives and environmental standards or be dropped from detailed analysis.

The decision maker will use the proposal objectives, together with environmental issues, as evaluation criteria to select the alternative that best fulfills the proposal's objectives and satisfactorily meets environmental guidelines.

1.3 Purpose of and Need for the Eddy Gulch Late-Successional Reserve Project

Two primary objectives are presented for the Eddy Gulch LSR Project based on the purpose and need for the project, differences between existing and desired resource conditions in the Eddy Gulch LSR, pertinent laws, and Forest Service direction.

The two objectives are as follows (no priority is assumed):

1. *Habitat Protection*—Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.
2. *Community Protection*—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

These objectives guided the development of the proposed treatments and activities designed to maintain or establish a trend toward desired natural and social resource conditions.

The following section summarizes the need for action (based on existing conditions) and desired conditions to demonstrate the link between those conditions and the purpose (objectives) of the Eddy Gulch LSR Project. Detailed descriptions of current conditions for 16 resource topics are contained in "Chapter 3: Affected Environment and Environmental Consequences." Chapter 3 also provides detailed descriptions of the desired conditions for the three core resources: forest vegetation, fire and fuels, and wildlife habitat.

Objective 1: Habitat Protection—Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.

Need for Action (Existing Conditions). The Eddy Gulch LSR Project is needed to reduce excessive fuel hazards to protect and conserve late-successional habitat. Current conditions have created the following problems:

1. Due to policies that required the control of all fires and excluded fire from the ecosystem, there have been changes in stand structures, including higher densities of ground and ladders fuels such as brush, small trees, and shade-tolerant tree species.
2. Most of the mid- and late-successional conifer stands in the Assessment Area are choked with small trees (less than 10 inches diameter at breast height [dbh]). Additionally, tree

mortality will continue to increase in response to current competition for resources and warmer temperatures, which contribute to higher fuel loads.

3. Fire modeling, using current conditions, indicates that under 90th percentile weather conditions:

   - flame lengths during a wildfire would be from 11 to 20 feet, contributing to crown fire behavior;

   - the rate of fire spread would range between 30 and 60 feet per minute, affecting the ability of suppression crews to contain fires; and

   - approximately 73 percent of the entire Eddy Gulch LSR (61,900 acres) would experience active/passive crown fires that would reduce or destroy habitat suitability for the NSO (including designated critical habitat) and other late-successional-dependent species.

Desired Conditions. The desired conditions are reduced fire behavior and increased resistance to the spread of wildfires (which together would improve suppression capability) throughout the LSR. Desired conditions include the following:

1. Safe, effective zones are available for firefighters to contain wildfires (such as fuelbreaks that can resist the spread of wildfires) and ground fuels are reduced over large areas of existing or future late-successional habitat (that is, resilience to disturbance will be increased).

2. Conifer stands more closely resemble the historic range of conditions that resulted from the pre-European settlement historic fire regime (Skinner et al. 2006).

3. There will be reduced fire behavior throughout the LSR, so fires of less severity are more likely to serve their historic roles as both a thinning agent for maintaining ground fuels and one of decomposition (USFS 1995). During a wildfire

   - flame lengths will be from 2 to 4 feet, allowing options for suppression strategies;

   - the rate of spread will be less than 20 feet per minute; and

   - no more than 11 percent of the treated acres in the LSR will experience passive/active crown fire.

4. The amount of NSO nesting and roosting habitat is being maintained.

Measurement Indicators—Acres that are resistant to the spread of or resilient to the effects of a wildfire; the percent of fire type (surface or passive or active crown fire); percent of NSO habitat adversely affected by wildfire; and conifer stand conditions (tree size and canopy cover).

Objective 2: Community Protection—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

Need for Action (Existing Conditions). The Eddy Gulch LSR Project is needed to reduce wildfire risk to communities by reducing fuel hazards and provide people with safe passage by reducing fuel hazards along emergency access routes that occur in the Eddy Gulch LSR.

1. Current fuel conditions are increasing the wildfire risk to residents, property, infrastructure, and municipal watersheds. Communities near the LSR would be at risk of high losses.

2. During a wildfire, emergency access routes (described in the Salmon River CWPP) may not be safe or passable because fuel loading and hazard trees along 60 miles of specifically identified road segments could potentially block primary escape routes in the event of a wildfire—this would compromise the safety of local residents who would need to evacuate ahead of the fire and potentially prevent firefighters from reaching the fire area to initiate and sustain suppression activities.

3. Vegetation treatments are needed to reduce fuel loading and continuity and to provide strategic locations where firefighters can safely work. Current conditions would be unsafe for firefighters because there are no fuelbreaks in place to serve as safe areas from which to fight fires, and fires would have the opportunity to grow very large.

4. In the event of a wildfire, much of the vegetation and ground cover would be removed from seven municipal watersheds, which would affect water quality for local residents who depend on these areas.

Desired Conditions.

1. There is a reduction in fuel hazards and fire behavior in WUI areas.

2. Fuel loading along the emergency access routes is such that wildfire behavior will be reduced—this will improve opportunities for evacuation for local residents and access for firefighters during wildfires.

3. A wildfire will not affect water quality in municipal watersheds.

4. Strategically placed fuelbreaks are in place to resist the spread of wildfires.

5. Important infrastructure will be protected during a wildfire.

6. Degradation of air quality will be reduced during a wildfire because fuels are at levels that will limit the intensity and size of wildfires, which will result in a reduction in emissions.

Measurement Indicators—Acres of WUI treated, miles of emergency access routes treated, acres of fuelbreaks constructed, important infrastructure protected, acres of municipal watersheds treated, and changes in emissions.

Table 1-1 summarizes the need for treatments in the Eddy Gulch LSR Project Assessment Area.

Table 1-1. Treatment needs for the Eddy Gulch LSR Project.

Current Conditions	Desired Conditions	Need	How Proposed Project Addresses Treatment Needs
Fire suppression has resulted in high levels of ground and ladder fuels. Under these conditions, most of the Assessment Area would be subject to crown fire under extreme weather conditions. Such a wildfire would spread quickly (30–60 feet / minute). There are few areas where fire behavior would allow suppression forces to safely work, so a wildfire would spread quickly throughout much of the Assessment Area.	Throughout the Assessment Area, ground and ladder fuels are at levels that support surface fires with low spread rates, allowing firefighters to safely engage in suppression operations.	Change fire behavior from crown fire to primarily surface fire; provide safe locations for firefighters to work.	Fuel reduction treatments will reduce the amount of fuel on the forest floor. Thinning will reduce the numbers of small trees which serve as ladders for surface fires to become crown fires. These actions will change fire behavior from primarily crown fire to surface fire within treated units, reducing spread rates. Fuel reduction treatments within strategically located zones will provide safe locations where suppression forces can engage a wildfire. **Indicator: Acres resistant to wildfire spread**
Fire suppression has resulted in high levels of ground and ladder fuels. Under these conditions, most of the Assessment Area would be subject to crown fire under extreme weather conditions.	Ground and ladder fuels are at levels that support surface fires.	Change fire behavior from crown fire to primarily surface fire.	Fuel reduction treatments will remove fuels and change fire behavior from primarily crown fire to surface fire within treated units. **Indicator: Percent of fire type**
Fire suppression has resulted in high levels of ground and ladder fuels. Conditions are such that fires can burn intensely, killing many trees and increasing risk of losing critical NSO habitat components over 73 percent of Eddy LSR.	Ground fuels and ladder fuels are at levels that allow fires to burn without killing large numbers of trees throughout the LSR.	Change fire behavior from crown fire to primarily surface fire in the LSR.	Fuel reduction treatments will remove fuels and change fire behavior within treated units from crown fire to primarily surface fire, reducing the amount of NSO habitat adversely affected by wildfire. **Indicator: Percent of NSO habitat adversely affected by wildfire**
Fire suppression has resulted in high densities of small trees (less than 10 inches dbh) in mid- and late-successional stands. Mortality is occurring and will continue to increase, creating high fuel loads and increasing risk of losing critical NSO habitat components over 73 percent of Eddy LSR.	Ladder fuels (small trees) in mid- and late-successional stands are at levels that allow fires to burn without killing large numbers of trees throughout the LSR.	Reduce the number of small trees in mid- and late-successional stands. Reduce overall basal area.	Thinning treatments will remove small trees, which will reduce fuel loads and reduce mortality among the remaining trees. **Indicator: Conifer stand conditions – canopy closure and basal area**
Fire suppression has resulted in high levels of ground and ladder fuels within the WUI areas. Under extreme weather conditions, these areas would be subject to crown fire, which would both prohibit effective suppression action and increase the risk to life and property.	Ground and ladder fuels are at levels that support surface fires.	Change fire behavior in the WUI from crown fire to primarily surface fire.	Fuel reduction treatments will change fire behavior within the WUI from crown fire to primarily surface fire. **Indicator: Acres of WUI treated**

Table 1-1. Treatment needs for the Eddy Gulch LSR Project (continued).

Current Conditions	Desired Conditions	Need	How Proposed Project Addresses Treatment Needs
Fire suppression and past harvest have resulted in high levels of ground and ladder fuels along emergency access routes that local residents would use for evacuation during wildfire, and suppression crews would use to enter the area. Fire behavior (primarily crown fire) would render these routes dangerous or unusable for evacuation.	Fire behavior along emergency access routes is primarily surface fire rather than crown fire. There are no hazard trees that might fall and block access during a wildfire event.	Change fire behavior from crown fire to primarily surface fire.	Fuel reduction treatments will change fire behavior along emergency access routes from crown fire to primarily surface fire. Removal of hazard trees will ensure that these trees do not fall and block access during emergency situations. These actions will render these access routes safer for emergency use and allow ingress and egress for firefighting forces. **Indicator: Miles of emergency access routes treated**
There are no fuelbreaks (the FRZs) within the Assessment Area where firefighters can safely work during suppression operations. Without effective suppression action, fires have an opportunity to grow very large.	FRZs are constructed in strategic locations, allowing firefighters to safely engage in suppression operations.	Construct FRZs in strategic locations across the landscape.	Firefighters can use FRZs as safe points to conduct suppression activities. **Indicator: Acres of FRZs constructed**
Fire suppression has resulted in high levels of ground and ladder fuels in the areas surrounding important infrastructure outside of WUI (the Eddy Gulch lookout and repeater sites). Conditions are such that fires can burn intensely, and the facilities would be at high risk of damage or destruction.	Ground and ladder fuels in areas adjacent to identified infrastructure targets are at levels that support surface fires.	Change fire behavior from crown fire to primarily surface fire near identified infrastructure targets.	Fuel reduction treatments will change fire behavior in areas adjacent to identified infrastructure targets. **Indicator: Important infrastructure protected**
High-intensity wildfire can burn through seven municipal watersheds, eliminating vegetation and soil cover that is important to maintaining water quality for local residents.	Ground fuels and ladder fuels are at levels that allow fires to burn through municipal watersheds while leaving a high percentage of vegetation and ground cover intact.	Change fire behavior from crown fire to primarily surface fire.	Fuel reduction treatments will change fire behavior within treated units from crown fire to primarily surface fire. This will result in retention of soil cover and vegetation. **Indicator: Acres of municipal watershed treated**
Wildfire, once it escapes control, can burn for weeks or even months. Emissions produced during wildfire events can degrade air quality and affect the health of local residents. Type and duration of emissions is dependent on the type of vegetation burned, weather patterns, and the ability of firefighting forces to suppress the fire.	Emissions from a wildfire are reduced from those expected under the current situation due to lower amounts of fuels available, and the smaller size of the fire (due to effective suppression operations).	Change expected wildfire size, intensity, and duration so that emissions from a wildfire are reduced from those expected under current conditions.	Fuel reduction treatments will reduce the amount of fuel that burns in a wildfire. Fire behavior within treated units will change from crown fire to primarily surface fire. Creation of FRZs (fuelbreaks) will allow suppression forces to effectively engage wildfires. These factors will limit the size and intensity of a wildfire, which will reduce emissions expected during a wildfire event. **Indicator: Changes in emissions**

1.4 Other Objective

The Notice of Intent (FR 2008) to prepare an EIS for the Eddy Gulch LSR Project identified a third objective for the project. That objective was titled, "Objective 3: Habitat Development—Promote the continued development of late-successional characteristics." Objective 3 was deleted after more intensive field reviews were conducted, and it was determined that none of the units initially proposed for treatment to promote habitat development would satisfy the evaluation criteria, as described below:

- 10 units, totaling 337 acres, did not meet habitat criteria for the NSO because the unit was not large enough to contain an NSO activity center, it was not located in a watershed with a concave topography or on the lower half of the slope, or it was not located near a stream;
- 5 units, totaling 114 acres, were greater than 150 years old, or thinning would not accelerate their development within 30 years;
- 2 units, totaling 6 acres, were small and isolated, and it would not be cost-effective to treat them; and
- 2 units (M4 and M21) are in proposed Fuel Reduction Zones (FRZs), and the prescriptions were changed to FRZ treatments rather than habitat-development treatments.

1.5 Summary of the Proposed Action

The Proposed Action is designed to improve and protect the LSR's ability to meet its designated objectives of providing habitat for late-successional forest-related species and protecting WUI values.

The interdisciplinary team (ID team) identified 25,969 acres of treatments to protect late-successional habitat and communities. Three primary treatment types were identified in the Eddy Gulch LSR Assessment Area: FRZs, Prescribed Burn Units (Rx Units), and Roadside (RS) treatments along emergency access routes, which are described below.

- **FRZs**—strategically located on ridgetops to increase resistance to the spread of wildfires. The FRZs would be wide enough to capture most short-range spot fires, and ground, ladder, and crown fuels are reduced so as to change crown fires to surface fires within the treated areas. The FRZs would provide safe locations for fire-suppression personnel to take fire-suppression actions during 90th percentile weather conditions, and they serve as anchor points for additional landscape-level fuel treatments, such as underburning.
  - ***Proposed Action.*** Construct 16 FRZs totaling 8,291 acres to increase resistance to wildfires. The 8,291 acres includes 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels.
- **Rx Units**—a series of landscape-level treatments (ranging from 250 to 4,300 acres in size) designed to increase resilience to wildfires by reducing ground and ladder fuels. Most of these treatments would occur on south-facing aspects where fuels dry faster, and treatments would support the role of the FRZs.

- ***Proposed Action***. Implement 17,524 acres of Rx Units to increase resiliency to wildfires.

- **RS treatments**—along 60 miles of emergency access routes identified in the Salmon River CWPP and designed to facilitate emergency access for residents to evacuate and for suppression forces to safely enter the LSR in the event of a wildfire.

    - ***Proposed Action.*** Treat 44 miles of emergency access routes in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (154 acres) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes.

Additional descriptions of the treatments are provided in Chapter 2 of this final EIS. Where land use objectives (LSR, Riparian Reserves, and WUI) overlap, treatments were designed to meet each objective to the fullest extent possible.

1.6 Management Direction, Policies, and Laws that Influence the Scope of this Environmental Impact Statement

National Forest management is guided by various laws, regulations, and policies that provide the framework for all levels of planning, including regional guides, land and resource management plans, and site-specific documents, such as an EIS. The higher-level documents are incorporated by reference and can be obtained from the Klamath National Forest or online at http://www.fs.fed.us/r5/klamath.

1.6.1 Klamath National Forest Land and Resource Management Plan

The Eddy Gulch LSR is managed as part of a system of multiple-use as directed by the Klamath LRMP, which provides both forestwide and management area direction. Forestwide direction, which applies to all management areas, is located on pages 4-3 through 4-66 of the Klamath LRMP (USFS 1995). Management areas have distinct management goals, management requirements, and desired conditions. The proposed project lies within “Special Habitat–Late-Successional Reserves” (Management Area 5) and “Riparian Reserves” (Management Area 10). (Note: all page references in this final EIS refer to the version of the Klamath LRMP that includes all amendments as of November 21, 2001 [http://www.fs.fed.us/r5/klamath/projects/forestmanagement/forestplan/index.shtml]).

1.6.1.1 Riparian Reserves and Key Watersheds

The Klamath LRMP includes the Aquatic Conservation Strategy (ACS) (Klamath LRMP Chapter 4, page 4-6), of which Riparian Reserves are a component. Specific direction for management of Riparian Reserves is found in the ACS and in the Klamath LRMP Standards and Guidelines for Management Area 10 (Chapter 4, pages 4-25 to 4-27 and pages 4-106 to 4-114). The Standards and Guidelines are designed to protect the unique functions (such as stream shade, sediment filtering, and large wood recruitment to the stream) of near-stream areas and preserve their integrity by not engaging in activities that disturb soils or destabilize slopes within Riparian Reserves. Adoption of the ACS through the Northwest Forest Plan Record of Decision (USDA, USDI 1994a) and the Klamath LRMP set the framework for significant changes in the way ecosystems are managed, conserved, and restored. Among these changes is the application of focused and prioritized restoration and protection in areas with the highest likelihood of recovery and retention of high-quality aquatic habitat.

The Riparian Reserves are designated along all intermittent and perennial stream courses, seeps, springs, lakes, and unstable areas and cover about 8,624 acres (14 percent) of the Eddy Gulch LSR. Within the Riparian Reserves, riparian-dependent resources receive primary emphasis and special Standards and Guidelines apply (USFS 1995).

The concept of Key Watersheds is another component of the ACS. Key Watersheds act as refugia for endangered salmonids and other aquatic and riparian-dependent species. The project Assessment Area lies within the Salmon River watershed, which is a Key Watershed. Guidelines require watershed analysis prior to major projects and no net increase in road miles. Because the Eddy Gulch LSR is in several watersheds, several watershed analyses and their resultant recommendations apply. Portions of the discussions about existing and desired conditions, as well as identification of the need for the Proposed Action, came from these analyses.

1.6.2 Healthy Forests Restoration Act

The 2003 *Healthy Forests Restoration Act* (HFRA) (US Cong. 2003) was passed to reduce wildfire risk to communities, municipal watersheds, and at-risk federal lands (Sec. 2 [1]). The act identifies CWPPs as collaborative efforts to identify and prioritize fuel reduction treatments on federal and nonfederal lands (Sec. 101[3]). Federal agencies are required to consider CWPP projects in environmental analyses, either as a part of the proposed action or as an alternative (Sec. 104[d][3]). Projects on federal lands receive priority funding if those projects protect at-risk communities or watersheds or implement CWPPs (Sec. 103[a]). All of the Eddy Gulch LSR Project is designed to reduce wildfire risk to communities, municipal watersheds, and federal lands occupied by a threatened species; additionally, the project considers projects in an approved CWPP.

Section 104 of the HFRA establishes special procedures when agencies prepare environmental assessments or EISs for authorized hazardous-fuel-reduction projects. Except for the act’s authorization to analyze fewer alternatives than required under the *National Environmental Policy Act* (commonly referred to as “NEPA”) (HFRA Sections 104(c) and (d)), most of the requirements of Section 104 are consistent with normal NEPA practices. Section 104(e) of the HFRA requires agencies to provide notice of the project and conduct a public meeting when preparing authorized hazardous-fuel-reduction projects. Section 104(f) encourages meaningful public participation during preparation of authorized hazardous-fuel-reduction projects. The U.S. Department of Agriculture Forest Service and U.S. Department of the Interior Bureau of Land Management shall facilitate collaboration when they are preparing authorized hazardous-fuel-reduction projects. As appropriate, collaboration should include representatives from tribes, local representatives from federal and state agencies, local governments, landowners, other interested persons, community-based groups, and other nongovernmental organizations (USDA, USDI 2004).

1.6.3 Klamath National Forest Forestwide Late-Successional Reserve Assessment

The *Record of Decision on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (USDA, USDI 1994b) established a network of LSRs and accompanying management standards and guidelines. The network of reserves is intended to provide old-growth-forest habitat, provide for populations of species that are associated with late-successional and old-growth forests, and help ensure that diversity of late-successional species will be conserved. This direction and Standards and Guidelines for management of LSRs was incorporated into the Klamath LRMP and can be found in several sections of the document, including forestwide Standards and Guidelines and Management Area 5 direction (Chapter 4 of the Klamath LRMP).

The 1999 forestwide LSR assessment was prepared for 11 LSRs in the Klamath National Forest, and it is a management tool intended to be used before habitat manipulation activities are designed and implemented. The purpose of the forestwide LSR assessment was to develop a management strategy for the LSRs and to provide information to decision makers who are managing for attainment of LSR goals and objectives.

The assessment covers the history and inventory of vegetative conditions, a list of late-successional-forest-associated species, a history and description of current land uses, a fire management plan, criteria for developing appropriate treatments, identification of treatment areas, a proposed implementation schedule, and proposed monitoring and evaluation components. Objective 1 for the Eddy Gulch LSR Project is to "protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR." This objective was adapted from Objectives 1, 3, and 6 of the forestwide LSR assessment.

1.6.4 National Forest Management Act

The *National Forest Management Act* of 1976 provides specific management requirements that need to be addressed when implementing timber harvest activities on National Forest System lands. The regulations include specific guidelines designed to ensure that timber will be harvested from National Forest System lands only where

- there is assurance that such lands can be adequately restocked within five years after harvest;
- soil, slope, or other watershed conditions will not be irreversibly damaged;
- protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat; and
- the harvesting system to be used is not selected primarily because it will give the greatest dollar return or the greatest unit output of timber (16 USC 1604 (g)(3)(E)).

1.6.5 National Environmental Policy Act

NEPA requires all federal agencies to initiate interdisciplinary planning that considers and discloses environmental effects in their decisions. To meet NEPA requirements, federal agencies must prepare a detailed statement that describes the effects of federal actions; this can be accomplished through an EIS, environmental assessment, or categorical exclusion. The U.S. Environmental Protection Agency reviews and comments on these documents prepared by other federal agencies.

1.7 Decision to Be Made

The Responsible Official (decision maker) for this action is the Klamath National Forest Supervisor. The decision maker will consider how well each alternative would meet the objectives (purposes) described above in Section 1.4 and addresses the issues described below under the summaries for the collaboration (Section 1.9.4.1) and scoping (Section 1.9.4.2) processes, and thus, would best meet the need. The decision maker will decide whether to implement an action or take no action. After the final EIS is completed, a Record of Decision will then be issued and will contain the rationale for the decision and a discussion of any applicable mitigation measures (referred to "resource protection measures" in this final EIS).

1.8 Project Schedule

The Responsible Official expects to make a decision on this project during the spring of 2010, with implementation to begin in 2011, and project activities continuing for 10 years.

1.9 Public Participation and Information

NEPA and the Council on Environmental Quality (CEQ) regulations that implement the act, require public participation during the environmental analysis process. The HFRA goes a step further, however, by encouraging citizen collaboration at the earliest stage of project planning, not just during NEPA's required "scoping" period. The collaboration and scoping efforts conducted on behalf of the Eddy Gulch LSR Project are described in Sections 1.9.4 and 1.9.5.

It was important at the start of the Eddy Gulch LSR Project to provide tools for ensuring that people interested in the project could stay informed and involved. Those tools include a project website, comprehensive mailing list, newsletters, fact sheets, and presentations.

1.9.1 Project Website

One of the first actions in October 2007 was to create a website for the project so public information materials, project updates, and meeting announcements would be available to everyone interested in the project (the website address is http://www.eddylsrproject.com). The website currently contains the project newsletters, fact sheets, Stewardship Fireshed Analysis, Notice of Intent, and Proposed Action, scoping summary, the draft EIS, this final EIS, and the related resource reports.

1.9.2 Project Mailing List

The project mailing list currently contains approximately 1,200 names. The list, in part, draws upon knowledge of the towns and neighborhoods described in the Salmon River CWPP. County records were searched (by zip code) to ensure the mailing list contains all residents, property owners, and businesses in proximity to the Eddy Gulch LSR who could be most affected by the proposed project.

1.9.3 Project Newsletters and Fact Sheets

Newsletters. The newsletters served as an important tool for keeping people informed about the early progress of the Eddy Gulch LSR Project. The first issue was distributed in November 2007, and the second issue was mailed in March 2008. The newsletters have been uploaded to the project website.

Fact Sheets. Two fact sheets have been placed on the project website: one provides background on the creation of LSRs, and the other provides a glossary of terms related to fire and fuels.

1.9.4 Citizen and Agency Collaboration under the Healthy Forests Restoration Act

The HFRA modified certain NEPA requirements for urgent fuels treatment projects in listed species habitat and at-risk communities, reducing, for example, the number of alternatives requiring evaluation, but adding an extended community collaboration process to help identify community concerns and issues. Although the act made some NEPA procedures more efficient, the act did not reduce an agency's obligation to complete appropriate environmental evaluation, nor did it shortchange the right of the public to understand agency proposals and provide their views to federal agencies on matters affecting public lands.

Collaboration with communities and the public is the cornerstone of "A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan" (US Cong. 2006). While some procedural requirements have been expedited, all existing environmental statutes remain in place.

1.9.4.1 Collaboration Meetings

The collaboration process for the Eddy Gulch LSR Project began with a meeting on September 25, 2007, with Siskiyou County, the U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS). Fourteen collaboration meetings were held between September 2007 and March 2008. District Ranger Ray Haupt hosted a field trip to the project Assessment Area on May 23, 2008. District Ranger Haupt initiated formal consultation with the Yurok Tribe, the Quartz Valley Indian Reservation, and the Karuk Tribe through letters dated October 15, 2007, and a letter to the Shasta Tribe dated March 12, 2008. He also met formally with Karuk Tribal leaders on September 13, 2007; December 10, 2007; June 12, 2008; and September 30, 2008, to discuss the Eddy LSR Project.

The communities closest to the Eddy Gulch LSR (such as Sawyers Bar and Forks of Salmon) were the focus when scheduling workshops and community dialogues. Meetings were also held in other communities such as Yreka, Orleans, Happy Camp, and Fort Jones. The intent was to make meeting attendance convenient for people in order to encourage greater participation. Attendance at each collaboration meeting ranged from 6 to 20 people. Collaboration meetings were also held with the USFWS and NMFS, Siskiyou County, and the Siskiyou County Firesafe Council in Yreka (see "Chapter 4: Consultation and Coordination").

Microsoft PowerPoint presentations were prepared for the first few meetings in late fall / early winter of 2008. The presentations and subsequent discussions centered on the creation and purpose of LSRs under the Northwest Forest Plan, the importance of protecting LSR resources, and current conditions in the Eddy Gulch LSR. The Salmon River CWPP was reviewed and discussed in order to understand community needs and how that information could be folded into objectives developed for the Eddy Gulch LSR Project. A PowerPoint presentation was also prepared to present the results of the Stewardship Fireshed Analysis that was conducted for the Eddy Gulch LSR Project.

People's suggestions and comments were used to develop the initial purpose (objectives) of the project, identify various problems in and surrounding the LSR, and design the early version of the Proposed Action. Activities at subsequent collaboration meetings included reviewing maps and giving people opportunities to draw on the maps and point out emergency access roads and other areas of concern. The Klamath National Forest is appreciative of the Salmon River Fire Safe Council's collaborative efforts—especially Jim Villeponteaux's and Petey Brucker's contributions to the development of this project. Objective 2 for the Eddy Gulch LSR Project (refer to Section 1.4 above) supports the issues and ideas expressed in the CWPP and public collaboration meetings.

Collaboration meetings in late winter focused on preliminary treatment areas and treatment types and on documenting participants' concerns and suggestions for the initial design of the Proposed Action. Comments were used to adjust the Proposed Action to create the version that would eventually be distributed for review during the scoping process.

1.9.4.2 What Was Learned During Collaboration

The discussions during the collaboration meetings were very valuable—participants voiced concerns, asked questions, and offered suggestions for the project, which aided in the development of the Proposed Action. Some of the comments are summarized below.

- Coarse woody debris must be maintained.
- Consider 60 percent canopy closure.
- Old-growth characteristics must be protected and maintained.
- Consider 80 percent canopy closure on north-facing slopes and 60 percent on south-facing slopes.
- Owls that are present must be protected.
- Don't plan treatments that can't feasibly be maintained.
- Implement multiparty monitoring before, during, and after project implementation.

- Do not build temporary roads; road issues are sedimentation, sliding, and mass wasting.
- Describe the amount of acres and average size of trees in the plantations; plantations should be a priority for thinning; consider pile and burn and leaving slash; consider the amount of dollars to treat plantations.
- Pull in a variety of ways to tie in components such as tanker sites, key emergency access routes, and private land interface areas; use the Salmon River CWPP in project planning.
- This draft EIS should address the dollars needed for pre-commercial thinning in a plantation; there is concern about slash left after pre-commercial thinning.
- Will there be subsistence firewood opportunities for public and commercial firewood?
- Underburning needs to be considered.
- Describe what logging systems will be used.
- Collaborative stewardship should be considered for this project.
- Bring fire back to the landscape.
- Look at the role of the hardwood component in stands and how hardwoods are used in stand structure.
- Need to make a distinction between dominant canopy and sub canopy.

1.9.5 Scoping Process under the National Environmental Policy Act

Scoping is described in the CEQ's NEPA implementing regulations as an early and open process to ensure that the full range of issues related to a proposed action are addressed and that all significant issues are identified. Scoping also provides the opportunity for agencies, elected officials, members of the public, and American Indian tribes to present additional background and technical information. Prior to the HFRA, public participation was initiated during the scoping process—after a federal agency had developed its proposed action. For the Eddy Gulch LSR Project, early citizen and agency collaboration was used as a valuable tool in helping to develop the Proposed Action. The Proposed Action was refined using suggestions and comments received from the public and agencies during the scoping process.

In the final set of collaboration meetings in early March 2008, participants stated they did not feel the need for meetings during the scoping period. They preferred a field trip to the Eddy Gulch LSR to visit some of the proposed treatment units. That field trip occurred on October 29, 2008, led by District Ranger Ray Haupt.

1.9.5.1 What Was Learned During Scoping

The purpose and need for the Eddy Gulch LSR Project and the Proposed Action were the topics of the second project newsletter, which was used as the formal "scoping letter" to the public and agencies. The newsletter provided two methods for people to submit comments: email or regular mail. Seven documents were received during the scoping period—three by regular mail and four by email. Of the seven documents, one asked about the date for close of the comment period and another asked if there was a map of "burn units produced in topographic format." These two documents were inquiries and not considered comment documents, although the senders did receive an email response to acknowledge receipt of their correspondence. The other five comment documents expressed issues or suggestions.

The CEQ regulations that implement NEPA guide federal agencies in handling nonsignificant issues by directing them to "identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review" (CEQ Section 1506.3; 40 CFR 1501.7). Nonsignificant issues are those that are (1) already addressed by law, regulation, forest plan, or other higher level decision; (2) beyond the scope of the purpose and need described in the Notice of Intent; (3) not connected to the proposed action; (4) conjectural and not supported by scientific or factual evidence; or (5) irrelevant to the decision to be made.

The project website (http://www.eddylsrproject.com) contains the full "Scoping Outcome Summary" under the link "Citizen Collaboration and Scoping Process." Below are excerpts from some of the issues expressed during the scoping process.

Significant Issue. One significant issue was identified during scoping:

Construction of temporary roads

Comment Temporary roads can allow for more effective and efficient management of the publics land. They can provide for better economics and in many cases reduce environmental impacts as compared to alternative treatments such as long skids and large clearings for helicopter landings.

Comment: We also ask that serious consideration be made for including temporary road construction that will assist with the implementation of this project.

Comment: We believe that upon examining a roadless alternative, you will conclude that a fair cost/benefit analysis will strongly suggest a road-free project is the superior course of action.

Comment: Please note that while new road construction is often described by the agency as "temporary," that all new road construction results in long-term impacts to soil health and productivity.

Comment: The NEPA document must anticipate risks posed by building new roads, including the possibility of road failure and resulting damage to downstream resources.

Outcome. Based on the above comments, "Alternative C: No New Temporary Roads Constructed" was developed to exclude temporary road construction that could increase erosion and adversely affect downstream resources.

Relevant Issues. The following are some of the relevant issues that were voiced during scoping:

Comment: **Project Feasibility**—consider the feasibility of implementing the large amount of prescribed burn acres and consider the limited operating periods and restrictions.

Comment: **Canopy Closure**—comments regarding canopy closure differed, with one commenter preferring 25 to 45 percent to ensure treatment effectiveness, and the other preferring 60 percent on south aspects and 80 percent on north aspects.

Comment: **Canopy Closure and Treatment Effectiveness**—we believe in order for these treatments to be totally effective, both ground and aerial vegetation needs to be treated. Canopy closure needs to be open, 25 to 40 percent, and the treatments need to provide for long-term effectiveness. There will be many instances when larger diameter trees (greater than 12 inches dbh) will need to be removed in order to fully meet your roadside and FRZ objective.

Comment: **Timeframe and Long-Range Desired Conditions**—when developing the prescriptions we ask that you identify the long-range desired condition, how long you want the proposed treatments to be effective, and then design the Rx [prescription] to meet the desired condition and time frame for the LSR land allocation. It must be clearly identified in the analysis if the proposed treatments will achieve these long-range desired conditions or if future treatments will be necessary to meet the stated goals.

Comment: **Diameter Limits**—as this is an HFRA project within LSR, we highly recommend disclosing diameters of trees, especially over 24 inches that would be marked for extraction.

Comment: **Diameter Limits**—our organizations have advocated small diameter thinning as a positive way to improve forest health and maintain an ecologically and economically sensible timber economy. While we recognize the value and encourage the thinning of ground and ladder fuels, we encourage the Forest Service to resist the temptation to remove larger diameter trees.

Comment: **Stand Density Index**—blanket SDI [stand density index] marking guidelines do not always adequately address fuels issues. Please be as specific as possible in draft EIS as to what marking guidelines / Rx is [are] for each stand and also the amount of volume in each stand.

Comment: **Snags and LWD** [large woody debris] / CWD [coarse woody debris]—please make sure that LWD that is currently down does not get removed or disturbed, and that guidelines for both snags and LWD / CWD are followed, perhaps even greater than guidelines.

Comment: **Cumulative Impacts / Threshold of Concern**—the Eddy Gulch LSR Project should contain project features and mitigation measures that are designed to minimize and/or reduce cumulative impacts to below thresholds of concern.

1.9.6 Draft EIS Review Period

The 45-day review period for the draft EIS ran from July 24, 2009 to September 8, 2009. Seven comment documents were received, and most comment documents identified individual concerns. Responses were developed for 68 individual comments. The exact words of each respondent were used rather than summaries of the person's words to ensure accuracy and objectivity. Public and agency comments, and Forest Service responses to comments, can be found in Section B.2 of Appendix B of this final EIS. Full copies of public and agency comment documents are contained in Section B.3 of Appendix B.

Edits were made to the final EIS (and related resource reports) based on public and agency comments. No changes were made to the two action alternatives (Alternative B: Proposed Action or Alternative C: No New Temporary Roads Constructed), and no additional action alternatives were developed.

1.10 Permits, Licenses, and Other Consultation Requirements

No federal permits, licenses, or entitlements are necessary to implement the proposed project. The USFWS and NMFS must approve biological assessments, consistent with the federal *Endangered Species Act*. State requirements, based on federal laws, and administered by the County Agricultural Commissioner for air and water quality management, will be followed. These requirements include burning only on permissive burn days or receiving a special variance prior to ignition. Smoke permits are required from the Siskiyou County Air Pollution Control District. Timber Harvest Activity Waivers are required from the California Regional Water Quality Control Board.

The Forest Service consulted with federal (USFWS and NMFS) agencies during the development of this final EIS. Details of these consultations, and consultations with federally recognized tribes and interested and affected tribes, are in "Chapter 4: Consultation and Coordination."

Chapter 2
Proposed Action and Alternatives

Welcome

You are now in the "Proposed Action and Alternatives" chapter. Here are the topics you can read about.

Chapter 2. Proposed Action and Alternatives

2.1 Introduction

The United States Department of Agriculture (USDA) Forest Service, Klamath National Forest, Salmon River and Scott River Ranger Districts is proposing treatments in the Eddy Gulch Late-Successional Reserve (LSR) Assessment Area to reduce the threat of stand-replacing wildfire that could eliminate or significantly reduce habitat suitability for late-successional species and at-risk fisheries or destroy or degrade private property, municipal watersheds, and infrastructure.

The Proposed Action has been designed to meet the purpose of the Eddy Gulch LSR Project (summarized below in two objectives) and to satisfy the need for action by using mechanical and prescribed burn treatments to reduce fuels and minimize the threat of stand-replacing wildfire. The two objectives (first identified in Chapter 1) are as follows (no priority is assumed):

- *Habitat Protection*—Protect existing and future late-successional habitat from threats of wildfire that occur in the Eddy Gulch LSR.
- *Community Protection*—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

These objectives helped guide the development of proposed treatments and activities to maintain or establish a trend towards desired resource and social conditions. The desired and existing conditions are summarized in "Chapter 1: Purpose and Need," with details provided in the various resource sections in Chapter 3 and the individual resource reports.

2.2 Description of the Alternatives Considered in Detail

The Council on Environmental Quality (CEQ) regulations for implementing the *National Environmental Policy Act* (NEPA) require federal agencies to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 Code of Federal Regulations [CFR] 1502.14). The Proposed Action for the Eddy Gulch LSR Project considered projects identified in the Salmon River Community Wildfire Protection Plan (CWPP), as required by the *Healthy Forests Restoration Act* (HFRA) (US Cong. 2003). A second action alternative (Alternative C), which does not include construction of 1.03 miles of temporary roads, was developed in response to public comments received during collaboration meetings (HFRA Sec. 104[c]) and the NEPA-required scoping process. The three alternatives analyzed in this final environmental impact statement (EIS) are

- Alternative A: No Action
- Alternative B: Proposed Action (Forest Service Preferred Alternative)
- Alternative C: No New Temporary Roads Constructed

2.3 Terms

Eddy Gulch LSR — the entire 61,900-acre LSR.

Assessment Area — the 37,239-acre portion of the Eddy Gulch LSR west of Etna Summit where various treatments are proposed. All inventoried roadless areas that occur in the LSR were excluded from planning efforts and are therefore not part of the Assessment Area.

Treatment Unit — the acres proposed for some type of on-the-ground treatment under a particular alternative.

Analysis Area — the area around treatment units considered in the effects analysis (the analysis area may be larger than the Assessment Area). The analysis area varies by resource.

2.4 Alternative A: No-Action Alternative

The no-action alternative complies with CEQ regulations for implementing NEPA (40 CFR 1502.14(d)). It is not a baseline condition but rather a description of future circumstances without implementation of the Eddy Gulch LSR Project. The no-action alternative is described in this final EIS as continuation of the current level of management and public use—this includes road maintenance, dispersed recreation (hunting, fishing, camping, and hiking), mining, watershed restoration projects, and a simulated 7,200-acre modeled wildfire, where a majority of the fire was characterized by a stand-replacing crown fire. The time frame for analysis is considered to be 20 years. Given the fuel hazard in the Eddy Gulch LSR and current predictions of climate change, it is assumed at least one wildfire will escape initial attack during the 20-year period and burn under 90th percentile weather conditions (defined as 10 percent of the days in the historical weather database that had lower fuel moisture and higher wind speeds compared to the rest of the days). An analysis of a wildfire for three days that escaped initial attack in the Eddy Gulch LSR Project Assessment Area indicates that fire would burn 7,200 acres. Of those 7,200 acres, 1,355 acres (19 percent) would be surface fire; 5,065 acres (70 percent) would be a passive crown fire; and 780 acres (11 percent) would be an active crown fire. These crown fires would result in extensive tree mortality, approaching 100 percent, over 81 percent of the total burned area.

2.5 Alternative B: Proposed Action

One goal of the Eddy Gulch LSR Project was to identify protection targets—those areas that would be threatened by wildfire. The areas of concern in the Klamath National Forest are the wildland-urban interface (WUI) areas, municipal watersheds, and emergency ingress and egress routes identified in the CWPP; northern spotted owl (NSO) nest sites and habitat; and other important resources and historic features as described in Sections 2.5.1.1–2.5.1.4 of this chapter. The protection targets were considered during design of the proposed treatments.

2.5.1 Identifying Treatment Locations

The proposed treatment locations and treatment types were developed in response to protection targets

- identified through the Stewardship Fireshed Analysis (SFA) process that was conducted for the Eddy Gulch LSR Project and the citizen collaboration workshops for the SFA and Eddy Gulch LSR Project;
- provided by the United States Fish and Wildlife Service (USFWS) in Yreka, California; and
- identified in the Salmon River CWPP, Black Bear Ranch Cooperative Fire Safe Plan, and Rainbow Cooperative Fire Safe Plan.

Numerous Forest Service documents guided development of this Proposed Action; those are the

- Klamath National Forest Land and Resource Management Plan (Klamath LRMP) (USFS 1995a)
- Klamath National Forest Forestwide Late-Successional Reserve Assessment (forestwide LSR assessment) (USFS 1999)
- Upper South Fork Ecosystem Analysis (USFS 1994)
- North Fork Salmon Ecosystem Analysis (USFS 1995b)
- Callahan Ecosystem Analysis (USFS 1997)
- Final Biological Assessment for Prescribed Fire and Fuels Hazard Reduction 2007–2011 Klamath National Forest (USFS 2007)
- Programmatic Biological Assessment and Evaluation for Pre-commercial Thin and Release Actions and Fuel Hazard Reduction Actions on the Klamath National Forest (USFS 2001)
- Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (USFS 2005)

2.5.1.1 Stewardship Fireshed Analysis for the Eddy Gulch LSR

The SFA provides a detailed discussion about the SFA process. The process was developed by the Pacific Southwest Regional Office of the USDA Forest Service fuels management staff. It was designed to promote the collaborative development of treatments for a large landscape. Its intent is to bring together diverse disciplines, stakeholders, and the Forest Service management team to develop projects that conserve forests and the communities in and adjacent to the forest from catastrophic (standing-replacing) wildfires. The SFA process was used to develop modeling schemes for the Eddy Gulch LSR Project in order to mimic historic wildfire and weather. Once the weather data and the problem fire (see Section 2.5.2.1 below) scenario were well developed, the interdisciplinary team (ID team) was able to see what effects a wildfire would have on the Eddy Gulch LSR and the protection targets. During citizen collaboration meetings, the fire behavior modeling gave the public an opportunity to comment on where they felt treatments should be applied. The modeling also showed the ID team where a wildfire would likely affect the LSR. This information assisted with development of the Proposed Action.

The ID team then looked at logical locations and types of treatments that could be implemented in the Eddy Gulch LSR Project Assessment Area. The prescriptions for these treatments were again tested with the problem fire to provide the ID team with an idea of how effective the treatments would be in reducing wildfire losses. The SFA for the Eddy Gulch LSR Project is on the project website (http://www.eddylsrproject.com).

The Problem Fire. Another goal of the SFA was to identify the problem fire. The problem fire is not a single modeled wildfire but rather a combination of attributes that include historic weather, historic large fire behavior and conditions, existing fuels and topography, historic ignitions that would contribute to fire spread and severity of wildfires, historic response capability (suppression), and Geographic Area Command priority. To identify the problem fire, the SFA process required the use of fire behavior models (FARSITE, FLAMMAP), a weather and fire history analysis tool (FIREFAMLY Plus), and ArcGIS, a Geographic Information System (GIS) software. The problem fire identified the potential fire behavior in the Eddy Gulch LSR landscape and how fire would affect vegetation and private property. This modeling, and extensive fire experience of the modeler, also provided the ID team with the opportunity to test proposed vegetation treatment prescriptions against the problem fire in order to analyze treatment effectiveness in reducing wildfire effects and potential resource losses.

2.5.1.2 U.S. Fish and Wildlife Priority Protection Areas

The USFWS in Yreka, California, identified four priority protection areas (Map A-3). These areas contain either large blocks of high-quality NSO habitat, provide for small NSO population clusters in the Eddy Gulch LSR, or are important for connectivity at a larger scale. Two of the areas (FWS-2 and FWS-4 on Map A-3) are entirely within the Eddy Gulch LSR Project Assessment Area and would benefit from treatments to protect these areas from wildfire. The majority of one other area (FWS-1) lies in designated roadless areas (which are excluded from the Eddy Gulch LSR Project), but the small portion of it that does lie within the Eddy Gulch LSR Project Assessment Area would benefit from the proposed treatments. The fourth area (FWS-3) lies completely within designated roadless areas and is not close enough to any proposed treatment unit to benefit from treatments identified in the Proposed Action.

2.5.1.3 Salmon River CWPP

The CWPP (SRFSC 2007) identifies community and individual water sources (watersheds and intake structures) for which water quality, and the structures themselves, could be degraded by wildfire. Two communities, Cecilville (south of the Assessment Area) and Sawyers Bar (north of the Assessment Area), were listed in the *Federal Register* (2001) as communities at risk from a wildfire. These communities and related infrastructure could be adversely affected by a fire starting outside the Eddy Gulch LSR or emanating from the LSR.

The Salmon River CWPP, dated October 30, 2007, identified the following five types of protection areas (these are identified on Map A-2 in Appendix A).

- *0.25-mile buffers*—public property surrounded by private property (CWPP page 30).

- *Municipal watersheds*—Eddy Gulch, Black Bear Ranch property (Argus and Callahan gulches), Cecilville (Crawford Creek), Whites Gulch, Counts Gulch, Rainbow property (Music Creek).
- *Property buffers*—these are 200-foot buffers on public property surrounding private properties.
- *Special areas*—areas below upslope private properties that are located high on slopes, as well as culturally or biologically significant areas (CWPP page 30) that are at risk from fire spreading up toward the property.
- *Emergency access routes*—200 feet above and below the road; prescription policy number 3 (CWPP page 30).

2.5.1.4 Black Bear Ranch Cooperative Fire Safe Plan

The Black Bear Ranch Cooperative Fire Safe Plan (SRFSC 2002) states that the "Black Bear Ranch property is at high risk of being burned over in a wildfire. The houses lie at the bottom of the upper half of the watershed. This slope position is considered a high risk in terms of fire behavior. Access would be particularly threatened in the case of a fire coming from above."

2.5.1.5 Rainbow Cooperative Fire Safe Plan

The Rainbow Cooperative Fire Safe Plan (SRFSC 2003) states that the Rainbow property is at "high risk of being burned over in a wildfire. The houses are near the top of the ridge with much fuel below. Access and egress would be particularly threatened in the case of a fire coming from below."

2.5.2 Developing of the Proposed Action

The ID team identified 25,969 acres of landscape-level treatments to protect late-successional habitat and communities. Three primary treatment types were identified in the Assessment Area: Fuel Reduction Zones (FRZs), Prescribed Burn Units (Rx Units), and Roadside (RS) treatments along emergency access routes—these are described below.

- **FRZs**—strategically located on ridgetops to increase resistance to the spread of wildfires to adjacent watersheds. The FRZs would be wide enough to capture most short-range spot fires, and ground, ladder, and crown fuels would be reduced so as to change crown fires to surface fires within the treated areas. The FRZs would provide safe locations for fire-suppression personnel to conduct fire-suppression actions during 90th percentile weather conditions, and they would serve as anchor points for additional landscape-level fuel treatments, such as underburning.
  - ***Proposed Action.*** Construct 16 FRZs totaling 8,291 acres to increase resistance to wildfires. The 8,291 acres include 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels.
- **Rx Units**—a series of landscape-level treatments (ranging from 250 to 4,300 acres in size) designed to increase resilience to wildfires by reducing ground and ladder fuels. Most of these treatments would occur on south-facing aspects where fuels dry faster, and treatments

would support the role of the FRZs. The Rx Units were designed and located in areas containing USFWS priority protection areas, which include clusters of NSO Activity Centers or are important to maintain connectivity in the LSR.

- ***Proposed Action***. Implement 17,524 acres of Rx Units to increase resiliency to wildfires and protect habitat for the NSO and other wildlife species that are dependent on late-successional forests.

- **RS treatments**—along 60 miles of emergency access routes identified in the Salmon River CWPP and designed to facilitate emergency access for residents to evacuate and for suppression forces to safely enter the LSR in the event of a wildfire.

  - ***Proposed Action*****.** Treat 44 miles of emergency access routes in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (approximately 154 acres) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes.

Additional descriptions of the treatments are provided below. Where land use objectives (LSR, Riparian Reserves, and WUI areas) overlap, treatments were designed to meet each objective to the fullest extent possible.

2.5.2.1 Fuel Reduction Zones

The ID team selected the locations of FRZs based on SFA modeling results and considered the following questions when determining the most effective locations for constructing the FRZs:

- Based on FLAMMAP and FARSITE fire behavior modeling and data on past fire history, where are the areas with the greatest likelihood of high-intensity fire?
- How could the Eddy Gulch LSR be protected from fires originating outside the LSR?
- What areas have the highest number of protection targets, such as WUI areas, evacuation routes, watersheds, important infrastructure (such as repeater sites, Eddy Gulch Lookout), NSO habitat, and USFWS priority protection areas?
- What high-elevation ridges (above the inversion layer—about 4,800 feet) would serve as the best locations for prohibiting wildfire from spreading into an adjacent watershed?
- What ridges have prominent geographical features that could serve as natural barriers for fire spread?
- Are there access points (roads) to the ridges for implementing treatments within an FRZ?
- What locations would provide the greatest potential for continuity of treatments within an FRZ and the potential to create continuity to the other proposed FRZs?
- How could habitat in the inventoried roadless areas be protected?

Sixteen FRZs, totaling 8,291 acres, would be constructed (see Maps A-4a and A-4b). The FRZs have two components:

- *M Units*—thinning treatments in conifer and hardwood stands where crown, ladder, and ground fuels would be reduced; and
- *Fuel reduction areas*—outside M Units, where ground and ladder fuels would be reduced.

Table 2-1 summarizes the purpose of each FRZ and size of each component in an FRZ. Where emergency access routes pass through FRZs, the treatment would be the same as that component of the FRZ. All hazard trees along emergency access routes will be identified and removed according to the Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (USFS 2005).

The construction of the FRZs would generally be consistent with "Activity Design Criterion 9: Shaded Fuelbreak," as described in the forestwide LSR assessment (USFS 1999). The exception to Criterion 9 is that forest canopy cover may be less than 40 percent in FRZs.

M Units in Fuel Reduction Zones. Forty-two M Units, totaling 931 acres, would be treated in the FRZs consistent with the range of natural variation (see Tables 2-1 and 2-2 and Maps A-4a and A-4b). A "Designation by Description" prescription with variable spacing would be used to retain the largest trees generally within 14–28 feet of the next adjacent largest conifer tree. Tree removal would thin from below, removing trees 8–28 inches diameter at breast height (dbh). No trees larger than 20 inches dbh would be removed in M Unit 8, M Unit 24, M Unit 31, and M Unit 43 to retain large trees in NSO habitat. Additional emphasis would be given to retaining desired conifer species and all hardwoods. Post-treatment canopy cover would range from 32 to 50 percent (Table 2-3). Snags and coarse woody debris would be reduced, where needed, to ensure firefighter safety; however, Klamath LRMP Standards and Guidelines would be achieved on a landscape level. Tractor yarding would occur on 361 acres and cable yarding on 570 acres. Following completion of thinning, all slash in tractor units would be grapple piled and burned, and all slash in cable units would be lopped and scattered and broadcast burned. Slash and other ground fuels would be removed to achieve post-treatment flame lengths of less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Crown base heights would be 8–15 feet to minimize crown fires.

Fuel Reduction Areas in Fuel Reduction Zones. The "fuel reduction areas" in FRZs are areas outside of M Units and total 7,383 acres. Ground and ladder fuels (conifer trees up to 10 inches dbh) would be masticated on 3,184 acres on slopes less than 45 percent. Prescribed burning would result in some mortality of intermediate, dominant, and codominant trees. Mortality would be highest in the smaller intermediate trees, and total mortality would not exceed 10 percent in a burn block. Most mortality would occur to individual trees scattered throughout the entire burn area; however, small openings may also occur where groups of 3 to 5 trees could be killed when high concentrations of surface fuels occur. Mortality would be lower in mid-successional and late-successional stands where trees are larger, the bark is thicker, and the branches are higher on trees. Following prescribed burning, the treated area would resemble conditions of an historic fire regime; that is, a mosaic of vegetation, consisting of large areas of mid- and late-successional forest, interspersed with more open conifer stands mixed with hardwoods or younger stands created by disturbances. The sum of all openings in a burn unit would not exceed 10 percent of any unit. Post-treatment flame lengths would be less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Crown base heights would be 8–15 feet to minimize crown fires.

Table 2-1. Proposed mechanical and prescribed burn treatment acres in FRZs.

FRZ	Total Acres Treated	Plantation[a] (Acres)	Riparian Reserves[a] (Acres)	Emergency Access Route[a] (Miles)	1. Purpose of FRZ 2. Road(s) This FRZ Would Protect 3. Municipal Watershed(s) This FRZ Would Protect
2	**Total acres treated: 947** • M Unit: 26 • Mastication: 645 • Prescribed Burn: 302	136	102	2.2	1. Protects Black Bear Ranch, infrastructure, and Blue Ridge Lookout (LO) from crown fire behavior west of Blue Ridge LO 2. Road 39, County Road 1E001 into Black Bear Ranch 3. Eddy Gulch and Black Bear Municipal Watersheds
3	**Total acres treated: 704** • M Unit: 93 • Mastication: 277 • Prescribed Burn: 427	43	34	4.4	1. Protects Blue Ridge LO, extends the FRZ to the southwest above Black Bear Ranch; maintains/improves existing treatments 2. Road 39, National Forest System (NFS) Road 39N23 3. Eddy Gulch and Callahan Municipal Watersheds
4	**Total acres treated: 326** • M Unit: 46 • Mastication: 142 • Prescribed Burn: 184	123	17	0.4	1. Protects Bacon Rind area; uses a strategic ridge 2. NFS Road 39N23 3. Isolates Callahan and Murphy drainages / Callahan Municipal Watershed
5	**Total acres treated: 540** • M Unit: 94 • Mastication: 185 • Prescribed Burn: 355	60	43	0.5	1. Important—links FRZs on west perimeter with west to east FRZs along Road 39; there is potential active crown fire behavior on either side of the FRZ 2. NFS Road 39N23 3. Callahan and Crawford Municipal Watersheds
6	**Total acres treated: 575** • M Unit: 40 • Mastication: 268 • Prescribed Burn: 307	214	49	2.1	1. Part of longest connected segments of FRZs, from above Cecilville and links to west-east FRZs along Road 39; protects Crawford Creek 2. NFS Road 39N23 3. Callahan and Crawford Municipal Watersheds
7	**Total acres treated: 723** • M Unit: 0 • Mastication: 238 • Prescribed Burn: 485	33	42	0	1. FRZ segment connects FRZs between Cecilville and segments running west to east along Road 39; protects Cecilville 2. County road from Cecilville to Forks of Salmon 3. —

Table 2-1. Proposed mechanical and prescribed burn treatment acres in FRZs (continued).

FRZ	Total Acres Treated	Plantation[a] (Acres)	Riparian Reserves[a] (Acres)	Emergency Access Route[a] (Miles)	1. Purpose of FRZ 2. Road(s) This FRZ Would Protect 3. Municipal Watershed(s) This FRZ Would Protect
9	**Total acres treated: 449** • M Unit: 35 • Mastication: 132 • Prescribed Burn: 317	98	38	0	1. Isolates large area of potential crown fire behavior in East Crawford Creek 2. NFS Roads 39N56 and 39N23 3. Crawford Municipal Watershed
10	**Total acres treated: 384** • M Unit: 19 • Mastication: 179 • Prescribed Burn: 205	9	12	0	1. Isolates large area of potential crown fire behavior in East Crawford Creek 2. — 3. Crawford Municipal Watershed
11	**Total acres treated: 334** • M Unit: 58 • Mastication: 101 • Prescribed Burn: 233	42	21	0	1. Isolates large area of potential crown fire behavior in East Crawford Creek 2. Road 39, NFS Road 39N20 3. Crawford Municipal Watershed
12	**Total acres treated: 447** • M Unit: 204 • Mastication: 193 • Prescribed Burn: 254	43	16	3.0	1. FRZ located at head of East Crawford Creek, with high proportion of potential active and passive crown fire behavior; protects Eddy Gulch LO 2. Road 39 3. Eddy Gulch and Counts Gulch Municipal Watersheds
13	**Total acres treated: 694** • M Unit: 69 • Mastication: 287 • Prescribed Burn: 407	105	38	2.0	1. Extends FRZ along Road 39, isolates East Shadow Creek, protects Russian Inventoried Roadless Area and FWS priority protection area # 1 2. Road 39, NFS Road 40N61 3. —
14	**Total acres treated: 254** • M Unit: 112 • Mastication: 103 • Prescribed Burn: 151	62	5	1.0	1. Forms east boundary of FRZ system, protects Russian Inventoried Roadless Area and FWS priority protection area # 4 from large area of potential crown fire behavior in East Shadow Creek 2. Road 39 3. —
15	**Total acres treated: 317** • M Unit: 7 • Mastication: 56 • Prescribed Burn: 261	5	111	0.4	1. Continuation of Grasshopper Ridge FRZ system, links to FRZ 16, isolates large area of potential crown fire behavior 2. Callahan to Cecilville County Road, Road 39 3. Shadow Creek in East Shadow Creek

Table 2-1. Proposed mechanical and prescribed burn treatment acres in FRZs (continued).

FRZ	Total Acres Treated	Plantation[a] (Acres)	Riparian Reserves[a] (Acres)	Emergency Access Route[a] (Miles)	1. Purpose of FRZ 2. Road(s) This FRZ Would Protect 3. Municipal Watershed(s) This FRZ Would Protect
16	**Total acres treated: 314** • M Unit: 108 • Mastication: 102 • Prescribed Burn: 212	53	53	0	1. Forms link that encloses East Shadow Creek at Grasshopper Ridge from large area of potential crown fire behavior, safe access route for firefighters, protects Eddy Gulch LO 2. — 3. Shadow Creek
17	**Total acres treated: 283** • M Unit: 0 • Mastication: 145 • Prescribed Burn: 138	61	38	0	1. First of two segments that separate Whites Gulch and Counts Gulch; increases protection to emergency egress-ingress routes 2. NFS Road 39N59 3. Eddy Gulch Municipal Watershed
20	**Total acres treated: 1,000** • M Unit: 20 • Mastication: 131 • Prescribed Burn: 869	95	279	5.1	1. Reduces hazardous fuels on steep western aspect along emergency ingress-egress route along county road, protects Rainbow Ranch, Taylor Hole, Russian Wilderness 2. County Road 1C01 from Etna Summit to Idlewild, NFS Roads 40N54 and 41N18 3. Music Creek Municipal Watershed
Total FRZ Acres Treated: 8,291 **M Unit Acres: 931** **Mastication Acres: 3,184** **Prescribed Burn Acres: 5,107[b]**		**1,182**	**898**	**21.1**	

Notes:

a. Plantation, Riparian Reserve, and emergency access route treatments are included in “Prescribed Burn” acres in column 2.

b. The “Prescribed Burn Acres” include priority fire treatments in FRZs and secondary treatments in M Units.

Table 2-2. Proposed thinning treatments for habitat and community protection.

M Unit	FRZ	Compartment Number	Stand Number	Forest Type[a]	CWHR Seral Stage[b]	Stand	Cable	Tractor	Construct New Temporary Roads	Former Logging Access Routes	Use Operational Spurs
						Acres			Feet		
3	6	438	751	DF	MS	7	2	5			
4	6	438	752	DF	MS	33	15	18			
7(N)	9	438	773	DF	MS	14	4	10			
7(S)	9	438	755	DF	MS	19	11	8			
8	5	438	756	WF	MS	5	5	0		2,154	
9	4	431	502	DF	MS	29	15	14		1,123	
10	5	438	757	WF	MS	32	0	32			
11	5	438	758	WF	MS	3	0	3			
12	3	431	509	DF	MS/LS	22	14	8			
13	3	433	303	WF	MS/LS	32	2	30			
15a&b	12	437	701	WF	MS/LS	138	52	86	1,577	1,381	
15c		437	701	WF	MS						
16	12	437	702	WF	MS/LS	4	4	0			
17	11	437	703	WF	MS/LS	12	12	0	550		
19	11	437	705	DF	MS/LS	46	46	0			
20	12	437	706	WF	MS	13	0	13			
21	16	437	707	DF	MS	108	47	61	1,074		
22	15	439	801	DF	MS	7	2	5			
23	14	439	802	WF	MS/LS	42	42	0			240[c]
24	14	439	803	WF	MS/LS	45	45	0	605		
25	13	439	804	WF	MS	27	23	4		519	
30	2	430	553	WF	MS	9	9	0			
31	20	416	351	WF	MS/LS	20	20	0			
32	2	430	552	DF	MS/LS	5	0	5			
35	13	439	805	WF	MS	4	4	0			
36	13	439	806	WF	MS	21	21	0	617		
37	12	437	708	WF	MS	12	12	0	560		
38	5	437	709	WF	MS	12	12	0			
39	5	438	759	DF	MS	14	14	0			100[d]
40	5	438	760	WF	MS	7	7	0			

Table 2-2. Proposed thinning treatments for habitat and community protection (continued).

M Unit	FRZ	Compartment Number	Stand Number	Forest Type[a]	CWHR Seral Stage[b]	Stand	Cable	Tractor	Construct New Temporary Roads	Former Logging Access Routes	Use Operational Spurs
						Acres			Feet		
43	5	438	762	MC	LS	12	6	6			
51	2	430	554	DF	MS	12	12	0			
52	10	437	710	DF	MS/LS	19	19	0			
54	12	437	712	WF	MS	37	0	37			
60	13	439	807	RF	LS	17	17	0			
61	14	439	808	WF	MS/LS	25	25	0			
65	5	438	764	DF	MS/LS	6	6	0			
66	9	438	765	DF	MS	2	2	0			
73	3	433	306	WF	MS/LS	26	26	0			
75	4	431	505	DF	MS	9	6	3	450		
76	4	431	506	DF	MS	8	8	0			
79	3	433	307	WF	MS	13	0	13			
80	5	438	772	WF	MS	3	3	0			
					Totals	**931**	**570**	**361**	**5,433**	**5,177**	**340**

Notes:

a. DF = Douglas-fir
MC = Mixed-conifer
RF = Red fir
WF = White fir.

b. MS = Mid-successional
LS = Late-successional.

c. The 240 feet is the total of four 60-foot spurs.

d. The 100 feet is for one spur.

Table 2-3. General thinning prescriptions (for trees larger than 8 inches dbh) at five years post treatment.

Type (Seral Stage)	Basal Area[a] (square feet per acre)	Stand Density Index[b]	Approximate Tree Spacing (feet)	Canopy Cover (percent)
Douglas-fir (MS)[c]	140	198	25	48
Douglas-fir (LS)	198	251	28	50
White fir (MS)	201	273	23	37
White fir (LS)	208	257	29	38
Red fir (LS)	235	284	29	32
Mixed-conifer (LS)	206	260	28	50

Notes:

a. Basal area—the combined area of the cross sections of tree boles at a height of 4.5 feet above the ground, generally given as square feet per acre.

b. Stand Density Index—a measure of the density of a stand of trees based on the number of trees per unit area and dbh of the tree of average basal area.

c. MS = mid-successional (dominant and codominant trees generally 14–18 inches dbh).
LS = late-successional (dominant and codominant trees generally larger than 18 inches dbh).

Plantations would be thinned to a 20-foot by 20-foot spacing, using mastication on slopes less than 45 percent. On slopes greater than 45 percent, plantations would be prescribed burned, except in eight strategic plantations in five FRZs where hand thinning, pruning (maintaining 60 percent canopy cover), and pile and burn would be necessary to maintain the integrity of the FRZs. Those treatments would occur on 56 acres in FRZ 2, 17 acres in FRZ 3, 28 acres in FRZ 5, 49 acres in FRZ 9, and 9 acres in FRZ 14.

Proposed Temporary Roads and Landings. The construction of new temporary roads and the use of former logging access routes are proposed to access treatment units.

- Approximately 1.03 miles (5,433 feet) of new temporary roads would be used to access all or portions of seven M Units. These roads are described as “New temporary road” in Table 2-4. All of these temporary roads would be closed (ripped and mulched, as needed) following thinning.

Table 2-4. Proposed new temporary roads, former logging access route updates, and short spurs.

Location	Length (feet)	Access for M Unit	Description
Intersection 39N53	1,577	M Unit 15 (Cable)	New temporary road
Intersection 39N20	550	M Unit 17	New temporary road
Intersection 39N73	1,074	M Unit 21 (Cable)	New temporary road
Intersection FS39	605	M Unit 24	New temporary road
Intersection 39N58B	617	M Unit 36	New temporary road
Intersection 39N53A	560	M Unit 37	New temporary road
Intersection 39N37A	450	M Unit 75	New temporary road
Intersection 39N23	1,123	M Unit 9	Former logging access route
Intersection 39N53	1,381	M Unit 15 (Tractor)	Former logging access route
Intersection 39N58	519	M Unit 25	Former logging access route
Intersection 39N04 – Lafayette Pt.	2,154	M Units 43 and 8	Former logging access route
Intersection FS39A	240	M Unit 23	Four logging spurs at 60 feet each–operations
Intersection 39N04A	100	M Unit 39	Short logging spur–operations

- Approximately 0.98 mile (5,177 feet) of former logging access routes would be re-opened (vegetation removed and bladed) to access all or portions of five M Units. These routes, described as "Former logging access route" in Table 2-4, would be water-barred and closed immediately after thinning is completed.

- Five short spurs, each less than 100 feet long, would be bladed for tractor or cable yarding operations in two units.

- Existing landings will be used. The ID team considered using whole-tree yarding to reduce slash treatments, but it would require larger landings and additional clearing and was therefore not considered further.

- Existing skid trails will be used. There may be short sections of skid trails that could be over 35 percent slope and that use the scarps (the steeper slope) to connect one flat bench to another flat bench. Please refer to the Soil RPMs in Section 2.9.4 below.

Proposed Haul Roads and Drafting Sites

Haul Roads—There are five basic routes that would be used to haul products out of the Assessment Area following thinning; all of these routes have been used in the past and are suitable for use with this project:

- **2E001 (Sawyers Bar).** The route connects to County Road 1C01 with haul to Etna and Highway 3 to Yreka.

- **40N61 (Whites Gulch Road).** The route connects to County Road 1C01 with haul to Etna and Highway 3 to Yreka.

- **FS39.** The route connects with County Road 1C02 with haul to Callahan and Highway 3 to Yreka.

- **39N20.** The route connects with County Road 1C02 at Shadow Creek with haul to Callahan and Highway 3 to Yreka.

- **39N23.** The route connects with County Road 1C02 at Cecilville with haul to Callahan and Highway 3 to Yreka.

Drafting Sites—Roads will be watered to reduce dust during hauling. Water drafting sites for dust abatement will occur at designated sites for that purpose—existing drafting sites and access routes will be used. No vegetation removal will be allowed at drafting sites with the exception of vegetation trimming done in such a way that existing vegetation and associated root strength along stream banks and access routes are maintained. Maps A-4a and A-4b show the locations of the proposed drafting sites (labeled as "Proposed Water Fill Locations" on the maps).

2.5.2.2 Rx Units

The ID team considered the following questions when designing the Rx Units:

- Based on FLAMMAP and FARSITE fire behavior modeling using 90th percentile weather conditions, would construction of FRZs alone accomplish the two project objectives? (See Section 2.1 above.)
- How could the Eddy Gulch LSR best be protected from fires originating from outside the LSR?
- How could the Eddy Gulch LSR best be protected from fires originating inside the LSR?
- Could late-successional characteristics and habitats be protected using treatments limited to ridgetops and buffers around property infrastructures and roads?
- How could fuel treatments best be accomplished on steep inaccessible ground with minimal effects on natural resources?

There are 11 proposed Rx Units (Table 2-5 and shown on Maps A-4a and A-4b) totaling 17,524 acres, to increase resiliency to wildfires and protect habitat for the NSO and other wildlife species that are dependent on late-successional forests. The units range in size from approximately 250 to 4,300 acres and would be generally located between the FRZs. Most of the Rx Unit treatments would occur on south-facing aspects where fuels dry faster, and treatments would support the role of the FRZs. The Rx Units were designed and located in areas containing the USFWS priority protection areas, which include clusters of NSO Activity Centers or are important to maintain connectivity in the LSR. The treatments would be consistent with “Activity Design Criterion 8: Hazard Reduction–Prescribed Burning,” as described in the forestwide LSR assessment (USFS 1999).

Broadcast burning, ignited by hand or with “ping pong” balls from a helicopter, would be used to remove ground and small ladder fuels (less than 4 inches dbh) and to achieve post-treatment flame lengths of less than 2 feet, with fuel loads maintained to achieve flame lengths of less than 4 feet over time. Implementation of prescribed burns would not be consistent across each Rx Unit, but rather small patches of heavier fuels would be maintained in burn areas, mimicking the range of natural variation that was created by the pre-European settlement fire regime. That historic fire regime produced a mosaic of vegetation, consisting of large areas of mid- and late-successional forest, interspersed with more open conifer stands mixed with hardwoods or younger stands created by disturbances. The prescribed burning would result in some mortality of intermediate, dominant, and codominant trees. Mortality would be highest in the smaller intermediate trees, and total mortality would not exceed 10 percent in a burn block. Most mortality would occur to individual trees scattered throughout the entire burn area; however, small openings may also occur where groups of 3 to 5 trees could be killed when high concentrations of surface fuels occur. Mortality would be lower in mid-successional and late-successional stands where trees are larger, the bark is thicker, and the branches are higher on trees. The sum of all openings in a burn unit would not exceed 10 percent of any unit. Snags and coarse woody debris densities would be consistent with Standards and Guidelines contained in the Klamath LRMP. Roads, topographic features, and hand-cut control lines would control prescribed fire size. Existing landings would be used if burning is ignited from a helicopter. Burns may be accomplished when air quality, weather, and fuel moisture conditions could be met.

Table 2-5. Proposed Rx Units.

Rx Unit[a, b]	Total Acres	Treatment Location: Plantations[c] (Acres)	Treatment Location: Riparian Reserves[c] (Acres)	Treatment Location: Along Emergency Access Routes (Miles)	1. Emergency Access Route(s) That Would Be Protected 2. Municipal Watershed(s) That Would Be Protected 3. Owl Activity Center(s) That Would Be Protected
1	1,301	17	508	3.6	1. FS39, 39N23, 1E001 2. 650 acres–Black Bear Ranch Watershed 158 acres–Black Bear Ranch 3. KL1035
2	1,972	98	514	3.2	1. 39N23 2. 1,946 acres–Callahan 3. KL1033
3	2,833	140	843	0	1. — 2. — 3. KL1014
4	4,339	393	1,546	3.0	1. 39N23, 39N23.15 2. 4,338 acres–Crawford Creek 3. KL1032, KL1031, KL1012
5	1,608	78	595	0	1. — 2. — 3. —
6	1,459	22	564	0	1. — 2. — 3. KL1028
7	1,130	221	220	8.1	1. FS39, 1C02 2. — 3. KL4026
8	863	35	290	1.6	1. 40N54, 40N54.4 2. — 3. —
9	1,247	46	351	1.4	1. 1C01, 41N18, 41N18.1 2. — 3. KL1046
11	251	97	46	0.7	1. 39N23 2. — 3. —
12	521	43	203	1.0	1. FS39, 39N60 2. 317 acres–Eddy Gulch 3. KL1034
Totals	**17,524**	**1,190**	**5,680**	**22.6**	

Notes:

a. Other activities in Rx Units may include prescribed underburns and fireline construction, including handline and machine-constructed fireline.

b. Rx Unit 10 is now part of FRZ 20.

c. Plantation and Riparian Reserve acres are included in “Total Acres” in column 2.

2.5.2.3 Roadside Treatments Along Emergency Access Routes

The ID team considered the following questions when determining what roads should be treated:

- Do all RS treatments for the Eddy Gulch LSR Project include roads identified in the Salmon River CWPP and conform to the RS treatment standards recommended in the CWPP?
- Are there other roads in the Assessment Area that need fuel treatments to protect health and safety of firefighters and the public? (These roads include open National Forest System (NFS) roads and Siskiyou County roads necessary for safe ingress and egress.)
- What locations along the CWPP-identified roads do fire behavior modeling and fire suppression experience show that flame lengths could span the roads, and where smoke from heavy fuels that buffer the roads could obscure visibility for extended periods?

Treatments are proposed along 60 miles of emergency access routes; 44 of the 60 miles would receive the same treatment as the FRZ or Rx Unit the route passes through. The following are the RS treatments proposed along 16 miles (approximately 154 acres) of emergency access routes that do not pass through FRZs or Rx Units (see Map A-4c):

- RS 1 treatments would consist of hand thin and pile burn of trees up to 6 inches dbh on slopes greater than 45 percent (43.1 acres).
- RS 2 treatments would involve mastication to remove trees less than 10 inches dbh on slopes less than 45 percent (40.6 acres).
- RS 3 treatments are in Riparian Reserves and would only consist of mastication, hand thin, and pile burn (69.5 acres).

Generally, the RS treatments would occur along the following roads (see Map A-4c):

- NFS Road 39 from County Road 1CO2 up to the northeast corner where it intersects the boundary of FRZ 15;
- NFS Road 40N61 (Whites Gulch) from the intersection with Road 39 to the county road; and
- the south side of NFS Road 40N54 from the intersection of the county road east to the intersection of 40N35.

All hazard trees would be identified and removed in accordance with Klamath National Forest Hazard Tree Policy (USFS 2005). To maintain the canopy cover requirements listed in the Salmon River CWPP, only small fuels within 50 feet of the road would be removed.

2.5.3 Designated Land Allocations and Critical Habitat

Late-Successional Reserve

All project activities would occur in the Eddy Gulch LSR.

Riparian Reserves

Small trees would be removed on approximately 6,578 acres of Riparian Reserves throughout the Assessment Area. A masticator would be used on slopes less than 45 percent and within 0.25 mile of a road on 875 acres of FRZs to remove trees less than 10 inches dbh. Hand thinning and pile burning would be used on 483 acres of slopes greater than 45 percent in FRZs, and low-intensity backing fires would be used on 5,107 acres in Rx Units to remove trees up to 6 inches dbh. The masticator would not exceed more than 6 pounds per square inch ground pressure. No treatments with mechanical equipment would occur within 30 feet of ephemeral, intermittent, or perennial streams. Equipment may cross dry ephemeral or intermittent streams in designated locations.

Northern Spotted Owl Critical Habitat

The project has been designed to minimize adverse effects and provide long-term beneficial effects on the primary constituent elements of NSO Critical Habitat (“the physical and biological features in the necessary and appropriate quantity and spatial arrangement essential to the conservation of the species” [50 CFR 17]). Silvicultural prescriptions focus on retaining primary constituent elements at the stand scale. For nesting and roosting habitat, the primary constituent elements include large (greater than 30 inches dbh) trees in stands with 60–90 percent canopy cover, multistoried canopy that allow birds to fly under the canopy, and with abundant large snags and coarse woody debris. In foraging habitat, tree height diversity, canopy closure, snag volume, and density of snags are important.

Prescribed burning in suitable habitat would not result in canopy cover going below 60 percent in nesting/roosting and foraging habitat or change by more than 10 percent, if the pre-treatment crown closure is less than 60 percent, or 40 percent in dispersal habitat (this includes hardwood, subdominant, and dominant tree components above 15 feet in height).

2.5.4 Implementation Sequence for the Proposed Action

The following sequence of treatments would be used to implement the Eddy Gulch LSR Project:

1. Complete FRZs (M Units and RS treatments) during the first four years.

   Construct FRZs in the following order:

   FRZs 2, 3, 12, 13
   FRZs 14, 15
   FRZs 4, 5, 6, 9
   FRZs 7, 10, 11
   FRZs 16, 17, 20

2. Complete FRZs (mastication and prescribed burn) during the first six years following the order above. Some prescribed burning may occur in Rx Units adjacent to FRZs to establish control points.
3. Complete Rx Units during the first 11 years. The approximate order would be:

   a. Northwest and western portion of Rx Unit 1 and Rx Unit 12
   b. Rx Unit 3 and Rx Unit 8

c. East side Black Bear Ranch Road in Rx Unit 1 and Rx Unit 2
d. West portion of Rx Unit 4 and Rx Unit 11
e. East portion of Rx Unit 4 and Rx Unit 9
f. Remainder of Rx Unit 1 and Rx Unit 5
g. Rx Unit 6 and Rx Unit 7

4. Within occupied or unsurveyed suitable habitat, no more than 50 percent of the nesting, roosting, or foraging habitat would be burned or mechanically treated in a single year in any one 7th-field watershed up to 3,500 acres in size. If the 7th-field watershed is more than 3,500 acres, apply the design criteria at the 8th-field watershed scale or in some other manner that meets the intent of the design feature.

2.6 Alternative C: No New Temporary Roads Constructed

Alternative C responds to public concerns regarding the environmental and economic effects of constructing new temporary roads. Alternative C is similar to the Proposed Action but approximately 1.03 miles (5,443 feet) of new temporary roads identified in the Proposed Action would not be constructed. As a result, no fuels treatments would occur in portions of seven M Units (see Table 2-6). This reduces the total acres of treatments in M Units from 931 under Alternative B to 832 under Alternative C (a reduction of 99 acres). Fuels treatments could not be carried out in those M Units because of excessive treatment costs, high existing dead crown fuel loadings, and potential heat damage to the overstory if these untreated units were prescribed burned. Thus, approximately 921 acres would still be susceptible to a crown fire. The inability to treat the 921 acres would result in vulnerable areas that could allow wildfires to escape to other areas of the LSR.

Table 2-6. Changes in M Unit treatment acres between Alternatives B and C with the elimination of new temporary roads.

M Unit	FRZ	Type (Seral Stage)*	New Temporary Roads Deleted (feet)	Alternative B Acres of Treatment		Alternative C Acres of Treatment	
				Cable Acres	Tractor Acres	Cable Acres	Tractor Acres
15a and b	12	White fir (MS/LS)	1,577	52	86	26	86
15c		White fir (MS)					
17	11	White fir (MS/LS)	550	12	0	7	0
21	16	Douglas-fir (MS)	1,074	47	61	26	61
24	14	White fir (MS/LS)	605	45	0	30	0
36	13	White fir (MS)	617	21	0	7	0
37	12	White fir (MS)	560	12	0	0	0
75	4	Douglas-fir (MS)	450	6	3	0	3
		Totals	**5,433**	**195**	**150**	**96**	**150**
				Total = 345		**Total = 246**	

Note: *MS = Mid-successional.
LS = Late-successional.

Under Alternative C, the FRZs would continue to total 8,291 acres; however, 99 acres in M Units would remain untreated. The total number of acres treated by tractor yarding would remain at 361 acres; however, the acres of cable yarding would be reduced from 570 acres under Alternative B to 471 acres under Alternative C. Reducing acres of M Units treated would also reduce the number of acres treated in Rx Units 5 and 6 because excessive fuels remaining in M Units would preclude safely burning portions of those Rx Units. Rx Unit 5 would be reduced by 26 percent (418 acres) because no treatment would occur in a portion of M Unit 17, and Rx Unit 6 would be reduced by 28 percent (404 acres) because no treatment would occur in a portion of M Unit 24 (see Maps A-6a and A-6b). Six-foot-wide control lines would be constructed around the perimeter of those untreated areas to keep prescribed burns out of those portions of Rx Units 5 and 6. There would be no changes in the miles of emergency access routes treated, transportation plan, or resource protection measures.

2.7 Alternatives Considered but Eliminated from Detailed Study

NEPA requires federal agencies to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public scoping comments yielded only one suggestion for an additional alternative—one that did not propose construction of temporary roads. That suggested alternative was carried forward for analysis as Alternative C.

Helicopter logging was considered but eliminated from detailed study. Additional larger landings would have to be constructed; the small size of the material being removed, the cost of the equipment, and current log market significantly constrain the economics of the operation; and limited operating periods to reduce impacts on NSO significantly constrain the operating season; and the large number of NSO activity centers would adversely affect logistics of operating helicopters.

2.8 Summary Comparison of Alternatives

Excessive fuel hazards in the Eddy Gulch LSR could result in a wildfire characterized by as much as 73 percent crown fire. This type of fire behavior would destroy late-successional habitat, communities, and municipal watersheds and could adversely affect emergency access routes. In response to this fire threat, fuel reduction treatments are needed for

1. **Habitat Protection**—Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.

2. **Community Protection**—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

Alternative A (No Action) would not meet the purpose and need because, without treatments, wildfire would threaten late-successional habitat, communities, and municipal watersheds and would not create conditions for safe evacuation along emergency access routes or access for suppression operations during a wildfire (Table 2-7). A wildfire would also generate large quantities of smoke and other emissions that could affect sensitive receptors in the LSR.

Under Alternative B (Proposed Action), treatments on 25,815 acres would increase resistance and resilience of the treated areas to the adverse effects of a wildfire, which would reduce threats to 50 percent of the NSO core areas in the LSR, treat 800 acres in the WUI, offer safe passage along 60 miles of emergency access routes, and protect infrastructure.

Table 2-7. Comparison of alternatives by project objectives, resource indicators, and effects on resources.

Indicators (By Project Objective)	Alternative A (No Action)	Alternative B (Proposed Action)	Alternative C (No New Temporary Roads Constructed)
Objective 1: Habitat Protection			
Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.	Late-successional habitat would be threatened by wildfires	Large portions of late-successional habitat would be protected from wildfires	Fewer acres of late-successional habitat would be protected from wildfires
• Acres that are (1) resistant to the spread of, or (2) resilient to the effects of a wildfire	(1) 0 acres (2) 2,890 acres	(1) 8,291 acres (2) 17,524 acres	(1) 8,192 acres (2) 16,702 acres
• Percent of fire type (1) surface or (2) crown fire in the entire LSR	(1) 27 percent (2) 73 percent	(1) 77 percent (2) 23 percent	(1) 75 percent (2) 25 percent
• Percent of NSO habitat in the LSR adversely affected by wildfire	100 percent of NSO core areas	50 percent of NSO core areas	55 percent of NSO core areas
• Conifer stands resemble historic range of conditions	2,890 acres	Treatments will move 25,815 acres of conifer stands in the direction of historic range of conditions	Treatments will move 24,894 acres of conifer stands in the direction of historic range of conditions
Objective 2: Community Protection			
Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.	Communities and municipal water supplies would be threatened by wildfires	Treatments would reduce the threat from wildfires to communities and municipal water supplies	Treatments would reduce the threat from wildfires to communities and municipal water supplies
• Acres of WUI treated	0 acres	800 acres	800 acres
• Miles of emergency access routes treated	0 miles	60 miles	60 miles
• Acres of FRZs (fuelbreaks) constructed	0 acres	8,291 acres	8,291 acres
• Important infrastructure protected	None	Repeater site, Eddy Gulch Lookout, campgrounds	Campgrounds
• Acres of municipal watersheds treated	0 acres	9,850 acres	9,850 acres
• Changes in emissions	29,300 tons of PM_{10}, $PM_{2.5}$, and carbon monoxide emitted from a wildfire	80 percent reduction in emissions	80 percent reduction in emissions

Under Alternative C (No New Temporary Roads Constructed [1.03 miles = 1.7 acres of disturbance]), treatments on 24,894 acres would increase resistance and resilience of the treated areas to the adverse effects of a wildfire. However, the inability to treat approximately 920 acres could increase the complexity and difficulty of suppression efforts and the number of acres burned by a stand-replacing crown fire. Treatments would reduce threats to 45 percent of the NSO core areas in the LSR, treat 800 acres in the WUI, offer safe passage along 60 miles of emergency access routes. However, the inability to treat all acres could result in a wildfire damaging important infrastructure, such as the Eddy Gulch Lookout and repeater site, which are necessary for fire detection and communication. Under both action alternatives, emissions from a wildfire would be reduced by 80 percent in the treated areas, compared to Alternative A.

Under both action alternatives, emissions from a wildfire would be reduced by 80 percent in the treated areas, compared to Alternative A.

2.9 Resource Protection Measures

Resource protection measures (also known as mitigation measures) are designed to avoid or substantially reduce a project's significant adverse environmental effects. The following resource protection measures have been incorporated into Alternatives B and C. These measures are in addition to Standards and Guidelines contained in the Klamath LRMP and approved Best Management Practices (BMPs).

2.9.1 Wildlife

2.9.1.1 Northern Spotted Owls

- No activities will occur between February 1 and September 15 within an active NSO 70-acre nest core.

- Noise-producing activities that are above ambient noise levels will not occur between February 1 and July 9 within 0.25 mile of an occupied activity center or unsurveyed suitable nesting/roosting habitat.

- No activities that remove or downgrade suitable NSO habitat will occur between February 1 and September 15 within 0.5 mile of an occupied activity center or unsurveyed suitable nesting/roosting habitat.

- Burning will not occur between February 1 and July 31 within 0.25 mile of an occupied activity center or unsurveyed suitable nesting/roosting habitat if the following conditions are met, seasonal restrictions may be waived:

  - A topographic feature buffers the activity center or unsurveyed suitable nesting/roosting habitat from smoke, or burning is conducted uphill of the known activity center or unsurveyed suitable nesting/roosting habitat.

  AND

  - Smoke is managed so that light to moderate dispersed smoke may be present within a canyon or drainage but dissipates or lifts within 24 hours.
  - Ignition will be discontinued if heavy, concentrated smoke begins to inundate the 0.25-mile buffer late in the afternoon.

- There will be no seasonal restrictions on burning or use of mechanized equipment if protocol surveys are current and negative.

- As an option to full protocol surveys, burning or other activities that will not remove or downgrade suitable NSO habitat may occur in spring if three surveys are completed in the year-of-action implementation and meet the following standards: (1) the first and second surveys begin after March 1 and are separated by a minimum of five days; (2) the third survey occurs after April 15; and (3) no owls are detected. If an NSO is detected during any of the surveys, no burning may occur within 0.25 mile of the activity center between February 1 and July 31, and no activities that create noise above ambient levels may occur within 0.25 mile of the activity center between February 1 and July 9, unless surveys determine *Non-Nesting* status. To determine *Non-Nesting* status, two observations of the owl(s) are required during the nest survey period (April 1 to June 1). Observations must be at least three weeks apart, with the second observation occurring after April 15.

- New temporary roads will be located to avoid trees larger than 20 inches dbh, where feasible.

- No more than 50 percent of the suitable habitat within a home range will be treated (thinning, underburning, and other fuels treatments) in a given year.

2.9.1.2 Northern Goshawk

- A seasonal restriction of March 1 to August 31 will apply to all activities (including activities that degrade or are beneficial) that modify habitat within 0.5 mile, or create smoke or noise above ambient levels within 0.25 mile of historic sites or any additional nest sites that are discovered in the Assessment Area.

- If protocol-level surveys indicate that an historic site is not occupied by breeding goshawks, seasonal restrictions may be waived.

2.9.1.3 Peregrine Falcon

- A seasonal restriction of February 1 to July 31 will apply to all activities that create noise above ambient levels within 0.25 to 0.5 mile (dependent on topographic features) of any active eyries that may be discovered in the Assessment Area.

2.9.1.4 Bald Eagle

- A seasonal restriction of January 1 to August 31 will apply to all activities that modify habitat within 0.5 mile, or that create smoke or noise above ambient levels within 0.25 mile of historic sites or any additional nest sites that are discovered in the Assessment Area.

2.9.2 Fisheries

2.9.2.1 Streamside Protection

- Except where a masticator is used, fuel treatments on all units may occur within 30 feet of intermittent or perennial streams less than 1-foot wetted width.

- Handpiling and pile burning may occur within 15–30 feet of intermittent or small perennial streams in areas where treatment units are not located on granitic soils, or where the sideslopes entering intermittent and small perennial channels do not exceed 35 percent, or where soil cover estimates within 15 feet of the intermittent or small perennial streams are greater than 50 percent. For perennial streams greater than 1-foot wetted width, handpiling with no burning may occur within 15–30 feet of the streambank. The guidelines for this to occur are as follows:

  – Demonstrate through a series of appropriately placed plots that estimated soil cover exceeds 50 percent within the adjacent 15-foot no-handpile buffer (15 feet adjacent to streambank);

  – Handpiles will be spread out and not be “stacked” above one another where, during burning, they could connect and affect a greater area than anticipated; or a linear area is developed that will increase the potential for erosion to occur;

  – Handpiles will be small in size—6 feet or less in diameter; and

  – Handline construction in riparian vegetation shall be avoided where practical.

- Logs will be suspended when being yarded across channels. Skid trail crossings of localized, hydrologically disconnected ephemeral channels (no Riparian Reserves present) will be uncommon and in such cases require remedial shaping.

2.9.2.2 Underburning

- No more than 10 percent of a 6th-field watershed will be burned in any one year in order to minimize the potential for cumulative adverse effects when underburning.

- Handlines in Riparian Reserves will be waterbarred and covered with organic material immediately following prescribed burning, when safe to do so.

2.9.2.3 Mastication

The following guidelines will apply when a masticator is used:

- Soil moisture will be below 18 percent.

- The track-mounted excavator will not operate within 50 feet of any perennial/intermittent stream less than 1-foot wetted width; however, the arm of the masticator may reach within this 50-foot buffer to treat competing vegetation (approximately a 30-foot reach). For perennial streams greater than 1-foot wetted width, a 100-foot buffer will be designated.

- The track-mounted excavator will not operate beyond break in slope of any inner gorge.
- Dry intermittent streams may be crossed by the track-mounted excavator/masticator at designated sites only after field review and approval by district fisheries biologist and/or hydrologist. No perennial streams will be crossed.

2.9.2.4 Water Drafting

All project water drafting will follow National Oceanic and Atmospheric Administration (NOAA)-Fisheries Water Drafting Specifications (USDC NMFS 2001), including, but not limited to the following:

- Drafting will not reduce the stream flow by more than 10 percent.
- When water is drafted, intakes will be screened with 3/32-inch mesh (for rounded or square openings) or 1/16-inch mesh for slotted opening.
- Pumping rate shall not exceed 350 gallons per minute or 10 percent of the stream flow.
- Pumping will be terminated when the water tank is full.
- Water drafting sites for dust abatement on roads will occur at designated sites for that purpose. Erosion-control measures will be employed on the access and/or main road to prevent water leakage from causing stream sedimentation. Hazardous material spill prevention and containment equipment will be present on water trucks. Water trucks and pumping equipment will be in a well-maintained condition, free of fluid leaks, and have hoses in good operating condition.

2.9.2.5 Special Areas

Refer to the Fish Biological Assessment / Biological Evaluation in the Eddy Gulch LSR project record for detailed information on “Areas With Watershed Concerns” and the cumulative watershed effects (CWE) analysis conducted for the project. Based on CWE assessments and field reviews, the proposed Eddy Gulch LSR Project treatment units were located and designed to avoid and protect sensitive areas in these watersheds to ensure cumulative effects do not result in adverse effects on Proposed (or Listed) anadromous fish or their habitat. The proposed treatments were designed to reduce the effects of wildfire but would not reduce CWEs due to existing main roads located in Riparian Reserves.

2.9.2.6 Riparian Reserves

- The Riparian Reserves have been mapped (Maps A-12a and A-12b). The Klamath LRMP defines standard slope distance for Riparian Reserves as two site-potential tree heights or 300 feet for anadromous and resident fish-bearing streams (whichever is greater) and one site-potential tree height or 150 feet for nonfish-bearing streams (whichever is greater). This project defines one site-potential tree height as 170 feet on each side of a qualifying stream channel. Therefore, the Riparian Reserve width is 340 feet for fish-bearing streams and 170 feet on each side of an active stream channel for nonfish-bearing streams.

- As a handline is being built into a draw, stop building the handline within 25 feet of the wetted edge of the channel to minimize disturbed soil adjacent to the stream.

- Prescribed fire will be ignited in a manner that minimizes the potential for moderate- or high-intensity burns.

- When underburning in Riparian Reserves, at least 90 percent of the large woody debris will not be consumed, both standing and on the ground.

- All entry to waterways occupied by spawning anadromous fish or where eggs would be incubating, as determined and indicated by a fisheries biologist, is prohibited. Restricted time periods are generally from October 15 through June 15. Additional restrictions may be appropriate for waterways containing Spring Chinook Salmon and summer-run steelhead, as determined by the District Fisheries Biologist. (The focus is protection of spawning and incubating eggs.)

- Where more than 80 percent shade exists, at least 80 percent shade on the water will be retained after treatment.

- Larger conifers (greater than 20 inches dbh) felled within perennial stream channels or inner gorges, will be left. However, slash will be minimized in the stream channel.

- BMPs and Wet Weather Operation Standards (USFS 2002) will be implemented during all activities.

- No new landings will be constructed in Riparian Reserves.

2.9.3 Water Resources

- Implement BMPs.

- Water drafting sites for dust abatement on roads will occur at designated sites for that purpose. Erosion-control measures will be employed on the access and/or main road to prevent water leakage from causing stream sedimentation. Hazardous material spill prevention and containment equipment will be present on water trucks. Water trucks and pumping equipment will be in a well-maintained condition, free of fluid leaks, and have hoses in good operating condition.

- Refueling and maintenance of project motorized equipment, including helicopters, will occur at least 200 feet away from any channel (USFS 2003).

- Mulch or slash any skid trails on slopes over 35 percent. Slash or certified straw will be placed on them to achieve a 70–80 percent soil cover.

- The new temporary roads will be closed (hydrologically restored) at project completion. The temporary roads will be outsloped (as necessary), covered with slash (if needed), and blocked after use (prior to the first winter after use). Road closure includes obliteration (recontouring) of temporary road segments; removal of berms and fills, any constructed stream crossing (none anticipated), tillage or scarification of compacted areas, waterbars, and slash or mulch cover of disturbed areas to 70 percent.

- Apply erosion control measures to the new temporary roads and former logging access routes that will be used during the project.

2.9.4 Soils

- Reuse existing skid trails and landings.
- No new full-bench skid trails will be built.
- Skid trail locations will be agreed to by the Forest Service.
- Prevent road or landing runoff from entering skid trails.
- Minimize soil erosion by water barring all skid trails.
- Ground-based yarding equipment is restricted to slopes less than 35 percent; however, there may be short sections of skid trails that could be over 35 percent slope and could use the scarps (the steeper slope) to connect one flat bench to another flat bench.
- Mulch or slash those short sections of skid trails on slopes over 35 percent. Slash or certified straw will be placed on them to achieve a 70–80 percent soil cover.
- No more than 15 percent of any treatment unit should be disturbed by primary skid trails, cable corridors, and landings.
- Conduct skidding operations during dry soil conditions (sufficiently dry to 10-inch depth) or follow wet weather logging guidelines.
- Track-mounted masticators can operate up to 45 percent slopes when soil is dry down to 10 inches or follow wet weather logging guidelines.
- Deck logs on existing road prism versus constructing new landings.
- Burn during spring-like conditions, in any season, to minimize the consumption of litter and coarse woody debris (down logs greater than 20-inch diameter). No direct firing on coarse woody debris.
- Retain existing levels or a minimum of 5 logs/acre of coarse woody debris (down logs great than 20-inch diameter) for soil productivity needs.
- Protect existing coarse woody debris by having ground-based equipment avoid the larger-diameter logs as much as practical.
- Post-treatment total soil cover will be 70–80 percent, depending on slope steepness and soil texture.

- Retain at least 50 percent soil cover as fine organic matter (less than 3-inch materials) in all treatment units.

- M Units 15, 17, 21, 22, 30, and 80 will be monitored for detrimental disturbance and/or compaction and will be subsoiled if detrimental disturbance exceeds 15 percent in each unit.

- Coordination. During implementation of this project, the project leader will coordinate with personnel from earth science and fire/fuels regarding protection of soils and unstable areas.

2.9.5 Geology

- Layout cable corridors to maximize log suspension and minimize surface disturbance to small areas of wet soil that occur in some thinning units.

- Mulch or slash any skid trails on slopes over 35 percent. Slash or certified straw will be placed on them to achieve a 70–80 percent soil cover.

- Use existing landings whenever available and design for stable cuts and fills to ensure that no sediment from landings is delivered to streamcourses.

- Scatter slash to 80 percent ground cover on any wet areas disturbed by yarding.

- Use all available tools in planning prescribed burning to avoid high-severity fire on active landslides and other unstable areas. This includes close coordination between fire and watershed personnel during field layout of burn units to identify unstable areas that are at risk of burning at high severity.

- Maintain 60 percent tree canopy on units identified as having higher slope stability risk.

- Close temporary roads. This includes removal of berms and fills, removal of any constructed stream crossing (none anticipated), tillage or scarification of compacted areas, waterbars, and slash or mulch cover of disturbed areas to 70 percent.

- Asbestos. The Forest Service will provide a description of health hazards from asbestos exposure and maps to contractors identifying areas that may have asbestos and suggest they may consider sealed cabs on their equipment. If timber haul routes change during project implementation, any additional roads would be checked against the bedrock map to determine if they are underlain by ultramafic rock, and the asbestos standards applied. Dust abatement is required on all roads underlain by ultramafic rocks, and it is recommended that masticators have positive-pressure climate-controlled sealed cabs.

- Coordination. Following award of the contract for this project, personnel from earth science, timber administration, and fire will coordinate details of implementation, including protection of unstable areas during logging and burning activities.

2.9.6 Botany

2.9.6.1 Forest Service Sensitive Plants

The measures required for *Cypripedium fasciculatum* (CYFA) and *Cypripedium montanum* (CYMO2) populations include the following:

- Avoid direct ground disturbance to plants: exclude mastication and hand-thinning in FRZs, RS treatments, and Riparian Reserves and exclude fireline construction (including handline and machine-constructed firelines) in Rx Units within 25 feet of population boundaries; exclude mechanical treatment and yarding within population boundaries.

- Maintain shade from overstory canopy cover: exclude mechanical harvest activities within one site tree distance on slopes to the south and southwest of populations and allow harvest activities to north and northeast of populations with trees felled away from populations.

- Avoid high-temperature burns from slash pile burning treatment: exclude all piling and burning of slash in FRZs within 25 feet of population boundary.

- Allow prescriptive burning (in FRZs and Rx Units) within population boundary outside of active growing season (September 2 to March 31); where conditions allow for burning during the active growing season (April 1 to September 1), mitigate to exclude burning of plants with either (i) use of fire retardant foam applied outside of the population boundary, or (ii) construction of a fireline (handline) 25 feet outside of population boundary.

The measures required for the two *Ptilidium californicum* (PTCA5) populations include the following:

- Avoid all direct disturbance to PTCA5 substrate trees: exclude mastication in RS treatments within 25 feet of substrate tree.

- Avoid harvest of PTCA5 substrate trees in RS treatments.

- Allow all prescriptive fire in FRZs but protect the lower bole of the PTCA5 substrate tree from all fire treatments, including treatment of slash: mitigate with either (i) the use of fire retardant foam applied in a buffer around the tree, or (ii) construction of a fireline (handline) in a buffer around the tree.

- Maintain shade from overstory canopy cover in population: exclude mechanical harvest activities within one site tree distance on slopes to the south and east of populations, and allow harvest activities to north and northeast of populations with trees felled away from populations.

Resource protection measures are not required for the *Smilax jamesii* population.

2.9.6.2 Sensitive Fungi

The six Forest Service Sensitive Fungi that are assumed to be present occur in the wetter environments of riparian areas and uplands within 25 feet of the riparian vegetation. This habitat is present in Riparian Reserves inside proposed FRZs and Rx Units, and does not occur in proposed M Units or RS treatments. RPMs are not proposed for the six Forest Service Sensitive Fungi. Instead, RPMs for Riparian Reserves are incorporated into the Proposed Action. The RPMs are designed to protect fish and water resources, and would also provide benefits to Sensitive fungi and habitat.

2.9.6.3 Noxious Weeds

Prevention

- Require all contractors and permittees to clean equipment prior to entering National Forest System lands and when moving within a treatment unit from known noxious weed sites; follow Provision B6.35 Equipment Cleaning (summarized below):

    - Vehicles used off roads shall not be used in the Assessment Area if it was last operated in an area infested with one of more invasive species of concern areas without having cleaned such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds. Equipment shall be considered clean when a visual inspection does not disclose seeds, soil, vegetative matter, and other debris that could contain or hold seeds.

- Flag noxious weed populations on the ground prior to project implementation to avoid all proposed project ground-disturbing activities.

- Avoid proposed ground-disturbing project treatments in units known to contain noxious weeds; these treatments include road construction, mastication, prescribed fire, and fireline construction (both hand and machine firelines and piling and burning of slash). See Table 6 in the Botanical Resources Report for weed sites and proposed treatment unit locations.

- Require the use of certified weed-free seed and straw to restore areas of ground disturbance.

- Mastication equipment will be brought in clean (debris free) and not be staged in areas known to have noxious weed infestations.

- Mastication treatment areas will be surveyed for new noxious weed populations after mastication treatments occur.

- New noxious weed populations, resulting from project implementation, will be treated and monitored.

Control

- Conduct post-treatment surveys in proposed treatment units and use site-specific evaluations to determine appropriate treatment to control any weed sites located.

Monitoring

- Monitor mechanical treatment units and RS treatments for noxious weeds, as part of the Klamath National Forest noxious weed program, after the proposed project treatments are completed or as long as it takes vegetation to recover from disturbance (as measured by ground duff cover and forb and shrub layer cover).

2.9.7 Heritage Resources

- Heritage resource sites have been flagged and will be avoided. “Avoid” means that no activities associated with the project that may affect heritage resource sites shall occur within a site’s boundaries.

- If previously unrecorded heritage resources are discovered during project implementation, the Archaeologist for the Salmon River and Scott River Ranger Districts will be contacted immediately. The heritage resources will be recorded, clearly delineated, and protected.

2.9.8 Air Quality

- Burn plans, which include smoke management plans, will be written prior to implementation of prescribe burn treatments. The burn plans will identify and comply with policies and regulations of the Siskiyou County Air Pollution Control District and Northeast Plateau Air Basin.

2.9.9 Scenery

Resource protection measures for project activities visible from Sensitive Viewing Locations:

- **Stump treatments.** In M Units where excessive stump contrasts would otherwise appear visually dominant (and therefore not meet the Partial Retention Visual Quality Objectives/VQOs), apply a low cut stump height of less than 4–6 inches within 75 feet of the road/trail edge. Where additional contrast reduction is needed to retain a dominantly natural-appearing roadside setting (Partial Retention Visual Quality Objective/VQO), visible stumps within this view zone shall be fully or partially concealed by application of dirt, duff, and woody debris.

- **Thinning by cable.** Minimize the difference in stand densities within and on either side of a cable corridor. Cover soil disturbance in cable corridors with debris, as needed, to retain a dominantly natural appearance (Partial Retention Visual Quality Objective/VQO) when viewed from sensitive viewpoints.

- **Treatment of activity debris.** Smooth turn piles or any other soil disturbance from machine piling within 75 feet from roads.

- **Retain visibly distinctive trees.** In M Units, retain visibly distinctive trees, such as those with atypical forms, distinctively colored or textured bark (such as large ponderosa pine or madrone), evidence of earlier fires (catfaces), acorn granaries, or colorful seasonal leaves (such as black oak, big leaf maple, Pacific dogwood).

- **Road actions.** Implement closure of new temporary roads, former logging access routes, and spurs to appear largely natural and not attract attention. Preferably, this is through the use of natural-appearing native boulder groupings, logs, and natural-appearing landforms, rather than unnatural-appearing dirt piles, trenches, signs, or gates.

2.9.10 Recreation

Measures to ensure the safety and convenience of the public include:

- Traffic Safety and Control Plans prior to commencing project operations. The Plan will provide for public safety on Forest Service controlled roads and trails open to public travel.
- Roads and trails open to the public will be kept open or only closed for short durations. Project activities will minimize conflicts with public use on weekends and holidays.
- Dispersed campsites will be maintained in a usable condition if possible; however, they are not protected nor managed as developed sites.
- Warning signs will be posted on the Pacific Crest National Scenic Trail during any adjacent project activities. Any damage to the trail will be immediately repaired.

2.10 Seasonal Constraints on Operations in the Eddy Gulch LSR Project Assessment Area

The following analysis of the Limited Operating Periods (LOPs) identified in the resource protection measures was prepared to identify constraints that could affect implementation of the Proposed Action.

- **Sensitive plants.** Burning during the growing season is restricted where Region 5 Sensitive plants occur; mitigation will be to flag and avoid for all types of treatments. The majority of populations are very small (less than 100 individual plants) and will not substantially reduce the number of acres treated.
- **NSO core areas.** All M Units can be harvested without constraint of an LOP, except M Units 19 and 69, which occur in two NSO core areas (assuming they are occupied) and cannot be harvested between February 1 and September 15.
- **NSO and northern goshawk activity centers.** LOPs restrict burning within 0.25 mile of an occupied or unsurveyed NSO or northern goshawk activity center (resulting in a 125-acre area) during spring. Except for the 125-acre buffered area, which generally occurs in the lower portion of concave watersheds, the majority of the remaining units can be burned, with proper smoke dispersal (Table 2-8). A number of these buffered areas are unoccupied, and as long as surveys are conducted and the activity center remains unoccupied, the LOP would not apply.

Table 2-8. Percent of FRZs and Rx Units that would not be affected by LOPs.

Prescribed Burn Area	Total Acres[a]	Available for Spring Burning	Percent Available for Burning[b]
Rx Unit 1 and FRZs 2 and 4	2,575	Everything except 125 acres (NSO nest buffer) immediately north of Black Bear Ranch and northwest of Road 1E001.	90
Rx Unit 2 and FRZ 3	1,972	Everything, except 125 acres (NSO nest buffer) in E ½ sec 24 and SE ¼ sec 18 and 125 acres (northern goshawk nest buffer) on Forest Service land adjacent to Black Bear Ranch.	81
Rx Unit 3 and FRZ 7	2,833	Everything except 250 acres (NSO and northern goshawk nest buffers) along Matthews Creek.	86
Rx Unit 4, FRZs 5, 6, 9, and 11	4,318	Two separate polygons: western polygon is constrained by 3 NSO nest buffers; eastern polygon, everything except 125 acres at the end of 39N46.	83
Rx Unit 5 and FRZs 12 and 16	2,370	No restrictions.	100
Rx Unit 6, FRZs 13 and 15	1,450	Everything except 125 acres (NSO nest buffer) in the NE ¼ sec 19.	90
Rx Unit 7 and FRZ 14	1,384	Everything except 125 acres (NSO nest buffer) in E ½ sec 20 and W ½ sec 21.	88
Rx Unit 8	863	No restrictions.	100
Rx Unit 9 and FRZ 20	2,247	Everything except 250 acres (2 NSO nest buffers).	78
Rx Unit 11	251	No restrictions.	100
Rx Unit 12	521	Southern portion between 39 road and 39N27.	20
Total	**20,784**		

Notes:

a. Acreage includes Rx Unit and adjacent FRZ.

b. Percent available for burning = Total Areas – (125-acre nest buffer (nests) + 125 acres/nest) to allow for location of control points and smoke dispersal.

- **NSO habitat.** No more than 50 percent of NSO nesting/roosting/foraging (n/r/f) habitat can be adversely affected in a 7th-field watershed (less than 3,500 acres) by mechanical treatment or burning in a single year. M Units generally avoid NSO habitat; therefore, the majority of treatment will be mastication or burning. For planning purposes assume each NSO home range (1.3-mile radius = 3,400 acres) occurs in a separate watershed, and NSO home ranges in the Eddy Gulch LSR have an average of 1,643 acres of n/r/f habitat or 48 percent of the home range within a 7th-field watershed. Thus, within NSO home ranges, approximately 1,640 acres (820 acres n/r/f + 820 acres nonhabitat) could be burned annually.

- **Fisheries water quality.** Project activities are scheduled to occur between April 15 and October 15. This period may be extended on either end of the stated seasonal range based on occurrence of all of the following criteria: (1) a long-term dry weather forecast, (2) the ability to winterize activities at the end of the day, (3) acceptance of recommendations from the district fisheries biologist and/or hydrologist (after meeting the first two criteria), and (4) authorization by the District Ranger (after meeting the first three criteria). Wet Weather Operation Standards (USDA Forest Service 2002a) will be followed whenever activities occur outside of the normal operating season (USDA Forest Service 2002). All landing, skid trail, and temporary road construction, road closure, and road re-conditioning will be conducted during the appropriate periods of weather and soil moisture to ensure BMP attainment and the avoidance of adverse effects on listed species (USDA Region 5

Soil Quality Handbook 1995b and BMP 5.6 in Appendix D of the Fish Biological Assessment / Biological Evaluation for this project). Favorable forecast periods will also be of a suitable length to allow completion or winterization of the task undertaken before precipitation events occur.

Chapter 3
Affected Environment and Environmental Consequences

Welcome

You are now in the "Affected Environment and Environmental Consequences" chapter. Here are the topics you can read about.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter summarizes the physical, biological, social, and economic environments of the Eddy Gulch Late-Successional Reserve (LSR) Project Assessment Area and the effects on these environments that would result from taking no action (Alternative A) or from implementation of "Alternative B: Proposed Action " or "Alternative C: No New Temporary Roads Constructed." This chapter also presents the scientific and analytical basis for comparison of the alternatives presented in "Chapter 2: Proposed Action and Alternatives."

Each resource section in this chapter is a summary of the respective resource reports. The following reports are available on the project website (http://www.eddylsrproject.com): Silviculture Report, Fuels and Air Quality Report, Wildlife and Habitat Report, Aquatic Resources Report for Water Quality and Fisheries, Botanical Resources Report, Soils Report, Geology Report, Scenery Report, Scenery Analysis, Recreation Report, Wild and Scenic Rivers Report, Social Assessment, Economics Analysis, and Roads Report. The following documents are also available on the project website: Biological Assessment/Biological Evaluation (BA/BE) for Wildlife, BA/BE for Fish, and BA/BE for Plants.

This "Environmental Consequences" chapter analyzes both beneficial and adverse effects that could result from selecting any of the alternatives described in this final environmental impact statement (EIS). This chapter includes a summary of laws and policies relevant to each resource topic and the methods used to analyze current conditions and potential effects.

3.1.1 Terms

Throughout this final EIS, acres presented will be identified (or apparent from context) as applying to one of the following areas:

Eddy Gulch LSR — the entire 61,900-acre LSR.

Assessment Area — the 37,239-acre portion of the Eddy Gulch LSR west of Etna Summit where various treatments are proposed. All inventoried roadless areas that occur in the LSR were excluded from planning efforts and are therefore not part of the Assessment Area.

Treatment Unit — the acres proposed for some type of on-the-ground treatment under a particular alternative.

Analysis Area — the area around treatment units considered in the effects analysis (the analysis area may be larger than the LSR Assessment Area). The analysis area varies by resource.

3.1.2 Definitions for Evaluating Effects

The "Environmental Consequences" section for each resource describes the effects that would result from taking no action or implementing either action alternative; those effects are described according to the following definitions.

3.1.2.1 Analysis Period (Duration of Effects)

Each resource section in this chapter defines the analysis period used for evaluating effects on that specific resource.

3.1.2.2 Types of Effects

- **Beneficial effects** are those that result in a positive change in the condition or nature of the resource, usually with respect to a standard or objective. A change that moves a resource toward its desired condition.

- **Adverse effects** are those that result in a negative change in the condition or nature of the resource, usually with respect to a standard or objective. A change that moves a resource away from its desired condition.

- **Direct effects** are caused by the action and occur at the same place and time as the action.

- **Indirect effects** are caused by the action and are later in time, further removed in distance, but are still reasonably foreseeable; or the response of the target resource is triggered by the reaction of another resource to the Proposed Action.

- **Cumulative effects** are those that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.

- **Irreversible commitments of resources** are permanent or essentially permanent resource use or losses. They cannot be reversed, except in the extreme long term. Examples include mineral extraction or loss of soil productivity.

- **Irretrievable commitments of resources** are losses of productivity or use for a period of time. One example is road construction on suitable timber lands. Timber growth on the land is irretrievably lost while the land is used as a road, but the timber resource is not irreversibly lost because the land could grow trees in the future, if the road were removed.

3.1.2.3 Intensity of Effects

Each resource section in this chapter contains the intensity of effects definitions used for evaluating effects on that specific resource. The intensity definitions are expressed as negligible, minor, moderate, and major.

3.1.3 Council on Environmental Quality Guidance on Cumulative Effects Analysis

The Council on Environmental Quality (CEQ) provided recent guidance (memorandum prepared by James L. Connaughton, Chairman, White House Council on Environmental Quality, June 24,

2005) on the extent to which agencies of the federal government are required to analyze the environmental effects of past actions when they describe the cumulative environmental effects of a proposed action in accordance with Section 102 of NEPA (42 United States Code [USC] 4332, and the CEQ Regulations for Implementing the Procedural Provisions of NEPA [*National Environmental Policy Act*], 40 Code of Federal Regulations [CFR] parts 1500-1508. CEQ's interpretation of NEPA is entitled to deference. Andrus v. Sierra Club, 442 U.S. 347, 358 (1979)).

The following is excerpted from that June 24, 2005, memorandum:

> The environmental analysis required under NEPA is forward-looking, in that it focuses on the potential impacts of the proposed action that an agency is considering.

CEQ interprets NEPA and CEQ's NEPA regulations on cumulative effects as requiring analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for action and its alternatives may have a continuing, additive and significant relationship to those effects. In determining what information is necessary for a cumulative effects analysis, agencies should use scoping to focus on the extent to which information is "relevant to reasonably foreseeable significant adverse impacts," is "essential to a reasoned choice among alternatives," and can be obtained without exorbitant cost. 40 CFR 1502.22.

3.1.4 Reasonably Foreseeable Future Projects in the Vicinity of the Eddy Gulch LSR Project

The Klamath National Forest Schedule of Proposed Actions was reviewed to identify current and reasonably foreseeable projects on the Salmon River and Scott River Ranger Districts that should be included in the cumulative effects analysis for the Eddy Gulch LSR Project. Ongoing projects include annual road maintenance, improvements to existing mining claims, hiking, and appropriate responses for fire suppression. Additional future projects include the following:

- Installing telephone and fiber-optic lines through the Ranger District (this involves digging a trench adjacent to roads to bury the lines and installing access points for future maintenance activities).
- North Fork Roads Stormproofing Project (this involves storm proofing 76 miles of road requiring blading, improving road drainage, and protecting riparian and stream systems; decommissioning 36 miles of roads to reduce sediment delivery to streams; and adding 2.4 miles of existing road).
- Construction of a fuelbreak system west of Black Bear Ranch (approximately 700 acres of ridgetop fuel reduction).
- A small amount of projects on private lands have been funded under the Salmon River Community Wildfire Protection Plan (CWPP). This includes funding to treat 75 acres of fuels on private properties in and around the Eddy Gulch LSR Project Assessment Area in the next 18 months. There may be funding for at least 50 acres in the following 18 months.

3.2 Forest Vegetation

3.2.1 Introduction

This section describes forest vegetation (conifer and hardwood) in the Assessment Area for the Eddy Gulch LSR Project. This report describes the natural and human factors that have contributed to current conditions of vegetation, composition, and structure of the forest. This section also describes the effects from taking no action (Alternative A) and effects that would result from implementing the Eddy Gulch LSR Project under the Proposed Action (Alternative B) or under Alternative C (No New Temporary Roads Constructed).

3.2.2 Methodology

3.2.2.1 Analysis Methods and Assumptions

All of the stands identified for thinning treatments are located in either a Fuel Reduction Zone (FRZ) or roadside (RS) treatment along an emergency access route. There are two categories for thinning treatments: trees to be thinned are *larger than* 8 inches diameter at breast height (dbh) and trees to be thinned are *less than* 8 inches dbh.

Field Inventories and Stand Exams. In order to ensure that silvicultural prescriptions are consistent with the Klamath LRMP, field inventories were conducted to measure attributes of existing vegetation. Data were used to determine site quality, timber volume, basal area, stand density index (SDI), average size of live trees in terms of quadratic mean dbh, number of trees per acre, tree growth, species present, and tree condition. All proposed thinning stands in the FRZs (with trees to be thinned larger than 8 inches dbh) were site reviewed by a silviculturist. A stand exam crew installed random plots and collected stand data that included basal area, trees per acre, volume per acre, canopy cover, site class, and stand density. The thinning units were inventoried using the current Forest Inventory and Analysis User's Guide for the United States Department of Agriculture (USDA) Forest Service Pacific Southwest Region. The stands were stratified into six categories:

1. Douglas-fir mid-successional,
2. Douglas-fir mid- / late-successional,
3. white fir mid-successional,
4. white fir mid- / late-successional,
5. red fir late-successional, and
6. mixed-conifer late-successional.

The stand diagnoses and strata-specific prescriptions were developed based on the field information.

The field data were then loaded into the Forest Vegetation Simulator (FVS) program, which is a forest growth model that predicts forest stand development following treatment. The model analyzed the field data collected for the six strata categories listed above. FVS calculates specific data for basal area and volume and models the information (such as canopy cover and stand density) based on data from local research, which is programmed into algorithms within the FVS. The model does not produce absolute values and approximates the natural processes.

Additional analyses included aerial photo interpretation and Forest Inventory timber type coverages in Geographic Information System (GIS). The Forest Inventory typing is vegetation-type mapping based on year 1995 aerial photographs. These were used to determine timber strata, size class, and densities. The GIS coverages were also used to determine land classification and allocation.

The topography and slope of and access to each treatment unit were used to determine the most appropriate system to be used for thinning. For treatment units in the Eddy Gulch LSR Project, ground-based (tractor) and cable yarding systems are proposed. Silvicultural prescriptions were based on a desired future stand condition using stand exam data, FVS projections, aerial photograph interpretation, and field review.

The prescriptions are designed to space trees to meet the fire objective of reducing crown fire potential. The FVS data analysis simulated thinning the stand from below to produce the predicted changes. Stand development was modeled for 5- and 30-year periods, using the proposed thinning (under Alternatives B and C) and with no thinning (under Alternative A), to display the differences between treating and not treating the stands.

The RS treatments along emergency access routes (roads or road segments) are long, linear management stands that traverse numerous vegetation types. The roads or road segments were inventoried, and the vegetation was classified into 1 of 3 categories (developed together by fuels and silviculture specialists) with associated generic prescriptions.

Prescription Development. A stand prescription was developed for each stratum shown in Appendix A of the Silviculture Report (Table A-1 for Alternative B and Table A-2 for Alternative C). The basic prescription is based on a designated largest leave tree spacing (DxD). The largest tree is determined by its dbh measurement. The spacing indicates a minimum and maximum distance in which the largest leave tree must be selected. This prescription works best in areas where tree spacing is more important than stand variability. It works well in meeting the objectives of an FRZ. The concept is that the largest trees within a prescribed distance will be left, and all other trees greater than 8 inches between the largest leave trees will be cut and removed. The spacing requirement minimizes tree crown contact by thinning from below, with emphasis on thinning clumps of conifer trees.

The interdisciplinary (ID) team silviculturist and fire/fuels specialists and the Klamath National Forest silviculturist and silviculture contract inspector visited a Rogue National Forest timber sale that had been marked using a DxD prescription. It was agreed that the DxD prescription would work well for the Eddy Gulch LSR Project.

The ID team silviculturist prepared draft DxD stand prescriptions for several white fir units in the Shadow Creek area. The forest silviculturist field reviewed these proposed prescriptions and agreed with using this prescription on the project.

An ID team fire/fuels specialist also field reviewed the above-mentioned draft prescriptions and agreed that they met the fire/fuels objectives.

Trees larger than the indicated maximum dbh will not be cut unless they fall under the prescriptions contained in the Klamath National Forest Hazard Tree Policy (USFS 2005—included as Appendix C of this final EIS). The DxD spacing was individually prescribed for each stand. Each stand was reviewed in the field, and the prescribed spacing was selected based on stand factors such as tree species, tree crown size, and tree age.

"Special Directions" (see the last column in Tables A-1 and A-2 in the Silviculture Report) are used to either emphasize or de-emphasize tree species selection. This was done by weighing dbh measurements by adding or subtracting inches to the indicated species dbh measurement. The Klamath National Forest Forestwide Late-Successional Reserve Assessment (forestwide LSR assessment) (USFS 1999) placed high value on retaining sugar pine, so most of the stand prescriptions have a special direction adding inches to the dbh measurement. White fir in some units did not meet stand objectives and was de-emphasized by subtracting inches from the dbh measurement.

All stand prescriptions remain the same for Alternatives B and C, with the only difference being the amount of acres in M Units that would be treated; that is, Alternative C would treat 99 acres less than Alternative B because, under Alternative C, no new temporary roads would be constructed to access some of the treatment units.

Refer to the "Fuels Report" for the Eddy Gulch LSR Project (or the "Fire, Fuels, and Air Quality" section in this document) for an analysis of the effects that would result from implementation of Rx Unit treatments under Alternative B (17,524 acres) and the reduction in Rx Unit treatments under Alternative C (16,702 acres).

3.2.2.2 Scope of the Analysis

Analysis Area. Vegetation management activities have localized effects on vegetation attributes (such as canopy cover, tree density, and tree size) that are generally confined to the treated area. Therefore, the direct, indirect, and cumulative effects analyses of vegetation resources are geographically bounded to the Eddy Gulch LSR Project Assessment Area.

Analysis Period. The timeframe for the effects analysis is 5 years for short-term effects and up to 30 years for long-term effects on vegetation. The western slope of the Klamath Mountains in the Klamath National Forest has a relatively high rate of vegetation establishment and growth due to high annual precipitation and productive forest soils. Within this time frame (up to 30 years following treatment), vegetation generally has sufficient opportunity to increase canopy cover, basal area, and tree density to a point where subsequent thinning would be needed to maintain stand vigor, health, and growth.

3.2.2.3 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout this effects analysis are described below.

Negligible. Effects would be at the lowest levels of detection and would have no appreciable effect on resources, values, or processes.

Minor. Effects would be perceptible but slight and localized.

Moderate. Effects would be readily apparent and widespread and would result in a noticeable change to resources, values, or processes.

Major. Effects would be readily apparent and widespread and would result in a substantial alteration (beneficial or adverse) or loss of resources, values, or processes and would likely be permanent.

3.2.2.4 Measurement Indicators

There are four measures (or indicators) that were used to assess current stand structure in the Assessment Area. These same indicators were used to assess effects of taking no action and effects that could result from implementation either Alternative B or Alternative C.

Indicators for Stand Structure

- Basal area
- SDI
- Tree size
- Canopy cover

Indicator: Basal area. Basal area is a measure of stand density or stocking. Basal area is the cross section area of a tree stem in square feet measured at breast height (4.5 feet above ground) and inclusive of bark, usually computed by using dbh or tallied through the use of basal area factor angle gauge. Stocking for an area, usually on a per-acre basis, is the sum of the basal areas for all trees in the area. It is a measure used to describe expected stocking levels for wildlife habitat.

Indicator: Stand Density Index. SDI, developed by Dunning and Reineke (1933)**,** is another measure of stand density. It is the number of trees per unit area that a stand would have at a given average dbh.

SDI can also be used as a species-specific measure of tree competition for resources (nutrients, water, and sunlight). The calculated SDIs for the stand management proposals were evaluated based on indicated inter-tree competition levels. Long (1985) identified four levels of competition using the SDI ratings developed by Dunning and Reineke. The four levels are

1. onset of competition—25 percent of maximum SDI;
2. lower limit of full site occupancy—35 percent of maximum SDI;
3. lower limit of self thinning (initiation of mortality due to resource competition, remaining trees continue to grow)—60 percent of maximum SDI; and

4. maximum stocking (mortality = biomass accumulation = no net growth in stands)—100 percent SDI.

The maximum SDI for the major conifer species in stands in the Eddy Gulch LSR Project Assessment Area are

800 for red fir;

760 for white fir;

600 for Douglas-fir; and

430 for mixed-conifer (using ponderosa pine as the key species).

Indicator: Tree Size. Tree size (average diameter) is an important wildlife habitat attribute. The forestwide LSR assessment emphasizes larger conifer stocking levels, particularly for trees greater than 24 inches dbh.

Indicator: Canopy Cover. Canopy cover is the degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky, expressed as a percent of ground area (is also referred to as canopy closure or crown cover). Canopy cover is another stand attribute that is used to describe wildlife habitat.

3.2.3 Affected Environment (Existing Conditions)

This section provides a description of the existing forest stand conditions for each of the four measurement indicators listed above.

3.2.3.1 Historic Influences on Stand Structure

Pre-settlement Influences. Prior to European settlement, fire was the primary disturbance regime that affected the composition and structure of forests in what is now the Eddy Gulch LSR. The fires were either ignited by lightning or Native Americans, and given the frequency of those fires, the intensity of the fires varied, resulting in a mosaic (variety) of forest stands that differed from today's stands. In a study conducted about 50 miles from the Eddy Gulch LSR Project, Taylor and Skinner (1998) reported that, in the Douglas-fir–dominated forests of the Klamath Mountains, upper slopes (ridge tops) had more frequent fires and more severe fires than middle and lower slopes (Table 3-1).

Table 3-1. Median and range of median fire return intervals (years) for sites by aspect and slope position for plots on Thompson Ridge, Klamath Mountains, California.

Slope Position	N (samples)	Median Fire Return Interval (year)	Range (year)
Lower (2,000–3,100 feet)	17	19	5–87
Middle (3,100–4,060 feet)	27	14	6.5–116
Upper (4,060–5,020 feet)	16	10.5	4–37.5

Source: Taylor and Skinner 1998.

Moreover, lower slope positions experienced mostly (75 percent) low-severity fires, whereas upper slopes experienced mostly (63 percent) moderate- and high-severity fires, with the mid-slope positions being intermediate. Severe fires were defined to be those that had less than four “tall” stems per acre remaining after the fire.

Skinner and Taylor (1998) concluded, “The cumulative effect of fire severity variation across slopes suggests that forests with late-successional characteristics (such as multilayered canopy, high density of large-diameter trees, snags, and coarse woody debris) were more commonly found at lower slope positions as well as on north- and east-facing slopes. Upper slope positions, as well as intermediate positions on south- and west-facing slopes, were more likely to display a pattern of scattered, remnant, older trees and patches, exhibiting some late-successional characteristics within a coarser-grained pattern largely of younger stands.”

In a study in the central Oregon Coast range, Impara (1997) also found that upper hillslope positions had higher frequency and severity of fire than lower hillslope positions. He noted, “An important feature of this result is that old-growth trees are more common at lower hillslope positions than at upper hillslope positions. This pattern of old-growth occurrence should be considered in studies of forest patterns and related management approaches to old-growth forests.”

Fire history also influenced the composition of stands in the Eddy Gulch LSR. Historically, stands in the Eddy Gulch LSR Project Assessment Area had a higher component of shade-intolerant species such as ponderosa, Jeffrey, and sugar pine in the overstory. These species are better adapted to the open stands created by frequent fires.

The ID team’s silviculturist reviewed photographs taken from the Eddy Gulch Lookout location in 1935 and from the same location in 1992. The Figure 3-1 photograph (1935) view area is east of the lookout towards the Deacon Lee trailhead and the Russian Wilderness Area. The Figure 3-2 photograph is of the same view area but was taken 57 years later in 1992. Note the road that is visible in the hardwood / brush fields in the 1935 photograph is totally obscured in the 1992 photograph by the conifer stands that now occupy the site.

The Figure 3-3 photograph (1935) is to the west of the lookout showing the upper portions of Eddy Gulch (right) and Crawford Creek (left). The Figure 3-4 photograph of the same view was taken in 1992. The southerly aspects in Crawford Creek in 1935 had large areas of hardwood / brush fields with scattered pockets of conifers. The 1992 photograph shows that conifer stands are now a major component of the landscape vegetation.

The northerly aspects on the upper slopes in Eddy Gulch did support less dense conifer stands. The stands appear to be less dense in 1935 than in the 1992 photograph.

The predominantly white fir conifer stands that developed in the hardwood / brush fields (as shown in the 1935 photos) have continued to grow and are now 70 years or more in age. Field examination of these stands indicates that they are densely stocked with a high level of inter-tree competition that is leading to poor stand health, higher fuel loads, and increased fire danger.

Figure 3-1. Photo taken in 1935—view area is east of Eddy Gulch Lookout.

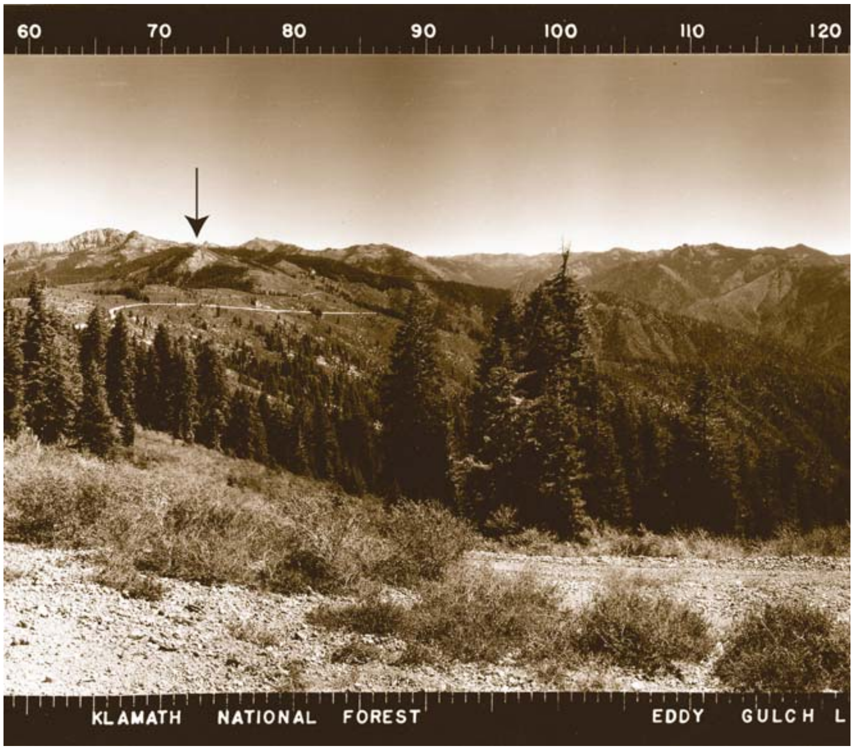


Figure 3-2. Photo taken in 1992—same view area as Figure 3-1.

Figure 3-3. Photo taken in 1935—view area is west of Eddy Gulch Lookout.

Figure 3-4. Photo taken in 1992—same view area as Figure 3-3.

Post-settlement Influences. Gold was discovered in about 1850 in the area that is now the Eddy Gulch LSR. Over the next four to five decades, miners removed much of the vegetation in the vicinity of the mining activities for tunnel timbers and structures and often burned the rest to expose the mineral resource (examples would be the lower portions of Whites Gulch and Eddy Gulch and areas around Black Bear Ranch). The result is a somewhat less-than-natural number of trees and stands over 130 years of age. With the creation of the Klamath National Forest shortly after the turn of the century, and the emphasis on fire suppression beginning about 1910, not only have forests returned to much of the potential forest land in the LSR, but most stands contain many more trees and other understory vegetation (along with limbs, logs, and other understory fuels) than would have been present under historical conditions. Approximately 84 percent of the Eddy Gulch LSR Project Assessment Area has not experienced fire since 1910. This has resulted in approximately 67 percent of the Assessment Area being classified as *severely departed* and approximately 28 percent classified as *moderately departed* from its historical biophysical conditions (Creasy 2008). Roughly 64 percent of the severely and moderately departed acres are in the true fir (genus Abies) zone, with the remaining 36 percent located in the lower elevations (Creasy 2008) (refer to the “Fuels Report” for further descriptions of departure from historical conditions).

3.2.3.2 Current Stand Structure

The current vegetation composition and structure in the Eddy Gulch LSR were shaped by physical and biological factors, primarily those that influence temperature, moisture, and disturbance. These factors include topography, aspect, soil conditions, hydrology, weather, and fire (USFS 1999). Fire suppression has had an effect on vegetation that would have existed historically or ordinarily in the presence of fire; that is, a mosaic of vegetation, which includes large areas of mid- and late-successional forest, interspersed with more open conifer stands mixed with hardwoods or younger stands created by disturbances.

Stand Structure in the Assessment Area. Historically, stands in the Eddy Gulch LSR Project Assessment Area had a higher component of shade-intolerant species such as ponderosa, Jeffrey, and sugar pine in the overstory. Currently, the dominant vegetation consists of true firs (red and white) in the upper elevations and Douglas-fir and mixed-conifer stands in the mid to lower elevations of the Assessment Area. Madrone and other hardwoods (such as black oak) are commonly found in stands below 4,000 feet elevation. Other common conifer species, which are scattered throughout the LSR in the lower and less-exposed areas, are ponderosa pine, sugar pine, incense-cedar, and knobcone pine. The dominant hardwood in the lower and more exposed areas is canyon live oak. The major vegetation types in the LSR include Douglas-fir, mixed-conifer-pine, white fir, red fir, and nonconifer vegetation. The mixed-conifer-pine forests occur below 5,000 feet and are found on dryer slopes. The Douglas-fir stands occur mostly on north-facing slopes below 5,000 feet. White fir increases in dominance with increasing elevation, north-facing slopes, and moisture. Red fir stands are found mostly on north-facing slopes above 5,500 feet and on south-facing slopes above 6,000 feet.

Forest stands can be described by dominant species and their distribution, successional stage (based on mean dbh of trees in the stand), or amount of canopy cover. The distribution of dominant species was described in the previous paragraph. The distribution and abundance of successional stages and amount of canopy cover for forest stands in the Eddy Gulch LSR are depicted on Map A-7 and Table 3-2 below. Approximately 30 percent of the Eddy Gulch LSR is characterized by late-successional forest. Approximately 43 percent of the late-successional and mid-successional stands are greater than 40 percent canopy cover.

Table 3-2. Current abundance of forest successional stages and canopy cover in the Assessment Area.

Stage / Canopy Cover	Mean DBH / Percent Canopy Cover	Acres
Late-Successional / Open	Over 25 inches / less than 40%	4,400
Late-Successional / Dense	Over 25 inches / greater than 40%	14,380
Mid-Successional / Open	12–25 inches / less than 40%	4,510
Mid-Successional / Dense	12–25 inches / greater than 40%	12,420
Early Successional / Pole	6–11 inches / greater than 40%	7,200
Early Successional / Sapling / Seedling	Plantations	2,310
Other Vegetation		16,680
	Total	**61,900**

Source: USFS 1999.

Stand Structure in the M Units. All of the stands slated for thinning of crown fuels (removal of trees larger than 8 inches dbh in FRZs or the M Units described in detail in Chapter 2 of this final EIS for the Eddy Gulch LSR Project) in the Assessment Area are located on ridgetops. The ridgetops were selected because they are optimum locations to increase resistance to wildfires (Millar et al. 2007). Each stand was evaluated, and the characteristics of those stands, by forest type and successional stage, are summarized in Table 3-3. All of the stands identified for treatment are mid- or late-successional stands, with a high proportion (over 50 percent) of trees less than 10 inches dbh. All of the stands exceed 60 percent of the maximum SDI, where mortality will likely increase as a result of competition for resources (such as nutrients, water, and sunlight). These stands are also very different than the remnant late-successional stands (described by Taylor and Skinner [1998] and Impara [1997]) that were present prior to European settlement. Table 3-3 shows current conditions for the four indicators: basal area, SDI, tree size, and canopy cover.

Table 3-3. Current stand structure on ridgetops where proposed M Units are located.

Summary of Current Strata Data		Summary of Current Conditions for Stand Structure Indictors (Basal Area, SDI, Tree Size, and Canopy Cover)							
SAF[a] Forest Type	CWHR[b] Seral Stage	TPA Total	TPA[c, d] >10"	BA[e]/acre >10"	Average dbh[f] >10"	TPA >24"	Canopy Cover (%)	SDI[g]	Consequence of SDI
DF[h]	MS[i]	441	135	192	16.1	5	73	405	Beyond self-thinning
DF	MS/LS[j]	235	120	249	19.5	20	72	425	Beyond self-thinning
WF[k]	MS	299	190	302	17.1	9	61	506	Beyond self-thinning
WF	MS/LS	275	124	284	20.5	29	58	479	Beyond self-thinning
RF[l]	LS	613	113	350	23.8	43	59	643	Beyond self-thinning
MC[m]	LS	255	159	320	19.2	28	69	453	Beyond self-thinning

Notes:
a. SAF = Society of American Foresters
b. CWHR = California Wildlife Habitat Relationship
c. TPA = trees per acres
d. > = greater than
e. BA = basal area (measured as square feet per acre)
f. dbh = diameter at breast height
g. SDI = stand density index
h. DF = Douglas-fir
i. MS = mid-successional
j. LS = late-successional
k. WF = white fir
l. RF = red fir
m. MC = mixed-conifer

Stand Structure in Roadside Treatments Along Emergency Access Routes. The Proposed Action would treat 44 miles of emergency access routes in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (with 154 acres of treatments) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes. The following are the proposed RS treatments along the 16 miles of emergency access routes that occur outside FRZs and Rx Units (see Map A-4c):

- **Route**—40N54 South Russian from the Forest Service bridge at the Assessment Area boundary to the intersection with the Rainbow Mine road and then along the road to the Rainbow Mine property line. The majority of the stand is in the South Russian Creek Riparian Reserve. Slopes are steep, except for the portion near the Forest Service bridge and the portion from the private bridge to the property boundary.

- **Route**—40N61 Whites Gulch from North Fork Salmon River bridge to 39 Road intersection. The lower portion of Whites Gulch, below the first switchback, has experienced heavy mining and logging activity. It is also located in the Whites Gulch Riparian Reserve. Conifer stocking is mostly Douglas-fir. The middle section has several large conifer plantations and significant portions of poor site conditions mostly supporting live oak. The upper section has several large conifer plantations intermixed with older true fir stands.

- **Route**—the 39 Road from the 1C02 intersection to intersection with FRZ 14. The topography traversed is generally steep (over 60 percent slopes). The lower-elevation vegetation is dense, consisting mostly of young Douglas-fir or mixed-conifer. The upper-elevation stands are older white fir stands intermixed with plantations (some older plantations are ponderosa pine).

3.2.3.3 Disturbances

The current condition of forest vegetation in the Assessment Area will not remain static because natural and human disturbances will continue to affect stand conditions and forest health. Major disturbances include insect and disease activity, weather, and wildfires; whereas, mining would have little effect on the Eddy Gulch LSR, as a whole, and is considered a minor disturbance in the Assessment Area. Insects, diseases, and weather-related events are the disturbances described below. The “Fuels Report” details the current fuels conditions in the LSR.

Insects and Diseases. Insects and diseases create dead and down material and recycle nutrients into the ecosystem, but they can also increase the potential for high-intensity fires by increasing the amount of dead and down fuel. This can have secondary effects on sediment production and changes in vegetative character, landslides, and atmospheric conditions. The removal of frequent low-intensity fires (replaced by infrequent high-intensity fires) has encouraged insects and diseases to replace fire as the primary disturbance process. This has exacerbated the fire behavior potential on many sites (USFS 1995).

Insects—Insect levels play an important role in stand health. Insects commonly attack trees weakened by disease, mechanical damage, and inter-tree competition. Increases in insect levels can have major effects on stand health when large numbers of weakened trees, including dominant and co-dominant trees, are killed. This can alter the pattern of forest succession and increase fuel loads and the likelihood of a stand-replacing fire. Insect levels are cyclic and are not easily predicted in the long term. Existing stand density and health conditions were used to evaluate possible future activity levels.

High and moderate levels of insect-caused mortality can be found throughout the Eddy Gulch LSR. This mortality amplifies the risk of severe fire effects and can hamper the ability to control fires in areas containing dead and down fuel loading and dead trees (snags), which pose a significant safety hazard. The areas of primary concern inside the LSR include the historically high-mortality area from Grouse Point west, both forks of Crawford Creek, and a moderate-mortality area from Grasshopper Ridge to the northwest and also in Music Creek and Highland Creek. Very little recent insect-caused tree mortality was observed during the 2008 field season, and current insect activity appears to be at or below the endemic level.

Fir Engraver Beetle. The fir engraver beetle (*Scolytus ventralis*) attacks most true fir species in the western United States. The attacks by this under-the-bark burrowing beetle can result in patch kill around the bole, top kill, and tree mortality. Top kill and tree mortality are often associated with trees already weakened by root disease, overstocking, drought, and heavy dwarf mistletoe infection (Keen 1952).

Western Pine Beetle. The western pine beetle (*Dendroctonus brevicomis*) is the most devastating insect affecting ponderosa pine in California and Oregon. Normally, this beetle breeds in windfalls, unhealthy trees, or in trees weakened by drought, stand stagnation, fires, and beetle infestations, which usually lead to tree mortality (Keen 1952).

Diseases—Diseases play an important role in stand health. The potential problems created by diseases include weakening of trees, which leads to increased tree mortality or susceptibility to blow down or breakage. This can alter the pattern of forest succession and increase fuel loads and the likelihood of a stand-replacing fire. Field observations of current disease types and levels of occurrence/severity were used to roughly predict future levels.

Dwarf Mistletoe. Dwarf mistletoe (*Arceuthobium* spp.) is found throughout the Assessment Area. It has a definite influence on stand health, particularly where edaphic (soil-related) factors or stand density place other limits on tree growth and health. Dwarf mistletoe is a host-specific (capable of living solely on or in one species) parasitic seed plant. Field reconnaissance of the Assessment Area identified mistletoe infection in the major conifer species (Douglas-fir, white fir, incense-cedar, ponderosa pine, and red fir) that are present in the Assessment Area, indicating that several different dwarf mistletoe species are present. Conifer species most affected in the area are red fir, Douglas-fir, and ponderosa pine.

Cytospora. Cytospora (*Cytospora abietis*) is a canker disease that affects red fir in the Assessment Area. This disease is closely associated with dwarf mistletoe. The progress of the disease starts with individual branch infections and proceeds in trees and stands to kill branches, until the crowns of trees are so weakened that fir engraver beetles, or other factors such as drought years, can successfully kill trees. Large areas of continuous fir forest offer little resistance to the spread of the canker. Larger openings can provide buffers to inhibit spread and are often responsible for breaks in disease occurrence. Management practices to reduce the spread of cytospora and increase success of stand development include large openings and reintroduction of fire. Red fir stands and red firs in white fir stands near ridgetops in the eastern portions of the Assessment Area are heavily infested with cytospora and dwarf mistletoe. The infestations are heaviest on the north slopes.

Sugar Pine Blister Rust. Sugar pine blister rust (*Cronartium ribicola*) is endemic in the LSR. This introduced disease affects western white pine, whitebark pine, foxtail pine, and sugar pine. The disease is introduced by spores from the alternate host (gooseberry), usually on limb tips, and moves through the tree tissue toward the main trunk. In many cases, young trees are killed and older trees have tops killed. This disease can reduce tree vigor to a point where other factors, including mountain pine beetle, can kill host trees. Blister rust was observed in minor amounts in the reviewed stands.

Fomes Annosus. Fomes annosus (*Heterobasidion annosum*) is a disease that decays tree roots. Incense-cedar, ponderosa pine, and sugar pine are resistant to the strain that infects white fir and red fir. The disease is considered to be prevalent in higher-elevation true fir stands in northern California. Not all areas in these stands are infested, and not all trees within them are highly susceptible to infection (DeNitto 1989). Very little recent tree mortality, particularly centers with patterns of chronic mortality, was observed during the 2008 field season.

Wind and Snow Events. Field observations of the effects on vegetation from weather-related events over the past 10 to 20 years were used to describe current conditions and roughly predict the effects of these events on proposed stand management activities.

The Eddy Gulch LSR has experienced high wind events that have uprooted or broken off numerous conifer and large hardwood trees. These events periodically occur during heavy snow and high wind storms. The last widespread snow/wind event occurred in the mid-1990s, and most of these areas were salvage logged at that time to reduce the fuel load hazard.

Heavy snow and wind events occurred during the winter of 2007–2008. The damage to stands was limited in scope when compared to the event in the 1990s. Significant damage is mostly confined to the Klamath Basin area in Eddy Gulch LSR. A moderate amount of damage occurred on the ridge between the east and west forks of Shadow Creek. Pockets of minor damage are found scattered throughout the western portion of the Assessment Area.

3.2.4 Desired Stand Conditions

3.2.4.1 M Units (Mechanical Thinning Removing Trees Larger than 8 Inches Diameter at Breast Height)

During the planning phase for the Eddy Gulch LSR Project, the ID team considered public comments, Forest Service and U.S. Fish and Wildlife Service recommendations, pre-European stand conditions, and consequences of climate change to reduce the probability of stand-replacing wildfires in the forested landscapes. The desired condition is that ground, ladder, and crown fuels have been reduced in the M Units, and this will successfully retard the spread of passive or active crown fires and set those stands on a trajectory to be similar to conditions that were present prior to European settlement.

The objectives for establishing the desired stand conditions for the M Units in the FRZs are documented in the forestwide LSR assessment (USFS 1999) in "Chapter 4 Management Recommendations, Shaded Fuelbreak" (same as an FRZ) development. The emphasis is on interrupting fuel continuity through tree canopy spacing and treatments to reduce fuels.

The desired condition of stands in the M Units in the Eddy Gulch LSR Assessment Area was established using the SDI (Table 3-4), which is a tool for measuring stand health and for predicting future conditions. The desired condition SDI was described as 60 percent or less of the maximum SDI at 30 years after treatment for each forest type. This standard was used because it is the point where mortality (as a result of inter-tree competition) is initiated. When the SDI was established, other stand characteristics (such as basal area per acre and canopy cover) were calculated (see Table 3-6 in Section 3.2.5.1 below) and compared to the desired conditions described in Chapter 3 of the forestwide LSR assessment (USFS 1999).

Table 3-4. Desired stand structure for the upper third of slopes, as described in the forestwide LSR assessment.

Stand Structure	(Aspect)	Klamath Forestwide LSR Assessment Desired Condition	
		Basal Area (square feet per acre)	Canopy Cover (percent)
DF[a]	(NE[b])	185–220	40–60
DF	(SW)[c]	160–195	30
MC[d]	(SW)	210–245	25
True Fir	(NE)	300	40–60
True Fir	(SW)	No data	No data

Source: USFS 1999.
Notes: a. DF = Douglas-fir c. SW = southwest
b. NE = northeast d. MC = mixed-conifer

Chapter 3 of the forestwide LSR assessment (USFS 1999) contains descriptions of desired conditions for late-successional forest stands on the upper one-third of slopes for all LSRs on the Klamath National Forest (Table 3-4). "The descriptions are to be used to guide the development of the prescriptions, with development and maintenance of LS/OG [late-successional / old-growth] habitat as the ultimate objective of the treatment" (USFS 1999). The guides are for areas where habitat conditions are the primary objective.

The proposed variable-spacing thinning prescriptions were designed to achieve the forestwide LSR assessment objectives for shaded fuelbreaks (same as the FRZs), where the primary treatment objectives are fire/fuel related (USFS 1999, Chapter 4). The primary objective is to limit the potential of crown fires by interrupting vertical fuel continuity (ladder fuels) and tree crown contact (canopy spacing).

The variable-spacing thinning stand attributes were also compared with the guidelines for the "LS/OG" habitat attributes described in Chapter 3 of the forestwide LSR assessment (USFS 1999).

Additional emphasis would be given to retaining desired conifer species and all hardwoods. Post-treatment canopy cover would range from 32 to 50 percent (Table 3-5).

Table 3-5. General thinning prescriptions (for trees larger than 8 inches dbh) immediately after thinning.

Type (Seral Stage)	Basal Area[a] (square feet per acre)	Stand Density Index[b]	Approximate Tree Spacing (feet)	Canopy Cover (percent)
Douglas-fir (MS)[c]	132	189	25	48
Douglas-fir (LS)	191	244	28	50
White fir (MS)	190	262	23	37
White fir (LS)	200	251	29	38
Red fir (LS)	230	280	29	32
Mixed-conifer (LS)	200	254	28	50

Notes:

a. Basal area— the combined area of the cross sections of tree boles at a height of 4.5 feet above the ground, generally given as square feet per acre.

b. Stand Density Index—a measure of the density of a stand of trees based on the number of trees per unit area and dbh of the tree of average basal area.

c. MS = mid-successional (dominant and codominant trees generally 14–18 inches dbh); LS = late-successional (dominant and codominant trees generally larger than 18 inches dbh).

3.2.4.2 Remaining Portions of Treatment Units

The desired condition in remaining portions of the FRZs, Rx Units, and RS treatments along emergency access routes is to increase the resilience to fire by reducing ground and ladder fuels and removing hazard trees that may block ingress or egress routes during an emergency event.

The Salmon River Community Wildfire Protection Plan (CWPP) (SRFSC 2007) recommended the following canopy cover in conifer stands for shaded fuelbreaks along emergency access routes: late-successional: 70–100 percent; mid-successional (40–80 feet tall), 50–80 percent; and early successional (less than 40 feet tall), 50–70 percent. The Salmon River CWPP recommendations for canopy cover were used in the development of treatments along the emergency access routes located *outside of* the FRZs.

Outside FRZs. It is desirable that ground and ladder fuel trees that are cut along emergency access routes outside the FRZs are less than 10 inches dbh, but larger hazard trees may be cut if they present a safety hazard. Conifer trees could be thinned to a 20-foot spacing in young conifer stands that are generally less than 10 inches dbh. Under desired conditions, suppressed conifers less than 10 inches dbh will be cut in larger conifer stands if they are contributing to the fuel ladder. Smaller, suppressed hardwoods (generally less than 6 inches dbh) may be cut in some dense hardwood stands (mostly live oak) and dense young conifer / hardwood stands.

Inside FRZs and Rx Units. For fuel reduction areas inside FRZs but outside the M Units and in the Rx Units, there would be mastication of ladder fuels (conifer trees up to 10 inches dbh on slopes less than 45 percent) and potential removal of larger hazard trees in accordance with the Klamath National Forest Hazard Tree Policy (USFS 2005—included as Appendix C of this final EIS). The exception is conifer plantations where trees could be thinned to a 20-foot spacing.

3.2.4.3 Disturbances

Insects. It is desirable to continue to have insect levels in the LSR, but they are generally maintained at endemic levels. It is important that insects do not reach levels that will create situations that will prevent the long-term sustainability of late-successional habitats (USFS 1999).

Diseases. While it is desirable to have levels of mistletoe in late-successional stands, too much of the disease could cause problems with allowing regeneration to get established as stands begin to deteriorate. Historically, fire kept mistletoe at lower levels than what is observed in some areas today. Managers will have to be aware of some of the potential problems that may be encountered by allowing mistletoe levels to continue to increase in the coniferous vegetative types (USFS 1999).

Weather-related Events. Weather-related events will continue to affect stands in the LSR. It is desirable that fuel reduction activities, including salvage logging, occur following these events and where sufficient amounts of damage have led to undesirable increases in fuel loading.

3.2.5 Environmental Consequences

This section provides a summary of the direct, indirect, and cumulative effects of the three alternatives. For Alternatives B and C (the action alternatives), effects are discussed in terms of the prescriptions proposed for each treatment type. Prescriptions with similar effects on vegetation are grouped together for the purposes of this analysis:

- Mechanical thinning and removal;
- Mastication and hand cutting (used to treat only small trees, generally less than 10 inches dbh); and
- Underburning.

The detailed descriptions of the prescriptions for the various treatment types are presented in Chapter 2 of this final EIS for the Eddy Gulch LSR Project.

3.2.5.1 Alternative A: No Action

Stand Structure

Indicators: Basal Area, Stand Density Index, Tree Size, and Canopy Cover

Direct and Indirect Effects. Maintaining the existing stand structure under Alternative A would favor shade-tolerant species such as white fir and incense-cedar. Currently, the older strata (mid-successional / late-successional and late-successional) are densely stocked (Tables 3-6a, b, and c) and are starting to show signs of deterioration, as indicated by smaller crowns and minor to moderate tree mortality levels. With no treatment, these conditions would continue, with increasing levels of tree mortality during the 30-year analysis period (Table 3-7).

SDIs for all strata are currently above the lower limit of self-thinning—60 percent SDI (refer to Table 3-3 above). Under Alternative A, SDIs would drop closer to the lower self-thinning level during the 30-year analysis period because stocking would be reduced as a result of tree mortality (Table 3-7). The exception is the mixed-conifer stands, where the SDI would still be well above the 60 percent SDI level after 30 years.

Table 3-6. Stand structure for M Units: comparison of current and 5- and 30-year stand data for Alternatives A, B, and C.

Current Strata Data		Table 3-6a. Summary of Current Conditions for Stand Structure Indicators (Basal Area, SDI, Tree Size, and Canopy Cover)						
SAF[a] Forest Type	CWHR[b] Seral Stage	TPA[c] Total	TPA >10"[d]	BA/ac[e] >10"	Average dbh[f] >10"	TPA >24"	Canopy Cover (%)	SDI[g] (this is for TPA Total)
DF[h]	MS[i]	441	135	192	16.1	5	73	405
DF	MS/LS[j]	235	120	249	19.5	20	72	425
WF[k]	MS	299	190	302	17.1	9	61	506
WF	MS/LS	275	124	284	20.5	29	58	479
RF[l]	LS	613	113	350	23.8	43	59	643
MC[m]	LS	255	159	320	19.2	28	69	453

Current Strata Data		Table 3-6a. Summary of Current Conditions for Stand Structure Indicators (Basal Area, SDI, Tree Size, and Canopy Cover)						
SAF Forest Type	CWHR Seral Stage	TPA Total	TPA >10"	BA/ac >10"	Average dbh >10"	TPA >24"	Canopy Cover (%)	SDI (this is for TPA Total)
DF	MS	441	135	192	16.1	5	73	405
DF	MS/LS	235	120	249	19.5	20	72	425
WF	MS	299	190	302	17.1	9	61	506
WF	MS/LS	275	124	284	20.5	29	58	479
RF	LS	613	113	350	23.8	43	59	643
MC	LS	255	159	320	19.2	28	69	453

Projected Strata Data		Table 3-6b. Alternative A: Summary of Predicted Conditions in 5 Years					
SAF Forest Type	CWHR Seral Stage	TPA >10"	BA/ac >10"	Average dbh >10"	TPA >24"	Canopy Cover (%)	SDI (TPA >10")
DF	MS	135	205	16.7	6	62	319
DF	MS/LS	113	251	20.1	21	62	349
WF	MS	185	315	17.7	12	56	462
WF	MS/LS	122	296	21.1	29	52	404
RF	LS	111	357	24.3	43	49	461
MC	LS	105	247	20.8	26	59	339

Projected Strata Data		Table 3-6d. Alternatives B and C. Summary of Predicted Conditions in 5 Years Post Project					
SAF Forest Type	CWHR Seral Stage	TPA >10"	BA/ac >10"	Average dbh >10"	TPA >24"	Canopy Cover (%)	SDI[g] (TPA >10")
DF	MS	68	140	19.4	6	48	198
DF	MS/LS	56	198	25.4	22	50	251
WF	MS	80	201	21.4	12	37	273
WF	MS/LS	53	208	26.9	29	38	257
RF	LS	52	235	28.7	33	32	284
MC	LS	57	206	25.7	28	50	260

Projected Strata Data		Table 3-6c. Alternative A: Summary of Predicted Conditions in 30 Years					
SAF Forest Type	CWHR Seral Stage	TPA >10"	BA/ac >10"	Average dbh >10"	TPA >24"	Canopy Cover (%)	SDI (TPA >10")
DF	MS	117	246	19.7	21	65	345
DF	MS/LS	94	267	22.8	26	62	354
WF	MS	145	355	21.2	36	56	484
WF	MS/LS	106	335	24.0	41	54	434
RF	LS	90	362	27.1	56	47	447
MC	LS	88	249	22.7	27	58	330

Projected Strata Data		Table 3-6e. Alternatives B and C. Summary of Predicted Conditions in 30 Years Post Project					
SAF Forest Type	CWHR Seral Stage	TPA >10"	BA/ac >10"	Average dbh >10"	TPA >24"	Canopy Cover (%)	SDI (TPA >10")
DF	MS	66	183	22.6	22	54	243
DF	MS/LS	55	226	27.5	29	54	279
WF	MS	74	254	25.1	38	42	323
WF	MS/LS	49	239	30.0	41	40	284
RF	LS	48	255	31.3	41	33	298
MC	LS	55	233	27.9	33	53	285

Notes:

a. SAF = Society of American Foresters
b. CWHR = California Wildlife Habitat Relationship
c. TPA = trees per acre
d. > = greater than
e. BA = basal area per acre
f. dbh = diameter at breast height
g. SDI = stand density index
h. DF = Douglas-fir
i. MS = mid-successional
j. LS = late-successional
k. WF = white fir
l. RF = red fir
m. MC = mixed-conifer

Table 3-7. Eddy Gulch LSR strata data and stand structure: current, 30-year desired conditions, and 30-year conditions post-thinning in M Units and with no treatment.

Species Composition Strata Data		Stand Structure						
				Trees Greater Than 10 Inches dbh				
							FVS Predicted 30-year Tree Mortality (per acre)	
SAF[a] Forest Type	CWHR Seral Stage	Desired Current SDI 35%	All TPA[b] Current SDI	Desired SDI[c] at 30 Years SDI 60%	FVS[d] Predicted SDI at 30 Years Post Thinning	FVS Predicted SDI at 30 Years No Treatment	Post Thinning	No Treatment
DF[e]	MS[f]	210	405	≤360	243	345	-2	-16
DF	MS/LS[f]	210	425	≤360	279	354	-1	-19
WF[e]	MS	266	506	≤456	323	484	-6	-40
WF	MS/LS	266	479	≤456	284	434	-4	-16
RF[e]	LS	280	643	≤480	298	447	-4	-21
MC[e]	LS	150	415	≤258	285	355	-2	-71

Notes:

a. SAF = Society of American Foresters
b. TPA = trees per acre
c. SDI = stand density index
d. FVS = Forest Vegetation Simulator
e. DF = Douglas fir; WF = white fir; RF = red fir; MC = mixed-conifer
f. MS = mid-successional; LS = late-successional

Over the 30-year analysis period, species composition would change in the Douglas-fir strata, with the Douglas-fir percent increasing and the hardwoods decreasing. The decrease in the percent of hardwoods would be a result of increased competition from the dense conifer tree stocking. In the white fir strata, the percent of white fir would increase with a reduction in the amount of red fir. A major change from red fir to white fir would occur in the red fir stand. The mixed-conifer stand that is heavy with ponderosa pine would continue to increase the percent of ponderosa pine, basically changing to a ponderosa pine type (Table 3-8).

The larger trees in the older strata (MS/LS and LS) are densely stocked and are starting to show signs of deterioration, as indicated by smaller crowns and minor to moderate tree mortality levels. These conditions would continue with increasing levels of tree mortality (Table 3-7). The smaller trees are heavily suppressed and mortality would be high.

During the 30-year analysis period (without treatment), mortality would reduce the number of trees greater than 10 inches dbh per acre by 14–24 percent in Douglas-fir and true fir stands. The loss of trees would reduce the canopy cover by 4–12 percent. At 30 years, 45 percent of the trees greater than 10 inches dbh would have died in the mixed-conifer stands. The basal area would be reduced; however, the SDI would still be above the desired condition, meaning mortality would continue. In all stands, most trees that had died during the first 5–10 years would fall, thereby increasing ground fuels, while most of the remaining standing trees would increase ladder fuels (Tables 3-6a, b, and c).

Basal areas would increase in all strata over the 30-year analysis period (without treatment), except in the mixed-conifer stands (Tables 3-6a, b, and c above). The basal area and number of larger trees (greater than 24 inches dbh) would increase as the residual trees continued to grow. The exception would be in the mixed-conifer stands where the high mortality would reduce the basal area and canopy cover. Any trees that died during this period would increase ladder fuels if they remain standing, and if they fall, would eventually increase large-material ground fuel loading.

Table 3-8. Percent species by strata: current, no thinning, and with thinning.

Strata / Year	Treatment	Douglas-Fir (%)	White Fir (%)	Red Fir (%)	Ponderosa Pine (%)	Sugar Pine (%)	Incense-Cedar (%)	Hardwoods (%)
Douglas-fir – mid-successional								
2008	Current	67			5			14
2038	No thinning	71			14			8
2038	With thinning	60			15			20
Douglas-fir – mid-successional / late-successional								
2008	Current	74	4			2		18
2038	No thinning	83	3			5		5
2038	With thinning	74			4	9		9
White fir – mid-successional								
2008	Current	6	77	16				
2038	No thinning		76	23				
2038	With thinning		80	19		3		
White fir – mid-successional / late-successional								
2008	Current	6	73	15		3		
2038	No thinning	5	80	8			3	
2038	With thinning	9	68	8			6	
Red fir – late-successional								
2008	Current		20	80				
2038	No thinning		63	37				
2038	With thinning		51	49				
Mixed-conifer – late-successional								
2008	Current	12			70	18		
2038	No thinning	8			90	2		
2038	With thinning	23			69	8		

Canopy cover in all stands would drop 5–10 percent during the 30-year analysis period (Tables 3-6a, b, and c above) as a result of self-thinning or disturbance events.

Comparison with Late-Successional Guidelines. The Douglas-fir stands and mixed-conifer stands currently exceed the basal area and canopy cover guidelines (refer to Table 3-4) contained in the forestwide LSR assessment (USFS 1999).

For true fir stands, the forestwide LSR assessment only lists the stand basal area guidelines for stands located on north and east aspects. The canopy cover guidelines apply to all aspects and positions on the slope. Approximately 80 percent of true fir strata acres in M Units are located on south or west aspects. The true fir stands are currently at guideline levels. SDI calculations and field stand examinations indicate that minor to major amounts of tree mortality are occurring (the red fir stand being the worst). SDI data indicates that, with no treatment, tree mortality would increase during the 30-year analysis period (refer to Table 3-6).

Effects from Disturbance

Insects. Changes in insect activity usually are a result of stresses on a tree or stand. These stresses include overcrowding, drought–moisture stress, and fire. Until a stress factor exists, insect levels would remain at background, generally low, endemic levels. Current beetle activity is at or below the average endemic level. Beetle population levels tend to be variable, depending on many factors, including weather and tree damage and health. It is anticipated that the beetle population levels would tend to increase with the anticipated reduction in tree vigor and increase in tree mortality under Alternative A.

Diseases. Diseases also need a stress factor to occur at more than background levels, where individual or small groups of trees of low vigor are attacked. Cytospora and dwarf mistletoe are well established in portions of the Assessment Area. Cytospora will tend to decline as the diseased red fir trees slowly die out and are mostly replaced by white fir. Dwarf mistletoe would continue to affect tree vigor and mortality in portions of the Assessment Area, with a minor increase during the 30-year analysis period. Both sugar pine blister rust and fomes annosus are minor in scope and are projected to remain so during the 30-year analysis period.

Wind and Snow Events. Wind and snow events have historically occurred in the Assessment Area and have caused variable levels of damage in the conifer stands. The heavy wind and snow events that occurred during the 2007/2008 winter season caused minor to moderate damage to several isolated stands. These events will continue to occur during the 30-year analysis period with unpredictable amounts of damage and increases in fuels.

Effect of Climate Change. Climate change will increase temperatures, the length of the fire season, and the number of acres burned (Lenihan et al. 2006; Westerling and Bryant 2006). Increases in temperature would result in replacement of Douglas-fir forests with Douglas-fir-oak forests (Lenihan et al. 2006). An increase in fire season length would increase the number of acres burned and mortality in conifer stands, leading to conversion to brushfields.

Changes resulting from temperature variations would likely be minor over the 30-year analysis period; however, changes in fire behavior could be substantial, dependent on the frequency and size of fires. Overall, the effects on the trees during the 30-year analysis period would be minor to moderate.

Cumulative Effects. Most other actions that may occur in the future would have little effect on forest vegetation, when considered at the landscape scale. The stands would remain overstocked until sufficient mortality occurs as a result of self-thinning or a wildfire. Changes in stand characteristics that occur from self-thinning would vary depending on stand age and condition. The reduction in the number of trees per acre from self-thinning in the younger, mid-successional stands would be beneficial in that it would reduce tree competition for nutrients, water, and sunlight. A reduction in the number of trees per acre in the older, late-successional stands would be detrimental if the stocking drops below the desired stocking level. These changes would occur gradually over time and would be a minor to moderate benefit in the younger stands and a moderate to major adverse effect in the older stands. In either case, the tree mortality would create additional ground and ladder fuels that would contribute to fire severity in the stands. The moderate to major adverse effects resulting from a wildfire would be immediate and long term.

Taking no action would affect each stratum and stand differently and at different times. Taking no action could eventually result in conditions that allow an insect or disease epidemic to occur. Different insects attack different species; for example, mountain pine beetles, western pine beetles, and Ips beetles (a genus of pine bark beetles) attack pine; Douglas-fir bark beetles attack Douglas-fir;

and spruce bud worms and scolytus beetles attack Douglas-fir and true firs. All need specific conditions to weaken trees to the point that an epidemic can happen. Mixed-conifer and Douglas-fir stands are currently overcrowded. A multiyear drought could trigger an epidemic.

Large high-intensity wildfires could create a breeding ground for insects or diseases to build to an epidemic level. These populations could then attack surviving trees that were weakened by the fire. With predictions for warmer temperatures and possibly less precipitation in the future, it would be more likely that insects would find more stressed trees to infest.

Construction of a fuelbreak system west Black Bear Ranch would have no effect on stand conditions in the Assessment Area and alone would have little effect on reducing the size or intensity of a wildfire.

Conclusion. The inter-tree competition that would continue under the no-action alternative would kill individual trees, resulting in long-term minor to moderate adverse effects at the landscape or ecosystem level. A wildfire would have immediate adverse effects that would continue over the long-term. A wildfire would have major adverse effects on individual stands burned by active crown fires, but the effects would be minor to moderate at the landscape level. In the long term, the increased mortality would increase fuels and contribute to higher-severity fires. The fires would result in substantially more mortality, which would result in long-term major adverse effects at the landscape or ecosystem level. Similarly, a drought that triggers an insect or disease epidemic would have long-term major adverse effects at the landscape or ecosystem level.

3.2.5.2 Alternative B: Proposed Action and Alternative C: No New Temporary Roads Constructed

Both action alternatives are addressed together because effects would be similar. Under Alternative C, approximately 99 fewer acres would be treated by mechanical thinning than under Alternative B because the 1.03 miles of new temporary roads would not be constructed. Maps showing the proposed treatment units under Alternatives B and C are contained in Appendix B of the Silviculture Report.

Direct and Indirect Effects: Stand Structure
Indicators: Basal Area, Stand Density Index, Tree Size, and Canopy Cover

Mechanical Thinning and Removal in M Units. The thinning prescriptions (refer to Tables A-1 and A-2 in the Silviculture Report) would reduce the SDIs of all strata to below or close to the 35 percent SDI (lower limit of full site occupancy), except in the mixed-conifer stand. The 30-year projection of SDIs indicates that all strata (except mixed-conifer) would be below the lower limit of self-thinning (60 percent SDI) (refer to Tables 3-6d and e).

The mixed-conifer stand is an older, larger tree stand that is currently very heavy with ponderosa pine and sugar pine (88 percent). The 30-year projection is that the percent of Douglas-fir would increase from 12 to 23 percent. The actual SDI for the stand would then be higher, given the higher SDI for Douglas-fir. The 30-year SDI for the stand would probably be slightly above the 60 percent SDI.

The thinning prescriptions would reduce the strata densities for trees greater than 8 inches dbh by increasing the average spacing between trees (Table 3-9). White fir, Douglas-fir, red fir, and incense-cedar would be the primary species removed, but some ponderosa pine and a limited number of sugar pine may also be removed.

Table 3-9. Average spacing between trees.

Strata* / Year	Alternative A No Action (tree spacing in feet)	Alternatives B and C With Thinning (tree spacing in feet)
DF MS		
5 years	18	25
30 years	19	26
DF MS/LS		
5 years	20	28
30 years	22	28
WF MS		
5 years	15	23
30 years	17	24
WF MS/LS		
5 years	19	29
30 years	20	30
RF LS		
5 years	20	29
30 years	22	30
MC LS		
5 years	20	28
30 years	22	28

Note: *DF = Douglas fir, WF = White fir, RF = Red fir, MC = Mixed-conifer, MS = Mid-successional, LS = Late-successional

After thinning, the percent of Douglas-fir (refer to Table 3-8 above) in the young Douglas-fir strata would be reduced, with a corresponding increase in the percent of hardwoods as the thinning reduces the number of conifers per acre, which lessens the current competition with the hardwoods. The percent of Douglas-fir in the older strata would remain the same as the current percent of Douglas-fir. The amount of hardwoods would continue to drop as a result of the longer period of competition from the conifers, which has reduced the hardwood trees crown size and vigor. However, the amount of hardwoods would still be higher than under the no-action alternative.

The largest trees in the M Units (refer to Tables 3-6a, d, and e above) would be retained, while generally the smaller trees would be removed, or if less than 8 inches dbh, would be thinned by underburning. Layering would be reduced. Five years after treatment, the number of trees greater than 10 inches dbh would be reduced (compared to the current stands) by 48 to 58 percent in Douglas-fir and true fir stands and 65 percent in mixed-conifer stands. This would reduce the basal area but increase the average dbh in each stand. Trees greater than 24 inches dbh would remain the same or increase, except in the red fir stands, where the number would decline by 25 percent as a result of thinning the clumps of larger trees. Canopy cover would be reduced, and the desired SDI would be achieved.

There would be little change in the number of trees greater than 10 inches dbh 30 years after treatment compared to the number of trees 5 years after treatment. However, the basal area, average dbh, and number of trees greater than 24 inches dbh would increase in all stands as a result of reduced competition and higher growth rates. The desired SDI would be achieved in all stands, except mixed-conifer.

The thinning treatments would reduce the strata densities for trees greater than 10 inches dbh by increasing the average spacing between trees (refer to Table 3-9 above). Ladder fuels would be reduced as a result of thinning from below to remove materials greater than 8 inches dbh. Tree mortality for the 30-year analysis period would be greatly reduced (refer to Table 3-7 above).

The thinning treatments would reduce the basal areas in all strata (refer to Tables 3-6a, d, and e above). The basal areas would continue to be less than they would under the no-action alternative during the 30-year analysis period.

The thinning treatments would initially reduce canopy cover by 15 to 20 percent (refer to Tables 3-6a, d, and e above), but it would increase back to the 40 to 55 percent range within the 30-year analysis period. The exception is the older, very decadent red fir stand that is heavily infested with cytospora and dwarf mistletoe. The proposed thinning would reduce the canopy cover by approximately 25 percent and remain at that level during the 30-year analysis period.

Comparison with Late-Successional Guidelines. The Douglas-fir and mixed-conifer stands would meet the forestwide LSR assessment guidelines for basal area and canopy cover at 5 years post-treatment, as shown in Table 3-10. The exception is the younger Douglas-fir mid-successional strata basal area. These strata would meet the basal area desired conditions within 30 years.

Table 3-10. Desired conditions for forest stands on the upper third of slopes compared with stand conditions at five years post-treatment.

	Klamath Forestwide LSR Assessment Desired Conditions		Eddy Gulch LSR Alternatives B and C at Five Years Post-Treatment		
Forest Type (Aspect)	**Basal Area (square feet per acre)**	**Canopy Cover (percent)**	**Forest Type (Successional Stage)**	**Basal Area (square feet per acre)**	**Canopy Cover (percent)**
DF[a] (NE[b])	185–220	40–60	DF (MS[e])	140	48
DF (SW)[c]	160–195	30	DF (MS / LS[f])	198	50
MC[d] (SW)	210–245	25	MC (LS)	206	50
True Fir (NE)	300	40–60	WF[g] (MS)	201	37
			WF (MS / LS)	208	38
			RF[h] (L / S)	235	32
True Fir (SW)	No data	No data	WF[g] (MS)	201	37
			WF (MS / LS)	208	38
			RF[h] (L / S)	235	32

Notes:

a. DF	=	Douglas-fir	f. LS	=	late-successional
b. NE	=	northeast	g. WF	=	white fir
c. SW	=	southwest	h. RF	=	red fir
d. MC	=	mixed-conifer	e. MS	=	mid-successional

The true fir stands (white fir) are close to the canopy cover guideline level (in the forestwide LSR assessment) for shaded fuel breaks (the FRZs). The red fir stands would be approximately 8 percent below the guidelines due to the advanced tree mortality already occurring in the stand. The basal area levels would be approximately 20 to 30 percent below the late-successional habitat guideline. The lower basal area level is prescribed to meet the tree spacing objective for FRZs.

The prescribed lower values for stand attributes in white fir and red fir stands in the Eddy Gulch LSR are more consistent with descriptions of stand characteristics prior to European settlement (Taylor and Skinner 1998). They contribute to increasing resistance to wildfires (Millar et al. 2007), particularly by reducing the probability of passive and active crown fires. The prescribed lower values would also contribute to lower mortality as the climate becomes warmer in the future.

Mastication and Hand Cutting. The mastication and hand cutting treatments proposed under Alternatives B and C would be located on slopes less than 45 percent. The treatment would involve trees less than 10 inches dbh. The number of trees per acre would be reduced, leading to a reduction in inter-tree competition. The effect on canopy cover would be minor.

Underburning. Underburning would be used on slopes greater than 45 percent in the FRZs and in the Rx Units to remove trees less than 4 inches dbh. These treatments would reduce fuel hazards but would not affect the species composition, average tree size, or have little effect on canopy cover.

Effects from Disturbance

Insects. Current beetle activity is at or below the average endemic level. Beetle population levels tend to be variable, depending on many factors, including weather, tree damage, and health. The thinning treatments would reduce inter-tree competition and the potential for tree mortality by removing most of the trees that are projected to die in the no-treatment 30-year analysis. Long-term beetle activity in these stands would be less than under the no-action alternative due to the reduction in inter-tree competition. All treatments would contribute to increased tree vigor over the long term—a beneficial effect—which would reduce the probability of insect attack. However, there could be a short-term increase in insect activity immediately after thinning, resulting from an increase in recently down fuels (logging slash and/or trees killed by underburning).

Disease. All treatments would increase tree vigor. This would result in a reduced probability of successful insect attack—a beneficial effect. However, if thinning and mastication are not done carefully, mechanical injuries to residual trees could result in pathogens attacking these trees. The thinning prescriptions would remove a large number of red fir infected with cytospora and dwarf mistletoe. The remaining infected red fir would continue to slowly deteriorate as additional branches die and until the trees weaken to the point where mortality occurs. The mortality level during the 30-year analysis period would be minor. The thinning treatments would not change the status of the blister rust from the no-action alternative.

Implementation of the thinning treatments would increase the possibility of fomes annosus infections in the true fir stands through the creation of stumps and some residual tree bole damage. Tree growth would be slowed if infections occurred, but any associated tree mortality would mostly occur beyond the 30-year analysis period. The affects would be within the habitat objectives for an LSR.

Wind and Snow Events. The thinning treatments would result in more open stands, and depending on location, the residual trees would be more exposed to the wind. Field observations by the silviculturist during the 2008 field season indicate that previously thinned stands have a minor increase in damage when compared to stands that have not been thinned.

Climate Change. The thinning treatments would reduce inter-tree competition—a beneficial effect—which would help reduce the effects of climate change on these stands. This could reduce the overall affects on the treated stands to a minor level during the 30-year analysis period.

Cumulative Effects. The ongoing and future projects would have little to no effect on forest vegetation in the Assessment Area.

Conclusion. Mechanical thinning, mastication, and underburning would all result in a major improvement in the health and vigor of residual trees at a landscape or ecosystem scale; therefore, beneficial effects would be moderate to major over the long term. Mechanical thinning, especially, would create more open stands, which would reduce the potential for crown fires and which would be more similar to stand conditions that occurred prior to European settlement, thus mimicking historic disturbance patterns. The M Units would be located along ridgetops, where the most open stands were historically located. Each treatment would affect the stands to different degrees, increasing tree species diversity in stands in the Assessment Area. Mechanical thinning would reduce current basal area stocking by 25 to 45 percent and canopy cover by about the same amount. Mastication and underburning would reduce basal area by about 2 to 13 percent, with a minor change to canopy cover.

3.3 Fire, Fuels, and Air Quality

3.3.1 Introduction

This document summarizes forest fuels and fire behavior in the Eddy Gulch Late-Successional Reserve (LSR) Project Assessment Area. The description includes the historical fire regime, current fuel hazards and resulting fire behavior, and the effects from taking no action (Alternative A) or from implementing Alternative B (Proposed Action) or Alternative C. This document also discusses the current air quality status for Siskiyou County and the potential effects on air quality from taking no action or from implementing the project under either action alternative.

3.3.2 Methodology: Fire and Fuels

3.3.2.1 Analysis Methods and Assumptions

Stewardship Fireshed Analysis. Initially, a number of key documents were reviewed to understand the fuel conditions and fire potential in the Eddy Gulch LSR Project Assessment Area; those documents include the Klamath Land and Resource Management Plan (Klamath LRMP) (USFS 1995), Klamath National Forest Forestwide Late-Successional Reserve Assessment (forestwide LSR assessment) (USFS 1999), Salmon River Community Wildfire Protection Plan (CWPP) (2007), Black Bear (2002) and Rainbow (2003) Cooperative Fire Safe Plans, Klamath National Forest Fire Management Plan (2004), and historic reference conditions for the Eddy Gulch LSR. The interdisciplinary (ID) team's fuels specialists reviewed line officer direction and currently proposed and past fuels treatment projects and silvicultural projects within the Eddy Gulch LSR Assessment Area, the remainder of the LSR, and adjacent areas that could impact or be impacted by fuel treatments or wildfires.

A Stewardship Fireshed Analysis (SFA) (Callenberger and Henderson 2008, see Attachment 1 of the fuels report) for the Eddy Gulch LSR Project was conducted to evaluate weather patterns, identify fire behavior and protection targets, and test and evaluate treatments. The evaluation area included the former boundary of the old Salmon River Ranger District. Field work in 2007 and 2008 involved gathering data for the SFA and evaluating potential protection targets, potential fuel treatment patterns, and roadside fuel treatments for safe ingress for suppression forces and egress by residents during a wildfire. The field work included inventories of dead and down (ground) fuels, ladder fuels, and crown fuels in 50 plots scattered throughout the Assessment Area (Table 3-11). These plots were used to select the appropriate fuel models used in fire behavior modeling, which was used to assess fire behavior potential before and after treatment and at 20 years post-treatment.

After stand inventories were completed and analyzed using the Forest Vegetation Simulator (FVS), information from FVS and the fuel profile inventories (data plots) were used to evaluate prescriptive fire treatments that could be implemented to meet project objectives (see Section 3.2 above or the Silviculture Report for more information about FVS.) Numerous fire modeling tools were used for the analysis:

- All current fire behavior indicators and crown bulk density were calculated with FMAPlus;

Table 3-11. Examples of fuel models that represent a majority of the Assessment Area and pose the high hazard in the Assessment Area.

Fuel Model TU5(165): Very High Load Dry Climate Timber Shrub The primary carrier of fire is heavy forest litter with a shrub or small tree understory.	
Fuel Model TL3(183): Moderate Load Conifer Litter The primary carrier of fire is moderate load conifer litter.	
Fuel Model SH2(142): Moderate Load Dry Climate Shrub The primary carrier of fire is woody shrubs and shrub litter.	

- Fire behavior in the Assessment Area was simulated using 90th percentile weather conditions and Fire Management Analyst, Nexus, Behave, FARSITE, and FLAMMAP; fire behavior indicators at 20 years were calculated with FVS–fire and fuels extension;
- Fire types were calculated with FLAMMAP; and
- Spatial analysis of fires was calculated with FARSITE (a fire and growth simulator).

Weather inputs were developed at a fireshed workshop attended by the USDA Forest Service Region 5 Stewardship Fireshed Assessment Team, the fire management staff for the Salmon River and Scott River Ranger Districts, and the ID team (fire and fuels, silvicultural, and wildlife specialists). Fire behavior in the Assessment Area was simulated using 90th percentile weather conditions and Fire Management Analyst, Nexus, Behave, FARSITE (a fire and growth simulator), and FLAMMAP. Weather data for fire behavior modeling included the hourly wind files from the Blue Ridge Remote Automated Weather Station (RAWS) for July 23–30, 2006. After consultation with local fire and fuels experts, the 90th percentile weather was modified by increasing wind speeds because higher wind velocities influenced fire behavior during recent wildfires and would be expected ahead of and after weather fronts and thunderstorms. Fuel moisture levels were developed using 90th percentile weather data from the Blue Ridge RAWS from July 1 through October 31, 2006—the primary fire months. Fire behavior information from three large fires (Uncle, Hancock, and Rush fires) that occurred in 2006 were used to validate the model results. The Uncle, Hancock, and Rush fires were used because of the availability of sufficient fire behavior data, as well as weather data. Also, the Forest Service fire specialist considers these fires to be typical examples of the current fire behavior.

The data produced for the Eddy Gulch LSR SFA are used throughout this report and were crucial for

- identifying the problem fire for the LSR based on fuels, weather, and topography and for articulating the need for the Eddy Gulch LSR Project;
- identifying protection targets; and
- designing and testing fuel treatments (which ultimately became the Proposed Action described in this final EIS) and patterns and displaying trade-offs.

During spring and summer of 2008, potential fire behavior was reviewed by the ID team, and the fuels team conducted additional field surveys to review and validate fuel models and fuel hazards. Prescriptions and fuel reduction treatments were also reviewed during the field reconnaissance.

Protection Targets. One objective of the SFA for the Eddy Gulch LSR Project was to identify community, cultural, and natural resources that should be protected—these are referred to as “protection targets” (refer to Table 3-12). These targets are based on protection of life and property first and then other high-value resources identified by the ID team, United States Fish and Wildlife Service (USFWS), and Salmon River CWPP. These targets are of critical concern to the public and agencies (such as the Forest Service, CalFire, and volunteer fire departments) tasked with providing fire protection inside the Klamath National Forest.

Table 3-12. Examples of protection targets identified in the SFA.

Protection Target
Public Safety and Infrastructure: Provide safe travel routes for the public and suppression forces; provide protection of infrastructure and municipal watersheds.
Other High-Value Resources: Private lands, northern spotted owl (NSO) core areas, late-successional habitat characteristics (and especially “remnant” old-growth stands); Key Watersheds, including areas of late-successional habitat that could sustain late-successional characteristics.
Plantations: Represent previous Forest Service investments in maintaining forest cover in the Eddy Gulch LSR.

Public Safety and Infrastructure—Cecilville and Sawyers Bar are listed in the *Federal Register* (2001) as communities at risk from a wildfire. Both communities are located within 1.5 miles of the LSR. The Salmon River CWPP identifies domestic watersheds and infrastructure improvements that are either in the LSR or potentially threatened by fire events coming from the LSR.[1] The CWPP also identifies roads that pass through the LSR as important for serving as emergency access routes to evacuate residents and bring in suppression resources in the event of a large fire threatening the communities. The nearby community of Forks of Salmon and its infrastructure could also be threatened by fire events outside of or emanating from the LSR.

Other High-Value Resources—

- **Private lands, NSO core areas, late-successional habitat characteristics (and especially "remnant" old-growth stands.** The results of FLAMMAP modeling show that all NSO activity centers, either partially or entirely within the Assessment Area, are susceptible to either passive or active crown fire (see the Wildlife and Habitat Report for the Eddy Gulch LSR Project). Fuel hazards can rapidly increase due to several types of natural disturbance (such as insect infestations, diseases, blow down, fires, or any combination of natural disturbances, including drought), thereby rapidly increasing the potential for an escaped fire in the LSR. Late-successional stands are generally resistant to stand-replacing fires; however, threats still remain to individual trees where heavy lavers of bark sluff and duff around the base can increase temperatures of fires and tree mortality.

- **Key Watersheds.** According to the Salmon River CWPP (SRFSC 2007), the Salmon River Key Watershed is the highest wildfire risk watershed in the Klamath Basin, and the Eddy Gulch LSR is a part of that watershed. An analysis completed for the CWPP found that over 408,000 acres of the 480,000-acre Salmon River Key Watershed have burned since 1910 (SRFSC 2007).

Plantations—There are approximately 3,900 acres of plantations that were planted between 1963 and 1990 in the Eddy Gulch LSR (Table 3-13). The stands in plantations are more susceptible to stand-replacing intensities because the lowest limbs of these younger trees are generally less than 4 feet above the ground fuels.

Table 3-13. Plantations inside and outside the Eddy Gulch LSR Assessment Area.

Locations of Plantations	Acres
Eddy Gulch LSR (including Assessment Area)	3,918
Assessment Area	3,493
In 1,320-foot LSR Buffer	889

1. The Salmon River Fire Safe Council sponsored development of the Salmon River CWPP (SRFSC 2007). Cooperators on the CWPP include community members, the U.S. Forest Service, CalFire, other managing agencies, Karuk Tribe, Salmon River Volunteer Fire and Rescue, Orleans/Somes Bar Fire Safe Council, and Salmon River Restoration Council. Starting in December 2000, the Salmon River Fire Safe Council held monthly meetings to deal with many issues, including development of detailed community and neighborhood fire safe plans; water tanks and hydrant systems; water source (tanker fill sites) identification, mapping, and signing; road signing; private properties universal number signage; helispot location and mapping; community outreach and education; training; and general cooperation and information sharing with stakeholders and agencies.

3.3.2.2 Scope of the Analysis

Analysis Area. The analysis area for fire and fuels analysis (Map A-1 in Appendix A of this report) includes the entire Eddy Gulch LSR Project Assessment Area; the communities of Cecilville, Sawyers Bar, and associated WUI areas that are included in the Salmon River CWPP; and hazardous conditions outside the LSR.

Analysis Period. Fire behavior was modeled for current conditions, immediately after treatment, and at 20 years after treatment.

3.3.2.3 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout this effects analysis are described below.

Negligible. Effects would be at the lowest levels of detection and would have no appreciable effect on resources, values, or processes.

Minor. Effects would be perceptible but slight and localized.

Moderate. Effects would be readily apparent and widespread and would result in a noticeable, but temporary, change to resources, values, or processes.

Major. Effects would be readily apparent and widespread and would result in a substantial alteration or loss of resources, values, or processes and would likely be permanent.

3.3.2.4 Measurement Indicators

Three indicators were used to assess current conditions and the effects of the forest fuel treatments: ground fuels, ladder fuels, and crown fuels. Changes in each indicator were quantified with measurements of fuel conditions or fire behavior (Table 3-14). Additionally, other indicators were used to determine how well an alternative met the purpose and need, including acres resistant or resilient to a wildfire, fire type, acres of fuelbreak constructed, miles of emergency access route treated, and acres of wildland urban interface treated.

Table 3-14. Indicators and their measurements to describe effects among the alternatives.

Indicator	Measurement
Ground fuels	Fuel load, flame length, or rate of spread
Ladder fuels	Crown base height
Crown fuels	Crown bulk density

Indicator: Ground Fuels—

Measurement: Fuel load. The weight of dead and down woody fuel measured in tons per-acre. The weight of standing brush tree boles and foliage can also be predicted if all or a portion is expected to be added to the dead and down fuel loading. Fuel loading is used to predict fire behavior by using the current and expected fuel loading to select the correct fuel model to use in fire behavior prediction systems. Components of fuel loading include fuel sizes and their proportion, arrangement, and continuity. Total fuel is all fuel, both living and dead, present on a site. Available fuel is the amount of fuel that will burn under a specific set of fire conditions.

Measurement: Flame Length. This is the length of flame measured in feet, from the base of the flame to the tip of the flame. Longer flame lengths increase resistance to control and the likelihood of torching events and crown fires. Flame length is influenced by fuels; weather and topography; fuel moisture volume in ton per-acre; and the type of fuel, dead and down or live; and presence of volatile resins in living vegetation, which are not a factor in this area. Other important influences are arrangement and continuity of fuels. A compact layer of ground fuel burns hot but the flame length is shorter than a fuel bed that is not compact. When flame lengths are long enough to ignite brush and small trees, torching of the largest trees becomes possible and flame lengths will increase dramatically. As illustrated in Table 3-15, increasing flame lengths above 4 feet may present serious control problems to firefighters, they are too dangerous to be directly contained by hand crews (Schlobohm and Brian 2002; Anderson 1982). Flame lengths over 8 feet are generally not controllable by ground-based equipment or aerial retardant and present serious control problems, including torching, crowning, and spotting.

Table 3-15. Relationship between flame length and potential for success of active suppression.

Flame Length	Description
Less than 4 feet	Fires can generally be attacked at the head or flanks by firefighters using hand tools. A hand line should hold the fire.
4–8 feet	Fires are too intense for direct attack at the head with hand tools. A hand line cannot be relied on to hold the fire. Bulldozers, engines, and retardant drops can be effective.
8–11 feet	Fire may present serious control problems, such as torching, crowning, and spotting. Control efforts at the head will probably be ineffective.
Greater than 11 feet	Crowing, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Source: NWCG 2004.

Measurement: Rate of Spread. Rate of spread is the horizontal distance that the flame zone moves per unit of time (feet per minute) and usually refers to the head fire segment of the fire perimeter. It is directly related to the amount of heat received by the fuels ahead of the flaming zone, and the heat is a function of the energy release rate per unit area of fire front. Rate of spread is strongly influenced by fuels, winds, and topography—it generally increases with increasing wind speed, slope, and amount of fine fuels.

Indicator: Ladder Fuels—

Measurement: Crown Base Height. Crown base height (CBH) is the distance from the ground to the lowest limbs of conifers or hardwoods. It indicates at what flame length trees will torch. When small trees or brush torch, they frequently serve as a catalyst that causes larger adjacent trees to torch up to the largest trees. Fuel loading, low CBHs and dense stands of trees are high risk areas for torching and active crown fire. Dense stands of conifers with low CBHs are indicative of the absence of natural-occurring fires or prescribed fire and usually include high numbers of white fir that can germinate and grow in shady conditions—this is referred to as shade-tolerant, fire-intolerant species.

Indicator: Crown Fuels—

Measurement: Crown Bulk Density. Crown bulk density (CBD) measures the amount of fuel in the crowns of individual trees or stands. High CBD indicate crown fires are readily propagated through the entire stand.

3.3.3 Affected Environment (Existing Conditions): Fire and Fuels

3.3.3.1 Fire Regime Condition Class

Fire Regime Condition Class (FRCC) is a classification of the amount of departure from the natural (historical) fire regime and is important for comparing pre-European conditions with current conditions in the Eddy Gulch LSR. Appendix B of the Fuels and Air Quality Report provides an explanation of FRCC as described by the National Interagency FRCC and the Landscape Fire and Resource Management Planning Tools Project (LANDFIRE) groups. Descriptions of the departure from the historic pattern in the Eddy Gulch LSR are based on earlier work by Taylor and Skinner (1998) and Skinner et al. (2006) and more recent work by M. Creasy (unpublished report for the Northern Province Ecology Program, June 24, 2008).

FRCC 3 makes up 67 percent of the Eddy Gulch LSR (Table 3-16) and is described as, “Fire regimes have been significantly altered from their historical range.” Under FRCC 3, the risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals—this results in dramatic changes to one or more of the following: fuel composition and fire size, frequency, intensity, severity, and pattern. Vegetation attributes have been significantly altered from their historical range. While the increased stand density and downed wood associated with this alteration can be desirable for some late-successional forest-related species, the NSOs and other species in the California Klamath Province have been shown to be more adapted to this area’s naturally frequent, low-intensity fires than individuals in the more northern provinces of the NSO’s range.

Table 3-16. Percent of acres within each FRCC, Eddy Gulch LSR.

Condition Class	Acres	Percent of the Area
1	2,890	4.6
2	17,763	28.4
3	41,957	67.0
	62,610	100.0

Note: The Eddy Gulch LSR is approximately 62,650 acres. The acres in FRCC total about 62,610. There is an approximate 40-acre discrepancy because some polygons were not included in the FRCC data.

Approximately 28 percent of the Eddy Gulch LSR is in FRCC 2, which is described as, “Fire regimes have been moderately altered from their historical range.” In these areas, the risk of losing key ecosystem components has increased to moderate. Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one natural Fire Return Interval (see Appendix B of the Fuels and Air Quality Report “Fire Regime Condition Class Definition”). This can result in moderate changes to one or more of the following: fuel composition and fire size, frequency, intensity, severity, and pattern. Vegetation attributes have been moderately altered from their historical range. Approximately 5 percent of the Eddy Gulch LSR is in FRCC 1, where the current fire regime is similar to the historic regime. Conversely, 95 percent of the LSR has substantially departed from the historic fire regime, making the Assessment Area at significant risk of losing key ecosystem components.

3.3.3.2 Fire Risk and Fire Hazard

The likelihood of future fires causing unacceptable resource damage is influenced by two factors: fire risk and fire hazard. *Fire risk* is the probability of a fire occurring in the LSR and is based on historic fire records. *Fire hazard*, on the other hand, is dependent upon fuel conditions, including the accumulation of dead and living vegetation and fire weather. Under historic fire return intervals, fuel accumulation would be considerably less than current levels. A particular area may have a low historic risk of fire occurrence, but the fuel hazard, and thus fire severity, may be high enough in the LSR to result in unacceptable lethal levels of vegetation mortality (lethal effects are those where fires result in greater than 70 percent mortality) (USFS 1999).

Figure 3-5 shows that from 1970 to 2005, the number of fires in the Salmon River and Scott River Ranger Districts ranged between 25 and 120 annually, and the number of acres burned exceeded 100,000 acres. The majority of fires occur during July and August, and these fire starts are primarily ignited by lightning strikes and quickly contained at less than 0.2 acre. Fire occurrence in the Eddy Gulch LSR is 0.69 fire per thousand acres per decade (USFS 1999:2-12), or about 4.3 fires in the LSR per year. The current fire risk is rated as "moderate," meaning that at least one fire would be expected to occur in 11 to 20 years per thousand acres. With a risk rating of moderate, the potential exists for 62 fire starts in the Eddy Gulch LSR during the next 20 years (USFS 1999:2-44).

There is evidence that suppression has affected the number of acres burned on the Salmon River and Scott River Ranger Districts. Since 1920 there has been an almost continuous reduction in the number of acres burned per decade by fires (0.3–299.9 acres) (Figure 3-6). During the same period, there appears to be an increase in the number of acres burned by fires greater than 300 acres. This demonstrates that successful suppression of fires has contributed to an accumulation of fuels that, when ignited, result in larger fires.

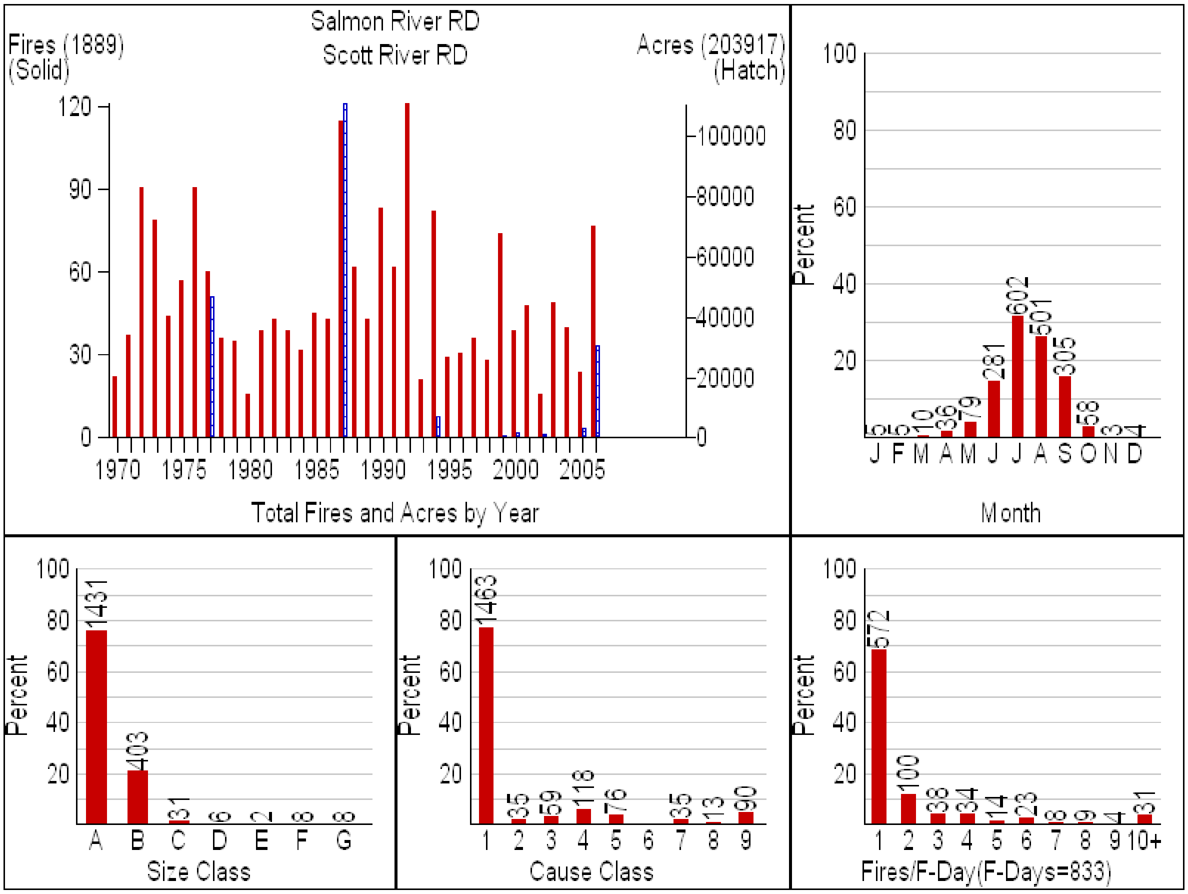
3.3.3.3 Current Fuel Conditions

Fire behavior describes how a fire burns, where it burns, how fast it travels, how much heat it releases, and how much fuel it consumes. It is important to understand what controls fire behavior and how to predict it because this knowledge helps predict fire effects, conduct prescribed burns, predict wildfire risk, and control wildfires.

Fire behavior is controlled by three interacting components: fuels, weather, and topography. Fuels provide the energy source for fire. Fuel availability, which depends on both fuel arrangement and fuel moisture, determines if fires will burn as surface or crown fires. Weather elements, such as temperature, relative humidity, wind, precipitation, and atmospheric stability, also combine to influence fire behavior by regulating fuel moisture and rate of spread. Topography can influence fire indirectly, by mediating wind patterns, or directly—fires burning upslope spread faster than fire burning on flat land.

Current conditions, as described by the fire and fuel indicators and their measurements (obtained from field surveys and modeling) are described in Table 3-17.

Figure 3-5. Fires in the Salmon River and Scott River Ranger Districts from 1970 to 2005.



Notes: Fire Size Classes

A = 0–0.2 acre	B = 0.3–9.9 acres	C = 10–99.9 acres	D = 100–299.9 acres
E = 300–999.9 acres	F = 1,000–4,999.9 acres	G = 5,000 acres plus	

Fire Cause Class 1 is lightning; 2–9 are various human causes.

“Fires per fire day” is the number of fires burning on any day with wildfires. Thus, of the 833 days experiencing one or more wildfires during the 1970 to 2005 time period, there were 572 days with only a single fire. There were also 31 days, nearly once per year average, with 10 or more fires burning on the same day.

Figure 3-6. Changes in fire size on the Salmon River and Scott River Ranger Districts since 1920.

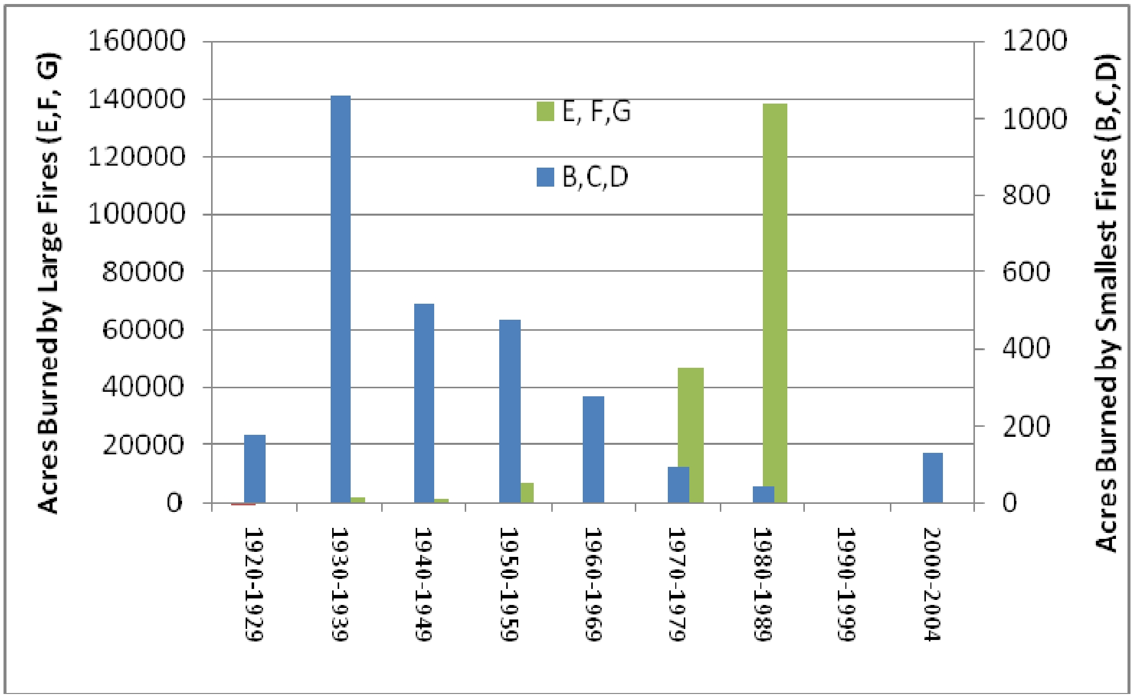


Table 3-17. Fire and fuels indicators and their measurements.

Indicator	Measurement	Current Conditions
Ground Fuels	Fuel Load	1-hour fuels: 0.5–3 tons/acre 10-hour fuels: 1–3 tons/acre 100-hour fuels: 2–8 tons/acre 1,000-hour fuels: 5–30 tons/acre (not tracked)
	Flame Length	11–20 feet
	Rate of Spread	30–60 feet per minute
Ladder Fuels	Crown Base Height	2–15 feet
Crown Fuels	Crown Bulk Density	0.131–0.351 kilograms/cubic meter (kg/m^3)

Measurement: Fuel Load. In the Assessment Area, fuel loading of dead fuels less than 1 inch in diameter range from 0.5 to 3 tons/acre, and loading of dead fuels 1–3 inches in diameter range from 2 to 8 tons/acre. The accumulation of ground fuels in the Assessment Area results from the fact that less than 10 percent of the entire LSR has burned in wildfires since 1955. Fuel loads are lower in areas where prescribed burning has recently occurred (Blue Ridge Lookout to Lafayette Point).

Measurement: Flame Length. Given the parameters described above, predicted flame lengths during a wildfire would range from 11 to 20 feet in the Eddy Gulch LSR. The simulated flame lengths and acres potentially burned in the LSR have implications to suppression capabilities. These data can be used to estimate the probability that a fire could be contained by initial attack by comparing flame length outputs with the Fire Characteristics Chart (Andrews and Rothermel 1982) and a simplified adjective rating with suppression implications—the fire adjective rating chart is presented in

Table 3-18 below. Assuming all fires with less than 3-foot flame lengths could be contained, fires with flame lengths of 3 to 7 feet may have a good chance of containment, and all fires with flame lengths longer than 7 feet could not be contained by initial attack. Initial attack by the closest suppression forces is critical to initial attack strategies, as resistance to control increases exponentially as fire perimeters and fire behavior increase.

Table 3-18. Fire adjective rating chart.

Adjective Rating	Flame Length (feet)	Acreage and Percent in Assessment Area		Suppressions Implications
Low	0–1	127	<1%	Fire will burn and spread; however, very little resistance to control and direct attack with firefighters is possible.
Moderate	1–3	8,340	14%	Fire spreads rapidly, presenting moderate resistance to control but can be countered with direct attack by firefighters.
Active	3–7	5,937	9%	Fire spreads very rapidly, presenting substantial resistance to control. Direct attack with firefighters must be supplemented with equipment and/or air support.
Very Active	7–15	47,025	75%	Fire spreads very rapidly, presenting extreme resistance to control. Indirect attack may be effective. Safety of firefighters in the area becomes a concern.
Extreme	>15	154	<1%	Fire spreads very rapidly, presenting extreme resistance to control. Any form of attack will probably not be effective. Safety of firefighters in the area is of critical concern.

Note: > greater than.
< less than.

There are potions of the Assessment Area that are inaccessible, with dense vegetation and steep topography that slows travel for firefighters and affects containment success. As shown on Table 3-18, fires in 15 percent of the Assessment Area could be contained, fires in 9 percent of the area may have a good chance of containment, while 76 percent would not be contained. These containment percentages correlate to the percentages in the third column of Table 3-18 and the corresponding adjective ratings. For example, 15 percent containment would be an adjective rating of “moderate” The results shown in Table 3-18 for the Assessment Area differ from those predicted in the forestwide LSR assessment (USFS 1999), where it was estimated that 66 percent could be contained and 26 percent could not be contained. The reason for this variation in containment percentage is due to the site-specific data gathered in 2007 and 2008 for the Eddy Gulch LSR Project, the availability of more sophisticated modeling tools, and the increase in vegetative growth and fuel loading over the past 10 years since the forestwide LSR assessment was prepared.

Measurement: Crown Base Height. CBH ranges from 2–15 feet, the result of mature brush in lower elevation stands and growth of small conifers and hardwoods throughout the LSR. The low crown base height throughout the LSR is a major factor leading to the higher percentages of crown fires now predicted in the LSR.

Measurement: Crown Bulk Density. CBD is a measurement generated by modeling stand structure. The current values indicate crown fires would be readily supported in the Eddy Gulch LSR.

Fire Behavior Throughout the LSR. An earlier analysis (forestwide LSR assessment [USFS 1999]), showed that approximately 8 percent of the Eddy Gulch LSR would have an active crown fire and approximately 39 percent would have a passive crown fire, or a total of 47 percent crown fire. In this analysis for the Eddy Gulch LSR Project, FLAMMAP model runs (using the Standard Fire Behavior Fuel Models 2005) show that, under 90th percentile weather conditions (2–3 mile per hour eye-level winds), approximately 46 percent of the LSR would experience a surface fire and 54 percent would experience crown fire (Table 3-19, also refer to Map A-3a in Appendix A of the Fuels and Air Quality Report). When only the eye-level wind speeds were increased to 3–6 miles per hour (as observed on ridgetops in the LSR and during the 2006 Uncles, Hancock, and Rush fires) only 27 percent of the LSR would experience a surface fire, while approximately 73 percent (45,190 acres) of the LSR would experience a crown fire (Table 3-19 below, Map A-9b in Appendix A of this final EIS). These current simulations resulted in substantially more crown fires than the earlier forestwide LSR assessment (USFS 1999), which estimated 47 percent crown fires in the Eddy Gulch LSR.

Table 3-19. Acreages by fire type based on current conditions in the Eddy Gulch LSR.

Fire Type Description[a]	Eye Level Wind Speed of 2 to 3 MPH	Eye Level Wind Speed of 3 to 5 MPH	Percent of LSR Burned with Wind Speed of 2 to 3 MPH	Percentage of LSR Burned with Wind Speed of 3 to 5 MPH
	Acres		Percent	
Surface Fire[b]	28,965	16,790	46	27
Passive Crown Fire[c]	33,053	38,135	53	61
Active Crown Fire[d]	510	7,602	1	12

Notes:

a. Fire type based on a westerly wind direction.

b. Surface Fire—a fire that burns ground fuels (surface litter, debris, and small vegetation).

c. Passive Crown Fire—the movement of fire through groups of trees; it usually does not continue for long periods of time.

d. Active Crown Fire—the independent movement of flames through the branches and top of the trees.

The expected fire severity (effect) was calculated with FLAMMAP using existing vegetation, topography, and constructed weather conditions for the Assessment Area (Map B-8 in Appendix B of the SFA). This analysis shows that, if subjected to wildfire, approximately 61 percent of the Eddy Gulch LSR would experience mixed levels of mortality from passive crown fire behavior. The potential for lethal fire effects from active crown fire behavior were identified for approximately 12 percent of the LSR. High-severity events are more of a concern on south and west aspects and steep slopes due to the slopes' alignment with prevailing winds and normal diurnal air movement caused by surface heating and cooling, and because fires burn faster up-slope due to fuel pre-heating ahead of the flaming front. Stand-replacing intensities are also more likely in young stands, particularly plantations, because the lowest limbs on these trees are close (generally less than 4 feet) to ground fuels and shrubs and grasses, as well as accumulated dead and down fuels, which are common ground fuels, making even moderate- to low-intensity wildfires stand replacing.

3.3.4 Desired Conditions for the Assessment Area

The potential for large stand-replacing fires would be reduced in the Eddy Gulch LSR. This would be achieved by reducing fuel hazards, which would result in different fire behavior (Table 3-20).

Table 3-20. Current and desired fire behavior and fuel profile under 90th percentile weather conditions for Eddy Gulch LSR Project Assessment Area.

Indicator	Measurement	Current Conditions	Desired Conditions	
Ground Fuels	**Fuel Load**	1-hour fuels: 0.5–3 tons/acre 10-hour fuels: 1–3 tons/acre 100-hour fuels: 2–8 tons/acre Not tracked, 1,000 hour fuels: 5–30 tons/acre	• 1-hour fuels: less than 1 ton/acre • 10-hour fuels: less than 2 tons/acre • 100-hour fuels: less than 3 tons/acre; 0.5-foot fuel bed depth	
	Flame Length	11 to 20 feet	2 to 4 feet	
	Rate of Spread	30 to 60 feet per minute	Equal to or less than 20 feet per minute	
Ladder Fuels	**Crown Base Height**	Average between 2–15 feet, with increased crown base heights at higher elevations. Brush and small conifers occupy from 30%–50% of many areas, decreasing with elevation.	In FRZs, 8- to 15-foot crown base height or a gap between the tops of understory trees to the lowest limbs of residual trees of 15–20 feet.	Outside FRZs, brush and lower limbs up to 15 feet are generally absent.
Crown Fuels	**Crown Bulk Density**	0.131–0.351 kg/m^3	In FRZs, 65-115 trees per acre; ≈40% crown closure; less than 0.0111 kg/m3 crown bulk density (Reinhardt and Crookston 2003)	Outside FRZs, conifers under 6 inches dbh are limited to 55%–70% of the area.
Fire Type	**Current Acres in the Eddy Gulch LSR, by Fire Type**	**Current Acres in the Assessment Area, by Fire Type**	**Desired Percent Change, by Fire Type**	**Desired Acres in Assessment Area, by fire Type**
Surface Fire	16,790	10,054	Increase 130%–200%	23,124–30,100
Passive Crown Fire	38,135	22,715	Decrease 45%–75%	12,495–5,630
Active Crown Fire	7,602	4,470	Decrease 70%–90%	1,340–450

The general desired condition is to move the LSR toward the historic range of variation, where fuel hazards and fire behavior varied across the landscape. Fuel hazards would be reduced and wildfires would exhibit substantially more surface fires that currently observed and predicted (Table 3-20). It is reasonable to expect that heavier scattered pockets of fuels will occur on relatively cool, moist sites, such as those found on north- and east-facing slopes, and low-elevation slopes adjacent to perennial riparian areas. Generally, south- and west-facing aspects and upper slope positions, which are typically drier and hotter, will contain lighter fuel loadings, with fewer scattered pockets of heavy fuel loads.

Generally, the following will help achieve desired conditions for fire behavior:

- The average large tree size is generally greater than 20 inches dbh, which helps trees survive wildfire disturbance events if the ground and ladder fuel components are reduced to acceptable levels.

- Large prescriptive fire projects in the Assessment Area have reduced the excessive accumulations of ground fuels, and ladder fuel profiles are discontinuous and at sustainable levels (consistent with habitat objectives for late-successional forest-related species). Crown spacing (expressed as “canopy bulk density”) is reduced, thereby reducing wildfires to primarily surface fires, with mixed severity typified by occasional torching and active crown fire behavior.

- Strategically located FRZs (fuelbreaks) are present, where ground fuel accumulations, ladder fuels, and crown spacing have reduced fire behavior potential. This will provide safe areas for suppression crews to work and anchor control lines, thereby reducing the probability of fires spreading to adjacent drainages and allowing safe use of roads that are key access routes for firefighters and escape routes for residents and other publics. Fuel conditions allow greater decision space for an "appropriate management response" (AMR[2]).

- Large-diameter trees are primarily Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and black oak (these trees are more resilient to wildfire).

The Salmon River CWPP contains a prioritized list of projects to focus and guide implementing landowners, organizations, and funders. A key product of the CWPP is the development of wildfire safety zones to reduce citizen and firefighter risks from future large wildfires. The list of recommended projects consists of structure protection strategies, prevention measures, and pre-treatment and shaded fuelbreak (same as an FRZ) construction to protect life and property in towns, residential areas, emergency access routes, and private/public interface areas. Other activities (such as maintaining adequate accessible water systems, plantation thinning, underburning, and natural fire management) were recommended in the CWPP (SRFSC 2007).

The CWPP objectives to provide for the safety of adjacent communities and people (residents and emergency respondents) would be met if the following desired conditions exist:

- Forests in the LSR are managed so as to minimize large-scale high-intensity fire threats to communities and infrastructure. Mechanical fuel treatments and prescribed burning have been implemented in areas projected to experience high fire intensity, and within strategically located FRZs to reduce fire intensity and provide locations from which to base suppression actions.

- CWPP-identified road segments and all open roads in FRZs are being managed to ensure the safety of the public and suppression resources during wildfires.

- Forest stands within the 0.25-mile radius around domestic water sources (such as spring boxes, wells, and water intakes) (SRFSC 2007) have a break in crown base height of at least 15 feet to eliminate fuel ladder conditions.

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2. AMR is a thoughtful approach to evaluating the conditions and context of a wildfire and designing a response to effectively address them. It encourages consideration of a wider spectrum of management options in response to each fire. The concept first appeared in the 2001 Review and Update of the 1995 Federal Wildland Fire Management Policy. The current Klamath National Forest Fire Management Plan defines AMR as "specific action taken in response to a wildland fire to implement protection and fire use objectives" by isolating topographic features to block-in fires when direct attack is not an appropriate action.

3.3.5 Environmental Consequences: Fire and Fuels

3.3.5.1 Alternative A: No Action

Direct and Indirect Effects. Current fire behavior is described above (Table 3-20). Excessive fuel loading would result in flame lengths of 11 to 20 feet and rate of spread of 30 to 60 feet per minute. Fuel ladders and dense canopies contribute to 73 percent crown fire in the Eddy Gulch LSR.

During the next 20 years, overstocked stands of trees would continue to self thin and increase ground fuels. Mortality of trees greater than 10 inches dbh could add an additional 7–23 percent increase in cubic feet of ground fuels, and that could increase to 17–26 percent in 30 years, as estimated by the FVS (Table 3-21). Understory vegetation and shade-tolerant trees will continue to grow, thereby increasing the ladder fuels and lowering the stands' crown base height, which would lead to a higher percentage of passive and active crown fires. Dense stands in the Assessment Area would become increasingly vulnerable to mortality from drought conditions, insects, disease, and storm damage and eventually contribute to the ground fuel load. Flame length would increase as ground fuels increased. The fuel hazard would continue to increase and fire behavior would become progressively worse, thereby creating risks to life and property, infrastructure values, private property, and natural resources in the Assessment Area. The chronic effects of climate change would place additional stress on trees, thereby increasing mortality rates, fuel loading, and fire intensity.

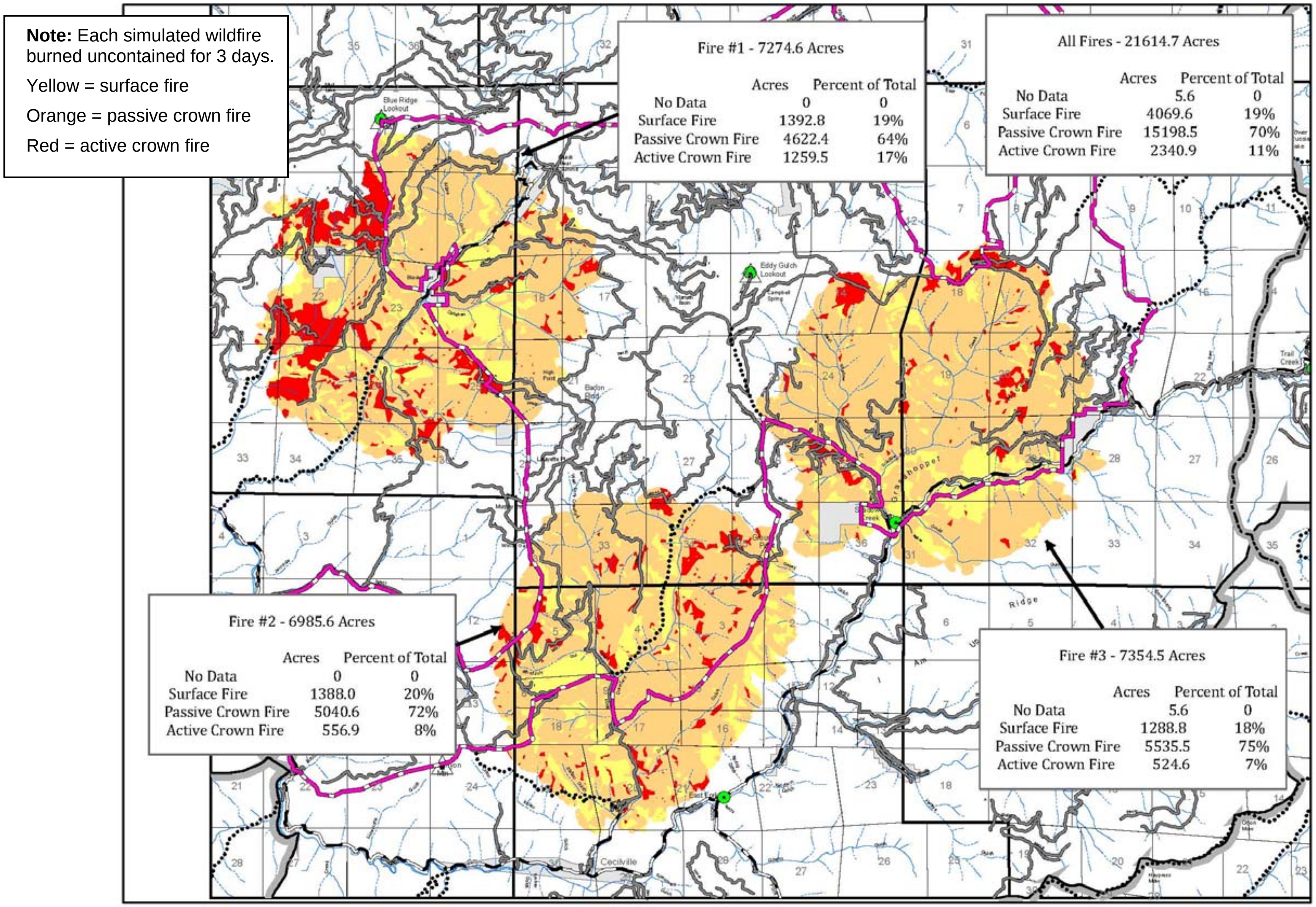
Table 3-21. Changes in tree mortality in forest stands in the Eddy Gulch LSR at 20 and 30 years into the future.

SAF Forest Type[a]	CWHR Seral Stage[b]	For Trees 10 Inches dbh and Greater	
		No Treatment FVS Predicted 20-year Tree Mortality (by cubic feet)	No Treatment FVS Predicted 30-year Tree Mortality (by cubic feet)
DF[c]	MS[d]	7.1%	16.9%
DF	MS/LS[d]	13.7%	20.5%
WF[c]	MS	12.6%	26.1%
WF	MS/LS	9.0%	17.7%
RF[c]	LS	12.4%	18.1%
MC[c]	LS	22.6%	26.4%

Notes: a. SAF = Society of American Foresters.
b. CWHR = California Wildlife Habitat Relationship.
c. DF = Douglas-fir; WF = white fir; RF = red fir; MC = mixed-conifer.
d. MS = mid-successional; LS = late-successional.

Direct and Indirect Effects of an Escaped Wildfire—Given the current fuel hazard in the Eddy Gulch LSR and predictions of climate change, the probability of a large wildfire will increase. Using past fire frequencies, current fuels conditions, and current 90th percentile weather conditions, three separate wildfire simulations were run to show probable direct effects of fires that have escaped initial attack. The simulations were run for only 72 hours using Farsite (a fire behavior program) to illustrate how a wildfire would spread and the acres of surface fire, passive crown fire, and active crown fire in the Eddy Gulch LSR Project Assessment Area under Alternative A (Figure 3-7). If the escaped fires were not contained in three days, an average of approximately 7,200 acres would burn with varying intensities, and result in 1,355 acres (19 percent) of surface fire; 5,065 acres (70 percent) of passive crown fire; and 780 acres (11 percent) of active crown fire. Surface fires would consume

Figure 3-7. Three randomly selected examples of wildfire simulations in the Assessment Area under Alternative A.



all litter, woody debris (less than 3 inches in diameter), and all shrubs; kill most small trees (less than 6 inches dbh); and some larger trees would die in the future, providing snags that will eventually fall to the ground and contribute to the fuel load. A passive crown fire would have the same effect, plus individual and groups of intermediate and mature trees would be killed immediately by the torching of crowns, and most of the stand would die by the end of the next summer from crown scorch and root and bole damage related stress from the wildfire. Mortality from an active crown fire would be almost immediately apparent, with nearly complete mortality.

An escaped fire could adversely affect protection targets (private property, municipal watersheds, infrastructure, and northern spotted owl [NSO] core areas). The high percentage of crown fire (81 percent) could result in the loss of private property, short-term adverse effects on municipal watersheds, and long-term losses of late-successional habitat, including NSO core areas.

Cumulative Effects. Construction of a fuelbreak system west of Black Bear Ranch would reduce fuel hazards on approximately 700 acres, and the fuel reduction projects (proposed in the Salmon River CWPP) on private property in and around the Assessment Area would reduce threats on private property. Alone, these fuel treatments offer limited resistance to a wildfire because fires can flank around them, or spot fires could ignite structures inside the limited fuelbreaks. Additionally, ingress and egress would be constrained because of the lack safe emergency access routes. The loss of key infrastructure, such as the repeater site near the Eddy Gulch Lookout, could adversely affect communication of emergency response crews during an escaped wildfire.

Conclusion. Prior to European settlement, frequent wildfires, with varying intensity, had the greatest influence on the structure and composition of forests in the Klamath Mountains. Fire suppression eliminated this key ecological factor, resulting in the buildup of excessive fuels and forests that are highly susceptible to stand-replacing crown fires. The no-action alternative will not reduce those fuel hazards, ensuring that crown fires will persist, potentially resulting in the loss of private property, long-term damage to municipal waterheds and important infrastructure, and the loss of habitat for late-successional-dependent wildlife species. Thus, the purpose and need for the project, as described in Chapter 1, would not be achieved. The limited number of other potential projects (the fuelbreak system west of Black Bear Ranch and fuel reduction projects on private land), if implemented, would have beneficial effects by reducing the threat of a wildfire; however, those effects would be limited and localized in scope and have little influence on most forest resources.

3.3.5.2 Alternative B: Proposed Action

Direct and Indirect Effects of Fuel Reduction in FRZs. Table 2-1 in Chapter 2 of this document lists the purpose of each FRZ. The construction of 8,291 acres of FRZs would reduce ground, ladder, and crown fuel in 931 acres of M Units and ground and ladder fuels in 7,360 acres of other fuel reduction treatments. Thinning trees in M Units is an important component of fuels treatments because it would reduce crown bulk density in stands by 51–82 percent (Table 3-22), resulting in approximately 40 percent crown closure. Thinning also increases the height from the ground to the lowest limbs, which when combined with the thinner canopy, directly reduces the potential for passive and active crown fires. These treatments would reduce crown fuels substantially more than underburning alone. The thinning treatments would improve stand health, which would reduce future mortality and the amount of material that will eventually accumulate as ground fuels. This would result in 50 to 95 percent less mortality in treated stands that otherwise would have died and become

Table 3-22. Change in crown bulk density and mortality in M Units as a result of treatments under Alternative B (based on FMAPlus).

SAF Forest Type[a]	CWHR[b] Seral Stage	Indicator: Crown Fuels Measurement: Crown Bulk Density[c]		Reduction in Crown Bulk Density Compared to No Treatment
		Existing Conditions	Post Treatment Conditions	
DF[d]	MS[e]	0.352	0.131	62%
DF	MS-LS[e]	0.131	0.052	61%
WF[d]	MS	0.243	0.089	63%
WF	MS-LS	0.139	0.044	69%
RF[d]	LS	0.181	0.089	51%
MC[d]	LS	0.277	0.051	82%

Notes: a. SAF = Society of American Foresters.

b. CWHR = California Wildlife Habitat Relationship.

c. Crown bulk density measured in Kg/m^3.

d. DF = Douglas-fir; WF = white fir; RF = red fir; MC = mixed-conifer.

e. MS = mid-successional; LS = late-successional.

ground fuels. Thinning would also move these stands toward the composition and structure that mimics conditions of the pre-European fire regime. That historic fire regime produced a mosaic of vegetation, consisting of large areas of mid- and late-successional forest, interspersed with more open conifer stands mixed with hardwoods or younger stands created by disturbances.

Prescribed burning after thinning would reduce existing ground fuels and slash generated from thinning and remaining ladder fuels (up to 4 inches dbh), including lower branches on residual trees (Table 3-23). Thus, the desired condition for forest fuels would be achieved. Similar treatments in the Sierra Nevada removed approximately 60 percent of ground fuels less than 3 inches in diameter and 60 percent of the small trees, which resulted in a post-treatment surface fire with 1-foot flame lengths (Stephens and Moghaddas 2005a). Thus, these treatments would achieve the desired flame lengths of less than 2 feet post-treatment in the Assessment Area. The combination of thinning and burning would reduce ladder and crown fuels and increase the crown base height to 8–15 feet.

In the study conducted by Stephens and Moghaddas (2005a), prescribed burning was effective in reducing tree density in trees 1 inch–10 inches dbh, but further states that prescribed fire treatment did not substantially remove dominant or co-dominant trees because fire behavior was not severe enough to kill many trees over 11 inches dbh. It is important to note that indirect mortality from increased insect activity, periods of drought, and pathogens may increase mortality in larger trees in prescribed fire and mechanical treatments followed by fire treatments. Thus, there is the potential that (depending on different site characteristics) scorching could result in post-treatment mortality in residual trees greater than 20 inches dbh, which would provide future snags and CWD (Stephens and Moghaddas 2005a). However, large trees and snags are typically not lost during prescribed fire. The burn plan (developed prior to implementing any treatments for the Eddy Gulch LSR Project) will design a prescribed fire that consumes smaller-diameter trees.

Table 3-23. Changes in fuel indicators in FRZs under Alternative B.

Indicator	Measurement	Current Conditions	Alternative B	
Ground Fuels	**Fuel Load** (Ground Fuels)	1 hour fuels: 0.5–3 tons/acre 10 hour fuels: 1–3 tons/acre 100 hour fuels: 2–8 tons/acre	Post-treatment 1 hour fuels: less than 1 tons/acre 10 hour fuels: less than 2 tons/acre 100 hour fuels: less than 3 tons/acre	20 years 1 hour fuels: 2.5 tons/acre 10 hour fuels: 2.5 tons/acre 100 hour fuels: less than 6.5 tons/acre
	Flame Length	11 to 20 feet	Less than 2 feet	Approximating pre-treatment fire-intensity characteristics
	Rate of Spread	30 to 60 feet per minute	Equal to or less than 20 feet per minute	
Ladder Fuels	**Crown Base Height**	Average between 2–15 feet, with increased crown base heights at higher elevations. Brush and small conifers occupy from 30%–50% of many areas, decreasing with elevation.	In FRZs, 8- to 15-foot crown base height or a gap between the tops of understory trees to the lowest limbs of residual trees of 15–20 feet	Average between 6–12 feet

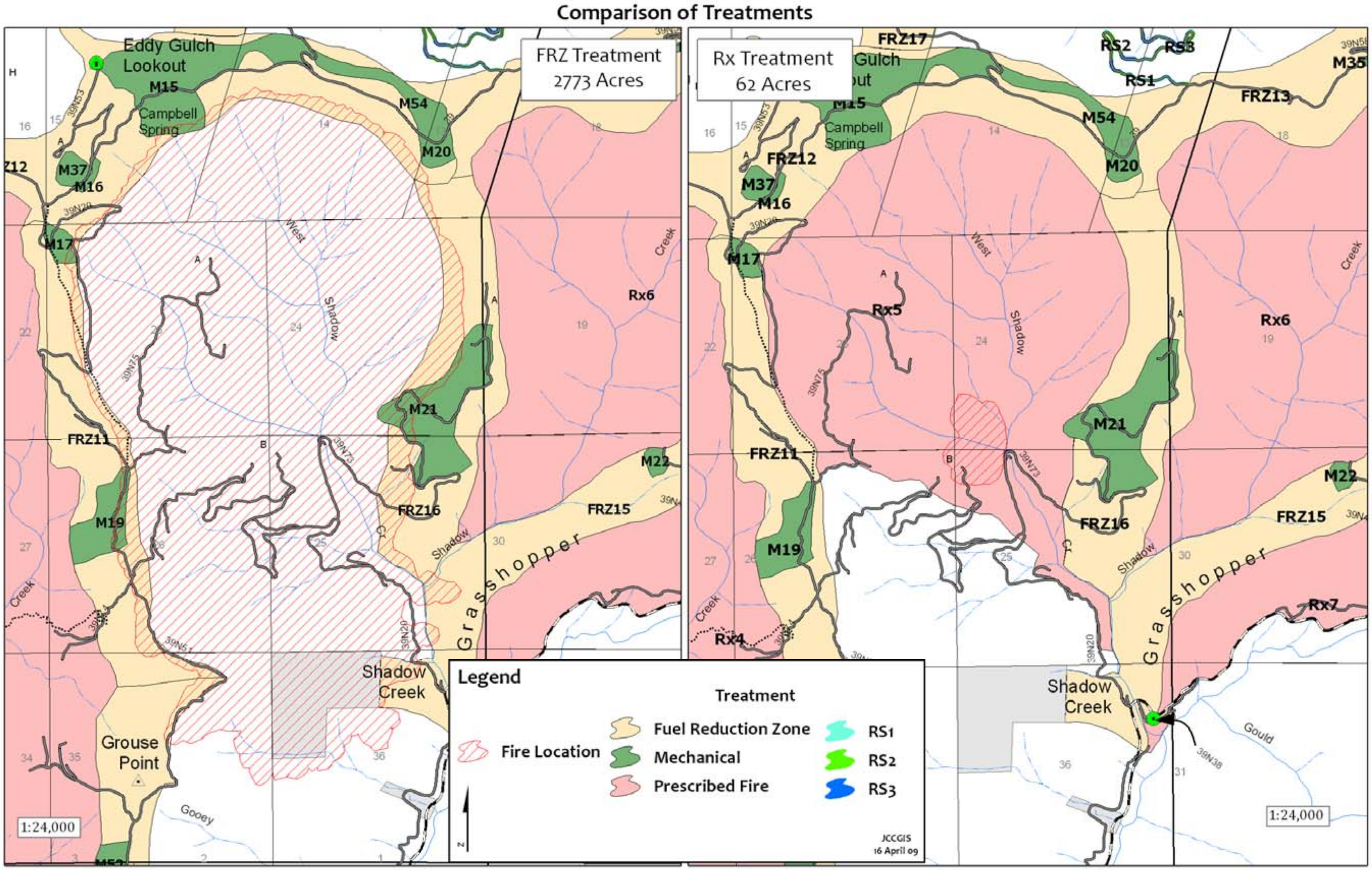
Prescribed burning outside of the M Units would reduce ground fuels and smaller (less than 4 inches dbh) ladder fuels, while mastication will reduce the arrangement of ground fuels and reduce ladder fuels up to 10 inches dbh. These treatments would result in flame lengths less than 2 feet high and increase CBH.

The effectiveness of the FRZ treatments is shown in Figure 3-8 (FARSITE was used for the predictions). The left pane of Figure 3-8 shows how fire would spread if only treatments in FRZs were implemented. Under 90th percentile weather conditions, the simulated wildfire burned approximately 2,773 acres, with flame lengths 6–10 feet long. When the simulated fire reached the FRZ, flame lengths dropped to less than 3 feet, where suppression crews could safely use direct attack strategies to contain the fire. Thus, the combined treatments in the FRZs would increase the resistance to a wildfire, providing a beneficial effect by increasing protection to late-successional habitat and communities.

The effectiveness of the treatments would vary over time. Ground and ladder fuels would increase (Table 3-23), and crown bulk density would increase as the canopy cover increases (see "Section 3.2 Forest Vegetation" in the EIS or the Silviculture Report for more information). Thinning and burning in M Units and mastication would remain effective for 15–20 years. Prescribed burning outside of the M Units would remain effective for a shorter period of time. Studies in the Sierra Nevada revealed that ground fuels increased to 80 percent of their pre-treatment levels 10 years after treatment; however, additional increases in fuels were very low for the next 20 years (Keifer et al. 2006).

Direct and Indirect Effects of Fuel Reduction in Rx Units. Table 2-5 in Chapter 2 of this document lists the purpose of each Rx Unit. Treatments in the Rx Units would reduce ground and ladder fuels on up to 17,524 acres. Similar treatments conducted by Stephens and Moghaddas (2005a) removed approximately 60 percent of ground fuels less than 3 inches in diameter and 60 percent of the small trees. The majority of the trees that were removed were small (less than 10 inches dbh)

Figure 3-8. Left pane: displays fire spread in an untreated area and effectiveness of constructing an FRZ. Right pane: displays fire spread in a treated Rx Unit.



because crown cover in the residual stand only declined by 10 percent. Ground and ladder fuel reductions and changes in flame length and rate of spread would be similar to that described in Table 3-23. All acres in the treatment areas would not be treated equally because of access and localized differences in fuel moisture, which will affect the amount of fuels consumed. The effectiveness of the treatments in Rx Units is shown in Figure 3-8 (FARSITE was used for the predictions). The right pane of Figure 3-8 shows that, following treatment, a simulated wildfire burning under 90th percentile weather conditions only grew to 62 acres of low-intensity surface fire in 3.5 days.

The introduction of large-scale prescribed fire to the Eddy Gulch LSR would restore a source of disturbance that influenced distribution and species composition of forest stands and associated wildlife. Low- to moderate-intensity fires would mimic the results of the historic fire regime; that is, a mosaic of vegetation, consisting of large areas of mid- and late-successional forest, interspersed with more open conifer stands mixed with hardwoods or younger stands created by disturbances. Although crown fuels would not change substantially, the treated areas would be more resilient to future fires and reduce the probability of a stand-replacing crown fire that would adversely affect late-successional habitat and local communities. Prescribed fire treatments would result in major short-term beneficial effects, and moderate long-term beneficial effects as the effectiveness of the treatments would decline within the first 10 years; however, fuel hazards would change little during the next 20 years (Keifer et al. 2006).

Direct and Indirect Effects on Fire Type in the Assessment Area. Treatments in the FRZs and Rx Units would shift the fire types in the Assessment Area from being primarily crown fires to primarily surface fires (Table 3-24), as identified in the SFA and the purpose and need for the project (refer to Chapter 1). The acres of surface fire would increase 188 percent as a result of these treatments, resulting in improved suppression capabilities and substantially less resource damage and property losses in the event of a wildfire.

Table 3-24. Changes in fire type in the Assessment Area, resulting from implementation of Alternative B.

Fire Type	Current Acres in the Assessment Area	Desired Acres in Assessment Area Fire Type	Post-Treatment Fire Type in Assessment Area
Surface Fire	10,054	23,124–30,100	28,898
Crown Fire	27,185	13,835–6,080	8,341

Direct and Indirect Effects of Roadside (RS) Treatments. Approximately 44 miles of designated emergency access routes (SRFSC 2007) would be treated in FRZs and Rx Units—fire behavior along those routes would be similar to that in the post-treatment FRZ or Rx Units. Approximately 16 miles of RS treatments along emergency access routes are outside of FRZs and Rx Units—about 80 percent of those routes would be treated within 50 feet of the road. Indirect effects would include improving their status as emergency access routes, allowing residents to safely evacuate and suppression crews access to the Assessment Area.

Direct and Indirect Effects on Community Protection Targets. Treatments in FRZs and Rx Units would reduce fuel hazards on approximately 9,850 acres of municipal watersheds and approximately 800 acres of 0.25-mile WUI around communities in the Assessment Area (Table 3-25). Additionally, treatments would reduce the threat of a wildfire on key infrastructure, such as the Eddy Gulch Lookout and repeater sites that are necessary for fire detection and communication. This would be a beneficial effect on local protection targets identified in the Salmon River CWPP and key infrastructure.

Table 3-25. Acres of municipal watersheds treated and 0.25-mile WUI around communities in the Eddy Gulch LSR Assessment Area.

Municipal Watershed	Acres Treated	0.25 mile WUI	Acres Treated
Black Bear Ranch Watershed	1,219	Black Bear Ranch	366
Callahan	2,334	Eddy Gulch	68
Counts Gulch	0	Finley Camp	24
Crawford Creek	5,692	Rainbow	195
Eddy Gulch	606	Taylor Hole	151
Shadow Creek	6	Whites Gulch	0
Music Creek	0	Music Creek	0

Cumulative Effects. Implementing Alternative B, constructing a fuelbreak system west of Black Bear Ranch, and implementing proposed work on private property, as outlined in the Salmon River CWPP, would reduce the threat of wildfire in the Assessment Area. The beneficial effects would vary over time because treatments would have different periods of effectiveness. Effectiveness would last longest in areas treated mechanically, perhaps as long as 15–20 years. The effectiveness of areas that are only treated with prescribed fire would decline after 5–10 years as trees that were killed by the treatment fall to the ground, and other fuels accumulate to approximately 60–85 percent of pre-treatment levels (Keifer et al. 2006).

Conclusion. The Proposed Action would reduce fuel hazards on 25,815 acres, increasing the amount of surface fire in the Eddy Gulch LSR to 77 percent of the Assessment Area and reducing crown fires to 23 percent of the Assessment Area. The shift to surface fires as the dominant fire type in the Assessment Area meets the purpose and need for the project. The Rx Units would be resilient to damage from wildfires and allow suppression crews to control those fires. The FRZs would increase resistance to wildfires, allowing suppression crews to contain those fires and minimize the potential for those fires to escape to adjacent watersheds. Combined, the treatments would place conifer stands in a trajectory toward the historic fire regime and reduce the effects of wildfires on late-successional habitat, communities, important infrastructure, and municipal watersheds. These changes would result in short- and long-term beneficial effects on natural resources, infrastructure, and private property.

3.3.5.3 Alternative C: No New Temporary Roads Constructed

Direct and Indirect Effects of Fuel Reduction in FRZs. Under Alternative C, the effects of treatments would be similar to Alternative B (refer to Tables 3-22 and 3-23), except all or portions of six M Units (15, 17, 24, 36, 37, and 75), totaling 99 acres, would not be treated. As a result, 72 acres of those untreated areas would be subject to a crown fire, similar to the no-action alternative. Wildfires that ignite in or burn through these untreated areas would emit fire brands that could land in adjacent untreated area, potentially increasing the complexity and difficulty of suppression efforts and the number of acres burned by a stand-replacing crown fire. Important infrastructure (such as the Eddy Gulch Lookout and repeater sites) and municipal watersheds could be threatened by a wildfire.

Direct and Indirect Effects of Fuel Reduction in Rx Units. Treatments in the Rx Units would reduce ground and ladder fuels on 16,790 acres, resulting in effects similar to Alternative B (refer to Table 3-23). The reduction in untreated acres (822 acres) compared to Alternative B, would result in 600 acres of crown fires. Wildfires that ignite in or burn through these untreated areas would emit fire brands that could land in adjacent untreated areas, potentially increasing the complexity and difficulty of suppression efforts and the number of acres burned by a stand-replacing crown fire.

Direct and Indirect Effects on Fire Type in the Assessment Area. Treatments in the FRZs and Rx Units would modify fire types in the Assessment Area (Table 3-26). This shift in fire type following treatments would result in less resource damage in the event of a wildfire. However, the inability to treat approximately 921 acres (99 acres in M Units and 822 acres in portions of Rx Units) would result in vulnerable areas that could allow wildfires to escape to other areas of the LSR.

Table 3-26. Changes in fire type in the Assessment Area, resulting from implementation of Alternative C.

Fire Type	Current Acres in the Assessment Area	Desired Acres in Assessment Area Fire Type	Post-Treatment Fire Type
Surface Fire	10,054	23,124–30,100	28,226
Crown Fire	27,185	13,835–6,080	9,013

As stated in the preceding paragraph, when completed, the treated areas would primarily support surface fires. Maps A-11a and A-11b in Appendix A show the treated areas in FRZs and Rx Units. In the strategically located FRZs, M Units would receive the most comprehensive treatments, where thinning would reduce ladder and crown fuels, resulting in an increase in crown base height and reduction in crown bulk density. The prescribed burning in FRZs would reduce ground fuels. Mastication would rearrange ground fuels and reduce ladder fuels up to 10 inches dbh. Treatments in M Units and masticated areas would maintain their effectiveness longer than the prescribed burn treatments because more fuels would be treated. The areas treated with only prescribed burning would reduce ground fuels and small ladder fuels up to 6 inches dbh. Burning in FRZs would be more effective than burning in Rx Units because the treatment areas in FRZs are smaller, and treatments would be more uniform. The Rx Units are larger, and treatments would not be as uniform due different ignition techniques and varying concentrations of fuels and fuel moisture, resulting in different fuel consumption rates. For instance, fuel treatments would be least effective in larger riparian areas that are moister than upland slopes, and less fuel would be removed in those areas.

When completed, the treated areas would primarily support surface fires, which is similar to that described under Alternative B. However, the 921 untreated acres would remain susceptible to stand-replacing crown fires. Maps A-10a and 10b in Appendix A show the treated areas in FRZs and Rx Units and the 921 acres of untreated areas under Alternative C.

Direct and Indirect Effects of RS Treatments. Approximately 44 miles of designated emergency access routes (SRFSC 2007) would be treated in FRZs and Rx Units—fire behavior along those routes would be similar to that in the post-treatment FRZ or Rx Units. Approximately 16 miles of RS treatments along emergency access routes are outside of FRZs and Rx Units—about 80 percent of those routes would be treated within 50 feet of the road. Indirect effects would include improving their status as emergency access routes, allowing residents to safely evacuate and suppression crews access to the Assessment Area.

Direct and Indirect Effects on Community Protection Targets. Treatments in FRZs and Prescribed Burn Units would reduce fuel hazards on approximately 9,850 acres of municipal watersheds and approximately 800 acres of 0.25-mile WUI around communities in the Assessment Area (refer to Table 3-18), similar to Alternative B. The lack of treatments in M Units 15 and 37 and Rx Unit 5 would increase the probability that a crown fire in untreated areas could damage key infrastructure, such as the Eddy Gulch Lookout and repeater sites, which are necessary for fire detection and communication.

Conclusion. Alternative C would reduce fuel hazards on 24,894 acres, increasing the amount of surface fire in the Eddy Gulch LSR Project Assessment Area to 75 percent and reducing crown fires to 25 percent. The inability to treat approximately 921 acres (99 acres in M Units and 822 in Rx Units) reduces the probability that wildfires could be controlled or contained, and increases the probability that wildfires will escape to other areas of the LSR. As a result, additional acres of late-successional habitat and municipal watersheds and key infrastructure would be threatened by crown fires. Thus, the purpose and need for the project would not be met as well as the Proposed Action.

3.3.6 Methodology: Air Quality

Data from the California Air Resources Board website, Siskiyou County Air Pollution Control District, and EPA were used to determine the current air quality for the county. Emissions from wildfires were modeled with First Order Fire Effects Model and emissions from dust generated during treatments were modeled with an emission factor (USFS 2008) and miles of dirt roads traveled during hauling.

3.3.6.1 Scope of the Analysis

Analysis Area. The analysis area for air quality includes all of Siskiyou County.

Analysis Period. Emissions were calculated during a wildfire, during implementation of treatments, and for post-treatment fire emissions.

3.3.6.2 Intensity of Effects

Negligible. No changes would occur, or changes in air quality would be below or at the level of detection. If detected, the effects would be slight.

Minor. The changes in air quality would be measurable but small and localized.

Moderate. The changes in air quality would be measurable and would have consequences, although the effect would be relatively local.

Major. The changes in air quality would be measurable, would have substantial consequences, and would be noticed regionally.

3.3.6.3 Measurement Indicators

Air Quality. Emissions is the only measurement indicator that was used to assess current air quality in the Assessment Area and to predict air quality under Alternatives A, B, and C.

Indicator: Emissions Output—Emissions are particulates or gases that are generated by soil disturbance (for example, disking, grading, or driving) or generated by an event, such as a wildfire.

There are numerous sensitive receptors in the vicinity of the Eddy Gulch LSR that are potentially susceptible to emissions from large wildfires, forest management activities, off-road recreation, and wind-generated dust from exposed soil surfaces. The amount and duration of these emissions vary by season, with most emissions from wildfires, timber harvest, and recreational activities occurring between May and late August, and emissions from prescribed burning occurring from late September through mid-November.

Attainment Status. Attainment refers to an area that meets air quality standards for a pollutant; an area that does not meet the standards is in nonattainment. Table 3-27 lists the air quality attainment status for Siskiyou County for ozone, carbon monoxide (CO), sulfur dioxide, and other compounds, including fine particulate matter (PM) less than 2.5 microns ($PM_{2.5}$) and larger particles that are greater than 10 microns (PM_{10}). The attainment status was derived directly from the 2006 report available on the California Air Resources Board website. Air Quality in the Eddy Gulch LSR is typically very good. Dust from recreational use of roads is the primary source of particle emission on a day-to-day basis.

Table 3-27. Attainment designations for Siskiyou County compared to national standards.

Compound	National Ambient Air Quality Standards	State Air Quality Standards
	Attainment Status	Siskiyou County Attainment Status
Ozone (1 hour)	N/A	Attainment
Ozone (8 hour)	Attainment/Unclassified	Nonattainment
Carbon monoxide (8 hour)	Attainment/Unclassified	Unclassified
Nitrogen dioxide (annual)	Attainment	Attainment
Sulfur dioxide (annual)	Attainment/Unclassified	Attainment
PM_{10} (24 hour)	Unclassified	Attainment
$PM_{2.5}$ (24 hour)	Unclassified	Unclassified

Source: EPA website (2008); California Air Resources Board website (2008).

Currently, Siskiyou County is in attainment status for PM_{10} (county wide) and unclassified for $PM_{2.5}$. According to the California Air Resources Board, the major contributors to both PM_{10} and $PM_{2.5}$ levels include forestry management burns, woodstoves, residential open burning, vehicle traffic, and windblown dust.

3.3.7 Affected Environment (Existing Conditions): Air Quality

The Eddy Gulch LSR Project Assessment Area is located in Siskiyou County, California, and the Siskiyou County Air Pollution Control District, which is within the Northeast Plateau Air Basin. The Northeast Plateau Air Basin includes all of Lassen, Modoc, and Siskiyou counties and is the fourth largest air basin in the state.

3.3.8 Environmental Consequences: Air Quality

3.3.8.1 Alternative A: No Action

Indicator: Emissions Output

Direct and Indirect Effects

Increased Emissions from Wildfires—Smoke from wildfires increases particulate and gaseous emissions, particularly PM_{10}, $PM_{2.5}$, and CO. Emissions were estimated using FOFEM (First Order Fire Effects Model, version 5.7). A 7,200-acre wildfire burning for three days would generate approximately 2,300 tons of PM_{10}, 1,900 tons of $PM_{2.5}$, and 25,000 tons of CO (Table 3-28). These emissions could not be managed and may affect any of the sensitive receptors identified in Siskiyou County (refer to Table 3-27), possibly resulting in a short-term health hazard.

Table 3-28. Selected emissions from a wildfire in the Assessment Area.

Emissions	No Action with Wildfire (tons/acre)	Total Emissions (tons)
PM_{10}	0.32	2,304
$PM_{2.5}$	0.27	1,944
CO	3.48	25,056

Cumulative Effects. The emissions from a wildfire would likely occur during summer, when vehicle traffic and windblown dust are the other primary sources of emissions. Implementation of the fuelbreak system west of Black Bear Ranch would have a temporary effect on emissions; however, the direct effects from implementation would occur during a single year and may or may not occur in the same year as the wildfire. Implementation of the fuelbreak system would do little to reduce emissions from a wildfire. Therefore, the cumulative effects may pose a temporary health threat; however, it would not change Siskiyou County's attainment status for CO or PM_{10}.

Conclusion—A wildfire would have a temporary but potentially major increase in emissions and degradation of air quality; however, a single event would not affect the county's attainment status.

3.3.8.2 Alternative B: Proposed Action and Alternative C: No New Temporary Roads Constructed

Indicator: Emissions Output

Direct and Indirect Effects

Increased Emissions from Project Implementation—Implementation of Alternative B or C would increase emissions, with the greatest source being from 22,631 acres of prescribed burning (FRZs and Rx Units). For this analysis it was assumed that 2,263 acres would be burned annually for 10 years. Annual emissions would increase but would only be approximately 20 percent of those generated by a wildfire (Table 3-29). It is unlikely that the estimated 24-hour emissions would exceed the California 24-hour standard for PM_{10} and $PM_{2.5}$ in the burn location; it would definitely not exceed annual state or federal standards; and it would not degrade air quality or attainment status. Smoke emissions during prescribed burning may reduce the visibility in some locations, but implementation of smoke management practices and plans (such as burning during favorable weather conditions when smoke is carried away from sensitive areas) and using the best available fire and emission control measures would minimize visibility impairments. Thus, emissions can be directed away from sensitive receptors, minimizing health hazards, as opposed to the no-action alternative where emissions cannot be managed.

Table 3-29. Selected annual emissions from prescribed burning in the Eddy Gulch LSR.

Emissions	Alternatives B: Proposed Action (tons/acre)	Alternative B: Proposed Action (tons/year)
PM_{10}	0.214	484
$PM_{2.5}$	0.182	411
CO	2.39	5,408

Fugitive dust from timber hauling, logging, road reconstruction, maintenance, and decommissioning activities would generate particulate emissions into the atmosphere for short periods of time during the day, while these activities are taking place. Vegetation treatments would increase the amount of fugitive dust above the no-action alternative (Table 3-30). The dust generated by these activities, though certain to occur, would be minimal compared to emissions generated annually by other activities in Siskiyou County (14,364 tons). No additional analyses of fugitive dust were estimated because Siskiyou County is in attainment, and a conformity determination is not required.

Table 3-30. Estimated amount of fugitive dust generated annually by the three alternatives proposed for the Eddy Gulch LSR Project.

	Alternative A	Alternative B	Alternative C
Log haul fugitive dust emissions for the Eddy Gulch LSR Project, per year, with implementation of RPMs for 3-year haul.	0	2.35 tons	3.25 tons

Effects from project implementation would be short term, and use of RPMs would reduce those effects. The California Air Resources Board has promulgated changes to Title 17 Smoke Management Guidelines for Agricultural Burning and Prescribed Fires. The new regulations require (prior to on-the-ground implementation of burning) submission of smoke management plans to the local air district for each burn plan and require permitting and increased coordination between burners and the local air district. The Forest Service, Region 5 has also signed a Memorandum of Understanding on Prescribed Burning on July 13, 1999, with the California Air Resources Board. In this memorandum, the Forest Service agrees to limit public exposure to smoke by considering all practical alternatives to burning, applying all appropriate emission-reduction techniques, limiting the amount of material to be burned on any one day based on meteorological and air quality conditions, and consultation with the local district and Interagency Fire Forecast Warning Unit. During treatment activities, fugitive dust would be reduced 50–80 percent because minimal soil moistures must be present for mechanical equipment to operate, and roads would be treated with water to reduce dust.

Decrease in Wildfire Emissions—Implementation of the project would have a beneficial indirect effect because the size and intensity of wildfires in the Assessment Area would be reduced and therefore result in fewer emissions.

Cumulative Impacts. Implementation of the Eddy Gulch LSR Project and construction of a fuelbreak system west of Black Bear Ranch would increase emissions over the short term; however, adverse effects on sensitive receptors would be minimized because the timing and duration of activities can be managed through established RPMs (mitigation measures) to reduce those emissions. Compared to the no-action alternative, reduced emissions from future wildfires would be reduced because the size and intensity of the wildfire would be less, compared to the no-action alternative.

Conclusion. Implementation of the project would increase emissions in the short term during treatment activities; however, the effects would be minimal compared to a wildfire. There would be an indirect beneficial effect because emissions from future wildfires would be reduced.

3.4 Wildlife and Habitat

3.4.1 Introduction

The Eddy Gulch Late-Successional Reserve (LSR) Project is an ecosystem-based approach for maintaining and conserving late-successional forest ecosystems, which serve as habitat for late-successional-forest dependent species. This section discloses potential effects on wildlife that occur in the project Assessment Area and prefer the late-successional habitat, the most notable is the northern spotted owl (NSO) and its designated Critical Habitat protected through the *Endangered Species Act* (ESA), but also included are the Northern goshawk and the Pacific fisher. Existing habitat conditions were reviewed as well as preferred habitat conditions. The current conditions were used to discuss the potentially affected environment and therefore the impacts to each individual species listed in Section 1.3. All other Forest Sensitive Species and all MIS species and associations with potential to occur in or near the Project are addressed in detail in the Wildlife and Habitat Resources Report (2009) and the Biological Assessment/Biological Evaluation (BA/BE).

3.4.2 Methodology

3.4.2.1 Analysis Methods and Assumptions

Wildlife species of particular interest and their associated habitats were analyzed using a combination of field assessments, aerial photos, and Geographic Information System (GIS) habitat maps based on the 1995 vegetation dataset or the stream dataset supplied by the Klamath National Forest. The 1995 dataset is the best available information on the vegetation in the Eddy Gulch LSR. Field assessments conducted by wildlife biologists and silviculturists concluded that, in general, the trend since development of the 1995 vegetation model has been continued forest growth and accumulation of hazardous fuels.

Northern Spotted Owl

Definitions of NSO nesting/roosting, foraging, and dispersal habitat for the NSO were translated into a model (USFS 1999:App. G) for use with the timber type vegetation data layer described in the 1995 Klamath Land and Resource Management Plan (LRMP) (USFS 1995). This model (Klamath NSO Habitat Layer, updated in 1998) was used to estimate the amount of suitable habitat available for NSOs in the Eddy Gulch LSR and in the project Assessment Area (Private lands were excluded in order to be consistent with the Forestwide LSR Assessment [USFS 1999, p. 2-25]). The NSO habitat suitability model may slightly underestimate the amount of currently suitable nesting/roosting and foraging habitat because of recent forest growth. The habitat model was used to analyze the habitat in and around NSO home ranges. Most of the west side of the Assessment Area has been extensively surveyed for NSOs for the past 22 years (Franklin unpubl. data), and most of the remaining area was surveyed in 2007–2008 (Herrera 2008). The NSO habitat model was also used for other forest-dependent species such as the northern goshawk and Pacific fisher.

Pacific Fisher

The Klamath National Forest has independently surveyed and is working with the FWS to survey fisher and fisher habitat. For example,

- Camera station surveys were conducted on the Happy Camp, Scott River, and Salmon River Ranger Districts in the early 1990s. There has been a re-survey of areas surveyed in the 1990s in the vicinity of the Collins Baldy and Mt. Ashland LSRs (in conjunction with Timber Products and the FWS).

- This is the fourth year of participating in a cooperative fisher genetic survey to determine preliminary population estimates for an area in northern Siskiyou County (in conjunction with Timber Products, California Department of Fish and Game, and the FWS).

- A project to develop a habitat model is called the "Distribution and Habitat Suitability for Fishers in the Eastern Klamath and South Cascades Bioregions in Northern California Study Area." The study area covers approximately 9,800 square kilometers (approximately 6,089 square miles) and includes portions of Siskiyou, Shasta, and Trinity counties in northern California. Public forest lands include wilderness, late successional reserve, and general forest lands of the Klamath, Shasta-Trinity, and Rogue River National Forests. Private holdings vary from large contiguous industrial timberlands to checkerboard patterns and smaller private individual holdings. According to the FWS, the survey protocol is consistent with previous sampling and modeling efforts and ongoing development of landscape habitat models being conducted at USDA Pacific Southwest Research Station. The project used a robust Primary Survey Unit design associated with Forest Inventory and Analysis grid cells. For the project, the current model for the Klamath Region (Carroll et al. 2005) will be used as a launching point in development of a model for the eastern Klamath and southern Cascades bioregion. Information from previous survey efforts, which used other protocols, will be used to evaluate the final FWS model. Jeffrey Dunk, from Humboldt State University, is currently under agreement with the FWS to conduct the habitat modeling and analysis in cooperation with Bill Zielinski, at Pacific Southwest Research Station.

- Another project, which began in October 2009 in the vicinity of the Mt. Ashland Fuels Reduction Project on the Klamath National Forest, is part of a regional study to assess changes in fisher movement patterns and habitat selection between pre- and post-treatment monitoring, at both individual and local population scales and to evaluate the short-term impact of treatments. According to the FWS, this study will be combined with other replicates of the study into a regional analysis on the impacts of treatment alternatives on fishers. The study will be used to generate recommendations on how managers can achieve fuel reduction objectives while minimizing impacts on fishers.

3.4.2.2 Scope of the Analysis

Analysis Area. The Eddy Gulch LSR Project Assessment Area encompasses the 37,239 acres of the LSR that were considered for treatment (refer to Chapter 2, Section 2.5.1.4). The area analyzed for most wildlife species includes only 25,696 acres in the Assessment Area that are actually proposed for treatment (the treatment units that include FRZs, Rx Units, and RS treatments along emergency access routes) and is thus referred to as the analysis area. However, the analysis area for wildlife and habitat extends beyond the Assessment Area for species that occur outside that area and that may be indirectly affected by the proposed treatments. These species include the NSO, northern goshawk, fisher, and some aquatic species. For each NSO activity center, the estimated home range (1.3-mile radius) was analyzed, and in many cases, this home range radius fell outside of the Assessment Area. A similar analysis was done for goshawks using a 1-mile radius. The analysis area for Pacific fisher includes the treatment units, as well as a 1.5- to 2.0-mile buffer that would contain one or more Pacific fisher home ranges. The analysis area for some aquatic species extended to the North and South Forks of the Salmon River adjacent to the Assessment Area, if it was reasonable that project effects could be detected beyond the Assessment Area. The species listed in Table 3-31 were identified by the Klamath National Forest or the USFWS as having the potential to occur in or near the Eddy Gulch LSR and in habitats either present on the LSR or with the potential to occur on the LSR.

Table 3-31. Wildlife species of special interest with the potential to occur in or near the Eddy Gulch LSR, Siskiyou County, CA.

Common Name	Status[a]	Preferred Habitat	Potential Presence in Assessment Area[b]
Federally Listed or Candidate Species			
NSO (*Strix occidentalis caurina*)	FT, CH	Prefers old-growth or late-successional forests but can also occur in managed forest with dense structure.	*Occurs.* Known to occur in the Assessment Area.
Forest Service Sensitive and State-listed Species			
Tehama chaparral (*Trilobopsis tehemana*)	FSS,	Prefers talus, rock outcrops, or caves with subsurface moisture; refugia includes leaf litter, particularly deciduous leaf litter, and woody debris in forested habitat.	*Low*. Suitable habitat exists within the Eddy Gulch LSR; species is not known to occur in the LSR but reportedly occurs on the Salmon River Ranger District (Duncan et al. 2003).
Southern torrent salamander (*Rhyacotriton variegatus*)	FSS	Cold, clear, well-shaded streams, waterfalls and seepages, particularly those running through talus and under rocks all year. Found from sea level to 4,500–5,000 feet.	*Unknown*. Suitable habitat exists but the Eddy Gulch LSR appears to be at the edge of the species' range.
Cascades frog (*Rana cascadae*)	FSS, MIS	Small streams, ponds, lakes in meadows or open coniferous forest.	*Low*. Occurs near the LSR, but there is only one known pond (private) and no lakes or languid streams in the Assessment Area.
Foothill yellow-legged frog (*Rana boylii*)	FSS	Rocky streams and rivers in various habitats. Usually in streams with abundant boulders and cobbles and with mix of sun and shade.	*Moderate*. The Assessment Area contains suitable habitat, but there are no reported records from the area.
Western pond turtle (*Actinemys marmorata*)	FSS	Slack- or slow-water aquatic habitat with many basking sites. Hatchlings require shallow water habitat with relatively dense submergent or short emergent vegetation in which to forage.	*Moderate*. Turtles may occur in low-gradient streams near the North and South Forks of the Salmon River or in ponds on private property.
Bald eagle (*Haliaeetus leucocephalus*)	FSS, SE	Forages over a variety of open habitats. Nests near tops of large trees in association with open water.	*Low*. There is no high-quality foraging habitat within 2 miles of the Assessment Area, but the lower Salmon Rivers may provide foraging habitat.
Northern goshawk (*Accipiter gentilis*)	FSS	Mature conifer forest. Nests usually in dense stands with open understory, often near water.	*Occurs.* Known to occur in the Assessment Area.

Table 3-31. Wildlife species of special interest with the potential to occur in or near the Eddy Gulch LSR, Siskiyou County, CA (continued).

Common Name	Status[a]	Preferred Habitat	Potential Presence in Assessment Area[b]
Peregrine falcon (*Falco peregrines anatum*)		Prominent cliffs or other precipitous features with ledges or other platforms.	*Occurs*. Known from two nesting sites just outside of the Project Area.
FSS and State-listed Species			
Great gray owl (*Strix nebulosa*)	FSS, SE	Mid- to high-elevation mature conifer stands adjacent to meadows with pocket gophers and/or voles.	*Low*. There are no meadows or herbaceous habitats, other than small scattered patches.
Willow flycatcher (*Empidonax traillii brewsteri*)	FSS, SE	Large patches of shrubby willows along streams or in wet meadows, generally over 2,000 feet elevation. Also wet scrub following disturbance.	*Low*. Willow patches may occur in Riparian Reserves, but these are most likely too small or shaded.
Pallid bat (*Antrozous pallidus*)	FSS	Many habitat types, especially open dry habitats with rocky areas for roosting. Uses caves, buildings, hollow trees, rock outcrops, bridges, and many other roost sites.	*High*. Suitable foraging and roosting habitat is widespread.
Townsend's big-eared bat (*Corynorhinus townsendii*)	FSS	Many habitats but may prefer moist areas. Roosting strongly associated with cave-like features, which may include buildings, tunnels, other man-made structures, usually cool. Sensitive to disturbance.	*Occurs.* Known to occur in caves just outside of the Assessment Area.
American pine marten (*Martes americana sierrae*)	FSS	Late-successional forest, typically in relatively wet high-elevation forests above Ponderosa pine and/or mixed-conifer forests where winter snow is persistent (that is, fir forests above 5,000 feet).	*Moderate*. Most likely to occur at high elevations. Recent surveys detected martens in the Marble Mountain Wilderness.
Pacific fisher (*Martes pennanti pacificus*)	FC[c], FSS	Mature, dense mid-elevation conifer forests with hardwoods, large snags and logs, and small brushy openings with diverse prey.	*Occurs.* Known to occur in the Assessment Area.
California wolverine (*Gulo gulo luteus*)	FSS, ST	Montane regions with persistent spring snowpack and openings in old-growth or mature forests that are isolated from man. Can travel widely.	*Low*. Historical in region, but there are no recent records from this region.
MIS: River and Stream Association			
Tailed frog (*Ascaphus truei*)	MIS	Cool, perennial streams in conifer-dominated habitats; occurs more frequently in mature or late-successional stands, and uses submerged rocks and logs in streams for cover.	*Occurs.* Known to occur in the Assessment Area.
Cascades frog (*Rana cascadae*)	MIS, FSS	Small streams, ponds, lakes in meadows or open coniferous forest.	*Low*. Occurs near the LSR, but there is only one known pond (private) and no lakes or languid streams in the Assessment Area.
American dipper (*Cinclus mexicanus*)	MIS	Along clear, fast-flowing, unpolluted perennial streams and rivers with rock faces, waterfalls, large boulders, or other features that provide similar niches for nesting.	*Occurs.* Known to occur in the Assessment Area.
Northern water shrew (*Sorex palustris*)	MIS	Montane riparian habitats.	*High*. Most likely common along most streams.

Table 3-31. Wildlife species of special interest with the potential to occur in or near the Eddy Gulch LSR, Siskiyou County, CA (continued).

Common Name	Status[a]	Preferred Habitat	Potential Presence in Assessment Area[b]
Long-tailed vole (Microtus longicaudus)	MIS	Montane riparian, wetlands, grasslands, and wet meadow habitats.	*Moderate*. Likely to be common in suitable habitat, but meadow-like habitats are sparse in the Assessment Area.
MIS: Marsh/Lake/Pond Association			
Western pond turtle (*Actinemys marmorata*)	MIS, FSS	Slack- or slow-water aquatic habitat with many basking sites. Hatchlings require shallow water habitat with relatively dense submergent or short emergent vegetation in which to forage.	*Moderate*. Turtles may occur in low-gradient streams near the North and South Forks of the Salmon River or in ponds on private property.
MIS: Hardwood Association			
Acorn woodpecker (*Melanerpes formicivorus*)	MIS	Hardwood, hardwood-conifer, or conifer habitats with mature oaks and snags.	*High*. Most likely in open oak/conifer habitats at lower elevations and perhaps locally common.
Western gray squirrel (*Sciurus griseus*)	MIS	Mature oak and mixed-conifer habitats, requiring large trees, mast crops, and snags.	*Occurs.* Known to occur in the Assessment Area.
MIS: Snag Association			
Vaux's swift (*Chaetura vauxi*)	MIS	Late-successional coastal forests, but also known to occur in other conifer-dominated forests below the zone of true firs, burned forests, and in towns with no canopy cover as long as large hollow trees or chimneys are available for nesting.	*Moderate*. Suitable habitat is widespread, but Vaux's swifts are generally uncommon and local.
Red-breasted sapsucker (*Sphyrapicus ruber*)	MIS	Montane riparian, montane hardwood-conifer, mixed-conifer, and true fir forests, preferring sites near meadows, clearings, or streams.	*Occurs.* Known to occur in the Assessment Area.
Downy woodpecker (*Picoides pubescens*)	MIS	Riparian deciduous and associated hardwood and conifer habitats and closely associated with riparian softwoods.	*High*. Most likely in riparian-dominated woodlands at lower elevations where it is probably uncommon in the Assessment Area.
Hairy woodpecker (*Picoides villosus*)	MIS	Open to moderately dense stands of mature conifers with snags of sparse to intermediate density; often favors burned stands.	*Occurs.* Known to occur in the Assessment Area.
White-headed woodpecker (*Picoides albolarvatus*)	MIS	Montane coniferous forests up to higher-elevation lodgepole pine and red fir habitats.	*Occurs.* Known to occur in the Assessment Area.
Black-backed woodpecker (*Picoides arcticus*)	MIS	Confined to recently burned lodgepole pine, red fir, or other higher-elevation forests; may occur in unburned forests if adequate prey is present.	*Low*. The Eddy Gulch LSR is on the edge of the species' range, but it could occur in response to large fires.
Pileated woodpecker (*Dryocopus pileatus*)	MIS	Mature conifer or hardwood-conifer habitats near permanent water; most common in late-successional and old-growth mixed-conifer forests with moderate to dense canopy cover and large numbers of snags, stumps, and logs.	*Occurs.* Known to occur in the Assessment Area.

Table 3-31. Wildlife species of special interest with the potential to occur in or near the Eddy Gulch LSR, Siskiyou County, CA (continued).

Common Name	Status[a]	Preferred Habitat	Potential Presence in Assessment Area[b]
Other			
Klamath shoulderband (*Helminthoglypta talmadgei*)	Formerly S&M Cat. D	Talus slopes and rockslides, often in limestone substrates, especially near springs or streams.	*Occurs.* Known to occur in the Assessment Area.
Tehama chaparral (*Trilobopsis tehemana*)	FSS; Formerly S&M, Cat. A	Prefers talus, rock outcrops, or caves with subsurface moisture; refugia includes leaf litter, particularly deciduous leaf litter, and woody debris in forested habitat.	*Low*. Suitable habitat exists within the Eddy Gulch LSR; species is not known to occur in the LSR but reportedly occurs on the Salmon River Ranger District (Duncan et al. 2003).

Notes: a. Categories of special status recognition used by federal and state agencies. Not all categories imply legal protection.

CH = Critical Habitat
FT = Federal Threatened
SE = State (California) Endangered
FC = Federal Candidate for Listing
FSS = Forest Service Sensitive Species
ST = State (California) Threatened

b. Definitions of Potential to Occur

Unknown: The probability of occurrence is unknown because the Eddy Gulch LSR is near the margin of the species' known distribution; suitable habitat is available, but some species, especially those with limited dispersal capability, are limited by factors (geological history, for example) other than habitat structure.

Low: Some habitat features may occur in the Eddy Gulch LSR, but important habitat features are lacking and habitat is marginal. If the species does occur, it is most likely a transient or occurs in very small numbers.

Moderate: The most important habitat features present in the Eddy Gulch LSR, but most or all of the area lacks at least one important habitat component; or, habitat exists but species is near the edge of its known distribution.

High: Species is expected to occur but has not been documented in the Eddy Gulch LSR. Habitat in Eddy Gulch LSR has all necessary components, species observed elsewhere in similar habitats.

Occurs: Species documented or known to occur in the Assessment Area.

c. On April 8, 2004, the USFWS determined that fisher populations in California, Oregon, and Washington warrant protection under the ESA but that listing under the act is "precluded by the need to take other listing actions of higher priority" (USFWS 2004). Candidate Notice of Review published December 6, 2007, in *Federal Register*, Vol. 72, No. 234 gave this species a listing priority of 6.

Analysis Period. The analysis period extends approximately 20 years, which is the maximum anticipated duration of the effectiveness of the proposed fuel reduction activities. The time frame for the effects analysis is 5 years for short-term effects and up to 30 years for long-term effects on wildlife habitat. The western slope of the Klamath Mountain in the Klamath National Forest has a relatively high rate of vegetation establishment and growth due to high annual precipitation and productive soils. Within this time frame (up to 20 years following treatment), vegetation, and thus habitat, would have sufficient opportunity to increase in canopy cover, basal area, and tree density to a point where subsequent treatments may need to be considered for wildlife habitat protection.

3.4.2.3 Intensity of Effects Definitions

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used in this analysis are described below.

Negligible. An action would result in no observable or measurable effects on individual survival or on native wildlife populations, their habitats, or the natural processes sustaining them. Occasional individual responses to disturbance could be expected but without interference to reproduction or other factors affecting survival.

Minor. An action would result in detectable effects on individuals or in small, short-term changes to populations, but it would not be expected to cause any measurable long-term effects on native species, their habitats, or the natural processes sustaining them.

Moderate. An action would result in detectable effects on native wildlife populations, their habitats, or the natural processes sustaining them. Key ecosystem processes may experience disruptions that would be outside the natural range of fluctuation (but would return to natural conditions). Sufficient habitat would remain functional to maintain viability of native wildlife populations.

Major. An action would result in large effects on native wildlife populations, their habitats, or the natural processes sustaining them. Key ecosystem processes would be disrupted for long periods or permanently.

3.4.2.4 Measurement Indicators

The affected environment for each species is described in terms of the amount and type of habitat present on the Klamath National Forest, and effects are estimated in terms of habitat amount and/or quality. The amount and type of habitat are described in terms of

- acres of habitat or miles of streams;
- canopy closure;
- basal area;
- large trees (diameter at breast height [dbh] of over 24 inches);
- snags (over 15 inches dbh);
- large CWD (over 15 inches dbh and longer than 10 feet); and
- hardwoods (presence of).

However, not all features will be used to describe habitat conditions for all species.

3.4.3 Affected Environment (Existing Conditions)

Approximately 45,220 acres of the 61,900-acre Eddy Gulch LSR (73 percent) are capable of producing late-successional habitat (USFS 1999, Table 2.38). Currently, at least 18,780 acres (or about 42 percent of the capable late-successional habitat [USFS 1999]) are vegetated by late-successional habitat. The combined acres vegetated by late-successional and mid-successional forest total 35,710 acres (or about 79 percent of the capable late-successional habitat). Relative to other LSRs in the Klamath National Forest, the Eddy Gulch LSR ranks moderate for both the proportion of late-successional and combined mid-successional/late-successional forested habitat (USFS 1999, 2:49).

The USFWS identified four priority protection areas (described in Section 2.5.1.4 of Chapter 2 and depicted on Map A-3 in Appendix A), which contain large blocks of high-quality NSO habitat, provide for small clusters of NSO populations within the Eddy Gulch LSR, or are important on a landscape connectivity scale.

3.4.3.1 Species Considered

The species listed in Table 3-31 above were identified by the Klamath National Forest or the USFWS as having the potential to occur in or near the Eddy Gulch LSR and in habitats either present on the LSR or with the potential to occur on the LSR. All of the species that have potential to occur on or near the Eddy Gulch LSR Project are addressed in detail in the Wildlife and Habitat Resources Report (2009).

3.4.3.2 Federally Listed Species

Northern Spotted Owl. The NSO is the only terrestrial wildlife species listed under the ESA that occurs or has habitat in the Eddy Gulch LSR. Currently, the primary range-wide threats to NSO are habitat loss from timber harvest, habitat loss from fire (or other natural events such as insects and disease), and barred owls (*Strix varia*), which have expanded into the range of NSO (USFWS 2008a).

Fire is now considered a greater threat to NSO habitat on federal lands than timber harvest or other management activities, especially in the relatively dry Klamath Province of Oregon and California, where loss of NSO habitat from fire has exceeded habitat loss from timber harvest since 1994 (USFWS 2008a). Recognition of the threat of fire stimulated the USFWS to identify recovery actions unique to the Klamath Province, including developing a strategy to achieve sustainable, fire-resilient and fire-resistant forests (Recovery Action 8) and the creation of a Dry Forest Landscape Work Group (Recovery Action 9) that will reexamine the effectiveness of the LSR system in the dynamic landscapes of the Klamath Province (USFWS 2008a).

Barred owls have displaced NSOs from many areas and are largely responsible for the alarming 7.1 percent annual decline of NSOs in Washington (Lint 2005). Whether the NSOs will be able to persist in areas with barred owls is unknown, but evidence to date suggests that NSOs are more likely to persist in, or be displaced into, drier areas, steep slopes, or higher elevations because barred owls prefer riparian areas with gentler terrain (Gutiérrez et al. 2007; USFWS 2008a). Individual barred owls were first detected in the Assessment Area in 2003 and have been occasionally detected (J. Rockweit, pers. comm. 2008), but so far, none of the NSOs tracked by Franklin's demographic study group have been displaced by barred owls, and no barred owl pairs have been observed in the Assessment Area (J. Rockweit, pers. comm. 2008). These factors suggest that the Eddy Gulch LSR, compared with other LSRs, may be relatively inhospitable to barred owls and an important refugium for NSOs.

NSOs inhabit older forests because they contain the necessary structures for nesting, roosting, foraging, and dispersal (Forsman et al. 1984; Gutiérrez 1996; LaHaye and Gutiérrez 1999). The habitat features that support *nesting and roosting* include:

- a multilayered, multispecies canopy with overstory trees larger than 30 inches dbh;
- moderate to high canopy closure (60 to 90 percent);

- a high incidence of trees with large cavities or other types of deformities (such as broken tops, mistletoe infections, and other evidence of decadence) (White 1996; LaHaye and Gutiérrez 1999);
- numerous large snags and an abundance of fallen trees and coarse woody debris (CWD);
- sufficient open space below the canopy for NSOs to fly (Thomas et al. 1990); and
- basal area in nest stands that may often exceed 200 square feet/acre (Solis and Gutiérrez 1990).

Table 3-32 compares the minimum habitat requirements (considered by the USFWS 2008b to be necessary for supporting nesting/roosting in interior northern California) with current conditions in the project Assessment Area. The minimum habitat requirements are based on research (Franklin et al. 2000) and observational studies (USFWS 2008b) in the Klamath Mountains and California Cascades physiographic provinces.

The nesting/roosting habitat currently occupied by NSOs in the Assessment Area has features consistent with those described in Table 3-32 (second column), but there are no *quantitative* data for occupied nesting/roosting stands in the Eddy Gulch LSR. The mid- to late-successional Douglas-fir stands sampled for this project (see Table 3-32 [fourth column] and Table 3-33) were mostly along ridges and not necessarily representative of nesting/roosting habitat that often occurs on the lower third of slopes, within 0.5-mile core areas more frequently used by owls.

Table 3-32. Minimum NSO habitat requirements compared to current conditions.

Minimum NSO Nesting / Roosting Habitat Requirement*	Current Nesting / Roosting Habitat Occupied by NSO in the Assessment Area*	Minimum NSO Foraging Habitat Requirement	Current Foraging Habitat Occupied by NSO in the Assessment Area*
Basal area ranges from 150 to more than 210 square feet per acre	Average basal area of 266 square feet per acre	Mix of basal areas ranging from 120 to over 180 square feet per acre	Average basal area ranges from 216 square feet per acre in Douglas-fir stands to 355 square feet per acre in red fir stands
Eight trees per acre over 26 inches dbh	Average 20 trees per acre	At least 5 trees per acre over 26 inches dbh	Average 5 to 43 trees per acre larger than 24 inches dbh
At least 60 percent canopy cover	Average 72 percent canopy cover	Mix of canopy closures ranging from 60 to 100 percent	Average 58 to 73 percent canopy cover

Note: *USFWS 2008b.

Table 3-33. Current stand structure on ridgetops where proposed M Units are located.

SAF Forest Type[a]	CWHR Successional Stage[b]	TPA[c]	TPA >10"	TPA >24"	BA[c]/ac >10"	Average dbh[c] >10"	Canopy Closure (percent)
Douglas-fir	Mid-successional (MS)	441	135	5	192	16.1	73
Douglas-fir	MS/Late-successional (LS)	235	120	20	249	19.5	72
White Fir	MS	299	190	9	302	17.1	61
White Fir	MS/LS	275	124	29	284	20.5	58
Red Fir	LS	613	113	43	350	23.8	59
Mixed-conifer	LS	255	159	28	320	19.2	69

Notes:

a. SAF = Society of American Foresters.

b. CWHR = California Wildlife Habitat Relationship.

c. TPA = trees per acre; BA = basal area; dbh = diameter at breast height.

Foraging habitat generally has attributes similar to those found in nesting/roosting habitat but may not always support successful nesting (USFWS 1992). Although general attributes, such as large trees, are common to foraging habitat across the NSO range, Irwin et al. (2007) suggest that optimal foraging conditions are found when the basal area is between 160 to 320 square feet per acre. The variability is in response to the main species of local prey (northern flying squirrels [*Glaucomys sabrinus*], or woodrats [*Neotoma* spp.]), which are the predominant prey both in biomass and frequency (Forsman et al. 1984; Zabel et al. 1995; Ward et al. 1998; Forsman et al. 2004). Woodrats are generally the dominant prey item in the drier forests typically found in the southern portion of the NSO range (Forsman et al. 1984; Zabel et al. 1995; Sztukowski and Courtney 2004), which includes the Eddy Gulch LSR (J. Rockweit, pers. comm. 2008). Dusky-footed woodrats (*N. fuscipes*) generally reside in brushy habitats (Williams et al. 1992), and densities have been found to be highest in 20- to 30-year-old sapling/bushy pole timber (Sakai and Noon 1993) or, in older forests, typically near riparian areas with fruit- and mast-producing hardwoods (Carey et al. 1999). Forests with little understory appear to be poorly suited for dusky-footed woodrats but are used by flying squirrels. Where wood rats are the primary prey, studies have found that, although NSOs selectively forage in areas with large trees (Call et al. 1992; Irwin et al. 2007), they also selectively forage along forest edges (Zabel et al. 1995; Ward et al. 1998) and riparian areas (Irwin et al. 2007). Canopy cover may not be a strong predictor of foraging habitat (Irwin et al. 2007), but NSOs typically avoid areas with less than 40 percent canopy (Call et al. 1994). Based on research (USFWS 2008a, 2008c) and observational studies in the Klamath Mountains and California Cascades physiographic provinces, the USFWS (2008b) considers the minimum habitat requirements necessary to support foraging in interior northern California (also refer to Table 3-32 above) to include a combination of stands that contain a mix of basal areas ranging from 120 to over 180 square feet per acre, at least 5 trees per acre over 26 inches dbh, a mix of canopy closures ranging from 60 to 100 percent, and stands that contain a mix of basal areas ranging from 80 to 120 square feet per acre and at least 40 percent canopy closure. The mid- to late-successional stands sampled for this project contained average basal areas that ranged from 216 square feet per acre in Douglas-fir stands to 355 square feet per acre in red fir stands, 58 to 73 percent canopy cover, and from 5 to 43 trees per acre larger than 24 inches dbh (refer to Table 3-33 above).

Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities (USFWS 2008a). Neither stand- nor landscape-level forest attributes have been thoroughly evaluated in terms of facilitating successful dispersal (Buchanan 2004), but dispersing juveniles that use open areas, such as clearcuts, suffer increased mortality if they cannot find cover (Franklin and Gutiérrez 2002). However, based on the movement of radio-tracked owls, openings do not appear to act as barriers to dispersal until they reach the size of large nonforested valleys or large water bodies (Forsman et al. 2002). It is unlikely that there are any limitations to NSO dispersal in the Assessment Area because most of the area is forested with at least 40 percent canopy cover, and adjoining drainages are typically connected by at least narrow patches of forest, even where most of the surrounding vegetation is dominated by nonforest types.

The Eddy Gulch LSR provides approximately 12,577 acres of nesting/roosting habitat and 16,220 acres of foraging habitat, for a total of 28,797 acres (47 percent of the 61,900-acre LSR) of NSO habitat (USFS 1999). Habitat acreages are useful, but acreage does not reflect other factors that affect NSO habitat use or their influence on NSO survival or reproduction. The most recent landscape-level analyses found that, in the southern portion of the subspecies' range, highest fitness is achieved where a mosaic of large patches of late-successional habitat are interspersed with other vegetation types that increase the amount of edge habitats (Franklin et al. 2000; Franklin and Gutiérrez 2002; Zabel et al. 2003; Olson et al. 2004). Homogeneous expanses of older forests, while generally supporting greater adult survival than younger forests or small patches of older forests (Franklin et al. 2000; Olson et al. 2004; Dugger et al. 2005), did not support a stable or increasing population (Franklin et al. 2000; Olson et al. 2004; also see Dugger et al. 2005). Franklin et al. (2000) hypothesized that a mosaic of different vegetation and successional stages may offer a stable prey resource for NSOs while providing adequate protection from predators. In the Eddy Gulch LSR, nesting/roosting and foraging habitat are fairly widely distributed in patches that range in size from less than a few acres to more than 500 acres. Although some patches of NSO habitat are isolated by nonhabitat, most patches of nesting/roosting habitat are connected by suitable foraging or dispersal habitat. Overall, the size, distribution, and connectivity of nesting/roosting habitat and foraging habitat vary among NSO territories, but in general, the pattern suggests high habitat fitness potential (Franklin et al. 2000).

The USFWS (Johnson et al. 2006) also used a landscape-level analysis to examine eight abiotic factors to help distinguish 36 activity centers from unused sites in three Klamath National Forest LSRs. The USFWS found that activity centers were associated with basin-like topography, the lower half of slopes, and streams. Additionally, numerous published articles have demonstrated that NSOs prefer use of lower-slope or mid-slope sites for foraging, roosting, and nesting, especially as sites are related to drainages or surface water (see Solis and Gutiérrez 1990; Blakesley et al. 1992; and Lahaye and Gutiérrez 1999). As might be expected, these abiotic habitat selection features coincide with conditions that favor forest growth and historically were relatively resistant to fire. Most of the activity centers in the Assessment Area are located in areas with similar topographic characteristics; that is, core areas are found no higher than mid-slope and are typically centered on prominent drainages.

Distribution and Population Trends. A total of 23 activity centers have been identified within the boundary of the Eddy Gulch LSR, 20 of which are in or overlapping the project Assessment Area (see Maps A-1a and A-1b in Appendix A of the Wildlife and Habitat Report). However, scattered sections in the Assessment Area, totaling 10 to 15 percent of the LSR, have not been surveyed, and at least three activity centers have not been surveyed for the past 10 years. The mapped activity centers are widely distributed across the LSR, but almost all occur below 5,500 feet on the lower one-half to two-thirds of the slope and in areas with basin-like topography, consistent with the findings from Johnson et al. (2006). Areas that apparently lack NSOs, but that have physical attributes (such as low-elevation basins) associated with sustainable activity centers, include China Gulch, Counts Gulch, Crawford Creek southwest of Grouse Point, and Butcher Gulch. Butcher Gulch may currently contain sufficient nesting, roosting, and foraging habitat, but the other areas may lack sufficient NSO habitat at this time.

The only portion of the Assessment Area that has been surveyed regularly is the long-term Klamath demographic study area on the west end of the Eddy Gulch LSR. This area has been surveyed annually since at least 1986 and includes five mapped activity centers[3] that are included in the data set analyzed by Franklin et al. (2000) and other demographic analyses, such as the 18-year (1985–2003) estimates of population growth, survivorship, and reproduction (Lint 2005; Anthony et al. 2006). These analyses found that the NSO has experienced a range-wide decline of about 3.7 percent per year, and the northwestern California population has declined about 1.5 percent per year. Annual adult survival in the northwestern California population was 86.9 percent, and greater than the 85 percent thought to be key to stationary populations (Lint 2005), but has also been declining. Adult females fledged 0.33 young per year, which was slightly less than the range-wide average. The number of young fledged annually in the five activity centers tracked by Franklin in the Eddy Gulch LSR averaged 0.38 over the last 22 years.

USFWS Section 7 Consultation Home Range Assessment. The amount of suitable habitat in a home range has been shown to influence NSO productivity and survivorship (Bart 1995; Franklin et al. 2000; Dugger et al. 2005). Consequently, when evaluating potential project effects on an NSO activity center, the USFWS evaluates the amount and type of habitat within an owl's home range to assess the quality or apparent fitness potential of that activity center. The average home range size varies geographically (USFWS 1990; Zabel et al. 1995), but the estimated annual home range in the Klamath Province is approximately 3,330 acres. For planning purposes, the USFWS (1992, 2008a) uses a 1.3-mile radius circle containing 3,398 acres to estimate the size and amount of home ranges. The portion of the home range that receives disproportionately high use (the core area) during the breeding season is smaller than that used during the remainder of the year (Forsman et al. 1984; Sisco 1990; Glenn et al. 2004; Bingham and Noon 1997; Irwin et al. 2000), so the USFWS also examines habitat within the core area, which is defined by a circle with a 0.5-mile radius (502 acres) from the activity center.

The USFWS has concluded that NSO survivorship and productivity are reduced when the amount of nesting/roosting or foraging habitat within a 0.5-mile core area falls below 80 percent of the area, and the amount of suitable habitat within a home range falls below 40 percent of the area (Simon-Jackson 1989; Thomas et al. 1990; USFWS 1990; D. Johnson, pers. comm. 2008). In the California Klamath Province, this equates to approximately 400 to 1,335 acres of suitable habitat, respectively (USDA, USDI 1990; Thomas et al. 1990; see also Franklin et al. 2000). In 2001 an interagency team of USFWS and Forest Service personnel produced a habitat-based model to predict the probability of NSO occupancy (USFS, USDI 2001), and their modeling results suggest that the probability of

3. The area includes six mapped Klamath National Forest activity centers, but two adjacent activity centers have never been occupied simultaneously, so Franklin's demographic study group considers the area to be occupied by only one pair that may alternate activity centers.

occupancy is highest when the ratio of nesting/roosting habitat to foraging habitat within a NSO core area is 2:1. Thus, the USFWS currently considers the minimum amount of NSO habitat to avoid "take" under the ESA to consist of at least 250 acres of nesting/roosting and 150 acres of foraging habitat within a 0.5-mile core area and at least 935 additional acres of foraging habitat within a 1.3-mile home range outside the core area (D. Johnson, pers. comm., Jan. 2009).

Approximately 28 home ranges of historic and recent activity centers overlap the Eddy Gulch LSR, with fewer than that found within the Assessment Area (Maps A-5a and A-5b in Appendix A). None of the activity centers in the Assessment Area meet or exceed 400 acres of nesting/roosting/foraging habitat within the 0.5-mile core area. However, almost all of the activity centers meet or exceed the 1,335 acres of nesting/roosting and foraging habitat within the 1.3-mile home range. Of the five activity centers that have less than the target 1,335 acres in the home range, only one (KL1047) has an apparent habitat deficit (approximately 16 percent) greater than 10 percent in the 1.3-mile home range.

Managed Owl Conservation Area (MOCA). The Eddy Gulch LSR occurs within MOCA-35. The MOCAs are areas that contain or will develop habitat intended to support stable and well-distributed populations of NSOs over time and allow for movement of NSOs across a larger network of MOCAs and other suitable habitats (USFWS 2008a). The Eddy Gulch LSR is included within a Type 1 MOCA, which is expected to support 20 or more pairs of breeding NSOs now or in the future. MOCAs in the Klamath Provinces of Oregon and California, including MOCA-35 in the Eddy Gulch LSR, are considered parts of an interim network until a landscape-management strategy is developed and adopted in these fire-prone provinces (USFWS 2008a).

Critical Habitat and Critical Habitat Units. The Eddy Gulch LSR occurs within the Scott and Salmon Mountains NSO CHU 25. The Scott and Salmon Mountains CHU subunit 35 includes all of the Eddy Gulch LSR, with the exception of 1,960 acres of private lands. NSO Critical Habitat and CHUs were originally designated by the USFWS in 1992 (USFWS 1992) but revised on August 13, 2008 (USFWS 2008c). They are based on a network of MOCAs.

The Assessment Area occurs within subunit 35 of the Scott and Salmon Mountains NSO CHU 25 (USFWS 2008c). The boundaries of subunit 35 closely align with the USFWS 1992 designation of NSO CHU CA25. Therefore, any analysis conducted herein for subunit 35 would also be applicable to CA25 as designated by the USFWS in 1992.

The goal of established CHUs is to maintain habitat that provides the Primary Constituent Elements (PCEs) that create self-sustaining and interconnected populations of the NSO over time. PCEs are the biological and physical features of critical habitat that are essential to the NSO conservation and recovery. The four PCEs identified in the Recovery Plan (USFWS 2008a) are nesting, roosting, foraging, and dispersal habitat.

Subunit 35 of the Scott and Salmon Mountains CHU, combined with the contiguous habitat in the Marble Mountains Wilderness, is expected to support 22 nesting pairs over time (D. Johnson, pers. comm. 2008). Historical surveys indicate that the Eddy Gulch LSR has supported between 19 and 25 NSO activity centers (USFS 1999), which is within or exceeds the Scott and Salmon Mountains CHU subunit 35 objective of 22 pairs. Subunit 35 also helps to connect the Western Klamath-Siskiyou Mountains CHU across the high-elevation habitat in the Salmon-Trinity Alps Wilderness and east to the Shasta-McCloud area of concern. Existing dispersal habitat within and surrounding the Scott and Salmon Mountains CHU subunit 35 exceeds 50 percent (with the possible exception of the Lower South Fork Salmon River, which was estimated to be 48 percent in 1992) (USFS 1999, ch. 2, pg. 49). Thus, subunit 35 appears to be providing intra-provincial connectivity with adjacent Wilderness Areas and other CHUs.

3.4.3.3 Forest Service Sensitive Species

The Wildlife and Habitat Report provides discussions of all Forest Service Sensitive Species that are listed in Table 3-31 above, and those species are analyzed in the Environmental Consequences section below.

Northern Goshawk. Northern goshawks are found in mid- to late-successional conifer forests; nest stands are usually characterized by a canopy cover that exceeds 50 percent, level terrain or “benches” of gentle slope, northerly aspects, proximity to water (usually less than one-third mile away), patches of larger trees, and proximity to meadows or forest openings. Telemetry studies suggest that foraging individuals avoid dense young forest stands and brush but use a wide variety of stand conditions, showing some preference for relatively mature stands with moderate canopy closure (Austin 1993; Hargis et al. 1994; Beier and Drennan 1997; Drennan and Beier 2003).

There are approximately 28,897 acres of suitable nesting habitat in the Assessment Area and five Goshawk Management Areas (GOMAs) with 1.0-mile home ranges that overlap the Assessment Area (Table 3-34). Two new goshawk territories were found in 2008 during the first large-area, protocol-level goshawk surveys in the Assessment Area (Herrera 2008). Klamath LRMP Standards and Guidelines specify that these GOMAs and active territories maintain 300 acres of dense mature forest within a 0.5-mile Primary Nest Zone and 900 acres in a mosaic of mid- to late-successional forest conditions in a 1.0-mile Foraging Habitat Zone.

Table 3-34. Northern goshawks in the Eddy Gulch LSR Project Assessment Area.

Territory	GOMA Established	Latest Survey/Status[a]	Prior Occurrence/ Reproduction	Home Range Overlaps Assessment Area	Home Range Overlaps an FRZ
Eddy Gulch	Yes-SAR1	2008/U	1991/1991	Yes	No
Matthews	Yes-SAR8	2008/U	1987/1987	Yes	No
Sixmile	Yes-SAR11	2008/U	1987/R	Yes	Yes
West Fork Whites	Yes-SAR14	1989/R	None	Yes	Yes
Blue Ridge Ranch	No	1994/R	1993/1993	No	No
Callahan Creek	No	1994/R	None	No	No
Russian River	Yes-SAR 13	2008/U	Unknown	Yes	No
Lower Shadow Creek	No	2008/R	2007/R	Yes	Yes
Lower Butcher Creek	No	2008/U	None	Yes	No

Notes:

a. R = reproducing (including number of fledged if known).
U = unknown.

Pacific Fisher. The Pacific fisher is a Federal Candidate for listing under the ESA. The Pacific fisher was petitioned for listing in November 2000. After a 12-month review, the USFWS found Pacific fisher to be a distinct population segment and gave a “warranted but precluded” decision to the petition. As a result of that decision, the West Coast distinct population has become a Federal Candidate species under the ESA (USDI 2004) and will be annually reviewed for its status and may be listed at a later date.

The Pacific fisher typically occurs in mid- to late-successional coniferous forest and deciduous riparian habitats. They prefer large blocks of dense multistoried (greater than 60 percent canopy closure), multispecies, mid- to late-successional coniferous forests with a high number of large (over 30 inches diameter at breast height [dbh]) snags and downed logs and a hardwood component (Ruggiero et al. 1994; Krohn et al. 1997; Zielinski et al. 2004a). This complex forest structure supports prey, provides individuals access to prey during winter, and provides typical fisher resting and denning sites. Habitat usually also contains small openings with understory vegetation and woody debris that support an abundance of diverse prey (such as voles, hares, porcupines, squirrels, mice, chipmunks, carrion, and fruit). Their preferred habitats are often connected by riparian corridors, saddles, or other linkages that serve as movement corridors. Fishers will den in brush piles, logs, snags, rocky areas, upturned trees, or in other protected cavities; hollow logs and snags are particularly important for denning. Young are typically born in February through May and remain with the female until late autumn.

The most influential variables affecting rest site selection in California fisher populations include maximum tree sizes and dense canopy closure, but other features are important to rest site choice as well, such as large-diameter hardwoods, large conifer snags, and steep slopes near water (Zielinski et al. 2004a). Across home ranges in a northern California study area, fishers selected sites made up of stands with large-diameter trees and dense canopy cover that were generally situated within drainage-bottoms (Yaeger 2005). Fishers select areas as rest sites where structural features are most variable but where canopy cover is least variable, suggesting that resting fishers place a premium on continuous overhead cover but prefer resting locations that also have a diversity of sizes and types of structural elements (Zielinski et al. 2004a, 2004b). Rest-site structures used by fishers include cavities in live trees, snags, hollow logs, fallen trees, canopies of live trees, mistletoe clumps, or large or deformed branches and to a lesser extent stick nests, rocks, ground cavities, and slash and brush piles (Heinemeyer and Jones 1994; Higley et al. 1998; Mazzoni 2002; Zielinski et al. 2004a, 2004b).

The Pacific fisher is an uncommon permanent resident in the Klamath National Forest. Although no den sites have been located in the Assessment Area, suitable denning, resting, and foraging habitat for fisher is widespread in the Assessment Area, especially below 5,000 feet. Fishers have been detected on numerous occasions at data stations in the Eddy Gulch LSR (Yaeger 2008; Zielinski et al. 2000). Additionally, camera stations have detected individuals near Etna Summit, on the south side of Etna Mill Creek, and in the Russian River Wilderness Area. The Eddy Gulch LSR is expected to support over 34,000 acres of suitable habitat (USFS 1999).

3.4.4 Desired Conditions

The Klamath LRMP specifies that LSRs are to be managed to maximize the amount of late-successional forest to a level reasonably sustainable because surrounding areas of Matrix and private lands are expected to contain relatively little late-successional forest habitat. However, dramatic differences in late-successional forest structure and process exist between forest community types in the LSR, and no single desired condition is appropriate for the entire landscape. It is desirable to have amounts of late-successional habitats that are between 45 and 65 percent identified functioning range to ensure continued functionality following inevitable natural disturbances.

Processes that historically have lead to the development of late-successional ecosystems include tree growth and maturation; death and decay of large trees; low- to moderate-intensity disturbances (such as fire, wind, insects, and disease) that create canopy openings and gaps in various strata of vegetation; establishment of trees beneath the maturing overstory trees, either in gaps or under the canopy; and closing of canopy gaps by lateral growth or growth of understory trees. These processes result in forests moving through different stages of late-successional conditions that may span several hundred years.

It is desirable to have variability in late-successional vegetative characteristics. It is neither desirable nor possible to have entire landscapes containing the same vegetative characteristics, stocking levels, tree sizes, and understory component. Within each vegetation community, desired conditions will vary according to site capability, which is influenced by elevation, slope, aspect, and soil conditions. Multistoried conditions will be scattered throughout the landscape, but they will be more prevalent on the lower half of the more mesic north and east aspects and in riparian areas. South- and west-facing slopes will have very few multilayered conditions, except in the Douglas-fir-tanoak series. Canopy closure will vary across the landscape, ranging from approximately less than 40 percent on primary ridgetops and south and west slopes to greater than 50 percent on north and east slopes and riparian areas. The upper portions of all aspects, except in the true fir type, will generally have lower densities compared to lower portions of the slopes. Snag and down log accumulations will be higher on the lower portions of slopes and decrease as one moves up slope.

It is desirable to provide habitat that contributes to the recovery of the NSO, especially the productivity of the existing pairs within the Eddy Gulch LSR. Variability in habitat attributes will be consistent with that described for late-successional habitats. Reintroduction of fire into LSRs may reduce the occurrence of habitat components locally. This is a recognized trade-off in order to create less hazardous fuels conditions that would otherwise put large areas of habitat at risk.

3.4.5 Environmental Consequences

3.4.5.1 Alternative A: No Action

Federally Listed Species

Direct and Indirect Effects on NSO Habitat in Areas Not Affected by Wildfire. Under the no-action alternative, and in the absence of wildfire, there would be no direct effects on NSOs or their habitat.

The amount or quality of NSO habitat in the Assessment Area would change slowly in areas not affected by fire. Continued forest growth could have beneficial or adverse indirect effects, depending on local conditions. In relatively young or open stands, continued forest growth could benefit NSOs by allowing for a slow increase in tree size, basal area, canopy cover, snags, and CWD. This could lead to an increase in the number of activity centers and the amount of nesting/roosting or foraging habitat in existing activity centers. Continued forest growth could also decrease fire risk as young or open stands develop a moister microclimate. In most stands, continued growth would increase stand density, density-related tree mortality, fuel hazards, and the probability of a stand-replacing fire. Continued growth could make some stands too dense for owls (Irwin et al. 2007) and reduce overall stand diversity. In summary, young or open stands not occupied by NSOs would most likely benefit from continued forest growth, but understory stand densities in many other areas, including stands occupied by NSOs, would most likely exceed the optimal stand density for nesting/roosting or foraging habitat because high understory density would limit owl movement. The risk of stand-replacing fires will also increase as ladder fuels increase.

Direct and Indirect Effects on NSO Habitat in Areas Affected by Wildfire. The modeled wildfire (refer to Section 2.4 in Chapter 2) would have various direct effects on Critical Habitat, NSOs, NSO habitat, and NSO prey, depending on the location, season, intensity, and pattern of the wildfire. Smoke may not affect most NSOs (Bevis et al. 1997); however, heavy and continuous smoke may affect NSOs during the nesting season when young birds cannot escape the fire (USDA 2007). Fire may also increase the risk of predation on NSOs as they move to unfamiliar territory, into more open habitats, or during the day.

There are approximately 28,797 acres of suitable NSO habitat within the portion of the Scott and Salmon Mountains CHU subunit 35 contained in Eddy Gulch LSR. Over time, if left untreated all of these acres have the potential to be affected by wildfire.

The 7,200-acre modeled wild fire would include 1,368 acres of low- to moderate-intensity fire that could benefit NSOs immediately after the fire by removing cover and/or concentrating prey into remaining patches of habitat (Lyon et. al. 2000). Jenness et al. (2004) concluded that relatively low-intensity ground fires probably have little or no short-term effect on the presence or reproductive success of Mexican spotted owls (*S. occidentalis lucida*). Similarly, Bond et al. (2002) hypothesized that NSOs have the ability to withstand the immediate, short-term (1-year) effect of fire occurring at primarily low to moderate severity within their territory. Short-term benefits would result in a mosaic of small openings that would invigorate forest understory and create new snags and down woody debris used by NSO prey, resulting in additional prey. Low- to moderate-intensity fires would also reduce the likelihood of future stand-replacing fires.

The modeled fire resulted in 81 percent crown fire (5,832 acres) where a moderate- to high-intensity fire could consume NSO nesting/roosting or foraging habitat, and extensive consumption of snags, CWD, understory, and litter and duff layers would reduce prey abundance. The modeled fire would have various indirect effects. Crown fires would result in substantial mortality, initiating successional changes that would replace mid- and late-successional forest stands with brush fields and dense young forests and increase the probability of future high-intensity wildfire. Fire may also affect enough nesting/roosting or foraging habitats that it could lead to changes in NSO occupancy of the area (Clark 2007). Excessive habitat loss in a core area and/or home range would most likely cause abandonment of one or more activity centers during or shortly following fire.

The USFWS considers habitat (in interior California) necessary to support NSOs to consist of 400 acres of suitable habitat made up of at least 250 acres of nesting/roosting and 150 acres of foraging habitat in the 0.5-mile core area. All but one core area within the Eddy Gulch Assessment Area are currently below 250 acres of nesting/roosting habitat. A crown fire would result in

75 percent mortality to trees greater than 20 inches dbh, removing most suitable nesting/roosting habitat, resulting in an adverse impact on NSO habitat in the Assessment Area. When the simulated fire behavior was compared to available nesting/roosting habitat, crown fires could adversely affect any of the 20 core areas. Table 3-35 below depicts the existing number of nesting/roosting acres with the potential number of acres and the percentage of nesting/roosting habitat that would be removed by the modeled fire in each of the 20 core areas, as any one of the core areas is susceptible to crown fire. Additionally, all four of the USFWS priority protection areas would lose a substantial amount of habitat in a wildfire.

Table 3-35. NSO core areas, in or overlapping the Assessment Area, that are susceptible to the simulated wildfire under the no-action alternative.

Activity Center	Acres of Nesting / Roosting Habitat in Core Areas	Acres of Nesting / Roosting Habitat in Core Areas Removed by Crown Fire	Percentage of Nesting / Roosting Habitat in Core Areas Adversely Affected by Crown Fire
KL0257	102	60	59
KL0365	141	51	36
KL1012[a]	174	140	80
KL1013	150	73	49
KL1014[a]	203	66	33
KL1028[a, b]	266	249	94
KL1030	244	150	61
KL1031[a]	140	129	92
KL1032[a, b]	161	154	96
KL1033[a]	254	165	65
KL1034[a]	209	138	66
KL1035[a]	169	116	69
KL1039	184	122	66
KL1040	166	104	63
KL1041	142	88	62
KL1046[a]	165	71	43
KL1047	100	89	89
KL1090	93	20	22
KL1258	132	23	17
KL4026[a]	171	145	85

Notes:

a. Denotes activity centers within which core areas will be treated with prescribed burning under Alternative A, and therefore are not expected to be susceptible to crown fires and thus habitat loss.

b. Denotes activity centers within which portions of the core areas would not be treated with prescribed burning under Alternative C, and therefore are expected to remain susceptible to crown fires and thus some habitat loss

Direct and Indirect Effects on Critical Habitat With and Without Wildfire. Under the no-action alternative, and in the absence of wildfire, there would be no direct effects on Critical Habitat. The amount or quality of Critical Habitat in the Assessment Area would change slowly in areas not affected by fire. Continued forest growth could have beneficial or adverse indirect effects, depending on local conditions. In relatively young or open stands, continued forest growth could benefit Critical Habitat by allowing for a slow increase in tree size, basal area, canopy cover, snags, and CWD. This could lead to an increase in the amount of nesting/roosting or foraging habitat available within the

Assessment Area. Continued forest growth could also decrease fire risk as young or open stands develop a moister microclimate. In other stands (most stands), continued growth would increase stand density, density-related tree mortality, fuel hazards, and the probability of a stand-replacing fire. Continued growth could make some stands too dense for owls (Irwin et al. 2007) and reduce overall stand diversity. In summary, young or open stands not currently containing suitable habitat would most likely benefit from continued forest growth, but understory stand densities in many other areas, including stands containing suitable habitat, would most likely exceed the optimal stand density for nesting/roosting or foraging habitat as increased understory stand density would limit owl movement, and as ladder fuels increase so will the risk of stand-replacing fires.

There are approximately 28,797 acres of suitable NSO habitat in the portion of the Scott and Salmon Mountains CHU subunit 35 contained in Eddy Gulch LSR. Over time, if left untreated, all of these acres have the potential to be affected by wildfire. Approximately 81 percent of the 7,200-acre wildfire would adversely affect PCEs in 20 percent of the suitable NSO habitat in CHU subunit 35 in Eddy Gulch LSR. Thus, the no-action alternative would have long-term adverse effects on Critical Habitat and the four PCEs by taking no action and failing to reduce the risk of stand-replacing fire in the landscape in a minimum of 5,832 acres within the Eddy Gulch LSR.

Moderate- to high-intensity fire could consume Critical Habitat. The modeled fire would have various indirect effects. Crown fires would initiate successional changes that would replace mid- and late-successional forest stands with brush fields and dense young forests and increase the probability of future high-intensity wildfire. Fire may also affect enough of existing Critical Habitat that it could lead to changes in NSO occupancy of the area. Excessive Critical Habitat loss would most likely cause abandonment of one or more activity centers during or shortly following fire.

Cumulative Effects on NSO and Critical Habitat. Changes to NSO habitat would be as described under direct and indirect effects. In the absence of fire, continued forest growth may increase NSO habitat in some areas, but fire hazard would increase in most areas. Proposed future activities on the Salmon River and Scott River Ranger Districts include the following: installation of telephone and fiber-optic lines along existing roads through the Ranger District; North Fork Roads Stormproofing Project (stormproofing 76 miles of road requiring blading, improving road drainage, and protecting riparian and stream systems; decommissioning 36 miles of roads to reduce sediment delivery to streams and adding 2.4 miles of existing road); and the construction of a fuelbreak system west of Black Bear Ranch (approximately 700 acres of ridgetop fuel reduction). These proposed future activities would have little effect on future wildfire behavior in the Assessment Area; therefore, the no-action alternative increases the potential for fire to remove the existing physical and biological features important to functioning Critical Habitat as well as dispersal habitat. Local community fuel reduction projects on private lands are small and would have little effect in reducing the risk or extent of fire in the Assessment Area.

Forest Service Sensitive Species

Tehama Chaparral and Klamath Shoulderband—

Direct and Indirect Effects. No measurable direct effects on the Tehama chaparral or the Klamath shoulderband are expected in areas that are affected by wildfires because the species lives in moist talus, especially during the dry season when fires are most likely.

Negligible to moderate indirect effects could be expected to occur, depending on the location and severity of wildfire. Their habitat is generally resistant to fire, but extensive loss of forest surrounding talus slopes and rocky area could lead to conditions that are to dry and inhospitable for these species. Under the no-action alternative, there would be no direct or indirect effects on the Tehama chaparral or Klamath shoulderband in areas that are not affected by wildfire.

Cumulative Effects. Under the no-action alternative, no incremental effects are expected as a result of present or future projects because no actions are proposed under this alternative. However, loss of riparian or overstory vegetation could reduce habitat suitability for the Tehama chaparral or the Klamath shoulderband in immediately affected areas, and this risk is higher in areas with accumulated fuels.

Southern Torrent Salamander—

Direct and Indirect Effects. In the absence of wildfire there would be no direct effects on salamanders. Over the long term, however, indirect effects could result as succession continues and the amount of late-successional habitat increases, providing benefits to the southern torrent salamander preferred habitat. Large diameter shade trees, CWD, and a deep litter layer would all continue to slowly increase as a result of the Alternative A.

Wildfire is not likely to directly affect individuals because southern torrent salamanders are rarely found away from aquatic habitat. However, fire could consume forest canopy that is an important component of the salamander’s habitat. The loss of forest canopy would result in indirect effects that would vary with fire intensity. Areas that burn with high intensity are likely to contribute sediment to streams. This sediment could fill interstitial spaces in coarse substrate that are used for cover by this species. Loss of vegetation that results in reduced shading may adversely affect the salamander, and perhaps small populations, because adults prefer cold, clear streams and are known to have a narrow range of preferred water temperatures (Welsh and Lind 1996). The loss of CWD and litter layer would reduce available cover for any individuals that may move out of aquatic habitat.

Cumulative Effects. There are no other proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the southern torrent salamander or its habitat beyond the project’s direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

Cascades Frog, Foothill Yellow-legged Frog, and Western Pond Turtle—

Direct and Indirect Effects. The effects on the Cascades frog, foothill yellow-legged frog, and Western pond turtle are discussed together because they primarily occupy aquatic habitats and similar effects are expected. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct or indirect effects on either species or their habitat.

Wildfire is not likely to directly affect individuals because these species are rarely found away from aquatic habitat during the fire season. Fire would not directly affect aquatic habitats used by these species, but it could remove shoreline vegetation (sometimes used by frogs) or harm turtles near upland nest sites depending on the timing of the fire. The indirect effects of fire would vary with fire intensity. Areas that burn with high intensity are likely to contribute sediment to aquatic habitats that could suffocate egg masses and/or tadpoles or reduce the macro-invertebrate prey base. This is generally more likely in low-gradient reaches where sediment may accumulate. Sedimentation could also reduce pond longevity. Loss of vegetation that results in reduced stream shading may benefit these species because adults require basking sites for thermoregulation, and increased stream temperatures would likely benefit larval or juvenile development, especially for the species near their upper elevational limits. For turtles, the loss of habitat components (such as large CWD) could remove basking sites, but recruitment of CWD and reduced vegetation would potentially create more basking sites and upland nest sites, especially in areas that are now densely shaded.

Cumulative Effects. There are no other proposed or anticipated actions in upland areas that would combine with Alternative A to cause cumulative effects on these species or their habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

Bald Eagle—

Direct and Indirect Effects. Direct effects would result if wildfire were to kill young eagles unable to escape the nest or roost area. Fire could also consume large nest trees or nesting habitat. Areas that burn with high intensity could lead to increased sedimentation and, in turn, affect prey (fish) adversely; however, this indirect effect would be short-term and negligible. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct or indirect effects on the bald eagle or bald eagle habitat.

Cumulative Effects. The no-action alternative would not provide for the long-term protection of nesting habitat from stand-replacing fire. Large-scale changes in stream conditions that could reduce prey availability are possible but unlikely. No other effects are expected as a result of ongoing or future projects.

Northern Goshawk—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no actions that would directly affect northern goshawks or their habitat. The amount or quality of northern goshawk habitat in the Assessment Area would change slowly in areas not affected by wildfire. The continued forest growth could result in either beneficial or adverse indirect effects, depending on local conditions. In relatively young or open stands, continued forest growth would benefit nesting habitat for northern goshawks by allowing for a slow increase in tree size, basal area, and canopy cover. It could also decrease fire risk as maturing stands develop a moister microclimate. In most other stands, continued growth would increase stand density, density-related tree mortality, fuel hazards, and the probability of a stand-replacing fire. Continued growth could also make some stands too dense for northern goshawks and reduce overall stand diversity.

The modeled fire would have various effects on northern goshawks, northern goshawk habitat, and prey depending on the location, season, intensity, and pattern of the fire. Fire or smoke may injure or kill northern goshawks, most likely during the nesting season when young birds may be unable to escape the nest or roost area. Direct effects would result if moderate- to high-intensity wildfire could reduce suitability of northern goshawk nesting, roosting, or foraging habitat, and extensive loss of snags, CWD understory, and litter and duff layers reduces prey abundance. Based on the modeled wildfire of 7,200 acres, up to 5,832 acres (81 percent) of the forested habitat could be removed or adversely affected. Depending on the exact location of the fire, this habitat loss would most likely cause adverse effects on or abandonment of one or more activity centers.

The modeled fire would cause various indirect effects. Excessive habitat loss in a core area and/or home range would most likely cause abandonment of one or more activity centers during or shortly following fire (although changes in goshawk occupancy may be delayed if some habitat remains following fire or if tree mortality is delayed; delayed mortality is common in low- to moderate-severity fire). Moderate- to high-intensity fire would initiate successional changes that could increase the probability of future stand-replacing fire as forest is replaced with brush fields and dense young forest. Low- to moderate-intensity fire could benefit northern goshawks by reducing the likelihood of future stand-replacing fire and by creating a mosaic of openings that would invigorate forest understory and create prey habitat.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the northern goshawk or its habitat beyond the project's direct and indirect effects discussed above. Continued forest growth may increase northern goshawk habitat in some areas, but fire hazard would increase in proportionally larger areas. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

Peregrine Falcon—

Direct and Indirect Effects. Wildfire would likely not result in direct effects on peregrine falcons because nest sites are in rocky cliffs, and heavy smoke is not likely to persist around an eyrie. Areas that burn with high intensity may create patches of reduced vegetation, which can reduce prey availability; however, this is expected to be a negligible indirect effect. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct or indirect effects on the peregrine falcon.

Cumulative Effects. There are no other proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the peregrine falcon or its habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

Willow Flycatcher—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, individual flycatchers in the Assessment Area and Riparian Reserve would not be disturbed, so there would be no direct or indirect effects on individual flycatchers. No suitable habitat is currently known to occur in the Assessment Area, so there would be no direct or indirect effects on habitat.

In areas affected by wildfire, those areas that burn with high intensity are more likely to benefit willow flycatchers by removing most or all of the forest canopy, allowing for extensive growth of a riparian shrub layer and nesting habitat for approximately 10–12 years. Vigorous brush fields created by stand-replacing fires could potentially provide suitable breeding habitat, just as clearcuts have sometimes led to the creation of suitable breeding habitat elsewhere in northwestern California (Harris 2006) and Oregon (Altman et al. 2003). Those areas that burn with low intensity would not benefit flycatchers because the overstory layer would remain intact.

Cumulative Effects—There are no other proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the willow flycatcher or its habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

Pallid Bat and Townsend's Big-eared Bat—

Direct and Indirect Effects. These two bats are analyzed together, but pallid bats are more likely to be directly affected because of their more general use of the forest for roosting. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no affect on habitat or disturbance to roosting bats in the Assessment Area and, therefore, there would be no direct effects on the pallid bat or Townsend's big-eared bat.

The amount or quality of habitat would change slowly in areas not affected by wildfire. The continued forest growth could have either beneficial or adverse effects, depending on local conditions. In relatively young or open stands, continued forest growth would benefit bats by allowing for a slow increase in snags. This could hypothetically lead to an increase in the number of maternal colonies, although it seems unlikely that pallid bats in the Project Area are limited by suitable roost sites. It could also decrease fire risk as maturing stands develop a moister microclimate. In other areas, continued growth would increase stand density, density-related tree mortality, fuel loads, and the probability of a stand-replacing fire. Continued growth could also make some stands too dense for foraging bats and reduce overall stand diversity.

In areas affected by the modeled wildfire, direct effects would occur if bats (specifically, juvenile bats or maternal colonies) are killed or harmed by fire or smoke, depending on the timing of fire. Fire could also consume snags and large hollow trees used as maternal colonies or roost sites, but fire would also create snags and cavities. Short-term loss of vegetation would reduce the abundance of aerial and terrestrial insect prey.

The modeled fire would have various indirect effects. Moderate- to high-intensity fire would initiate successional changes that could increase the probability of future stand-replacing fire (and the loss of large trees and snags) as forest is replaced with brush fields and dense young forest. Low- to moderate-intensity fire could benefit bats by creating snags and cavities and by creating a mosaic of openings that would invigorate forest understory and increase the abundance of insect prey.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects on the bats or their habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating in the Assessment Area.

American Pine Marten and Pacific Fisher—

Direct and Indirect Effects. In the absence of wildfire, there would be no actions that would directly affect martens, fishers or their habitat. However, over the long term, the amount or quality of habitat in the Assessment Area would change slowly in areas not affected by wildfire. The continued forest growth could result in either beneficial or adverse indirect effects, depending on local conditions. In some young or open stands, continued forest growth would benefit these species by allowing for a slow increase in tree size, basal area, canopy cover, snags, and CWD. This could lead to an increase in denning and resting habitat or foraging habitat. It could also decrease fire risk as maturing stands develop a moister microclimate. In other areas, however, continued growth would increase stand density, density-related tree mortality, fuel hazards, and the probability and extent of stand-replacing fire.

The modeled wildfire could have various direct effects on martens or fishers, their habitat, and their prey, depending on the wildfire's location, season, intensity, and pattern. Fire or smoke may injure or kill individuals, most likely during the breeding season when young animals may be unable to escape. Fire may also increase the risk of predation as individuals move into more open habitats. Any type of fire could reduce the amount of resting, denning, and subnivean access habitat, and extensive consumption of snags, CWD, understory, and litter and duff layers would reduce prey abundance in the short-term. Beneficial direct effects would include the creation of snags that could be used as resting or denning sites. Fire could also increase prey availability by removing cover and/or concentrating prey into remaining patches of habitat

Areas that burn with moderate to high intensity would reduce the overall number of available acres over the long term. Based on the modeled fire of 7,200 acres, up to 5,832 acres (81 percent) of forested habitat could be removed or adversely affected. Depending on the exact location of the fire, this habitat loss would likely cause adverse effects on or abandonment of one or potentially two territories.

The modeled wildfire would have various indirect effects. Low- to moderate-intensity fire could benefit habitat by reducing the likelihood of future stand-replacing fire and by creating a mosaic of openings that would invigorate forest understory and increase recruitment of snags and CWD used as denning and resting sites as well as by prey (and as subnivean access). Moderate- to high-intensity fire would initiate successional changes that could increase the probability of future stand-replacing fire as forest is replaced with brush fields and dense young forest.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the marten, fisher or their habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating inside the Assessment Area.

California Wolverine—

Direct and Indirect Effects. In the absence of wildfire, it is unlikely that the amount of potential habitat available for the wolverine in the Assessment Area would change in the short term. Over the long term, however, continued forest growth would increase stand density, density-related tree mortality, fuel loads, and the probability of a stand-replacing fire. Currently, there would be no direct or indirect effects on the wolverine because none are known to occur in the Assessment Area.

The modeled fire could have various direct effects on wolverines, wolverine habitat, and wolverine prey depending on its location, season, intensity, and pattern. Fire or smoke may injure or kill wolverines, most likely during the breeding season when young animals may be unable to escape. Moderate- to high-intensity fire could consume wolverine habitat, but the effect from a fire the size of the modeled fire may be minor with respect to a wolverine's large home range. Extensive consumption of snags, CWD, understory, and litter and duff layers would reduce prey abundance in the short-term, but fire could increase prey availability by removing cover, by concentrating prey into remaining patches of habitat, or by killing or injuring animals and thus providing a source of carrion.

The amount or quality of wolverine habitat in the Assessment Area would change slowly in areas not directly affected by wildfire, but the modeled fire would have various indirect effects. Moderate- to high-intensity fire would initiate successional changes that could increase the probability of future stand-replacing fire as forest is replaced with brush fields and dense young forest. However, this could benefit wolverines if the early successional habitats increase the availability of large prey and if large prey, such as deer, are limiting to wolverines in the region. Low- to moderate-intensity fire would reduce the likelihood of future stand-replacing fire and create a mosaic of openings that would invigorate forest understory used by prey species. This would also create a more variable landscape that is closer to the historical landscape condition when wolverines regularly occurred in California.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the wolverine or its habitat beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating inside the Assessment Area.

Forest Service MIS Associations

River and Stream MIS Association—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct effects on river and stream habitats or to current population trends. Large-diameter shade trees and CWD would increase over the long term, resulting in indirect beneficial effects.

Wildfires may consume vegetation that adjoins aquatic habitats, but fire would not directly affect aquatic habitat. Wildfires, especially a high-intensity fire, could remove riparian vegetation, which would adversely affect stream temperatures and other habitat components. Areas that burn with high intensity are likely to contribute sediment to aquatic habitats that could suffocate egg masses and/or tadpoles or reduce the macroinvertebrate prey base. Sedimentation effects would vary with stream type, as low-gradient reaches are more likely to accumulate sediment and small debris than high-gradient reaches. Fire could increase the recruitment of CWD to streams, but very long-term recruitment (well beyond 20 years) of CWD would eventually approach zero in areas burned by stand-replacing fire.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to broadly cause cumulative effects to the River and Stream MIS Association beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating inside the Assessment Area. Mining effects would continue to create habitat quality problems in local areas, including sedimentation and bank cutting.

Marsh, Lake, and Pond MIS Association—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct or indirect effects on individuals, population trends, or aquatic habitats, including Riparian Reserves.

The modeled wildfire would not directly affect aquatic habitats or current population trends, but it could remove shoreline vegetative cover. Wildfires, especially the high-intensity fire, could remove all or a portion of overstory vegetation, which could affect water temperature. Areas that burn with high intensity are likely to contribute sediment to aquatic habitats, which could suffocate egg masses and/or tadpoles or reduce the macroinvertebrate prey base. Sedimentation could also reduce pond longevity.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects on the Marsh, Lake, and Pond MIS Association beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating inside the Assessment Area.

Hardwood MIS Association—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct effects on hardwood habitats or to population trends of the individual species. In areas not affected by fire, tree size and snags are expected to slowly increase. However, areas not affected by wildfire would likely become increasingly dominated by a dense conifer overstory, which would decrease hardwood productivity and dominance and thus decrease use of the habitat by species that prefer hardwoods but avoid conifer forests.

Based on the modeled fire, up to 81 percent of the hardwood habitat in a given area could be removed or adversely affected. Any kind of fire could consume hardwood snags and CWD, but fire would also create snags and cavities that provide nest or roost sites. Fire could benefit hardwoods by removing competition from encroaching young conifers.

The modeled fire would have various indirect effects. Moderate- to high-intensity fire would initiate successional changes that could increase the probability of future stand-replacing fire as forest is replaced with brush fields and dense young forest. This would prevent the development of mature hardwood habitats. Low- to moderate-intensity fire is likely to benefit hardwood habitats by reducing the likelihood of future stand-replacing fire, by creating a mosaic of openings, by initiating tree and snag decay that would create foraging opportunities and nesting/roosting structure, and by reducing competition from conifers.

Cumulative Effects. There are no proposed or anticipated actions that would combine with Alternative A to cause cumulative effects to the Hardwood MIS Association beyond the project's direct and indirect effects discussed above. Local community fuel reduction projects would decrease the risk of fire in the Assessment Area, but those areas represent a small fraction of the area surrounding the Assessment Area and would not affect fire behavior originating inside the Assessment Area.

Snag MIS Association—

Direct and Indirect Effects. In the absence of wildfire, and with no fuel reduction activities under the no-action alternative, there would be no direct effects on snags or population trends of species associated with snag habitat within the Assessment Area, and snags would slowly increase in areas not affected by wildfire. This could increase habitat suitability in some stands, but habitat in other stands would suffer from reduced tree growth and accumulation of only small snags, which are much less valuable to wildlife than large snags. Snags would not be produced by fire, which is an important factor in snag recruitment. The risk of high-severity fire would increase in most areas.

Any kind of fire could consume snags, but fire would also create snags and cavities that provide nest or roost sites. Although fire generally creates more snags than it destroys, most of the snags created by moderate- to high-intensity fire would not be located in live forests. Based on a modeled fire, up to 81 percent of the forested habitat could be removed or adversely affected.

The modeled wildfire would have various indirect effects. The extent of these effects, whether beneficial or adverse, would vary by species and fire intensity, size, and pattern (Saab et al. 2007), but is unlikely to affect current population trends. The modeled fire may benefit snag-associated species by recruiting snags and by increasing foraging opportunities in the short term as beetles and other insects colonize newly killed trees. However, high-intensity wildfire would remove forest overstory (required by some snag-dependent species) and could initiate successional changes to brush fields that would reduce long-term snag recruitment.

Cumulative Effects. The no-action alternative would not provide for the long-term protection of Snag MIS Association habitat in forested settings from the effects of high-severity wildfire. No other effects are expected as a result of ongoing or future projects.

3.4.5.2 Alternative B: Proposed Action

Federally Listed Species

Direct and Indirect Effects on NSO Habitat from Treatments in M Units (Inside FRZs). Thinning in M Units could reduce three features that are used to define suitable NSO nesting/roosting or foraging habitat: canopy cover, basal area, and the number of large-diameter trees. Treatments in M Units would have little effect on individual NSO or their Critical Habitat because

- the M Units are along ridges, and the physiographic features associated with most of the M units indicate a low probability of use by foraging or nesting/roosting individuals;
- the M Units avoid all but one NSO core area, part of which occurs along a ridgeline; and
- all NSO home ranges in which M Units occur will retain habitat sufficient to support NSOs following treatment.

Mechanical thinning of M Units in NSO home ranges would downgrade[4] 36.4 acres of nesting/roosting habitat to foraging habitat (Table 3-36), and 199.7 acres of foraging habitat within home ranges would be modified. In some cases affected habitat polygons are shared by more than one NSO activity center (see Table 3-37), and individual M Units are counted more than once, but acreage calculations are not.

Treatments would modify 199.7 acres of foraging habitat in nine 1.3-mile radius home ranges. Treatments in M Unit 19 would modify 5.7 acres of foraging habitat within a core area (KL 1032), where foraging habitat exceeds the required 150 acres of foraging habitat (Table 3-37). The Proposed Action has been designed to maintain basal area and trees per acre that are characteristic of NSO foraging habitat, and thus proposed treatments are not expect to create habitat changes that would affect occupancy of the activity centers.

Treatments in M Units would remove small trees and reduce the basal area and canopy cover in 36.4 acres of nesting/roosting habitat in home ranges of six activity centers (Table 3-37), two of which overlap the same M Units. Treatments would downgrade mapped nesting/roosting habitat in two NSO home ranges (8 acres in KL1033 and 14.7 acres in KL1034). Treatments in M Units would also downgrade additional acres of mapped nesting/roosting habitat (11.2 acres in KL1028, 2.4 acres in KL1031, 0.4 acre in KL1035, and 11.2 acres in KL 4026) in four NSO home ranges. All treatments occur on ridgetops, a landscape feature not typically used as nesting/roosting habitat (Irwin et al. 2000; Irwin et al. 2004), thus it probably functions as foraging habitat, which is in excess in all of the activity centers (Table 3-37).

4. Definitions for treatments to owl habitat:
- Downgrade—proposed treatment will change the habitat suitability classification from nesting/roosting to foraging or from foraging to dispersal.
- Modify—treatment proposed within owl home ranges will not change the habitat suitability class, but will alter the current canopy cover, basal area, and/ or trees per acres.
- Remove—proposed treatment will remove habitat, no habitat suitability classification will apply to remaining habitat.

Table 3-36. Breakdown of NSO habitat within M Units, pre- and post-treatment.

M Unit	Total Acres	Within Home Range (HR) or Core Area (CA)[a]	Pre-Treatment NSO Habitat Within M Unit (acres)		Habitat Removed or Downgraded in M Unit (acres)		Post-Treatment NSO Habitat in M Unit (acres)	
			N/R[b]	F[b]	N/R	F	N/R	F
3	7	HR	0	1.5	0	0	0	1.5
4	33	HR	0	30	0	0	0	30
7N	14	No habitat	0	0	0	0	0	0
7S	19	HR	0	1.3	0	0	0	1.3
8	5	HR	1.4	0	1.4	0	0	1.4
9	29	HR	1.1	23.6	1.1	0	0	24.7
10	32	HR	0	6.14	0	0	0	6.14
10[c]	32		1.2	2.6	1.2	0	0	3.8
11	3	No habitat	0	0	0	0	0	0
12	22	HR	0.2	2.37	0.2	0	0	2.39
13	32		9.7	16.5	9.7	0	0	26.2
15	138		0	6.3	0	0	0	6.3
16	4	No habitat	0	0	0	0	0	0
17	12	HR	0	10.36	0	0	0	10.36
19	46	HR and CA	0	5.7	0	0	0	5.7
20	13	HR	0	0.18	0	0	0	.18
21	108	HR	0	15.80	0	0	0	15.8
21[c]	108		5.3	58.6	5.3	0	0	63.9
22	7	HR	0	4.6	0	0	0	4.6
23	42	HR	2.5	29.1	2.5	0	0	31.6
24	45	HR	8.7	28.6	8.7	0	0	37.3
25	27	No habitat	0	0	0	0	0	0
30	9		0	8.8	0	0	0	8.8
31	20	HR	0	7.54	0	0	0	7.54
32	5	HR	0	0.9	0	0	0	0.9
35	4	No habitat	0	0	0	0	0	0
36	21	No habitat	0	0	0	0	0	0
37	12	No habitat	0	0	0	0	0	0
38	12	No habitat	0	0	0	0	0	0
39	14	HR	0	0.38	0	0	0	0.38
40	7	HR	0	3.41	0	0	0	3.41
43	12	HR	1.1	2.21	1.1	0	0	3.31
51	12	HR	0.2	2.8	0.2	0	0	3
52	19		0	10.7	0	0	0	10.7
54	37		0	1.4	0	0	0	1.4
60	17	No habitat	0	0	0	0	0	0
61	25	HR	0	1.5	0	0	0	1.5
65	6	HR	0	1.57	0	0	0	1.57
65[c]	6		0	2.6	0	0	0	2.6
66	2	HR	0	2	0	0	0	2
73	26	HR	14.5	7.76	14.5	0	0	22.26
75	9	HR	2.4	6.44	2.4	0	0	8.84
76	8	HR	4.3	3.91	4.3	0	0	8.21
79	13		0	12.3	0	0	0	12.3
80	3	No habitat	0	0	0	0	0	0
			52.6	**319.47**	**52.6**	**0**	**0**	**371.89**

Notes: a. All M Units are found within Critical Habitat.
b. N/R = nesting/roosting; F = foraging.
c. M Units also found partially within home range.

Table 3-37. Acres of proposed thinning in M Units in occupied NSO habitats.

Activity Center	Pre-project Habitat Within 0.5-Mile Core Area			Acres Habitat Downgraded[a] or Removed[b] in 0.5-mile Core Area		Post-project Acres Habitat in 0.5-mile Core Area		Pre-project Habitat Within 1.3-mile Home Range			Acres Habitat Downgraded or Removed in 1.3-mile Home Range		Post-project Acres Habitat in 1.3-mile Home Range	
	NR [250][c]	F [150]	Total [400]	NR	F	NR	F	NR	F	Total [1,335][d]	NR	F	NR	F
KL1012	174	111	285	0	0	174	111	865	909	1,774	0	0	865	909
KL1013	150	115	365	0	0	150	115	838	751	1,589	0	0	838	751
KL1014	203	152	355	0	0	203	152	797	951	1,748	0	0	797	951
KL1028	267	84	351	0	0	267	84	826	592	1,418	11.2	0	814.8	603.2
KL1029	207	156	363	0	0	207	156	920	760	1,680	0	0	920	760
KL1030	244	94	338	0	0	244	94	727	552	1,279	0	0	727	552
KL1031	140	199	339	0	0	140	199	775	774	1,549	2.4	0	772.6	776.4
KL1032	161	192	353	0	0	161	192	521	947	1,468	0	0	521	947
KL1033	254	133	387	0	0	254	133	987	1,042	2,029	8	0	979	1,050
KL1034	209	46	255	0	0	209	46	1,003	985	1,988	14.7	0	988.3	999.7
KL1035	169	230	399	0	0	169	230	793	1,231	2,024	0.4	0	792.6	1,231.4
KL1047	100	187	287	0	0	100	187	316	748	1,064	0	0	316	748
KL4026	171	159	330	0	0	171	159	747	1,000	1,747	11.2	0	735.8	1,011.2

Notes:

a. Defined as changing the current habitat classification from nesting/roosting to foraging.

b. Defined as changing the current habitat classification to an unclassified state.

c. USFWS minimum acres necessary to support breeding pairs.

d. USFWS minimum acres of combined nesting/roosting and foraging habitat necessary in NSO home ranges.

The Proposed Action is designed to retain trees larger than 20 inches dbh, and the post-treatment basal area will meet or exceed standards for foraging habitat. Because the treatment units will maintain the targets for basal area and trees per acres (greater than 24 inches), these units are expected to function as NSO foraging habitat post-treatment. Reducing the canopy cover is consistent with that of the pre-European fire regime (refer to Section 3.2 [Forest Vegetation] above), and it will allow more sunlight to reach the forest floor, increasing surface resources in the long term and increasing prey that are dependent on those resources.

All home ranges in which there are M Units exceed the 1,335 acres of suitable habitat and the 935 acres of suitable foraging habitat outside the core area, so M Unit treatments would not affect occupancy. Additionally, creating such mosaics of different vegetation and successional stages may offer a stable prey base (Franklin et al. 2000).

Limited thinning outside of core areas is unlikely to affect NSO habitat use because the thinning activities are either along ridgetops away from known usage areas, or thinned acres are found within home ranges that have an excess of habitat (beyond USFWS minimum requirements). Some owls may shift their activity centers in response to thinning, but changes in home range sizes attributable to thinning treatments are unlikely (Irwin et al. 2000). Effects are especially unlikely where thinning prescriptions are designed to retain foraging habitat or where thinning occurs along ridges or on the periphery of the home range.

The construction of 1.03 miles of new temporary roads, disturbing 1.7 acres on ridgetops, under Alternative B would remove 0.60 acre of foraging habitat and 0.02 acre of habitat classified as nesting/roosting. However, based on the ridgetop location of the 0.02 acre of nesting/roosting habitat, it is presumed to function as foraging habitat for NSOs. None of the temporary roads occur in NSO core areas, and the roads will be closed (ripped and mulched, as needed) following treatment, so there would be no long-term effects on NSOs. No new landings are proposed, and existing landings will not be expanded under Alternatives B and C, thus no long-term effects on NSOs are expected.

Direct and Indict Effects of Treatments in Fuel Reduction Areas in FRZs and Along Emergency Access Routes. Treatments along emergency access routes would be similar to the FRZ or Rx Unit the route passes through. These treatments would have little effect on canopy cover because burning would remove smaller trees that do not contribute substantially to canopy cover in the overstory. Fuel reduction treatments would cause changes in the amount and/or types of snags, CWD, understory vegetation (including small trees), and prey. Treatments could potentially consume existing snags but may also create new snags. Typically, large trees and snags are not lost during prescribed fire. The burn plan (developed prior to implementing any treatments for the Eddy Gulch LSR Project) will design a prescribed fire that consumes smaller-diameter trees. Prescribed fire would consume most of the smaller down woody debris and some of the CWD, but much of the CWD would likely remain when burning in spring prescriptions. A study by Stephens and Moghaddas (2005b) noted that the reduction in volume of existing snags and CWD following prescribed fire treatments depends on both tree diameter and decay class (decay classes 1–3 for snags and CWD denote sound structural integrity of the heartwood, wherein decay class 4 denotes rotten heartwood and decay class 5 denotes no structural integrity). For example, total sound CWD (decay classes 1 and 2) was not significantly reduced by treatments. The most dramatic change of CWD in this study was the reduction of rotten CWD, especially in decay class 4, as a result of prescribed fire treatments.

Treatments would remove or consume existing snags and individual hazard trees along 16 miles of emergency access routes outside of FRZs or Rx Units, but effects on NSOs would be negligible because (1) treated areas would generally avoid NSO nest stands; (2) snag retention would follow Klamath LRMP guidelines in NSO nesting/roosting and foraging habitat treated mechanically or by hand; and (3) snag loss would be concentrated in ridgetop FRZs where NSOs are not likely to nest or roost. NSOs in KL1047, the only core area where roadside hazard fuel reductions are proposed, would be protected by resource protection measures designed to avoid disturbance effects on owls, suitable habitat would be maintained by following Klamath LRMP guidelines and resource protection measures, and hazard trees are expected to be individual trees along only the road prisms and is not expected to affect canopy cover. Similarly, treatments would destroy or consume most of the smaller woody debris and some of the CWD, but CWD retention would follow Klamath LRMP Guidelines in NSO nesting/roosting/ and foraging habitat treated mechanically or by hand, and some CWD would also remain when burning in spring prescriptions. Stephens and Moghaddas (2005b) note that most understory vegetation would also be removed in fuel reduction areas. Mastication would not remove trees greater than 10 inches dbh, and burning would not remove trees greater than 4 inches dbh. Removing small trees and brush would have no effect on existing foraging or nesting habitat.

Overall, snag, woody debris, and understory removal are not likely to directly affect NSOs, but fuel reduction activities could affect NSOs by impacting their prey, including woodrats (Wirtz et al. 1988; Lyon et al. 2000). However, treatments are designed to minimize effects on prey by limiting treatments to no more than 50 percent of the suitable habitat within a home range within a given year, and treatments in the Assessment Area would be spread over a 5-year period. Prescribed fire is also designed to leave a mosaic of burned and unburned areas so some shrubs, snags, and CWD would remain to provide cover or food for prey species (Lyon et al. 2000; Lehmkuhl et al. 2006b) and minimize effects on NSOs. NSOs may temporarily benefit from fuel reduction activities as rodent prey move to avoid disturbance or concentrate in remaining patches of habitat. A reduction in understory cover may also facilitate NSO foraging efficiency. After treatment, NSO prey species are likely to increase as understory vegetation and litter layers recover and down woody debris is recruited from the snag population (Waters et al. 1994; Carey and Wilson 2001; Suzuki and Hayes 2003; Gomez et al. 2005). Reduced vegetative competition would also accelerate tree growth in some areas (refer to Tables 3-6, 3-7, and 3-8 in Section 3.2 above).

Direct and Indirect Effects of Treatments in Rx Units. Prescribed fire would cause changes in the amount and/or types of snags, CWD, understory vegetation, and prey. These treatments would have little effect on canopy cover because burning would remove smaller trees that do not contribute substantially to canopy cover in the overstory. There is the potential that treatments could consume existing snags but may also create new snags. Typically, large trees and snags are not lost during prescribed fire. The burn plan (developed prior to implementing any treatments for the Eddy Gulch LSR Project) will design a prescribed fire that consumes smaller-diameter trees. Prescribed fire would consume most of the smaller down woody debris and some of the CWD, but much of the CWD would likely remain when burning in spring prescriptions. A study by Stephens and Moghaddas (2005b) noted that the reduction in volume of existing snags and CWD following prescribed fire treatments depended on both tree diameter and decay class (decay classes 1–3 for snags and CWD denote sound structural integrity of the heartwood, wherein decay class 4 denotes rotten heartwood and decay class 5 denotes no structural integrity). For example, total sound CWD (decay classes 1 and 2) was not significantly reduced by treatments. The most dramatic change of CWD in this study was the reduction of rotten CWD, especially in decay class 4, as a result of prescribed fire treatments.

Prescribed fire is likely to kill, injure, or displace NSO prey, including woodrats (Wirtz et al. 1988; Lyon et al. 2000). However, treatments are designed to minimize effects on prey by limiting treatments to no more than 50 percent of the suitable habitat within a core area or home range within a given year. Burning may also provide a temporary benefit as prey move from burned areas to unburned areas, increasing their availability to NSO. Additionally, treatments in the Assessment Area would be spread over the 11-year timeframe to complete treatments (refer to Section 2.5.4 in Chapter 2 of this final EIS), thus reducing effects over time. Prescribed fire is also designed to leave a mosaic of burned and unburned areas (the total sum of all openings in any given burn unit would not exceed 10 percent) so some shrubs, snags, and CWD would remain to provide cover or food for prey species (Lyon et al. 2000; Lehmkuhl et al. 2006b), minimizing the effects on NSOs.

CWD and litter layers would begin to accumulate after treatment, and understory vegetation would regenerate in most areas. These changes are expected to benefit NSO prey (Waters et al. 1994; Carey and Wilson 2001; Suzuki and Hayes 2003; Gomez et al. 2005). Reduced vegetative competition would also accelerate tree growth in some areas (refer to Tables 3-6, 3-7, and 3-8 in Section 3.2 above). Prescribed low-intensity fire, as described in Chapter 2, is unlikely to affect activity center occupancy or reproduction (Bond et al. 2002; Jenness et al. 2004; Clark 2007).

Prescribed fire treatments would benefit NSOs and NSO habitat by reducing fuels to a level that would decrease the likelihood of a crown fire. Fire would still burn with sufficient intensity to create small openings in untreated areas. This type of pattern would be consistent with patterns under historic fire regimes and is consistent with the recommendations for maintaining habitat for northern flying squirrels (Lehmkuhl et al. 2006a; Lehmkuhl et al. 2006b) and woodrats in inland forests, while managing for fire and healthy forest ecosystems. Additionally, prescribed fires and under thinning would create a patchwork of small openings within the forest that support mature hardwoods and a variable understory of hardwoods and shrubs used by woodrats and other prey. Denser forest (at least 60 percent canopy cover), with numerous large snags and large CWD, would remain widespread and continue to provide habitat for flying squirrels.

Direct and Indirect Effects on NSOs from Barred Owl Competition. It is unclear whether forest management has an effect on the outcome of interactions between barred owls and NSO (Gutiérrez et al. 2007). However, the proposed thinning and fuel reduction treatments are not likely to influence the outcome of such potential interactions because they would have limited effects on the factors most likely to be responsible for management-related outcomes: NSO habitat, habitat use, or prey species or prey availability. If barred owls were to out-compete NSOs in the LSR, it is very unlikely that the proposed fuel reduction activities would have influenced the outcome.

Direct and Indirect Effects on NSO Habitat and NSOs in Areas Affected by Wildfire. Fire behavior modeling in the Eddy Gulch LSR Project Assessment Area showed that a wildfire ignited in an Rx Unit would burn 62 acres with a low-intensity fire during a 3.5-day period (refer to Figure 3-8 in Section 3.3 of this final EIS). This would provide sufficient time for suppression forces to effectively contain and control that fire, leaving potential NSO habitat with an underburn and creating minimal disturbance or effects on existing NSO habitat. Wildfires ignited in FRZs would be controlled and contained at smaller sizes. Wildfires allowed to burn under an appropriate management response could be larger. It is unknown how much of the area affected by a crown fire would be NSO habitat. Under either scenario, 10 NSO core areas (5,000 acres) would not be adversely affected in treated areas but are more likely to experience more low- to moderate-intensity surface fires (instead of crown fires) based on the fire model (refer to Table 3-35). Ten core areas (5,000 acres) may still be adversely affected in untreated areas and would continue to be susceptible to loss of habitat if affected by a crown fire.

Additionally, treatments would modify fire behavior and reduce the loss of habitat in all or substantial portions of the four USFWS priority protection areas (refer to Section 3.4.3 above). All four areas are likely to have similar conditions to those found in the Assessment Area and thus are likely to benefit from reductions in the fuel load and the potential for future stand-replacing wildfires. Only two of these priority protection areas are entirely within the Assessment Area, and both would directly benefit from proposed treatments to protect them against stand-replacing wildfires. The other two areas are within nventoried roadless areas and would indirectly benefit by having fuel hazard reduction projects in adjacent habitat, thus increasing the ability of suppression crews to limit the size of wildfires.

Direct and Indirect Effects on NSO Critical Habitat. Approximately 16.2 additional acres of nesting/roosting Critical Habitat outside of existing home ranges would be downgraded to foraging habitat as a result of treatments in M Units (refer to Table 3-36); the total of 52.6 acres of nesting/roosting habitat downgraded in the entire Assessment Area represents less than 0.5 percent of existing nesting/roosting habitat in the entire CHU subunit 35. Treatments to all 52.6 acres of nesting/roosting habitat are scattered throughout 13 M Units and range in habitat patch size from 0.2 acre to 14.5 acres. These treatments would result in a decrease in basal area (trees greater than 10 inches dbh, ranging from 140 to 206 square feet per acre), a decrease in canopy cover (ranging from 37 percent in mid-successional white fir habitats to 50 percent in late-successional Douglas fir and mixed-conifer habitats), and reducing the trees per acre over 24 inches dbh (ranging from 6 trees per acre in mid-successional to 28 trees per acre in late-successional habitat). The decreases in basal area, canopy cover, and trees per acre (over 24 inches dbh) are all relatively minor changes from existing conditions and are not considered habitat downgrading. Please refer to Table 3-6 in Section 3.2 above for further details.

Approximately 200 additional acres of foraging Critical Habitat would be modified by the proposed treatments. The total of 319.5 acres of foraging habitat modified by thinning activities represents 3 percent of existing foraging habitat in the Assessment Area, and approximately 2 percent of the total foraging habitat in the CHU. However, silvicultural prescriptions are designed to retain habitat function in these stands post-treatment. Treatments in 91 acres of foraging habitat in mid-successional Douglas-fir stands would result in basal area of 140 square feet per acre, canopy cover of approximately 48 percent, and six trees per acre over 24 inches dbh. All other treatments would retain approximately 200 square feet basal area per acre, greater than 12 trees per acre over 24 inches dbh, and trees greater than 20 inches dbh. In addition, because the patches of foraging habitat to be modified are along ridgetops and are widely dispersed in less than 1-acre to 59-acre patches across the Assessment Area (refer to Table 3-36), fuel reduction activities are not expected to affect the ability of the LSR or the Scott and Salmon Mountains CHU subunit 35 to provide NSO foraging opportunities or create barriers to intra-provincial connectivity. Thinning in red fir and some other stands may target trees heavily infected by dwarf mistletoe, but mistletoe removal is not likely to affect NSO habitat use or prey densities because mistletoe would remain widespread on the landscape.

NSO dispersal is common and widespread throughout the Assessment Area and is not considered to be a limiting factor. All habitat that is currently classified as dispersal will remain dispersal habitat under the proposed treatments; no treatment will drop canopy cover to below 33 percent (in red fir stands) to 54 percent (in Douglas fir stands), and basal area will not drop below 183 square feet per acre for trees over 10 inches dbh.

Treated stands would be more resistant to large-scale fires but would burn with sufficient intensity to create small openings (less than 1 acre) in untreated patches. This type of pattern, which would create a mosaic of stands in different successional stages, would be consistent with patterns under historic fire regimes; such patterns would likely enhance Critical Habitat function by providing horizontal diversity of habitat across the landscape (Franklin et al. 2000; Irwin et al. 2007). Treated stands that may burn under future conditions are not expected to affect the overall suitability of existing habitat.

Over time prescribed fires are expected to enhance the function of Critical Habitat within CHU25. Prescribed fire treatments would benefit Critical Habitat by reducing fuels to a level that would decrease the likelihood of a crown fire. Fire would still burn with sufficient intensity to create small openings in untreated areas. This type of pattern would be consistent with patterns under historic fire regimes and is consistent with the recommendations for maintaining habitat for northern flying squirrels (Lehmkuhl et al. 2006a; Lehmkuhl et al. 2006b) and woodrats in inland forests, while managing for fire and healthy forest ecosystems. Additionally, prescribed fires would create a patchwork of small openings within the forest that would support mature hardwoods and a variable understory of hardwoods and shrubs used by woodrats and other prey. Denser forest (at least 60 percent canopy cover), with numerous large snags and large CWD, would remain widespread and continue to provide habitat for prey species.

Effects on Critical Habitat from other proposed project activities throughout the Assessment Area, such as road construction, are expected to be minimal. Under Alternative B the construction of 1.03 miles of new temporary roads would create a loss of approximately 0.60 acre of foraging habitat and 0.02 acre of habitat classified as nesting/roosting. However, based on the physiographic features of the locations of the 0.62 acre, it is more likely to function as dispersal habitat. The roads will be closed (ripped and mulched, as needed) following treatment, so no long-term effects are expected on Critical Habitat. No new landings are proposed, and existing landings will not be expanded under Alternatives B and C, thus no long-term effects on Critical Habitat are expected.

Late-successional habitat will not be removed during project activities. Thinning and fuel reduction treatments have been designed to minimize the removal of trees greater than 20 inches dbh, and all prescriptions retain adequate canopy cover in existing NSO habitat, and LSRA recommendations for snag and CWD retention are followed. Thus, the project is not expected to affect connectivity of late-successional habitats or the ability of the Eddy Gulch LSR to provide a functional, interactive, late-successional forest.

Cumulative Effects on NSOs and Critical Habitat. Alternative B, combined with local community fuel reduction projects, including the proposed fuelbreak system west of Black Bear

Ranch, would further decrease the risk of high-intensity fire inside and near the Eddy Gulch LSR. The other proposed or anticipated actions include the installation of a fiber-optic line and North Fork Roads Stormproofing Project and, when combined with Alternative B, would cause no cumulative effects on NSOs, Critical Habitat, or NSO prey beyond the project's direct and indirect effects.

There are approximately 28,797 acres of suitable NSO habitat within the portion of the Scott and Salmon Mountains CHU subunit 35 contained in Eddy Gulch LSR. Cumulatively, the project would affect the Scott and Salmon Mountains CHU subunit 35 by removing less than 0.5 percent of the existing nesting/roosting habitat and modifying 2 percent of the existing foraging habitat within this subunit; all of these acres would continue to function as foraging habitat. Due to the limited effects on the PCEs, Alternative B would not significantly increase the cumulative effects on the CHU regardless of other reasonably foreseeable future actions, including installation of a fiber optic line, North Fork Roads Stormproofing Project, and the fuelbreak system west of Black Bear Ranch. Reducing fuel levels would have long-term beneficial effects on Critical Habitat by reducing the risk of stand-replacing fire in the landscape.

Forest Service Sensitive Species

Tehama Chaparral and Klamath Shoulderband—

Direct and Indirect Effects. No direct effects are anticipated to the Tehama chaparral, the Klamath shoulderband, or their habitat. The animals are likely to be subsurface during the burning season, and no fuel reduction activities are proposed that would significantly affect conditions on talus. Thinning and fuel reduction treatments are expected to have a beneficial indirect effect by substantially reducing the chances and extent of stand-replacing fires which can remove riparian vegetation and lead to increased temperatures and desiccation. Large-diameter shade trees and CWD would increase over the long-term as a result of Alternative B.

The construction of 1.03 miles of new temporary roads (which would disturb approximately 1.7 acres) is not expected to have any significant effect on the species because all temporary roads are on ridgetops or near-ridgetop locations, and the amount of disturbance is small at the landscape level. All of the temporary roads would be closed using normal erosion control measures (ripped and mulched, as needed). Implementation of hazard tree removal is not expected to have any effect on the overall amount of suitable habitat for these species because the removal of a few scattered trees would not affect canopy shade.

Cumulative Effects. Alternative B, alone or in concert with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on these species or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects on the Tehama chaparral or the Klamath shoulderband.

Southern Torrent Salamander and Foothill Yellow-legged Frog—

Direct and Indirect Effects. Thinning and mastication would not have any direct effects on these two species because they are protected by design standards and Resource Protection Measures designed to minimize effects on aquatic habitats and Riparian Reserves. Prescribed fires that burn in Riparian Reserves may reduce vegetative cover, but limited low-intensity fire in Riparian Reserves is not likely to affect individuals because they are not likely to occur in terrestrial habitats that would be affected by fire. Direct effects from road-related activities are highly unlikely because all temporary roads are on ridgetops or near-ridgetop locations, and the amount of disturbance is small at the landscape level. No proposed roads are near Riparian Reserves, none require any stream crossing structures, none traverse unstable slopes, and none are proposed on granitic or similarly noncohesive soils. All of the temporary roads would be closed using normal erosion control measures (ripped and mulched, as needed).

Thinning and fuel reduction treatments are expected to have a beneficial indirect effect in the long-term on southern torrent salamander by reducing the chances and extent of stand-replacing fires (to approximately 10 percent of existing conditions), which can remove riparian vegetation and lead to increases in increases in stream temperature and sedimentation. Large-diameter shade trees and CWD would increase over the long term under Alternative B.

The indirect effects on southern torrent salamander from temporary road construction and fuel reduction activities would be negligible because any sedimentation would be minimized by the retention of buffers around all Riparian Reserves. These buffers, as well as Best Management Practices (BMPs), would minimize the sediment load that could reach stream channels.

Thinning and fuel reduction treatments may have a minor beneficial indirect effect on foothill yellow-legged frogs by reducing the chances and effects of sedimentation from stand-replacing fires. Thinning and mastication would not cause sedimentation of streams because Klamath LRMP Standards and Guidelines would be followed, including Riparian Reserve buffers and implementation of BMPs.

Limited low-intensity prescribed fire in Riparian Reserves is not likely to affect habitat for foothill yellow-legged frogs because such fires are not likely to affect aquatic habitat or substantially affect stream shading. However, reduced fire frequency resulting from proposed treatments may reduce fire-return intervals below historical intervals and reduce habitat available for species that benefit from sunlight on aquatic habitats.

Cascades Frog and Western Pond Turtle—

Direct and Indirect Effects. Thinning and mastication would not have any direct effects on these species because their habitat is protected by design standards and Resource Protection Measures designed to minimize effects on aquatic habitats and Riparian Reserves. Prescribed fires that burn in Riparian Reserves may reduce vegetative cover, but limited low-intensity prescribed fire in Riparian Reserves is not likely to affect frogs because they are not likely to occur in terrestrial habitats that would be affected by fire. Treatments on land adjacent to Riparian Reserves may affect upland turtle nest sites, although these effects should be rare events because turtles select open areas dominated by grasses and herbaceous annual plants, and fuel reduction activities would be focused on forest or shrub habitats on forested ridges. Direct effects from road-related activities are highly unlikely because effects are similar to those described above for the southern torrent salamander and foothill yellow-legged frog.

Fuel reduction activities are not expected to affect the amount of habitat along the edge of the Salmon Rivers or along the edge of private ponds. Underburns would not be expected to have a significant effect on shade within Riparian Reserves. Creation of temporary roads, followed by subsequent closure following thinning, may have negligible, short-term indirect effects on stream habitat as a result of the potential for sediment delivery to streams within the Assessment Area. Implementation of BMPs and protection measures for fish would eliminate any potential downstream effects (in the Salmon Rivers) of sedimentation from roadwork. There would be no indirect effects on Cascades frog or pond turtle habitat as a result of sedimentation.

Alternative B supports habitat components of late-successional forests that would provide for increased CWD and thus potential basking structure for the pond turtle over the long-term. However, reduced fire frequency promoted by the proposed treatments may reduce fire-return intervals below historical intervals and reduce habitat available for species that benefit from sunlight on aquatic habitats.

Cumulative Effects—Southern Torrent Salamander, Cascades Frog, Western Pond Turtle, and Foothill Yellow-legged Frog. Alternative B, combined with local community fuel reduction projects, would decrease the risk of high-intensity fire in and near the Assessment Area. No other ongoing or reasonably foreseeable future actions within the Assessment Area would combine to create any significant cumulative effects on the southern torrent salamander, the Cascades frog, Western pond turtle, the foothill yellow-legged frog, or their habitat.

Bald Eagle—

Direct and Indirect Effects. No direct effects are expected to occur from implementation of Alternative B. Fuel reduction activities could potentially affect bald eagles through the production of fire, smoke, and visual and noise disturbance near their nests. There are no known nests, but if a new nest is discovered, a seasonal restriction of January 1 to August 31 would protect eagles from all activities that that modify habitat within 0.5 mile, or that create smoke or noise above ambient levels within 0.25 mile of any nest sites that are discovered within the Assessment Area.

Thinning and other fuel reduction treatments are not likely to directly affect bald eagle habitat because, there is only one FRZ (FRZ 7) within 2 miles of potential foraging habitat, and no M Units or other overstory thinning would occur in FRZ 7. Understory treatments would not be expected to affect bald eagle habitat.

Thinning and fuel reduction treatments may have beneficial indirect effect by reducing the potential loss of nest trees or nest stands from higher-intensity fires and by reducing potential sedimentation effects on foraging habitat from stand-replacing fires. Thinning and mastication would not cause sedimentation of the Salmon River because Klamath LRMP Standards and Guidelines would be followed, including Riparian Reserve buffers and implementation of BMPs.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the bald eagle, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Northern Goshawk—

Direct and Indirect Effects. Habitat use by goshawks and NSOs in the Klamath region are similar. Thus the nesting/roosting and foraging habitat discussions for the NSO also apply to the goshawk.

Thinning and, to a much lesser extent, prescribed burning and mastication would reduce features that are used to define suitable goshawk nesting and foraging habitat: canopy cover, basal area, and the number of large-diameter trees. However, thinning and other fuel reduction activities would not affect goshawk habitat because the prescriptions avoid downgrading existing habitat. Fuel reduction activities would have little effect on canopy cover because burning would remove smaller trees that do not substantially contribute to canopy cover in the overstory. All M Units in FRZs would have canopy cover reduced below 60 percent, but all stands would still function as foraging habitat as the prescriptions maintain at least 40 percent canopy cover and retain all trees greater than 20 inches dbh. The construction of 1.03 miles of temporary roads under Alternative B would create a loss of less than one acre of forested habitat; additionally, these roads are scattered, thus habitat losses are small and dispersed and the roads would be closed upon project completion. No temporary roads are proposed in or near known goshawk activity centers.

The 1.0-mile home ranges of two GOMAs (Sixmile and West Fork Whites) and another activity center located during 2008 surveys (Shadow) lie within proposed FRZs. The proposed treatments would not harm any of these protected areas because thinning or other fuel reduction activities would retain foraging habitat and because nesting habitat would not be reduced to less than 300 acres in the one activity center for which mechanical treatments are proposed (approximately 37 acres within the Primary Nest Zone of the Shadow Creek territory). No overstory thinning is proposed for the West Fork Whites GOMA, with the exception of the removal of individual roadside hazard trees, which would not affect the number of acres of suitable habitat. Thinning prescriptions in the Sixmile GOMA ensure that thinned stands in the Foraging Habitat Zone (FHZ) would retain at least 40 percent canopy and all trees greater than 20 inches dbh, meeting Klamath LRMP Standards for goshawk FHZ

Fuel reduction activities, primarily fire and mastication, may kill, injure, or displace prey, but is not expected to reduce overall canopy cover. Although prey densities may be reduced in affected areas, treatments are designed to minimize effects on prey by limiting treatments to no more than 50 percent of NSO suitable habitat within a year. Prescribed fire is also designed to leave a mosaic of burned and unburned areas so some shrubs and snags would remain to provide cover for prey species and minimize effects on goshawks.

Limited thinning outside of nest areas is unlikely to affect goshawk occupancy of historic nest stands. Many thinned stands that downgrade habitat would also become at least foraging habitat over time as canopy cover increases.

Thinning and fuel reduction treatments are expected to benefit goshawk habitat by substantially reducing the forest's susceptibility to stand-replacing crown fires. Fire would still burn with sufficient intensity to create small openings within forested habitat. This type of pattern, which would create a mosaic of stands in different successional stages, would be consistent with patterns under historic fire regimes. This pattern would likely benefit goshawks by providing horizontal diversity of habitat across the landscape.

Fuel reduction treatments would cause changes in the amount and/or types of snags, CWD, understory vegetation including small trees, and prey. Treatments would remove or consume many existing snags and hazard trees, but effects on northern goshawks would be negligible because prescribed burning would create some new snags and seasonal restrictions would apply to all treated areas within historic or additional sites within the Assessment Area (please refer to the Resource Protection Measures, Section 2.9.1.2 in Chapter 2 of this final EIS). Most understory vegetation would also be removed in fuel reduction areas. Mastication would not remove trees greater than 10 inches dbh, and burning would not remove trees greater than 4 inches dbh. Emergency access routes are hand treatments along sides of roads, and hazard tree removal would follow pre-approved guidelines (USFS 2005). Removing small trees would have no effect on existing foraging or nesting habitat.

Fuel reduction treatments would initiate successional changes in forest understory, including snags and CWD. The CWD would accumulate from fallen snags and understory vegetation would regenerate in most areas. Reduced vegetative competition would also accelerate tree growth in some areas. Northern goshawk prey species are likely to increase as understory vegetation and litter layers recover, CWD is recruited from the snag population, and additional snags are recruited. Thus, effects on goshawk prey species abundance and distribution are expected to be minimal.

Thinning and fuel reduction activities have the potential to affect northern goshawks through the production of fire, smoke, visual, and noise disturbance. Northern goshawks are sensitive to noise disturbances during nesting and will often exhibit defensive territorial behavior around nest sites when disturbed (CDFG 1990). Noise produced during fuel reduction activities may alter nesting behavior.

Disturbance may also occur from fire, smoke, or other activities associated with prescribed fire. Heavy smoke at ground level and in forested stands may have adverse effects, but light to moderate smoke that is mixing or venting well is probably of little consequence to northern goshawks. It is expected that adults are sufficiently mobile to avoid direct injury by fire. To ensure that breeding goshawks are not disturbed by activities that create noise above ambient levels or smoke near nest stands, seasonal restrictions will be in place from March 1 to August 31 that apply to all activities that modify habitat within 0.5 mile, or create smoke or noise above ambient levels within 0.25 mile of historic sites or any additional nest sites that are discovered within the Assessment Area. Dates for seasonal restrictions cover the time period from which adult goshawks typically initiate breeding activity to the point where juveniles are physically capable of moving away from such disturbances.

Temporary roads proposed for construction under Alternative B would be closed (ripped and mulched, as needed) following thinning and thus become available as habitat over the long term.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on northern goshawks, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat within established GOMAs, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Peregrine Falcon—

Direct and Indirect Effects. Peregrine falcon nesting/roosting habitat would not be directly or indirectly affected by the proposed fuels reduction activities. Peregrine falcons are known to be susceptible to disturbance near their nests. There are no known nests in the vicinity; if a new nest is discovered, a seasonal restriction of February 1 to July 31 would protect peregrines from all activities that create noise above ambient levels within 0.25 to 0.5 mile (dependent on topographic features) of active eyries.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the peregrine falcon, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Willow Flycatcher—

Direct and Indirect Effects. Thinning and fuel reduction treatments are not expected to have any direct or indirect effects on willow flycatchers. However, the prevention of stand-replacing fire—the only process that would likely create mostly treeless riparian scrub required by the flycatcher—would likely preclude use of the Assessment Area by willow flycatchers. Limited low-intensity prescribed fire in Riparian Reserves could affect individuals if suitable patches of riparian scrub (not known from the Assessment Area, but possible) were burned.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the willow flycatcher, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Pallid Bat and Townsend's Big-eared Bat—

Direct and Indirect Effects. Fuel reduction treatments and temporary road construction are expected to have short-term minor adverse direct effects on both bat species. Project activities may remove individual trees or snags that may be used for roosting, especially by the pallid bat, which occurs widely in many forest types. Destruction of active roosts through felling and/or removal of trees or snags may kill or harm individual bats, especially during the breeding season when young may be unable to escape. However, effects on roosting habitat are expected to be minimized by the lack of thinning in NSO core areas, by employing the Klamath LRMP Standards and Guidelines for snag and large-diameter tree retention in most of the FRZs, and by implementing limited operating periods for the NSO and northern goshawk that overlap the period when bats rear their young. Noise from project activities could disturb bats and cause temporary roost abandonment. Abandonment of maternity roosts could result in lowered reproductive success or death of the young of the year. However, disturbance at any specific roost would be short term and occur only during the year of project implementation.

Prescribed fires may affect prey availability, either positively or adversely, as vegetation and litter layers are consumed. Thinning and other fuel-reduction treatments are expected to have long-term beneficial effects by promoting the development of large-diameter trees, which may provide suitable roosting sites. Reintroduction of fire would also be likely to create basal hollows and other cavities used by bats. Additionally, these activities would change expected fire behavior over time, resulting in fires of less intensity, thus reducing the potential that existing habitat would be removed.

Prey availability would most likely increase over time because prescribed fire promotes vigorous growth of understory vegetation and insect production. Felling of snags and removal of logs may reduce the amount of microhabitat available for some insects, but new fire-killed snags would also provide a new resource for some insects such as wood-boring beetles.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the pallid and Townsend's bats, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

American Pine Marten—

Direct and Indirect Effects. All proposed activities, including road-related activities, in the vicinity of suitable habitat could disrupt marten use and movement in the area and create short-term adverse direct effects on individuals. Thinning and fuel reduction activities have the potential to affect martens through the production of fire, smoke, and noise disturbance. Noise produced during fuel reduction activities may alter marten behavior, but preliminary studies have not found martens to be particularly sensitive to noise (Zielinski et al. 2004c). Underburning in the vicinity of den sites could cause mortality of young if dens are above ground or are not well ventilated. It is expected that adult animals are sufficiently mobile to avoid direct injury by fire.

Thinning of 931 acres in FRZs (approximately 3.8 percent of the mid- and late-successional habitat in the Assessment Area), and, to a much lesser extent, prescribed burning and mastication, would reduce canopy cover, basal area, and the number of large-diameter trees. All thinned stands in FRZs would have canopy cover reduced below 60 percent, but many stands would still function as habitat because they would retain large trees and at least 40 percent canopy cover.

Fuel reduction treatments, primarily prescribed fire but also mastication and thinning, would also cause changes in the amount and/or types of snags, CWD, and understory vegetation, but would have little effect on canopy cover because burning would remove smaller trees that do not substantially contribute to canopy cover in the overstory. Thinning would remove snags, but the effects on martens would most likely be negligible because the treated areas would be limited in extent (approximately 11 percent of the FRZ area) and would also avoid NSO core areas and Riparian Reserves.

Mastication would destroy small down woody debris, and some snags but would retain large snags and large-diameter down woody debris according to Klamath LRMP guidelines. Prescribed fire would consume much of the smaller down woody debris and some snags but would create many new snags. Much of the large down woody debris would likely remain when burning in spring-like conditions, and this would help ensure that subnivean access is available in winter. Temporary displacement of individuals may occur; however, no long-term adverse effects on the species are expected from the loss of smaller CWD and occasional snags.

Fuel reduction activities, primarily fire and mastication, may also kill, injure, or displace prey. Although prey densities may be reduced in affected areas, treatments are designed to minimize effects on prey by limiting treatments to no more than 50 percent of the suitable NSO habitat within a year. Prescribed fire is also designed to leave a mosaic of burned and unburned areas so some shrubs, snags, and CWD would remain to provide cover for prey species and minimize effects on martens. Martens may temporarily benefit from fuel reduction activities as rodent prey move to avoid disturbance or concentrate in remaining patches of habitat.

Thinning, mastication, and prescribed burning activities may result in short-term reductions in available prey as CWD and understory vegetation are reduced. However, fuel reduction treatments are expected to benefit martens by substantially reducing the forest’s susceptibility to stand-replacing crown fires. As the habitat develops over time, it is expected that there would be an increase in denning and resting sites (with an increase in CWD), as well as complex structure near the forest floor that would provide prey habitat and marten direct access to the subnivean zone for marten.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the marten, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Pacific Fisher—

Direct and Indirect Effects. The potential direct effects on Pacific fishers from vegetation management activities under Alternative B consist of modification or loss of habitat or habitat components, especially with regard to denning and resting habitat and foraging and movement habitat. Direct effects would also include behavioral disturbance to denning from thinning, road construction, prescribed fire, or other associated activities.

Direct effects from noise and prescribed fires can lead to the displacement of individuals or the disruption of foraging and breeding activities. Denning effects are expected to be negligible because Resource Protection Measures put in place to protect the NSO during the breeding season would indirectly protect denning individual fishers. Fishers are also a highly mobile species such that effects on foraging individuals would be minor, as areas with human disturbance would likely be avoided by foraging individuals. Temporary displacement of individuals may occur as a result of the proposed treatments; however, the Resource Protection Measures put in place to protect 50 percent of all suitable NSO habitat, over the course of any one season, would minimize disturbance to any fisher sharing similar habitat. Additionally, by ensuring that breeding NSOs are not disturbed by activities that create noise above ambient levels or have an intrusion of smoke at the nest, the seasonal restriction within owl habitat would indirectly reduce disturbance likelihood on fishers.

Fisher habitat is typically characterized as mature, structurally diverse, closed canopy stands, but fisher will occupy managed or burned stands if remnant structures are maintained (Jones 1991; Yaeger 2005). Thinning in FRZs and, to a much lesser extent, prescribed burning and mastication, would reduce four features that are used to define suitable resting, denning, and foraging habitat: canopy cover, basal area, CWD, and the number of large-diameter trees. However, because fisher denning and resting habitat is considered a subset of suitable NSO habitat, thinning and other fuel reduction activities would downgrade 47 acres and is therefore unlikely to affect individuals or overall habitat in size and scope of the landscape and total available habitat that remains. Additionally, the prescriptions modifying 323 additional acres of suitable habitat will adhere to NSO standards and would indirectly protect features preferred by the Pacific fisher.

All thinned stands in FRZs would have canopy cover reduced below 60 percent (no less than 48 percent in Douglas-fir or mixed-conifer stands), but stands that retain at least 40 percent canopy cover would still function as movement habitat and as foraging habitat because they would retain large trees (with basal areas in the range of 132 to 230 square feet per acre), and thinning would generally proceed from below so that the larger trees would remain, including all trees larger than 28 inches (except hazard trees). Thinning would reduce canopy cover below 40 percent (to no less than 32 percent) in some white and red fir stands, but preferred habitat is common and widespread in the Assessment Area, so a small reduction in ridgetop movement habitat would not create any dispersal barriers for individuals. Additionally, Resource Protection Measures for Riparian Reserves would ensure habitat connectivity and movement patterns for individuals.

Fuel reduction treatments, primarily prescribed fire, but also mastication and thinning, would cause changes in the amount and/or types of snags, CWD, and understory vegetation, but would have little effect on canopy cover because burning would remove smaller trees that do not substantially contribute to canopy cover in the overstory. Thinning would remove snags but the effects on individuals would most likely be negligible because the treated areas would be limited in extent (approximately 11 percent of the FRZ area), and would be located along ridges, which are used less frequently by resting individuals. Mastication would destroy small down woody debris and some snags but would retain large snags and large-diameter down woody debris. Prescribed fire would consume much of the smaller down woody debris and some snags but would create many new snags. Much of the large down woody debris is likely to remain when burning in spring-like conditions. Effects on fisher would also be minimized by retaining unburned habitat (at least 10 percent) in the ridgetop FRZs.

Fuel reduction activities, primarily fire and mastication, may kill, injure, or displace preferred prey. Although prey densities may be reduced in affected areas, treatments are designed to minimize effects on NSO prey, and therefore indirectly to fisher prey, by limiting treatments to no more than 50 percent of the NSO suitable habitat within a year. Prescribed fire is also designed to leave a mosaic of burned and unburned areas so some shrubs, snags, and CWD would remain to provide cover for prey species and minimize effects on the Pacific fisher.

Construction of 1.03 miles of temporary roads under Alternative B would create a short-term loss of approximately 0.62 acre of suitable NSO habitat; the habitat loss is small and widely scattered, and includes only 0.5 acre of late-successional habitat. Additionally, the roads would be closed (ripped and mulched, as needed) following thinning, and those areas would become available as habitat over the long term.

Approximately 47.3 acres of resting/denning would be downgraded within the entire Assessment Area, but large-diameter trees, snags, and CWD would be retained on the landscape. Because the patches of habitat to be removed are along ridges and are dispersed across the Assessment Area, fuel reduction activities are not expected to affect the ability of remaining habitat to provide foraging opportunities or create barriers to movement. Therefore, the action alternatives are not expected to affect the ability of the habitat to provide resting, foraging, and dispersal abilities for the Pacific fisher.

The prescriptions for thinning and fuels treatments are consistent for maintaining habitat for small mammals in northern interior forests while managing for fire and healthy forest ecosystems. Fuel reduction treatments would initiate successional changes in forest understory, including snags and CWD. Prey species are likely to increase as understory vegetation and litter layers recover and CWD is recruited from the snag population. Reduced vegetative competition would also accelerate tree growth in some areas (see Tables 3-6, 3-7, and 3-8 in Section 3.2 above). Thus, effects on Pacific fisher prey species abundance and distribution are expected to be minimal.

Thinning and fuel reduction treatments are expected to benefit fisher habitat by reducing the forest's susceptibility to stand-replacing crown fires to approximately 10 percent of current conditions. Fire would still burn with sufficient intensity to create small openings within forested habitat. This type of pattern, which would create a mosaic of stands in different successional stages, would be consistent with patterns under historic fire regimes. This pattern would likely benefit fisher and their prey by providing horizontal diversity of habitat across the landscape.

The protection of NSO activity centers, northern goshawk habitat, and Riparian Reserves would provide connectivity between large blocks of suitable habitat. Implementation of either action alternative would not increase any large-scale, high-contrast fragmentation above current levels.

Riparian zones (used as movement corridors) would not be altered by the proposed treatments; therefore, indirect effects that could result from implementation of either action alternative would have minimal effects on the movement patterns of Pacific fishers. Implementation of Alternative B should have little effect on the suitable denning and foraging habitat. Additionally, design features of FRZs would retain habitat elements within the range of those used by fisher for foraging and dispersal, such that the FRZs would likely not create large barriers to further expansion and connectivity to fisher habitat. Temporary roads under Alternative B would be closed (ripped and mulched, as needed) following thinning, and those areas would become available as habitat over the long term.

The risk for potential stand-replacing fires would be considerably higher under the no-action alternative than Alternative B, which could mean a loss of many more acres of potentially suitable denning, foraging, roosting, and travel habitat in the long term. The Pacific fisher may be affected by project activities, but the activities are not expected to result in significant indirect effects.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the fisher, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

California Wolverine—

Direct and Indirect Effects. The effects of the proposed treatments on wolverine habitat would be similar to the effects on fisher and marten habitat, except that wolverines are most likely less dependent on closed-canopy forest and more susceptible to disturbance. Thinning, mastication, and road-related activities would employ heavy machinery and may require repeated visits to a site. Because wolverines are sensitive to human disturbance, these activities would likely prevent wolverines from using portions of the Assessment Area during project implementation. Short-term disturbance effects on movement and foraging activities are possible, but these effects would be localized and would not affect the population's viability over time given the species' low likelihood of presence in the region.

Fuel reduction treatments, primarily prescribed fire but also mastication and thinning, would cause changes in the amount and/or types of snags, CWD, and understory vegetation. Thinning would remove snags, but the effects on individuals would most likely be negligible because the treated areas would be limited in extent (approximately 11 percent of the FRZ area). Mastication would destroy small down woody debris and some snags but would retain large snags and large-diameter down woody debris. Prescribed fire would consume much of the smaller down woody debris and some snags but would create many new snags. Much of the large down woody debris is likely to remain when burning in spring-like conditions. Effects on wolverine would also be minimized by retaining unburned habitat (al least 10 percent) in the ridgetop FRZs.

Fuel reduction activities, primarily fire and mastication, may kill, injure, or displace preferred prey. Although prey densities may be reduced in affected areas, treatments are designed to minimize effects on NSO prey and therefore indirectly to some wolverine prey, by limiting treatments to no more than 50 percent of the suitable habitat within a year. Prescribed fire is also designed to leave a mosaic of burned and unburned areas so some shrubs, snags, and CWD would remain to provide cover for prey species and minimize effects on the wolverine.

The construction of 1.03 miles of temporary roads under Alternative B would create a short-term loss of approximately 0.62 acre of habitat; however, the habitat loss is small and scattered and includes only 0.5 acre of late-successional habitat. Additionally, the roads would be closed (ripped and mulched, as needed) following thinning, and those areas would become available as habitat over the long term.

Over time, thinning and fuel reduction treatments are expected to benefit wolverines by reducing fuels to a level that would decrease the likelihood of extensive, high-intensity fire. Fire would still burn with sufficient intensity to create small openings within forested habitat. This type of pattern, which would create a mosaic of stands in different successional stages, would be consistent with patterns under historic fire regimes. This pattern would likely benefit wolverines by providing horizontal diversity of habitat across the landscape, including habitat conditions favored by prey such as deer and elk.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions listed in Section 3.1.4 above, is not expected to cause any cumulative effects on the wolverine, their prey, or their habitat. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to overall habitat conditions and natural resources. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative B would decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

Forest Service MIS Associations

River and Stream MIS Associations—

Direct and Indirect Effects. Thinning and mastication would not have any direct effects on the habitat because it would be protected in the Riparian Reserves. Prescribed fires that would be implemented in Riparian Reserves may reduce vegetative cover over the short term, but limited low-intensity fire in Riparian Reserves is not likely to affect the overall habitat.

Thinning and fuel reduction treatments are expected to have a beneficial indirect effect in the long term by reducing the chances and effects of stand-replacing fires, which can remove riparian vegetation and lead to increases in increases in stream temperature and sedimentation. Large-diameter shade trees and CWD would increase over the long term as a result of Alternative B.

Road-related activities have the potential to affect habitat. The construction of 1.03 miles of new temporary roads would not have a significant effect on riparian-associated species because all new temporary roads would be on ridgetops or near-ridgetop locations. None of the new temporary roads would be near Riparian Reserves, none require any stream crossing structures, none traverse unstable slopes, and none are proposed on granitic or similarly non-cohesive soils. All of the new temporary roads would be closed using normal erosion control measures (ripped and mulched, as needed). Thus, direct adverse effects from road-related activities would be negligible.

Temporary road construction and fuel reduction effects would be negligible because any sedimentation would be minimized by the retention of buffers around all Riparian Reserves. These buffers, as well as BMPs, would minimize the sediment load that could reach stream channels.

Implementation of hazard tree removal would not change canopy cover at the stand or landscape level because the individual trees that are removed would be limited to road prisms and scattered throughout the landscape. Removal of a few scattered trees would not have a significant effect on habitat suitability or function for these species.

In summary, the amount and quality of river and stream habitat in the Assessment Area would be the same pre- and post-project. Degradation of habitat components (such as riparian vegetation, individual shade trees) would occur in Riparian Reserves. A temporary shift or relocation of individuals may result from proposed activities in the landscape, but it is not expected to affect populations or population trends for tailed frogs, American dippers, or Cascade frogs.

Cumulative Effects—River and Stream MIS and Marsh, Lake, and Pond MIS Associations. Future actions on upland areas in the Assessment Area are not expected to affect aquatic habitats, individuals, or population numbers. Therefore, Alternative B would not increase cumulative effects on species in these associations.

Marsh, Lake, and Pond MIS Associations—

Direct and Indirect Effects. No direct effects are expected to occur as a result of thinning or mastication under Alternative B because aquatic habitats are protected by Resource Protection Measures, BMPs, and Riparian Reserves.

Although riparian habitat is not the vegetation type proposed for prescribed burns, the burns could move into riparian habitat; however, protective measures would be in place to ensure that upland habitat is protected while benefiting from the positive effects of a light underburn.

Fuel reduction activities are not expected to affect the amount of habitat along the edge of the Salmon Rivers nor along the edge of private ponds. Underburns would not be expected to have a significant effect on shade within Riparian Reserves. The creation of temporary roads, followed by closure after thinning is complete, could deliver sediment to pond habitats, but implementation of BMPs would reduce any indirect effects to negligible. Treatments on land adjacent to Riparian Reserves may affect upland turtle nest sites, although these effects should be rare events because turtles select open areas dominated by grasses and herbaceous annual plants, and fuel reduction activities would be focused on forest or shrub habitats on forested ridges.

Temporary road construction (under Alternative B) and fuel reduction effects would be negligible because any sedimentation would be minimized by the retention of buffers around all Riparian

Reserves. These buffers, as well as BMPs, would minimize the sediment load that could reach stream channels.

Implementation of hazard tree removal would not change canopy cover at the stand or landscape level because the individual trees that would be removed are limited to road prisms and scattered throughout the landscape. Removal of these trees would not have a significant effect on habitat suitability or function for these species.

Cumulative Effects. Refer to the cumulative effects discussion above for the River and Stream MIS Association.

In summary, the amount and quality of marsh, lake, and pond habitat in the Assessment Area would be the same pre- and post-project. Temporary degradation of some habitat components (such as riparian vegetation, basking sites, and upland nest areas) would occur in Riparian Reserves. A temporary shift or relocation of individuals may result from proposed activities in the landscape, but it is not expected to affect populations or population trends for the Western pond turtle.

Hardwood MIS Associations—

Direct and Indirect Effects. Thinning in FRZs and construction 1.03 miles of temporary roads may remove important structural components of hardwood habitats such as large-diameter trees, snags, and CWD under Alternative B. However, the removal of large-diameter trees would only occur under limited circumstances; large snags or groups of snags would be retained over most of the landscape, and large-diameter hardwoods and CWD would be retained where consistent with FRZ objectives. Therefore, effects on the distribution and abundance of these habitat components are expected to be minimal.

Fuel reduction treatments (prescribed fire and mastication) also have the potential to remove hardwoods, snags, and CWD. However, prescriptions are designed to imitate low-intensity fire and are designed to retain these components, especially hardwoods. Thus, fuels treatments are not expected to have a significant effect on important structural components of hardwood habitats.

Thinning and fuel reduction treatments are expected to benefit hardwood habitats by reducing fuels to a level that would decrease the likelihood of extensive, high-intensity fire. Treatments would also increase hardwood dominance in some areas by reducing conifer overstory and competition from young conifers that have encroached into mature hardwood stands during the era of fire suppression.

Hardwood MIS and Snag MIS Associations—

Cumulative Effects. Alternative B, combined with local community fuel reduction projects, including the proposed fuelbreak system west of Black Bear Ranch, would further decrease the risk of high-intensity fire inside and near the Assessment Area. The other proposed or anticipated actions include the installation of a fiber-optic line and North Fork Roads Stormproofing Project and, when combined with Alternative B, would cause no cumulative effects on hardwood habitat beyond the project's direct and indirect effects.

Overall, the amount of hardwood habitat in the Assessment Area would be the same pre- and post-project. Degradation of habitat components (such as individual trees) would occur with the removal of some hardwoods in mixed hardwood-conifer stands and plantations and the removal of large conifers. Shifting or relocation of territories may result from proposed activities in the landscape, but it is not expected to affect populations or population trends for western gray squirrels or acorn woodpeckers.

Snag MIS Associations—

Direct and Indirect Effects. Thinning, hazard tree removal, and construction of 1.03 miles of temporary roads may remove large-diameter snags. However, the removal of large-diameter snags would only occur under limited circumstances, and snags would be retained at Klamath LRMP Standards and Guidelines. Removal of snags and CWD is consistent with the Alternative B treatment objectives in effectively reducing the existing fuel loads. Though the objectives are to reduce fuels loading in proposed M Units and FRZs, components for adequate amounts of snag and CWD will be met at a landscape level as described in the Klamath LRMP Standard and Guidelines (pages 4-25 and 4-39). Naturally, there is a high degree of variability of snags and CWD across the stands of the Eddy Gulch LSR. Prescribed fire and mastication would also remove snags; however, prescriptions are designed to imitate low-intensity fire and would also create many snags. Thus, habitat for snag-dependent species would remain abundant and well distributed throughout the Assessment Area, and the effect is considered negligible to populations and population trends.

Thinning and fuel reduction treatments would benefit snag-dependent species in forested habitats by reducing fuels to a level that would decrease the likelihood of extensive stand-replacing fire. Fire would still burn with sufficient intensity to create snags within forested habitat. This type of pattern would be consistent with patterns under historic fire regimes.

Cumulative Effects. Alternative B, combined with other ongoing or reasonably foreseeable future actions, is not expected to cause any cumulative effects on snag habitats, individual species associated with the snag habitat, or population numbers. Combined with local community fuel reduction projects, Alternative B would decrease the risk of high-intensity fire both inside and near the Assessment Area.

3.4.5.3 Alternative C: No New Temporary Roads Constructed

Federally Listed Species

Direct and Indirect Effects on NSO Habitat from Treatments in M Units (Inside FRZs). Alternative C would be similar to Alternative B; however, the 1.03 miles of temporary roads would not be constructed, resulting in 99 fewer acres being treated. This would result in no treatments or changes to 30 acres of foraging habitat outside of any NSO core area but within home ranges. These 30 acres would, however, be susceptible to a wildfire.

Direct and Indirect Effects of Treatments in Fuel Reduction Areas in FRZs and Along Emergency Access Routes. Effects would be the same as found under Alternative B.

Direct and Indirect Effects of Treatments in Rx Units. Treatments under Alternative C would have the same effect as those found under Alternative B, but 822 fewer acres would be treated because no temporary roads would be created for access to these acres. These untreated areas would be susceptible to a wildfire, which could remove habitat in the home range of KL1028.

Direct and Indirect Effects on NSO from Barred Owls Competition. Effects would be the same as under Alternative B.

Direct and Indirect Effects on NSO Habitat and NSOs in Areas Affected by Wildfire. Effects on NSO under Alternative C are very similar to Alternative B, except 1.03 miles of temporary roads would not be constructed, and 99 acres of M Units and 822 acres in Rx Units would not be treated. Without temporary roads only two NSO core areas would be treated differently than under Alternative B. KL1028 would have fewer acres treated (less than 400 acres) with prescribed fire and thus would leave greater than 80 percent of the core area and nesting/roosting habitat at risk of a crown fire, as well as the activity center. If a wildfire were to occur, approximately 81 percent of the 400 acres that would not be treated would be subject to a crown fire, substantially removing that habitat. Under Alternative C, KL1032 approximately 10 percent of foraging habitat and 1 percent of nesting/roosting habitat, which is along or over a ridgetop from the activity center, would not be treated and could be subject to a crown fire. However, loss of such a small portion of the core area in KL1032 is not likely to affect a nesting pair or the status of the activity center. Fire brands from crown fires in untreated areas could land in other untreated areas, which could escape initial attack and adversely affect other NSO core areas or NSO Critical Habitat. Failure to treat 400 acres in KL1028 would also remove habitat should a wildfire occur in the Grasshopper Ridge USFWS priority protection area.

Direct and Indirect Effects on NSO Critical Habitat. Approximately 30 acres of foraging habitat would not be affected by thinning activities under Alternative C, otherwise effects are the same as discussed under Alternative B. The 30 acres of foraging habitat that were treated in M Units under Alternative B are outside of any NSO core area and found only within home ranges that had an excess of foraging habitat. This was not considered to be an adverse effect on Critical Habitat.

Treatments under Alternative C would have the same effect as Alternative B; however, 822 fewer acres would be treated in Rx Units because no temporary roads would be created for access to these acres. The 822 acres of Critical Habitat that were treated under Alternative B will not be treated under Alternative C and would therefore be subject to a higher fire danger and potential loss.

Alternative C would be similar to Alternative B; however, the 1.03 miles of temporary roads would not be constructed, and this would result in 30 fewer acres of suitable habitat being treated. These 30 acres of Critical Habitat that would be treated in M Units under Alternative B, would not be treated under Alternative C and would thus be subject to a higher fire danger and potential loss.

Cumulative Effects on NSOs and Critical Habitat. The cumulative effects on NSOs under Alternative C are similar to Alternative B, except additional habitat could be burned during a wildfire if that fire occurred in one of the untreated areas.

Forest Service Sensitive Species

Tehama Chaparral and Klamath Shoulderband—

Direct and Indirect Effects. Affects are the same as found under Alternative B.

Cumulative Effects. Cumulative effects are the same as found under Alternative B.

Southern Torrent Salamander and Foothill Yellow-legged Frog—

Direct and Indirect Effects. Affects are the same under Alternative B.

Cumulative Effects—Southern Torrent Salamander, Cascades Frog, Western Pond Turtle, and Foothill Yellow-legged Frog. Future actions in or near the Assessment Area are not expected to affect aquatic habitats; therefore, Alternative C would not result in cumulative effects on these species.

Cascades Frog and Western Pond Turtle—

Direct and Indirect Effects. Affects are the same as found under Alternative B.

Cumulative Effects. See cumulative effects above under southern torrent salamander and foothill yellow-legged frog.

Bald Eagle—

Direct and Indirect Effects. Effects are expected to be the same as found under Alternative B. The untreated habitats in Alternative C are not near potential nesting habitat.

Cumulative Effects—Eagle, Northern Goshawk, Peregrine Falcon, Willow Flycatcher, Pallid Bat, Townsend's Big-Eared Bat, American Pine Marten, Pacific Fisher, and California Wolverine. Alternative C, alone or in concert with other ongoing or reasonably foreseeable future actions in or near the Assessment Area, is not expected to cause any cumulative effects on these species, their habitat, or prey. Combined with local community fuel reduction projects, which will not be removing habitat, Alternative C would both decrease the risk of high-intensity fire in and near the Assessment Area. No other actions would combine to create any significant effects.

The cumulative effects on bald eagles under Alternative C are expected to be the same as under Alternative B.

Northern Goshawk—

Direct and Indirect Effects. Without temporary roads 921 acres will remain untreated. Eight hundred twenty-two fewer acres treated with prescribed fire would thus leave habitat at risk of a crown fire. Ninety-nine fewer acres would be treated within M Units, but these units are outside of any protected GOMAs.

Habitat use by goshawks and NSOs in the Klamath region are similar under Alternative C. Thus the nesting / roosting and foraging habitat discussions for the NSO also apply to the goshawk, please refer to NSO effects under Alternative C.

Cumulative Effects. Refer to the cumulative effects discussion above for the NSO.

Peregrine Falcon—

Direct and Indirect Effects. Peregrine falcon nesting/roosting habitat would not be directly or indirectly affected by the proposed fuels reduction activities under Alternative C. Peregrine falcons are known to be susceptible to disturbance near their nests, but a seasonal restriction of February 1 to July 31 would protect peregrines from all activities that create noise above ambient levels within 0.25 to 0.5 mile (dependent on topographic features) of active eyries.

Cumulative Effects. Cumulative effects are the same as found under Alternative B.

Willow Flycatcher—

Direct and Indirect Effects. Effects are expected to be similar to Alternative B, but additional untreated habitat may slightly increase the potential for stand-replacing fire to initiate early successional habitats used by willow flycatchers.

Cumulative Effects. Effects are expected to be similar to Alternative B, but additional untreated habitat may slightly increase the potential for stand-replacing fire to initiate early successional habitats used by willow flycatchers.

Pallid Bat and Townsend's Big-eared Bat—

Direct and Indirect Effects. Effects are expected to be the same as found under Alternative B.

Cumulative Effects. Refer to the cumulative effects discussion above for the NSO.

American Pine Marten, Pacific Fisher, and California Wolverine—

Direct and Indirect Effects. All proposed activities in the vicinity of suitable habitat under Alternative C could disrupt marten, fisher, and wolverine use and movement in the area and create short-term adverse direct effects on individuals just as was described under the Alternative B effects. Without temporary roads 921 acres will remain untreated. Eight hundred twenty-two fewer acres treated with prescribed fire within drainages and 99 fewer acres would remain untreated along ridgetops. These areas would thus leave dispersal, foraging, and denning / resting habitat at risk of a crown fire.

Cumulative Effects. Refer to the cumulative effects discussion above for the NSO.

Forest Service MIS Associations

River and Stream MIS Association—

Direct and Indirect Effects. Affects are expected to be the same as found under Alternative B.

Cumulative Effects—River and Stream MIS and Marsh, Lake, and Pond MIS Associations. Future actions in the Assessment Area are not expected to affect aquatic habitats; therefore, Alternative C would not increase cumulative effects on species in these associations.

Marsh, Lake, and Pond MIS Association—

Direct and Indirect Effects. Affects are expected to be the same as found under Alternative B.

Cumulative Effects. Refer to the cumulative effects discussion above for the River and Stream MIS Association.

Hardwood MIS Association —

Direct and Indirect Effects. Affects are expected to be the same as found under Alternative B.

Cumulative Effects—Hardwood MIS and Snag MIS Associations. Alternative C, alone or in concert with other ongoing or reasonably foreseeable future actions in the Assessment Area, is not expected to cause any cumulative effects on hardwood habitats. Combined with local community fuel reduction projects, Alternative C would decrease the risk of high-intensity fire both inside and near the Assessment Area.

Refer to the cumulative effects discussion above for the NSO.

Snag MIS Association—

Direct and Indirect Effects. Affects are expected to be the same as found under Alternative B.

Cumulative Effects. Refer to the cumulative effects discussion above for the Hardwood MIS Association.

3.5 Aquatic Resources

3.5.1 Introduction

This section summarizes information contained in the July 2009 “Aquatic Resources Report for Water Quality and Fisheries” and the April 2009 “Biological Assessment / Biological Evaluation (BA/BE) for Threatened, Endangered, Proposed, and Sensitive Fish Species That May be Affected by the Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project. This document also describes the effects on the environment that would result from taking no action (Alternative A) or from implementation of actions Alternative B or C. Refer to “Section 3.5.4.4 Summary of Effects on Special Status Species and Their Habitat.”

Five facts are central to the analysis of the Proposed Action for the Eddy Gulch LSR Project. The first fact derives from natural elements—hot dry summers, steep slopes, and an abundance of forest growth—that create conditions that lead to frequent fires. The potential for increased fire intensity also presents risks related to soil erosion and accelerated sediment delivery to streams. The second fact is the Salmon River watershed (within which the project is located) is a designated Key Watershed (USFS 1995a), with its attendant management guidelines aimed at preserving aquatic and riparian habitats for anadromous salmonids and other riparian-dependent species. The third fact considered is the management emphasis in the Klamath Land and Resource Management Plan (LRMP) on promoting and protecting late-successional terrestrial habitats. Fourth, most of the North Fork Salmon River and South Fork Salmon River are congressionally designated under the *Wild and Scenic Rivers Act*, a legal status precluding dam construction and placing further emphasis on management for habitat and other noncommodity values. The fifth fact is that there are seven municipal watersheds within the analysis area for aquatic resources capable of supplying water to approximately 250 residents in the Salmon River subbasin.

3.5.2 Methodology

3.5.2.1 Analysis Methods and Assumptions

The aquatic resources analysis for the Eddy Gulch LSR Project has five basic components: (1) a review of known information; (2) thorough examination of aerial imagery; and (3) field review of proposed treatment units, Riparian Reserves, current water uses, and areas of sensitivity; (4) application of the Klamath National Forest Cumulative Watershed Effects (CWE) model to assess aggregated effects of the Proposed Action and alternatives to the risk of sediment delivery to streams through surface erosion and landsliding and potential change in flow, and (5) use of the Water Erosion Prediction Project (WEPP) model to estimate the magnitude of post-wildfire surface erosion rates.

Aerial Imagery. Aerial imagery was used to identify sensitive watershed areas such as active landslides, active surface erosion, and stream channels undergoing scour and enlargement. Information collected in this phase was used to focus the field review of areas outside of or adjacent to the proposed treatment units.

The field review included the following elements:

- Traverses of all proposed thinning units where ground-based yarding or fuel treatments are proposed.

- Field review of the most actively unstable areas in or near proposed treatment units.
- Collection of information on erosion or drainage problems on existing roads.
- Stream survey of selected stream reaches to validate and supplement existing information on channel type, channel stability, pool frequency, sedimentation, and stream temperature.
- Field review of Riparian Reserves with proposed treatments.

Cumulative Watershed Effects Model. The CWE model tracks watershed disturbance and management activities to gauge the relative risk of impairing watershed functions (such as infiltration) that can then produce secondary off-site effects. The CWE model used by the Klamath National Forest has three components.

1. The "Equivalent Roaded Acre" (ERA) component tracks acres of soil disturbance by converting all disturbances to the common currency of an ERA.
2. The GEO component looks at the potential for the generation of sediment from management-induced landslides.
3. The third component is based on the Universal Soil Loss Equation (USLE) and models project effects on surface rill and gully erosion.

Water Erosion Protection Project. WEPP is a soil erosion prediction model developed by the National Soil Erosion Laboratory of the USDA Agricultural Research Service. It uses soil, topography, and climate data to predict soil erosion rates and probabilities of sediment delivery to streams. The Forest Service WEPP interface was used in this application.

3.5.2.2 Scope of the Analysis

Analysis Area. The Eddy Gulch LSR is within the Salmon River basin on the Klamath National Forest. The LSR is approximately 61,900 acres in size and lies primarily within tributary watersheds (7th-field hydrologic units) between the North Fork (5th-field hydrologic unit) and South Fork (5th-field hydrologic unit) Salmon River. A small portion of the LSR (6,771 acres) overlaps into the headwaters of Etna and Mill creeks (6th-field hydrologic units), tributary to the South Fork Scott River (5th-field hydrologic unit).

With the exceptions noted below, the analysis area includes all areas within the 7th-field watersheds in which project activities are proposed, and areas downstream that could be affected by proposed activities. These watersheds are listed in Table 3-38. Because the proposed FRZs tend to drape across ridges as a matter of their design, a few of the 7th-field watersheds make the list but actually contain very small acreages of treatment. Three of the twenty 7th-field watersheds (Kanaka-Olsen, Robinson-Rattlesnake, and Upper Etna) have proposed treatments covering less than 20 acres. In each instance, the proposed treatments involve a low-impact combination of underburning and mastication. These three watersheds are included in the CWE analysis (Appendix D of the Aquatic Resources Report) but will not be discussed further in this document because fisheries biologists and hydrologists determined that these activities would have no effect on water quality, aquatic species, or their habitat. All twenty 7th-field watersheds are shown in Table 3-38.

Table 3-38. Analysis area 7th-field watersheds, proposed treatment acres, and miles of fish-bearing streams.

7th-Field Watershed	Proposed Treatment Acres	Miles of Fish-Bearing Streams
Black Bear Creek	5,217	4.3
Cody-Jennings	1,577	5.3
Crawford Creek	6,600	4.2
Eddy Gulch	1,022	2.7
Gooey-Ketchum	86	4.8
Gould-East Fork, South Fork Salmon River	974	0.5
Indian Creek	82	1.0
Lower North Russian Creek	1,006	4.7
Lower South Russian Creek	461	2.2
Matthews Creek	1,799	1.5
Shadow Creek	5,064	1.9
Sixmile Creek	441	2.5
Tanner-Jessups	89	2.6
Taylor Creek	683	0.0
Timber-French	204	7.1
Upper North Russian Creek	1,011	1.2
Whites Gulch	574	1.6
Kanaka-Olsen	18	3.6
Robinson-Rattlesnake	2	4.6
Upper Etna	0.02	1.1

The 7th-field watersheds listed in Table 3-38 are within three 5th-field watersheds (North Fork Salmon River, South Fork Salmon River, and the South Fork Scott-French). The main streams within these 5th-field watersheds are part of the affected environment because water quality and aquatic habitat in the LSR is hydrologically linked to these downstream areas. The South Fork Scott-French watershed contains less than 1 acre of treatment area within the Upper Etna 7th-field watershed. For the same reasons cited earlier (minimal acreage proposed, resulting in no effect on water quality, aquatic species, and their habitat) for the Upper Etna watershed, the South Fork Scott-French 5th-field watershed is not analyzed further in this document.

In summary, in addition to the 7th-field watersheds listed in Table 3-38 above, the following 5th-field watersheds are also within the analysis area because aquatic habitat in the LSR is hydrologically linked to downstream areas:

- North Fork Salmon River
- South Fork Salmon River
- South Fork Scott-French

Analysis Period. Relative to vegetation recovery and soil cover, short-term effects refer to 0–5 years and long-term effects refer to longer than 5 years. Relative to sedimentation and streams, short-term effects refer to pulse effects that subside almost immediately and long-term effects refer to chronic effects.

3.5.2.3 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout the effects analysis are described below:

No Effect. The appropriate conclusion when it has been determined the Proposed Action will not affect species or their habitat.

Negligible or Discountable. The appropriate conclusion when effects on species or their habitat are expected to be discountable (extremely unlikely to occur) or insignificant.

Minor. Chemical, physical, or biological changes to water quality and hydrology would be detectable in and/or immediately adjacent to treatment units but would be well below limits set by state and federal water quality standards or criteria and would be within historical or desired water quality and hydrologic conditions.

Moderate. Chemical, physical, or biological changes to water quality and hydrology would be detectable downstream of treatment units but would not be detectable in 5th-field receiving streams. Any changes would be at or below limits set by state and federal water quality standards or criteria. Water quality and hydrology would be altered compared to historical baseline or desired water quality and hydrologic conditions.

Major. Chemical, physical, or biological changes to water quality and hydrology would be readily measurable in 5th-field receiving stream and would be frequently altered from the historical baseline or desired water quality and hydrologic conditions. Chemical, physical, or biological water quality standards or criteria would be periodically exceeded.

3.5.3 Affected Environment (Existing Conditions)

3.5.3.1 Fisheries

The following Pacific salmonid Evolutionarily Significant Units and their habitat occur in the area affected by the Proposed Action:

Endangered:	None
Threatened:	Southern Oregon Northern California Coasts (SONCC) coho salmon
Critical Habitat:	SONCC coho salmon
Proposed:	None
Sensitive:	Upper Klamath-Trinity (UKT) Chinook salmon; Klamath Mountain Province (KMP) steelhead

Essential Fish Habitat:	SONCC coho salmon; UKT Chinook salmon
Management Indicator Species:	Steelhead; resident rainbow trout

Conclusions regarding anadromous fish and their habitat (including critical habitat) occurrence are based on field review of habitat suitability, professional judgment, District fish survey records, and California Department of Fish and Game (CDFG) information (refer to Maps A-13a and A-13b for fish distribution in the Assessment Area). Field surveys, CDFG information and professional judgment of fisheries biologists were compiled into the Klamath National Forest steelhead trout distribution layer in their Geographic Information Systems (GIS) electronic library. The steelhead trout distribution over-estimates the extent of coho salmon, critical habitat, Chinook salmon, and Pacific salmon Essential Fish Habitat, except where site-specific field surveys refine Chinook salmon, coho salmon, and critical habitat distribution (such as the habitat is found to be inaccessible for coho salmon, Chinook salmon, or both). The Klamath National Forest considers the use of their Steelhead Trout Distribution Layer to define Chinook salmon habitat, and coho salmon critical habitat, as a conservative (inclusive) approach for assessment of effects on coho and Chinook habitat (including critical habitat) because coho and Chinook salmon may not occupy the same waters as steelhead due to the differences in jumping abilities. The maximum jumping height for coho is approximately 2.2 meters (7 feet), Chinook salmon is 2.4 meters (8 feet), and steelhead is 3.4 meters (11 feet) (Meehan 1991).

North Fork Salmon River. The North Fork Salmon River (5th-field watershed) is one of two major forks of the Salmon River and is part of the National Wild and Scenic River System. The North Fork Salmon River provides habitat for the Klamath River's largest wild run of spring Chinook, as well as KMP summer-run steelhead. These wild Salmon River runs are unaffected by hatchery-produced salmonids because there are no fish hatcheries in the Salmon River basin. The watershed is comprised of approximately 130,200 acres. Approximately 1 percent of the watershed is privately owned, and the remainder is federal land managed by the Klamath National Forest. The forest manages 43 percent as wilderness, and the remainder is managed for other resource values.

The North Fork stream lacked down woody material, fine sediment was a problem, embeddedness was high, and there was a lack of pool habitat (USFS 1995c). The North Fork of the Salmon River met desired pool frequency in 2 out of 17 reaches surveyed and did not meet fine sediment in the lowest seven reaches, which are below Little North Fork. Water quality, including water temperature, is a concern in the Salmon River basin. Shade is lacking along the entire North Fork of the Salmon, with the exception of the upper-most reaches. Tributary temperatures were below lethal levels. The Little North Fork had the largest cooling effect on the North Fork of the Salmon River due to its significant flow contribution. The North Fork of the Salmon River exceeds maximum recommended temperatures (below 70ºF) during the summer. High water temperatures have resulted in fish kills of spring-run Chinook salmon and summer steelhead during warm low-flow drought conditions of some summer seasons, such as in 1994.

Approximately 29 percent of the watershed is designated as Riparian Reserves (refer to Maps A-12a and A-12b), which include unstable or potentially unstable lands and stream buffers. Current conditions and uses of Riparian Reserves are related to historic uses, which have included grazing, roads, stream crossings, and mining. An analysis of air photos from 1944 showed that, at the time, most stream channels were fully vegetated with a mixture of conifer and hardwood species. The 1964 flood resulted in major changes to the stream channel in that the channel widened and long segments were scoured out. The entire length of the North Fork of the Salmon River was modified and stripped of riparian vegetation. In 1995 the Klamath National Forest estimated that the main stem North Fork of the Salmon River showed 20 percent initial recovery since the 1964 flood. This may be because, in general, larger streams recover more slowly than smaller streams (the Klamath National Forest also studied recovery of smaller streams) due to larger surface areas affected by scour and larger streamflows acting on this surface. Unstable areas and disturbed streams that have poorly defined primary channels may recover slowly due to frequent re-disturbance by subsequent high flow events.

Significant portions of Riparian Reserves were burned in the past with moderate to high severity by the Hog, Yellow, and Specimen fires. Riparian vegetation recovery to a mature state within granitic terrains takes approximately 80 years (to re-establish large conifers).

In addition to fires, landsliding is a significant watershed process of concern in the North Fork Salmon River. During the Twentieth Century, 75 percent of the landslide-derived sediment, which entered the stream, was associated with flood and storm events that occurred from 1964 to 1975. Roads produced landslides at a rate much higher than undisturbed lands. Harvested or burned areas produced landslides at a rate much lower than roads but higher than undisturbed lands.

The CDFG estimated spawning populations in the Salmon River for a five-year period—population estimates ranged from 1,000 to 4,000 (CDFG 1994 *in* USFS 1995c). The North Fork of the Salmon River “holding” summer steelhead population estimates for the period of 1980 through 1994 were less than 75 individuals per year observed. The North Fork of the Salmon River “holding” spring-run Chinook salmon populations for the same time period ranged from 3 to 363 individuals. On average, 25 percent (of total observed from 1980 through 1994) of spring-run Chinook salmon and summer steelhead were in the main stem Salmon River and 20 percent in the North Fork of the Salmon River. These surveys also showed that 75 percent of adult spring-run Chinook salmon and summer steelhead holding in the North Fork of the Salmon River use the reach, which extends from the mouth of the North Fork of the Salmon River to the Little North Fork, and on average, 94 percent of the Chinook salmon spawning occurs in the same reach.

South Fork Salmon River. The South Fork Salmon River (5th-field watershed) provides important habitat for native fish, including steelhead, spring and fall-run Chinook salmon, coho salmon, Pacific lamprey, sturgeon, dace, Klamath small-scale sucker, and sculpin. The South Fork Salmon River is important refugia for the last remaining wild-run spring Chinook salmon in the Klamath River basin and provides important holding and spawning habitat for summer steelhead.

Watershed conditions have been impacted by fires, roads, and historic timber harvest practices associated with mining. Wildfire is probably the largest single disturbance affecting watershed conditions in the lower South Fork. Subwatersheds in the lower South Fork considered as Areas With Watershed Concern (AWWCs) include Indian Creek, and Black Bear Creek. The original road system was developed to provide access to gold mines and later was extended for timber harvest. Inner gorges are found along streams in all parts of this watershed and have naturally high debris slide rates. Debris sliding, surface erosion, and channel erosion all contribute sediment to streams.

Flooding with debris torrents have occurred and have triggered debris slides and torrents. The Klamath National Forest rated large wood as sparse in most reaches. Summer water temperatures are a concern in the lower South Fork, which has low shade values due to the width of the stream and bedrock dominated terrain. The lower South Fork has had high turbidities attributed to landsliding in the wilderness headwaters of the upper South Fork watershed.

The 7th-field watersheds in the Eddy Gulch LSR are described below in the context of existing conditions of the three habitat indicators selected for this analysis: sediment, temperature, and LWD.

3.5.3.2 Sediment

The Klamath National Forest rates many of the 7th-field watersheds in the Eddy Gulch LSR as being “at risk” for the sediment indicator, which means that the amount of fine sediment was higher than desired, and/or cobble embeddedness was 20 percent or greater, or watersheds had relatively high CWE ratings. Crawford Creek and Black Bear Creek were rated at “properly functioning” for sediment. The following watersheds were rated as “at risk” for watershed disturbance history (see checklists in the fish BA/BE for this project): Shadow Creek, Taylor Creek, Crawford Creek, Mathews Creek, Black Bear Creek, Upper North Russian Creek, Lower North Russian Creek, Lower South Russian Creek, Whites Gulch, and Eddy Gulch.

Disturbances

Landslides. Channel and valley morphology (steep, structurally controlled slopes within narrow valleys) in the Eddy Gulch LSR have the greatest influence on fish habitat, including channel gradients, wood storage, gravel availability/storage, and fine sediment distribution. Stream channels in the LSR are primarily moderate to high gradient, boulder dominated, step/pool beds with high energy and confined within steep inner gorges. Thus, these streams have low sedimentation potential (that is, sediment accumulation potential) due to gradients and generally confined channel conditions that result in high stream power and transport of sediment downstream. Fish habitat (such as pools and spawning substrate) is periodically and frequently reset due to sediment inputs from streamside landslides and debris flows. These are the dominant natural landscape processes relative to sediment that drive existing conditions of fish habitat in the LSR.

Floods. Floods have been a dominant disturbance process that periodically affect fisheries habitat. The major floods that have occurred in the Salmon River basin corresponded with landsliding, which produced sediment to stream channels. The 1964 flood resulted in major channel widening, and the flood of 1997 resulted in loss of pool depths and riparian vegetation.

The most vulnerable rock types from the standpoint of mass movement and surface soil erosion are highly weathered granodiorites (coarse-grained igneous rock) and the unconsolidated sedimentary deposits formed from them. Only South Russian Creek has significant areas in this rock type, and none of it lies within areas planned for project activities. Incredibly destructive debris torrents are the most common mass movement in this rock type. South Russian Creek experienced just such an event in the aftermath of severe thunderstorms in 1996.

Riparian Reserves are components of the landscape that are critically important to protection of aquatic resources, either because of their proximity to streams or their special sensitivity to disturbance. Riparian Reserves may be thought of as falling into two subtypes: “wet” Riparian

Reserves are streams and other water bodies and their adjacent riparian zones; generally, “dry” Riparian Reserves are areas of past or present slope instability. Both types of Riparian Reserves are protected through application of Standards and Guidelines described in the Klamath National Forest LRMP and are managed to meet ACS objectives.

Roads. Road density is considered “properly functioning” in a watershed if there are less than 2 miles per square mile (mi/mi^2) of roads, with no valley bottom roads. Road density in the Eddy Gulch LSR varies. For example, lower North and South Russian creeks, North Fork Salmon River, North Russian Creek, Gould-East Fork South Fork Salmon, South Fork Salmon River, Taylor Creek, Upper North and South Russian Creek watersheds all have road densities that are rated as “properly functioning.” Mathews Creek, Shadow Creek, and Whites Gulch are rated as “at risk” for road density, and Eddy Gulch is rated as “not properly functioning” for road density (road density is 4.44 mi/mi^2). Eddy Gulch and Mathews Creek both have main roads that parallel the stream for a considerable distance.

Table 3-39 presents a summary of road development in Riparian Reserves by 7th-field watersheds. Ten of the 17 listed watersheds have road densities above 2.0 mi/mi^2. Fifteen of the 17 listed watersheds have road densities in Riparian Reserves above 2.0 mi/mi^2; some are much higher. This is generally the result of historically built roads that parallel streams. Road density is greater in Riparian Reserves than in watersheds, in some instances, due to the greater proportion of roads in the relatively smaller area of Riparian Reserves.

Table 3-39. Summary of past road development by 7th-field watershed.

7th-field Watershed	Road Density in Riparian Reserve (mi/mi^2)	Road Density in Watershed (mi/mi^2)
Black Bear Creek	1.9	2.7
Cody-Jennings	2.8	1.4
Crawford Creek	2.9	3.1
Eddy Gulch	5.2	4.5
Gooey-Ketchum	4.0	1.9
Gould-East Fork South Fork Salmon	2.5	2.0
Indian Creek	2.4	3.2
Lower North Russian	4.3	1.7
Lower South Russian	6.4	3.6
Matthews Creek	3.5	2.7
Shadow Creek	1.8	2.7
Sixmile Creek	2.2	1.7
Tanner-Jessups	4.6	3.2
Taylor Creek	2.3	1.7
Timber-French	3.1	1.6
Upper North Russian	3.8	2.6
Whites Gulch	3.3	2.2

Changes in sediment regimes were assessed using the CWE predictive models or estimates of stored sediment in stream channels. Both are employed in this report to describe existing sediment delivery regimes.

Cumulative Watershed Effects Model. The Klamath National Forest's CWE model has two components that address sediment delivery potential. The USLE component uses a long-established predictive algorithm to estimate changes in rates of rill and gully erosion and its delivery to streams. The GEO component predicts sediment delivery from potential landslide events based on disturbance history and site geology and geomorphology. The CWE model's current condition assessment is described below. The model output reports risk ratios. Risk ratios are the result of dividing the parameter of interest (sediment yields from the USLE component is an example) by the threshold of concern (TOC) established by assessing watershed sensitivity. It is a type of normalizing such that the critical value of the risk ratio is 1.0. Watersheds are judged to be well below TOC when risk ratios are well under 1.0.

The CWE model, USLE component, identifies two 7th-field watersheds as being near or over threshold for sediment delivery from surface runoff: Eddy Gulch (risk ratio = 1.05) and Shadow Creek (risk ratio = 0.94). All other 7th-field watersheds have risk ratios between 0.24–0.56, indicating that these watersheds meet desired condition. The GEO component identifies four 7th-field watersheds with potential concerns over landslide-related sediment delivery: Upper North Russian (risk ratio = 0.87), Indian Creek (risk ratio = 0.87), Eddy Gulch (risk ratio = 0.79), and Kanaka-Olsen (risk ratio = 1.53). The “Aquatic Resources Report for Water Quality and Fisheries” contains a considerable amount of detail about the CWE analysis conducted for the project and tables showing results of the CWE modeling.

The Salmon River CWPP identifies the following 7th-field drainages as municipal watersheds based on their existing or potential use as sources of domestic water supply; Black Bear, Eddy Gulch, Callahan Gulch, Crawford Creek, Shadow Creek, Counts Gulch, and Music Creek. No evidence was found to indicate that current levels of sediment storage or transport adversely affect these uses.

Flood Return Intervals. The amount of impervious area increases within a watershed when a higher proportion of precipitation and snow melt takes rapid, overland flow paths rather than infiltrating into the soil. If this runoff does not encounter infiltration opportunities along its flow path, it rapidly reaches the main channel. Under the right circumstances, and with sufficient impervious area, the magnitude of short return-interval flood peaks can increase, leading to channel scour. Limiting impervious area is the primary mitigation for this impact. It is exactly this condition that is indexed by the ERA component of the Klamath National Forest's CWE model (refer to the “Aquatic Resources Report for Water Quality and Fisheries” for this project).

3.5.3.3 Large Woody Debris

Large wood is one of the primary watershed products the Eddy Gulch LSR supplies and replenishes to downstream aquatic/anadromous salmonid habitat. The predominant mechanism for large wood recruitment in the LSR is streamside landsliding with some mass wasting. Thus, the level of recruitment depends on the availability of large conifers on inner gorges. Wood transport downstream occurs via debris torrents and large flood events, such as the 1997 flood, which resulted in numerous landslides. The primary functions of large wood include pool formation, cover, nutrient input, and sediment storage and metering.

Field survey results rated Eddy Gulch, Mathews Creek, Crawford Creek, Black Bear Creek, and Whites Gulch as “at risk” based on low amounts of large wood documented in the bankfull channel.

An abundance of small to mid-size diameter wood pieces was observed during field reviews of these streams, generally reflecting the size of trees in Riparian Reserves. Large woody debris (LWD) levels have been reduced by past disturbances, including the 1964 flood, which scoured and transported large wood out of these stream systems; and past fires and timber harvest, which reset vegetation in Riparian Reserves. Lower North Russian, Lower South Russian, Music Creek, North Russian Creek, Shadow Creek, Sixmile/Gould, Taylor Creek, and Upper North and South Russian creeks are all rated as “properly functioning” for LWD, which indicates they have more than 80 pieces of large wood (defined as dbh larger than 24 inches and longer than 50 feet) per mile.

As discussed above, the condition of Riparian Reserves is a primary influence on water quality and fisheries habitat and is discussed in this section. Many of the streams in the Eddy Gulch LSR have narrow, deeply incised channels with a minor component of obligate riparian vegetation. Debris torrents and channel scour associated with flood events are common occurrences and periodically reset streamside vegetation that is immediately adjacent to streams. Willow, big leaf maple, and alder colonize these disturbed areas and are critical for recovery of riparian function and for input of nutrients. Conifers, and in many stream reaches, steep incised topography, provide the primary stream shade in Riparian Reserves in the LSR. In addition, conifers provide the bulk of large wood and root stability to streamside areas in the LSR. However, the LSR also has a number of acres that are on south- and west-facing slopes with shallow soils and hot, dry conditions, which are not conducive to dense coniferous stands.

During field surveys of 7th-field watersheds, riparian vegetation was observed to be a mosaic of mostly mid-successional, with some late-successional characteristics. Large trees were usually present but not predominant. Road incursions, salvage logging, fire, floods, and old landslides are the agents that have produced earlier successional patterns in riparian stands.

Even though all riparian stands may not be at full potential relative to late-successional characteristics, stream shade is abundant. Where past disturbance has removed conifer canopy, riparian hardwoods (alder, big leaf maple, dogwood, and willow) have rapidly filled the gap. With the exception of road crossings, shade canopy was observed to be over 80 percent and often near or above 90 percent.

At higher elevations, some of the hardwood component disappears in favor of brush species with lower water demand. As such, the component of shade provided by non-coniferous vegetation declines, as does overall shade. At elevations above about 4,500 feet on intermittent channels, shade values were observed to be more commonly in the 60–70 percent range.

Except where permanent roads are located in or near riparian zones, ground cover was observed to be almost always at or near 100 percent in Riparian Reserves. As a result, the sediment filtering capacity of most Riparian Reserves is very good. The specific areas where road incursions have impacted the sediment filtering capacity of Riparian Reserves include South Russian Creek (road 40N54), Whites Gulch (40N61), Black Bear Creek (1E001), and lower Crawford Creek (39N23).

3.5.3.4 Stream Temperature

There are 8,624 acres of Riparian Reserves in the Eddy Gulch LSR. Prior to the 1995 Klamath LRMP, timber harvest occurred in areas now designated as Riparian Reserves, and as a result, approximately 4 percent of Riparian Reserves are in plantation status and lack desired vegetation characteristics, including structural diversity, which provides adequate thermal regulation and supplies coarse wood to streams.

All of the 7th-field watersheds in the LSR have stream temperatures that are considered “properly functioning.” Water temperatures are considered “properly functioning” in lower order streams when temperatures are 69ºF or less. In addition to previous data collected by the Klamath National Forest for all 7th-field streams, some streams were sampled in 2008: main stem reaches of Whites Gulch and Shadow Creek measured 59ºF in mid-August. Temperatures sampled in mid-July 2008 were as follows: Mathews Creek–62.5ºF, South Music–61ºF, Taylor Creek–55.5ºF, and Russian Creek–55.5ºF. During field reviews of the Assessment Area in mid-August 2008, water temperatures were measured in numerous seeps and springs that flowed into Whites Gulch, South Music, and Sixmile Creek, and temperatures ranged from 46.5ºF–57ºF. These small, low-flow perennial cold seeps and springs are common in the analysis area and collectively feed 7th-field drainages downstream, and are crucial for maintaining cool temperatures in summer and fall months. Cool water temperatures in tributaries in the LSR highlight the importance of these streams relative to providing cool water inflows to warmer habitat downstream of the LSR that are used by anadromous salmonids, including within the North Fork and South Fork Salmon River.

3.5.4 Environmental Consequences

3.5.4.1 Alternative A: No Action

Actions with Potential to Affect Sediment Indicator under Alternative A

Road construction—No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units—There are no thinning treatments associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels—No mastication would occur under Alternative A.

Prescribed underburning—No prescribed underburning would occur under Alternative A.

Water drafting—Water drafting would be a likely activity related to wildfire suppression. Water drafting under conditions of a wildfire may not occur with the same level of resource protection as would be expected under normal project conditions.

Wildfire and suppression actions—Loss of cover exposes soil to raindrop impact and subsequent erosion. This, in turn, can lead to loss of soil productivity and delayed recovery through vegetative regrowth. Where fire severity is high adjacent to streams, erosion can lead to sediment delivery to those streams. The direct effect, in this instance, would be to stream segments directly impacted by moderate to high-intensity fire. The magnitude of the direct effect is dependent on the total length of channel experiencing high-intensity fire. In general, the indirect effect of accelerated sediment delivery is of greater concern because sediment moves downstream to affect an ever-increasing amount of aquatic habitat.

The modeled wildfire under the no-action alternative is 7,200 acres in average extent. Eleven percent, or approximately 780 acres, is predicted to experience stand-replacing fire intensity. This would generally include 50–100 acres of Riparian Reserves. While much canopy would be retained, most soil cover in the form of litter and duff would be consumed.

Impervious surface can be created through soil disturbance and compaction and from the creation of hydrophobic soils. Under the no-action wildfire scenario, increases in impervious surface can result from the use of heavy equipment in fire suppression (disturbance/compaction) and high-intensity fire (hydrophobic soils). When sufficient impervious surface has been created within a watershed, a higher proportion of storm and snowmelt runoff is manifest as surface runoff. A smaller proportion infiltrates into the soil, taking slower paths to stream channels. This can result in higher peak flows for each unit of precipitation or snowmelt. When these conditions persist, it represents a shortening of flood return intervals. A fundamental shift in the frequency of channel-shaping flood events can produce an increased potential for channel scour. Where impervious surfaces are created in near-stream areas, these effects can be disproportionately higher.

The indicators related to sediment are comprised of the risk ratios produced by the Klamath National Forest's CWE model as described above in Section 3.5.2.2 each of the three risk ratios assesses a particular type of watershed disturbance process. The ERA risk ratio looks at creation of impervious surface relative to a threshold based on watershed sensitivity. The USLE risk ratios look at sheet and rill erosion potential from soil disturbance. The GEO component indexes the potential for landslide-generated sediment. Each component assesses actions with the potential to generate sediment. As such, the desired condition for this indicator is for all risk ratios in all 7th-field watersheds to be below 1.0.

The CWE model requires spatially specific disturbance information as input. This information was supplied by output of the fire behavior model FLAMMAP. Fire and Fuels specialists on the Interdisciplinary (ID) team ran the model with three separate ignition points, each point representing a likely point of human-caused ignition. Each ignition produced wildfires of similar size and intensity but in different locations. For purposes of the CWE analysis, fire model output for the Shadow Creek Campground ignition point was used. The rationale for this selection includes these points:

- The Shadow Creek ignition produces the greatest concentration of burned acres within a single 7th-field watershed (Shadow Creek).
- Shadow Creek has a relatively large amount of past disturbance (existing roads and regeneration harvest units) when compared to other 7th-field watersheds in the analysis area.
- Shadow Creek is a municipal watershed.

The no-action alternative with the modeled wildfire just described was analyzed using the CWE model. Table 3-40 displays risk ratios produced by the CWE model for this alternative.

Table 3-40. CWE model results for the no-action alternative with modeled wildfire scenario.

7th-field Watershed	USLE Component		ERA Component		GEO Component	
	Pre-fire	Post-fire	Pre-fire	Post-fire	Pre-fire	Post-fire
Sixmile Creek	0.516	0.545	0.122	0.142	0.364	0.388
Gould-East Fork South Fork Salmon	0.347	1.383	0.164	0.645	0.454	0.838
Shadow Creek	0.934	2.854	0.181	1.002	0.408	1.067
Gooey-Ketchum	0.259	0.413	0.118	0.176	0.497	0.538
Crawford Creek	0.457	0.458	0.216	0.216	0.287	0.287
Whites Gulch	0.283	0.299	0.128	0.134	0.186	0.188

Major increases in the risk ratios for Shadow Creek and Gould-East Fork Salmon are evident. Especially high is the 2.85 USLE risk ratio for Shadow Creek, highlighting the potential of the wildfire to increase sediment yield. These results should be interpreted with caution. They are not a statement of the expected outcome of a specific action but an example of a reasonably possible outcome. Only watersheds affected by the modeled wildfire are shown in the table. Under the no-action alternative, all other 7th-field watersheds have risk ratios that reflect current conditions only.

Because the CWE model produced the dramatic increase in the USLE risk ratio, a second approach was employed to corroborate the CWE model's suggestion of a high potential to increase erosion and sedimentation. The WEPP soil erosion and sediment delivery model was used to estimate sediment delivery rates from a prototypical slope profile under natural vegetation and modeled wildfire. Model results suggest an approximately 50-fold increase in per-acre sediment yield in the first year following fire, declining to pre-fire conditions in 5–10 years. Using local climate data, the model also predicts a 90–100 percent chance of sediment delivery in the first year following the fire. These effects would be predicted to occur on the 7,200 acres that burn under the modeled wildfire scenario.

Taken together, the results of the WEPP and CWE analyses suggest that the potential severity of increased sedimentation from wildfire is high. The potential to adversely affect domestic use of water from municipal watersheds under such a wildfire scenario is reasonably likely. Such an increase in sediment yield has a reasonable likelihood of resulting in measurable increases in stored in-channel sediment, thus adversely affecting aquatic habitat. The magnitude of this potential effect is judged to be moderate to major (depending on the spatial pattern an actual fire would produce) with an expected duration of a decade or less.

Actions with Potential to Affect Flood Regime Change Indicator under Alternative A

Road construction—No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units—There are no thinning treatments associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario, but the exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels—No mastication would occur under Alternative A.

Prescribed underburning—No prescribed underburning would occur under Alternative A.

Water drafting—Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the flood regime indicator.

Wildfire and its suppression—The measurement indicator that gauges the potential for altered flood regimes due to the creation of impervious surface is the ERA component of the CWE model. The desired condition is a risk ratio less than 1.0 in each 7th-field watershed in the analysis area. That would indicate that the total amount of impervious surface (ERA) from all past, current, and reasonably foreseeable activities is below the threshold of concern. The reader is again referred to Table 3-6 above for the results of the CWE model. The wildfire scenario causes an estimated increase in the ERA risk ratio for Shadow Creek that pushes up to the 1.0 inference point. This is not an actual effect but serves to point out that a fire of this magnitude and spatial pattern has the potential to create adverse hydrologic conditions. The best way to categorize the situation relative to flood regime change in Shadow Creek is “at risk.” A risk ratio substantially over 1.0 would be necessary to arrive at a higher estimation of the magnitude of the effect. The Klamath CWE model uses fairly conservative ERA threshold of concern values so some factor of safety is built into these risk ratio estimates.

Actions with Potential to Affect Stream Temperature Indicator under Alternative A

Road construction—No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units—There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels—No mastication would occur under Alternative A.

Prescribed underburning—No prescribed underburning would occur under Alternative A.

Water drafting—Water drafting would be a likely activity related to wildfire suppression. Water drafting under conditions of a wildfire may not occur with the same level of resource protection as would be expected under normal project conditions and could therefore affect stream temperatures if flows were substantially reduced (due to implementation of NMFS’ Water Drafting Guidelines this will not occur).

Wildfire and its suppression—Stream temperature is likely to be adversely affected due to the 50–100 acres of Riparian Reserve predicted to be consumed by high-intensity wildfire. This effect is dependent on the actual extent and location of stand-replacing fire in Riparian Reserves. For example, many small burned-out patches dispersed across the landscape would have less impact on these indicators than a few large contiguous blocks in a single watershed. Wildfire modeling does not provide conclusive evidence that stream temperature would be significantly affected.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator under Alternative A

Road construction—No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units—There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels—No mastication would occur under Alternative A.

Prescribed underburning—No prescribed underburning would occur under Alternative A.

Water drafting—Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the LWD indicator.

Wildfire and its suppression—A wildfire could reduce long-term LWD recruitment at the 7th-field scale if Riparian Reserves were burned. Modeled wildfires average 6–7 percent of Riparian Reserves consumed by high-intensity fire within the fire perimeter. This would add cumulatively to existing low levels of LWD in 7th-field streams and in habitat downstream that receives large wood from the analysis area. Low levels of large wood in the subject 7th-field streams are partly due to the physical attributes of streams, which facilitate wood transport rather than storage. However, a wildfire would add cumulatively to existing low levels of LWD in the analysis area and would decrease long-term recruitment to downstream alluvial reaches and pools, where wood plays a vital role in habitat complexity for spawning and rearing salmonid.

Hazard tree removal—Hazard trees may be removed along roads and could affect LWD in Riparian Reserves. However, the Klamath National Forest Hazard Tree Guidelines (USFS 2005) will be implemented and trees felled within Riparian Reserves would be left on site. Therefore, LWD levels in Riparian Reserves will not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator under Alternative A

Road construction—No new roads would be constructed under Alternative A.

Skid trails, landings, and cable corridors associated with thinning units—There is no timber harvest associated with Alternative A. Fireline construction would be expected under the anticipated wildfire scenario. Exact locations and types of firelines would depend on location of fire and its behavior.

Mastication of fuels—No mastication would occur under Alternative A.

Prescribed underburning—No prescribed underburning would occur under Alternative A.

Water drafting—Water drafting would be a likely activity related to wildfire suppression. Water drafting does not affect the Road Density indicator.

Wildfire and its suppression—These actions would not change road density under Alternative A.

Conclusion: Summary of Potential Effects on Aquatic Resources under Alternative A

CWE model risk ratios serve as the metric for sediment-related indicators. Table 3-41, which is presented under the discussion of Alternative B, contains risk ratios for the current condition plus foreseeable future actions, along with those for the action alternatives. The following discussion makes reference to these risk ratios. In the interest of avoiding redundancy, Table 3-41 is not repeated in this discussion of Alternative A. Table 3-40 (presented previously) contains risk ratios relevant only to the modeled wildfire scenario, and thus, is only pertinent to Alternative A.

Direct and Indirect Impacts on Fisheries Habitat under Alternative A (Beneficial Use "COLD")

Based on the modeled wildfire and the modest amount of Riparian Reserves that would be burned, it is unlikely that a wildfire would directly kill fish. The habitat effects of a wildfire would likely constitute an indirect effect on fish since they would occur later in time. Although a surface fire would consume litter, small woody debris, shrubs, and some large trees, Riparian Reserves have higher fuel moistures, resulting in low potential for direct effects on fish; that is, there is low potential for a severe fire to burn over streams and directly kill fish. Indirect effects on fisheries are evaluated in the bulleted items that follow.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of protective soil cover, leading to accelerated erosion and sedimentation. High USLE and ERA risk ratios resulting from CWE analysis of the modeled wildfire indicate that potential adverse sediment effects on fish habitat would be high under the no-action Supporting this conclusion is the WEPP model output showing a 50-fold increase in first year erosion rates with a virtual certainty that a portion of this accelerated erosion will reach streams.

- The magnitude of this impact is judged to be moderate to major depending on the dispersion of high-intensity fire across 7th-field watersheds. The duration of adverse effects is likely to be on the order of 5 to 10 years.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying increase of impervious ground surface, leading to an increase in overland surface runoff. Based on conditions predicted by the modeled wildfire scenarios, sediment effects related to altered runoff regime are likely to be negligible to minor. This is due to the modest amounts of Riparian Reserves consumed by high-intensity fire and the high probability that suppression-related disturbance would likely be concentrated along ridgetops and existing roads. Additionally, the loam-clay loam soils characteristic of the analysis area are not the kind of noncohesive soils most prone to developing hydrophobic conditions following fire. The duration of effects is likely to be short term as regrowth of vegetation and other processes break up impervious surfaces and areas of hydrophobic soils. The intensity of this effect is negligible to minor.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of riparian shade canopy, leading to stream temperature increases. Where stand-replacing fire intensity occurs in streamside zones, shade canopy is lost, exposing streams to increased amounts of solar radiation. To experience a measurable increase in temperature, relatively large contiguous segments of stream must experience significant reduction in shade canopy. Spatial patterns of high-intensity fire produced by the wildfire model do not exhibit this pattern. The model suggests that 6–7 percent of Riparian Reserves would experience stand-replacing fire in a patchy, noncontiguous spatial pattern. Most 7th-field tributaries are narrow, steep, and north-south trending, all of which suggests lower vulnerability to temperature increases.

- Adverse effects on stream temperature under the no-action alternative are expected to be negligible to minor and of short duration because the regrowth of riparian shrubs is usually quite rapid following the removal of overstory, and physical conditions as described above may attenuate loss of stream shade. No significant effects are expected due to this process.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of snags and large trees near streams. The no-action alternative may cause indirect effects on fish and their habitat because fuel loadings are high in the LSR, and groups of trees could be killed in Riparian Reserves if a large wildfire were to occur. If overstory vegetation were damaged or lost, future large wood recruitment would be reduced. Post-fire (short- to mid-term) recruitment may increase due to the amount of dead trees. However, future long-term large wood recruitment in Riparian Reserves would likely be impacted (decreased).

  Indirect adverse effects on LWD recruitment are judged to be minor due to the relatively small area of Riparian Reserves predicted to be impacted by high-intensity fire.

Cumulative Effects on Fisheries Habitat under Alternative A (Beneficial Use “COLD”). The no-action alternative would not add project-related incremental effects to the effects of past, present/ongoing, or future projects because no management activities are proposed. However, were a wildfire to occur that is similar to the modeled wildfire, cumulative adverse effects on fish habitat are likely. Aquatic habitat is recovering from past disturbances, and fish populations are at low levels. Past surveys indicate that LWD is present in less than desired levels. Thus, a severe wildfire, in combination with past, present/ongoing, and future actions, could result in cumulative effects on fish associated with increases in sediment supply, localized increases in water temperature, and reduced long-term LWD recruitment. The magnitude of effects is expected to be minor to moderate (sediment impacts could be major within one or two 7th-field watersheds), depending on the spatial pattern of high-intensity fire. Temperature and sediment effects would be expected to recover within 5 to 10 years, while effects on large wood recruitment would persist for multiple decades.

Foreseeable future actions are listed in Section 3.1.4 above. Two of the listed actions (North Fork Roads Stormproofing Project and construction of a fuelbreak system west of Black Bear Ranch) were also included in the input to the CWE model and are reflected in the model output. In all 7th-field watersheds affected by future projects, the net effect of those projects is a small but consistent decrease in risk ratios. The road project represents a major long-term improvement to watershed condition in the affected drainages. The details of the fuel break project are not yet fully developed.

Assuming it involves only underburning and mastication along ridgetops with no road development, it is highly unlikely to have detectable adverse effects and will provide improved wildfire suppression and protection to the Black Bear and Callahan municipal watersheds.

Municipal/Domestic Uses of Water under Alternative A (Beneficial Use "MUN")

Direct and Indirect Effects—Direct effects to municipal/domestic uses of water are unlikely. Damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion are the most likely processes fitting the definition of "direct effect." Under the no-action alternative, inadvertent actions related to wildfire suppression would be the most likely mechanism producing direct adverse effects on municipal/domestic use. These are not foreseeable consequences and are dismissed from further analysis or discussion. Indirect effects on municipal/domestic use are evaluated in the bulleted items that follow.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying loss of protective soil cover, leading to accelerated sedimentation and high turbidity during major runoff events. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. CWE and WEPP model results suggest that a likely wildfire could be expected to have significant adverse effects on existing or potential municipal/domestic use of water, especially when stand-replacing fire intensity is concentrated within a 7th-field watershed.

- The magnitude of this effect is judged to be moderate, mostly because of the uncertainty associated with the location and spatial distribution of wildfire effects.

- Failing to implement fuels reduction treatments would increase the risk of stand-replacing wildfire and the accompanying increase in impervious surface, leading to alteration of channel-shaping flood regime. Channel and bank scour that could potentially result from this process can increase sediment loads and damage water diversion infrastructure in ways similar to those already discussed.

- The magnitude of this effect is judged to be negligible. This determination is based on the moderate increase in the Shadow Creek ERA risk ratio (Table 3-40) under the modeled wildfire scenario and the observation that most 7th-field channels are well-armored and highly confined transport channels with low potential for rapid incision or lateral migration.

Cumulative Effects on Municipal/Domestic Uses of Water under Alternative A (Beneficial Use "MUN"). No evidence was found to indicate that existing sediment or turbidity levels cause impairment to municipal / domestic uses of water. Because the CWE model input includes information from past and foreseeable future projects, its output offers the best quantitative assessment of potential cumulative effects to municipal / domestic use in the form of accelerated sedimentation. Listed municipal watersheds include Eddy Gulch, Black Bear Creek, Shadow Creek, Callahan Gulch, Counts Gulch, Crawford Creek, and Music Creek. Of these, Eddy Gulch and Shadow Creek are the only drainages with CWE risk ratios that could be described as "at risk." The CWE model values shown in Table 3-41 include the values for the current condition (2008), including past actions. The Kanaka-Olsen and Indian Creek watersheds are over the threshold of concern, but the risk ratios are decreasing and would fall below the threshold of concern by the time the project is fully implemented in 2014. The same risk ratio for Shadow Creek is 0.93. No other risk ratios for municipal watersheds are in the "at risk" or higher range.

It is reasonable to conclude that the effects of wildfire in these two drainages would be superimposed on an existing level of disturbance that would make it easy to exceed thresholds of concern. Table 3-40 above supports this conclusion by showing a USLE risk ratio change from 0.93 to 2.85 for Shadow Creek based solely on the effects of the modeled wildfire. Based on this, it is reasonable to conclude that the potential adverse effects of wildfire on municipal watersheds is so great that the existing condition of the affected watershed may not matter, being wholly overwhelmed by fire effects.

3.5.4.2 Alternative B: Proposed Action

The primary concerns related to Aquatic Resources center on (1) the effects of temporary road construction and its potential for sediment delivery to streams; (2) the potential adverse effects of all project activities on municipal/domestic use of water; (3) the potential effects of modifying vegetation in Riparian Reserves to the detriment of sediment regime, stream temperature, and LWD recruitment; and (4) the potential adverse effects on fish and water quality from water drafting.

Both action alternatives propose thinning, fuels reduction treatments, and underburning, and both alternatives are similar in scope, scale, and location. The difference between the action alternatives is that Alternative C does not propose construction of 1.03 miles of new temporary roads, 822 fewer acres would be underburned, and handlines would be constructed around some burn units. Thinning in M Units would be reduced by 99 acres, from 931 acres in Alternative B to 832 acres in Alternative C. The magnitude of differences between the two action alternatives relative to potential effects on fish and their habitat are very small because mechanical units and proposed temporary roads are not within Riparian Reserves and are located on or near ridgetops. The differences between alternatives with regard to underburn acreage and handline construction would not result in any differences in effects on fish or their habitat. The proposed temporary roads would not cross any streams or other Riparian Reserves and are dispersed in a number of short segments across several watershed areas. The temporary roads would be closed, ripped, and re-contoured after use.

Design features applicable to both action alternatives include BMPs, Wet Weather Operating Standards (WWOS) (USFS 2002), forestwide soil cover standards, as well as Klamath LRMP Standards and Guidelines. Application of these measures would minimize the effects of each action alternative on aquatic resources considered herein.

Table 3-41. CWE model results for Alternative B combined with the North Fork Roads Stormproofing Project.

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
7th-field Watersheds												
Black Bear Creek	0.39	0.39	0.50	0.39	0.32	0.32	0.32	0.18	0.44	0.44	0.42	0.39
Cody-Jennings Creek	0.41	0.41	0.41	0.41	0.24	0.24	0.20	0.16	0.49	0.49	0.47	0.43
Crawford Creek	0.46	0.46	0.47	0.46	0.22	0.22	0.29	0.20	0.29	0.29	0.28	0.27
Eddy Gulch	1.05	0.90	0.91	0.90	0.39	0.32	0.35	0.33	0.79	0.62	0.61	0.60
Gooey-Ketchum Creek	0.26	0.26	0.26	0.26	0.12	0.12	0.12	0.11	0.50	0.50	0.50	0.50
Gould-East Fork South Fork Salmon River	0.35	0.35	0.35	0.40	0.16	0.16	0.17	0.21	0.45	0.45	0.45	0.45
Indian Creek	0.53	0.53	0.53	0.53	1.04	1.04	0.59	0.24	0.87	0.87	0.78	0.66
Kanaka-Olsen Creek	0.19	0.15	0.15	0.15	0.30	0.27	0.17	0.10	1.53	1.43	1.18	0.90
Lower North Russian Creek	0.24	0.21	0.22	0.21	0.17	0.15	0.16	0.15	0.47	0.41	0.41	0.41
Lower South Russian Creek	0.40	0.30	0.31	0.30	0.54	0.42	0.40	0.31	0.55	0.36	0.35	0.34
Matthews Creek	0.42	0.42	0.43	0.42	0.15	0.15	0.16	0.15	0.47	0.47	0.46	0.46
Robinson-Rattlesnake Creek	0.24	0.21	0.21	0.21	0.17	0.16	0.13	0.13	0.34	0.32	0.31	0.31
Shadow Creek	0.94	0.93	0.96	0.97	0.18	0.18	0.29	0.25	0.41	0.41	0.41	0.41
Sixmile Creek	0.52	0.52	0.52	0.52	0.12	0.12	0.12	0.13	0.36	0.36	0.36	0.36
Tanner-Jessups Creek	0.47	0.34	0.34	0.34	0.51	0.46	0.37	0.32	0.61	0.41	0.39	0.38
Taylor Creek	0.26	0.23	0.23	0.23	0.16	0.14	0.14	0.13	0.20	0.15	0.15	0.15
Timber-French Creek	0.24	0.24	0.24	0.24	0.14	0.14	0.12	0.10	0.31	0.31	0.31	0.30
Upper North Russian Creek	0.35	0.27	0.30	0.27	0.32	0.26	0.37	0.23	0.87	0.60	0.59	0.58
Whites Gulch	0.53	0.28	0.29	0.28	0.21	0.13	0.14	0.12	0.35	0.19	0.17	0.17

Table 3-41. CWE model results for Alternative B combined with the North Fork Roads Stormproofing Project (continued).

	USLE				ERA				GEO			
	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current/ Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021	Current (2008)	Current Plus Future Action (2009)	Current, Future, and Sequenced Proposed Action 2014	Current, Future, and Sequenced Proposed Action 2021
6th-field Watersheds												
Cecilville-Crawford Creek	0.37	0.37	0.35	0.34	0.20	0.20	0.20	0.15	0.36	0.36	0.35	0.33
Main East Fork South Fork Salmon River–	0.38	0.38	0.38	0.39	0.13	0.13	0.16	0.15	0.29	0.29	0.29	0.29
North Russian Creek	0.28	0.24	0.25	0.24	0.21	0.18	0.21	0.16	0.46	0.35	0.35	0.34
Plummer-Black Bear Creek	0.23	0.23	0.26	0.24	0.25	0.25	0.21	0.13	0.41	0.41	0.38	0.35
South Russian Creek	0.21	0.15	0.16	0.15	0.20	0.16	0.14	0.10	0.27	0.16	0.15	0.14
Whites-Jackass	0.55	0.39	0.39	0.39	0.26	0.21	0.19	0.18	0.49	0.35	0.34	0.33
5th-field Watersheds												
North Fork Salmon River	0.19	0.15	0.13	0.13	0.23	0.20	0.16	0.11	0.55	0.48	0.41	0.34
South Fork Salmon River	0.29	0.29	0.28	0.28	0.26	0.26	0.23	0.17	0.38	0.38	0.36	0.33

The following discussion of Alternative B includes multiple references to risk ratios produced by the Klamath National Forest's CWE model. Table 3-41 lists results of CWE analysis for watersheds in the analysis area under Alternatives B. The risk ratios reported under the column heading "2009" represent existing conditions plus foreseeable actions as listed in Section 3.1.4 above. The values reported for 2014 represent conditions at a point in time when all mechanical treatments (thinning units and FRZs) will be complete. The values reported for 2021 represent the point in time when all treatments have been implemented. A supplemental analysis of the effects of the 2008 and 2009 wildfires in the Salmon River subbasin was done by Klamath National Forest hydrologist Gregg Bousfield (Eddy Gulch CWE addendum, September 23, 2009), and the conclusion was that the fires did not occur in any 7th-field watersheds in the affected environment and that no CWE values were pushed over threshold. Therefore, there is no significant change in the Proposed Action's direct, indirect, or cumulative effects on water quality and aquatic resources as analyzed in the draft EIS: The wildfires did not cause any of the 7th- or 5th-field watersheds to significantly change model values, nor did these wildfires push model values over thresholds when combined with the Proposed Action.

Actions with Potential to Affect Sediment Indicators under Alternative B

Road construction. Seven segments (totaling 1.03 miles) would be constructed as new temporary roads. The longest new temporary road segment is 1,577 feet in length, and all temporary roads are on ridgetops or near-ridgetop locations. None are near Riparian Reserves, none require any stream crossing structures, none traverse unstable slopes, and none are proposed on granitic or similarly noncohesive soils. All of the temporary roads would be closed using normal erosion control measures (ripped and mulched, as needed).

Four segments (totaling 0.98 mile) of former logging access routes currently closed to vehicle use, would be re-opened under Alternative B. The longest of these is a 2,154-foot segment of old fireline for accessing M Units 8 and 43. The former logging access routes are on ridgetops or near-ridgetop locations and no cross streams or other Riparian Reserves. These routes would be water-barred and closed immediately after thinning is completed.

The temporary roads and former logging access routes are associated with thinning units (the M Units), and would be used primarily to provide yarder access to steeper ground that can only be thinned by cable yarding. These roads/routes, taken together, are distributed across three 7th-field watersheds as follows: Black Bear (0.25 mile), Crawford Creek (0.43 mile), and Shadow Creek (1.05 miles).

Construction of new temporary roads has the potential to increase sediment delivery to streams. A substantial body of literature suggests that roads can be significant producers of sediment and can alter hydrologic patterns on a hillslope (Trombulak and Frissell 2000). Road segments that present the greatest risk for sediment delivery have a number of common traits, including (1) alignments parallel to stream, (2) numerous stream crossings, (3) alignments that traverse unstable slopes, (4) constructed in noncohesive soils, and (5) steep side slopes creating large cut and fill slopes. None of the temporary roads proposed under Alternative B exhibit these characteristics.

The disturbance associated with temporary roads was incorporated into the input for the CWE model and is reflected in the resulting risk ratios that serve as the metrics for the sediment indicator.

Model results do not segregate road impacts from other disturbances. However, when taken together, all project-related disturbances associated with Alternative B fail to result in any 7th-field watershed producing risk ratios over threshold. This is best assessed by comparing "2009" risk ratios with those for "2014" when all roads would have been constructed, and the thinning units they access would have been harvested. Increases are, without exception, minimal—measurable mostly at the second decimal. Some risk ratios actually decline due to the North Fork Roads Stormproofing Project and natural recovery over time.

Skid trails, landings, and cable corridors associated with thinning units—Approximately 73 existing landings (wide spots in roads or forest openings) would be used to support treatments in M Units. All of these are associated with tractor units. Cable yarding would use the road prism for "hot decking" of logs such that no additional landings are proposed for cable units. (Basically, hot decking occurs when the running surface of the road is not wide enough for both the cable yarder and the logs. The logs have to be moved out of the way so another load can be brought to the road, where trucks haul them away—this eliminates the need for landing construction because the road prism itself serves as the landing.) Total clearing for landings over the entire Assessment Area is estimated to cover 18 acres (the landings are shown on Maps A-6a and A-6b in this final environmental impact statement [EIS] report). None of the landings are in Riparian Reserves or other sensitive lands. All landings will receive post-project erosion control as described in the Klamath LRMP.

Cable corridors would be located approximately 150 feet apart and oriented parallel to each other when possible. Several exceptions to the parallel alignment of corridors exist. Logs will have one-end suspension with the other end dragging on the slope. Heavy yarding volume in any one corridor can cause excessive soil disturbance. This is not expected to occur because harvest volumes per acre are generally light and because slash on the ground helps cushion and protect the soil from excessive disturbance. Resource protection measures (included in Alternative B) require erosion control measures in cable corridors where soil disturbance exceeds ground-cover retention guidelines.

Mastication of fuels—Mastication of understory fuels is proposed in Fuel Reduction Zones (FRZs) where slopes are less than 45 percent. This usually involves the ridgeline itself and a short distance downslope on either side. Masticators are small, low ground pressure, tracked machines that minimize soil disturbance and compaction compared to much larger equipment such as log skidders. Mastication produces abundant ground cover in the form of small fragments of woody vegetation processed by the equipment. Effects on soil erosion and sedimentation processes from mastication would be minimal and are significantly outweighed by the benefits of breaking up fuel continuity and creating ample ground cover in the process.

Prescribed underburning—Prescribed fire is proposed on several thousand acres in the LSR. The prescribed burns will target consumption of understory fuels while retaining adequate soil and canopy cover. Due to the uneven distribution of fuels and fuel moistures, exact adherence to cover guidelines cannot be guaranteed on every acre subject to treatment. Limited but unforeseen flare-ups in fuel accumulations are likely to occur in some areas. The greatest potential for sediment generation would be related to flare-ups within Riparian Reserves. Adverse effects would be associated with the generation and subsequent movement of sediment in the critically important near-stream zone. Within this zone, adequate soil cover helps maintain an effective filter to buffer streams from sediment generated from upper slope positions. Loss of cover reduces the filtering function and can expose soil to erosive forces. Sediment generated within the near-stream zone has a much higher chance of reaching the stream due to the shorter flow path. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (Aquatic Conservation Strategy [ACS], Riparian Reserve Standards and Guidelines, Best Management Practice (BMPs), and related RPMs).

Underburning will be consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year to prevent adverse effects to aquatic habitat and fish.

Water drafting—The only action that would occur in stream channels that would have the potential for direct effects on fish or their habitat is water drafting. Nineteen proposed water drafting sites have been identified. Nine sites are within (the following) fish-bearing streams: Lower North Russian Creek (3), Upper North Russian Creek, Robinson-Rattlesnake, Crawford Creek, Shadow Creek, Whites Gulch, and Cody-Jennings. Drafting sites have existing access but may be rocked to reduce surface erosion of dirt roads. Water drafting will be done according to the NMFS Water Drafting Specifications (NMFS 2001), which limits the amount and rate at which water can be withdrawn during pumping and requires pumps to be screened. By following these specifications and considering the instincts of fish to flee when a water truck approaches, potential effects of water drafting in fish-bearing reaches would be negligible.

Wildfire and suppression actions—The risk of stand-replacing wildfire and its associated increase in erosion and sedimentation would be reduced by project activities. Thinning and FRZ treatments on ridgetops, along with roadside fuel reductions, provide more and better options for wildfire control tactics.

Actions with Potential to Affect Flood Regime Change Indicator under Alternative B

Road construction—Roads contribute to the total amount of impervious ground surface. Too many miles of road, especially roads located in near-stream areas, can result in large increases in surface runoff which can lead to larger volumes of stormflow reaching stream channels in a shorter period of time. Where roads are more distant from channels, surface runoff generated from the road prism has much more opportunity to infiltrate at points along its flow path.

The ERA risk ratios in Table 3-41 above show no increases of concern. This includes the effect of proposed temporary roads as well as all other project activities.

Skid trails, landings, and cable corridors associated with thinning units—Under Alternative B, the use of existing landings and skid trails will be maximized. This renews disturbance on those sites but minimizes the creation of new impervious surfaces elsewhere. All skid trails and landings will receive full erosion control implementation upon project completion.

Cable corridors do not produce important amounts of impervious surface and thus present no risk relative to flood regime change.

Skid trails and landings are included in the CWE model input and reflected in its output. As previously stated, nothing in Alternative B would result in a significant increase in any risk ratio in any watershed.

Mastication of fuels—No impervious surfaces will be created as a result of mastication. This is because the masticator is a small, low-ground-pressure machine, and the process of mastication increases ground cover and reduces the formation of erosion pavements.

Prescribed underburning—No impervious surfaces will be created as a result of prescribed underburning. Some handline construction may occur but is unlikely to produce any measurable adverse effects.

Water drafting—Water drafting does not create new impervious surface and does not contribute to flood regime change. Existing access roads will be used.

Wildfire and its suppression—The reduced risk of wildfire would lower the potential to create impervious surfaces as a result of wildfire and suppression activities. The RS treatments along emergency access routes would provide greater opportunity for carrying out control strategies from existing roads, and fuelbreaks (the FRZs) would result in less need for fireline construction.

Actions with Potential to Affect Stream Temperature Indicator under Alternative B

Road construction—No roads are proposed in any Riparian Reserve. Proposed road construction or reconstruction would not affect stream temperature because no riparian or near-stream vegetation will be affected.

Skid trails, landings, and cable corridors associated with thinning units—No skid trails or landings are proposed in Riparian Reserves. No near-stream vegetation will be affected by skid trails or landings. Because of this, no impact on stream temperature would result from the use of skid trails and landings.

Some thinning units (M Units 15, 19, 21, 24, 40, 51, 61, and 76) have small portions of Riparian Reserves within or near their boundaries. In each instance, streamside management zones have been prescribed to ensure that canopy and ground cover guidelines are met. The small amount of area involved, along with Streamside Management Zone (SMZ) protections, ensures that no stream temperature impacts would result.

Mastication of fuels—No mastication is anticipated in Riparian Reserves. In the rare event that mastication does occur in a Riparian Reserve, operation will be limited in order to meet ground cover and canopy cover retention guidelines. Effects on near-stream vegetation will be non-existent to extremely limited.

Prescribed underburning—The greatest potential for adverse stream temperature effects would be related to flare-ups within Riparian Reserves. Flare-ups could remove canopy and create openings adjacent to streams. The magnitude of this potential effect is dependent on fuel continuity and fuel moisture within Riparian Reserves at the time of ignition. Burn prescriptions can and will exert control over this by specifying burn patterns, points of ignition, fuel moistures, and other factors that will limit it.

Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related RPMs). The magnitude of this effect is expected to be very similar between Alternatives B and C because only 99 acres less cable thinning and 822 acres less underburning would occur under Alternative C.

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001) which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year, to prevent adverse effects on aquatic habitat and fish.

Water drafting—Water drafting is unlikely to affect stream temperature because it does not result in modification of near-stream vegetation and NMFS (2001b) water drafting guidelines will be implemented to protect instream flows.

Wildfire and its suppression—The reduced risk of wildfire would lower the potential for stand-replacing fire in Riparian Reserves.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator under Alternative B

Road construction—No roads are proposed in any Riparian Reserve. Proposed road construction or reconstruction is unlikely to affect LWD recruitment because no riparian or near-stream vegetation will be affected.

Skid trails, landings, and cable corridors associated with thinning units—No skid trails or landings are located in Riparian Reserves, and no near-stream vegetation would be affected by skid trails or landings; because of this, there would be no adverse effects on LWD recruitment.

Some thinning units (M Units 15, 19, 21, 24, 40, 51, 61, and 76) have small portions of Riparian Reserves within or near their boundaries. In each instance, streamside management zones or Riparian Reserves have been prescribed to ensure that canopy and ground cover guidelines are met. There would be no effect on LWD or future LWD recruitment due to the small amount of acreage of Riparian Reserves near or within units, the fact that M Unit treatments will be outside of Riparian Reserves, the fact that Riparian Reserves are not on perennial streams, and because RPMs would be employed.

Mastication of fuels—No mastication is anticipated within Riparian Reserves. In the rare event that mastication does occur in a Riparian Reserve, operations will be limited to meet ground cover and canopy cover retention guidelines. Effects on near-stream vegetation will be non-existent to extremely limited.

Prescribed underburning—The greatest potential for adverse effects on LWD recruitment would be related to flare-ups within Riparian Reserves. Flare-ups could remove canopy and create pockets of standing dead trees adjacent to streams. Initially, there would likely be an increase in LWD as fire-killed trees decay and fall. This would be followed by a long period of no recruitment from these areas. The magnitude of this potential effect is dependent on fuel continuity and fuel moisture within Riparian Reserves at the time of ignition. Burn prescriptions can exert control over this by specifying burn patterns, points of ignition, fuel moistures, and other factors that will limit the level of effects. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related RPMs).

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year to prevent adverse effects to aquatic habitat and fish.

Water drafting—Water drafting will have no effect on LWD or LWD recruitment because there would be no modification of near-stream vegetation, and only existing access roads will be used.

Wildfire and its suppression—The reduced risk of wildfire would lower the potential for stand-replacing fire in Riparian Reserves and loss of LWD.

Hazard tree removal—Hazard trees may be removed along roads and could affect LWD in Riparian Reserves. However, the Klamath National Forest Hazard Tree Guidelines (USFS 2005) will be implemented, and trees felled within Riparian Reserves would be left on site; therefore, LWD levels in Riparian Reserves would not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator under Alternative B

Road construction—Alternative B proposes 1.03 miles of new temporary road construction and 0.98 mile of re-opening former logging access routes. All 2.01 miles of temporary roads/routes occur in three 7th-field watersheds: Black Bear (0.25 mile), Crawford Creek (0.43 mile), and Shadow Creek (1.05 miles). These are the only drainages in which road density would be affected. Shown below are the changes in road density that would result from implementation of Alternative B.

	Pre-project (mi/mi^2)	Post-project (mi/mi^2)
Black Bear Creek	2.67	2.69
Crawford Creek	3.09	3.12
Shadow Creek	2.73	2.85

Although all reported road densities in these drainages exceed the desired threshold of 2.0 mi/mi^2, the magnitude of the increase is very small. Closing these roads immediately after use will hasten vegetative regrowth such that these increases to the threshold will be recovered to pre-project levels within a decade. There will be no changes to road density in Riparian Reserves because no construction of temporary roads or re-opening of former logging access routes would occur in those areas.

Skid trails, landings, and cable corridors associated with thinning units—These actions would have no effect on road density.

Mastication of fuels—This action would not affect road density.

Prescribed underburning—This action would not affect road density.

Water drafting—This action would not affect road density because only existing access roads will be used.

Wildfire and its suppression—These actions would not affect road density.

Direct and Indirect Impacts on Fisheries Habitat under Alternative B (Beneficial Use "COLD")

Water drafting from streams has the potential to adversely affect fish by temporarily dewatering channels and entraining young fish into pump intakes—Existing water drafting sites will be used. The incorporation of NMFS (2001b) Water Drafting Specifications as RPMs will prevent these potential impacts. Erosion control and drainage will prevent sedimentation and turbidity increases.

Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams and degrade fish habitat—The proposed 1.03 miles of temporary road construction and re-opening of 0.98 mile of former logging access routes are minor in extent, totaling only 2.01 miles for the entire project. Their locations are well away from streams or unstable slopes. The extent of proposed road construction produced a minute increase in CWE risk ratios and road density values. Closure following thinning will hasten recovery of road sites through erosion control and vegetative regrowth. The adverse effects of road construction would be negligible to minor, and the duration of the negligible or minor effects would not exceed one decade.

Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams—Most mechanical units are on ridgetops or upper slope locations, with minimal overlap with seasonal (nonperennial) stream Riparian Reserves. Where those overlaps occur, SMZs and other RPMs (including quantitative ground cover requirements) are in place to ensure that near-stream areas do not become sediment sources and that their sediment filtering capacity is maintained. Tractor yarding is limited to slopes below 35 percent. All mechanical units have been designed with RPMs that conform to Klamath LRMP guidance in meeting the ACS and Riparian Reserve Standards and Guidelines, thus ensuring retention and, where needed, rapid re-establishment of soil cover.

CWE risk ratios (sediment indicators) indicate that mechanical treatments will not result in any "properly functioning" watershed degrading in status to "at risk" or worse. Potential adverse effects from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves—Potential effects are increased sediment delivery to streams, increased stream temperature, and altered rates and patterns of LWD recruitment. All such effects would be detrimental to fish habitat. Such events are expected to be few in number and limited in size by the fact that burn plans will incorporate retention of cover in conformance with Klamath LRMP guidance (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related resource protection measures). This potential effect is expected to be negligible. Should such effects occur, they would be short term because regrowth and adjacent unburned stands would contribute to the rapid re-establishment of soil cover. The magnitude of this effect is virtually identical between Alternatives B and C because the locations and amounts of underburn treatments are nearly identical.

Underburning will be implemented consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), which limits burn prescriptions and design within Riparian Reserves, and establishes a cap on the amount of acreage that can be burned in a given year, to prevent adverse effects on aquatic habitat and fish.

Cumulative Effects on Fisheries Habitat under Alternative B (Beneficial Use "COLD")

Cumulative effects on fish are those effects of the project combined with other effects in the subject watersheds, including past natural disturbances and anthropogenic-induced effects and effects from reasonably foreseeable future actions (the foreseeable future actions are listed in Section 3.1.4 above. These projects are expected to have either no effect (fiber optic project) or to result in net improvement (North Fork Roads Stormproofing Project and fuelbreak system west of Black Bear Ranch) to watershed conditions and aquatic resources. Private land activities in proximity to the LSR include mining, domestic use, and fuel reduction activities. The other activities (private land activities, recreation, mining, and watershed restoration) do not typically occur on the same land at the same time as the proposed actions. The physical and temporal separation between activities, low probability of sediment moving off site and into streams from proposed treatments, and the protective measures that will be implemented all serve to minimize the risk of adverse cumulative effects on water quality, anadromous fish, and their habitat. Cumulative effects, including the proposed treatments, are considered to be minor.

Cumulative effects are also discussed in the fish BA/BE for the Eddy Gulch LSR Project (this document is contained in the Eddy Gulch LSR Project Record). There are approximately 178 miles of streams in the Eddy Gulch LSR that provide habitat for steelhead and resident trout, and 7.8 miles of streams on private lands that provide habitat for steelhead and resident trout. The Eddy Gulch LSR includes 60,331 acres of Klamath National Forest lands and 2,323 acres of private lands. The reasonably foreseeable future actions on these private lands have the potential to increase sedimentation into these streams, possibly impacting habitat for these species. However, activities would occur under the State Forest Practice Rules, which include measures to protect riparian and stream habitat. Thus, effects on salmonids and their habitat would be less than significant.

The actions proposed in Alternative B are consistent with guidelines in the *Biological Assessment and Evaluation for Pre-Commercial Thin and Release Actions and Fuel Reduction Actions on the Klamath National Forest* (USFS 2001), and they also comply with Standards and Guidelines in the Klamath LRMP (USFS 1995). These guidelines include measures to protect aquatic habitat and place a cap on the amount of underburning that occurs in a given year within a given watershed. The proposed treatments are not expected to cause adverse effects on anadromous fish, resident fish, or their habitat. This is based on previous consultation with NMFS, on the ground monitoring of the types of actions proposed, and field reviews of proposed treatment units (refer to the BA/BE prepared for the proposed action).

There would be no risk to viability for the anadromous fish described in this document because the needs of species influenced by federal land management activities will continue to be met through compliance with Klamath LRMP Standards and Guidelines. Additionally, it is expected that compliance the Standards and Guidelines will provide an amount and distribution of habitat adequate to support the continued persistence of vertebrate and nonvertebrate species in the analysis area.

Direct and Indirect Effects on Municipal/Domestic Uses of Water under Alternative B (Beneficial Use "MUN")

Direct effects on municipal/domestic uses of water are unlikely. The processes that most likely fit the definition of "direct effects" include damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion. Under Alternative B, no activities are proposed near known points of diversion or use that could produce such direct effects. Indirect effects would most likely be associated with accelerated sediment delivery to streams. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. Indirect effects on municipal/domestic use are evaluated in the bulleted items that follow.

- Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams, resulting in damage to water delivery systems or rendering water unfit for consumption. As previously discussed, the minor extent of road construction and their location away from streams and unstable slopes makes this effect highly unlikely. Points of diversion are typically located near residences in the lower portion of watersheds, which creates the maximum possible distance between disturbances and points of domestic use. This creates abundant opportunities for runoff infiltration and sediment deposition where it will not affect this beneficial use.

- Additionally, CWE model risk ratios suggest no significant increase in sediment delivery potential from all project activities, including road construction. The potential adverse effect of road construction on municipal / domestic uses of water would be negligible to minor, and the duration of effects would not exceed one decade.

- Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Sediment indicators do not show significant increases for project activities, including mechanical treatments. The same rationale presented under Fish Habitat effects (discussed above) applies here (also refer to "Section 3.5.4.4 Summary of Effects to Special Status Species and Their Habitat"). Low disturbance treatments, such as thinning and mastication, ridgetop and upper slope location, minimal overlap with Riparian Reserves, full implementation of RPMs, and extremely small increases in CWE risk ratios all support the conclusion of minimal impact on municipal / domestic use from project-related accelerated sedimentation.

The proposed action complies with the Clean Water Act through implementation of BMP's, meeting water quality objectives (suspended sediment, turbidity, and temperature), and protecting beneficial uses (USDA Forest Service 2007a). These actions ensure compliance with the Clean Water Act and North Coast Regional Water Quality Board Basin Plan. Further, projects must comply with the California Regional Water Board's Categorical Waiver for Discharges Related to Timber Harvest Activities on Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No. R1-2004-0015 (Waiver). The Eddy Gulch LSR Project meets all conditions and eligibility requirements of the Categorical Waiver.

Potential adverse effects on municipal/domestic uses of water from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves—Such events are expected to be few in number and limited in size by the fact that burn plans will meet cover retention requirements in conformance with Klamath LRMP guidelines (ACS, Riparian Reserve Standards and Guidelines, BMPs, and related RPMs). This potential effect is expected to be negligible. Should such effects occur, they would be short term because regrowth and adjacent unburned stands would contribute to the rapid re-establishment of soil cover. The magnitude of this effect is virtually identical between Alternatives B and C because the locations and amounts of underburn treatments are nearly identical.

Cumulative Effects on Municipal / Domestic Uses of Water under Alternative B (Beneficial Use "MUN"). No evidence was found to indicate that existing sediment or turbidity levels cause impairment to municipal / domestic uses of water. Because the CWE model input includes information from past and foreseeable future projects, its output offers the best quantitative assessment of potential cumulative effects on municipal / domestic use in the form of accelerated sedimentation. Listed municipal watersheds include Eddy Gulch, Black Bear Creek, Shadow Creek, Callahan Gulch, Counts Gulch, Crawford Creek, and Music Creek. Of these, Eddy Gulch and Shadow Creek are the only drainages with CWE risk ratios that could be described as "at risk." Table 7 shows Eddy Gulch with a USLE risk ratio of 0.90, which represents existing condition plus effects of foreseeable future projects. This increases very slightly to 0.91 in 2014 when all road construction and mechanical treatments are complete. The same risk ratio for Shadow Creek is 0.93, increasing to 0.96 in 2014. These increases are extremely small and likely not significant. No other risk ratios for municipal watersheds are in the "at risk" or higher range.

Cumulative adverse effects from project activities, when superimposed on past and foreseeable future actions, are expected to be negligible to minor. Full recovery to pre-project conditions, as judged from CWE risk ratios, is likely upon project completion in 2021.

3.5.4.3 Alternative C: No New Temporary Roads Constructed

As mentioned in the discussion of Alternative B, the differences between the two action alternatives are very small. The 1.03 miles of new temporary roads would not be constructed under Alternative C, and as a result, 99 acres in M Units and 822 acres in Rx Units would not be treated. This reduction in thinning acres would affect M Units 15, 17, 21, 24, 36, 37, and 75. The magnitude of differences between the two action alternatives relative to potential effects on fish and their habitat are very small because mechanical units and the proposed temporary roads would be located on or near ridgetops and not in Riparian Reserves.

Because the differences between the action alternatives are so small, most of the discussions of potential effects presented under Alternative B are applicable to Alternative C. Rather than repeat those sections, the discussion that follows only focuses on the differences in effects on aquatic resources.

The design features applicable to both action alternatives include BMPs, WWOS, forestwide soil cover standards, as well as Klamath LRMP Standards and Guidelines. Application of these measures would minimize the effects of proposed treatments equally under both alternatives.

Actions with Potential to Affect Sediment Indicators under Alternative C

Road construction—There would be no construction of the 1.03 miles of new temporary roads, but the former logging access routes (0.98 mile) would still be re-opened (vegetation removed and bladed) to access all or portions of five M Units for yarder access and skidding of logs. Other than this change, this discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units—All of the 99 acres of thinning that are eliminated under Alternative C were proposed for cable yarding because of slope steepness. This will produce a slight decrease in the potential for soil disturbance. The landings (and associated skid trails) proposed for tractor yarding in the thinning units will remain part of Alternative C. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels—See discussion under Alternative B (no change).

Prescribed underburning—Approximately 822 acres in Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Water drafting—See discussion under Alternative B (no change).

Wildfire and its suppression—Not thinning the 99 acres within ridgetop FRZs and not treating 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated increase in erosion and sedimentation. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Flood Regime Change Indicator under Alternative C

Road construction—The slight reduction in road construction is too small to have any measurable effect on the potential for flood regime change. No effect is expected from Alternative B, so none would be expected from Alternative C. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units—No adverse effect on flood regime change is expected from Alternative B so none would be expected from Alternative C in which overall soil disturbance is slightly less. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels—See discussion under Alternative B (no change).

Prescribed underburning—Since underburning does not create impervious surface, the 99 acre increase is unlikely to produce an adverse effect. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Water drafting—See discussion under Alternative B (no change).

Wildfire and its suppression—Not thinning on 99 acres within ridgetop FRZs and not treating 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to increase the amount of impervious surface. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Stream Temperature Indicator under Alternative C

Road construction—See discussion under Alternative B (no change).

Skid trails, landings, and cable corridors associated with thinning units—Under Alternative B, eight thinning units required SMZs because of overlap or adjacency with seasonal stream (nonperennial streams) Riparian Reserves. Three of those units (M15, M21, and M24—all in Shadow Creek) would have thinning acres reduced from 144 to 62 acres, with a minimal difference in effects. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels—See discussion under Alternative B (no change).

Prescribed underburning—See discussion under “Skid trails, landings, and cable corridors associated with thinning units.”

Water drafting—See discussion under Alternative B (no change).

Wildfire and its suppression—Not thinning on 99 acres within ridgetop FRZs may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to consume portions of Riparian Reserves. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Actions with Potential to Affect Large Woody Debris Recruitment Indicator under Alternative C

Road construction—See discussion under Alternative B (no change).

Skid trails, landings, and cable corridors associated with thinning units—Under Alternative B, eight thinning units required SMZs because of overlap or adjacency with seasonal stream (nonperennial streams) Riparian Reserves. Three of those units (M15, M21, and M24—all in

Shadow Creek) would have thinning acres reduced from 144 to 62 acres, with a minimal difference in effects. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Mastication of fuels—See discussion under Alternative B (no change).

Prescribed underburning—See discussion under "Skid trails, landings, and cable corridors associated with thinning units."

Water drafting—See discussion under Alternative B (no change).

Wildfire and its suppression—Not thinning on 99 acres within ridgetop FRZs and the reduction of 822 acres in Rx Units may slightly reduce the effectiveness of treatments relative to the risk of stand-replacing wildfire and its associated potential to consume portions of Riparian Reserves. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Hazard tree removal—The removal of hazard trees along roads could potentially affect LWD in Riparian Reserves under both action alternatives. However, the Klamath National Forest Hazard Tree Guidelines will be implemented and trees felled within Riparian Reserves would be left on site, so the LWD levels in Riparian Reserves would not be affected by hazard tree removal.

Actions with Potential to Affect the Road Density Indicator under Alternative C

Road construction—The discussion under Alternative B highlighted the extremely small increases in road density associated with 1.03 miles of new temporary road construction. The deletion of 1.03 miles of proposed temporary road segments under Alternative C results in pre-project road density, as shown below.

	Pre-project (mi/mi^2)	Alternative B Post-project (mi/mi^2)	Alternative C Post-project (mi/mi^2)
Black Bear Creek	2.67	2.69	2.67
Crawford Creek	3.09	3.12	3.09
Shadow Creek	2.73	2.85	2.73

The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

Skid trails, landings, and cable corridors associated with thinning units—These actions would not affect road density.

Mastication of fuels—This action would not affect road density.

Prescribed underburning—This action would not affect road density.

Water drafting—This action would not affect road density. Existing access roads would be used.

Wildfire and its suppression—These actions would not affect road density.

Direct and Indirect Effects on Fisheries Habitat under Alternative C (Beneficial Use "COLD")

Water drafting from streams has the potential to adversely affect fish by temporarily dewatering channels and entraining young fish into pump intakes—Existing water drafting sites will be used. The incorporation of NMFS (2001b) Water Drafting Specifications as RPMs will prevent these impacts. Erosion control and drainage will prevent sedimentation and turbidity increases. This impact assessment is identical between Alternatives B and C.

Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams and degrade fish habitat—Under Alternative B, this potential for this impact was evaluated as negligible to minor. Because Alternative C eliminates 1.03 miles of new temporary road construction, but retains use of the 0.98 mile of former logging access routes, the impact would be slightly less under Alternative C and still negligible to minor. The duration of effects would not exceed one decade.

Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams—Alternative C contains 99 fewer acres of thinning, thus slightly reducing the magnitude of this impact. However, the magnitude of adverse effects under Alternative B was determined to be negligible, thus the reduction would be discountable. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C. Handlines that will be constructed around prescribed burn areas will be mitigated (water-barred and covered with organic material) immediately following prescribed burning, when safe to do so, to restore soil cover and minimize the potential for erosion.

The potential adverse effect under Alternative B was judged to be negligible to minor, and with even fewer acres receiving mechanical treatment under Alternative C, potential effects on fish habitat from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves—Approximately 822 acres of Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C. The duration of effects is expected to be 5–10 years due to rapid re-establishment of ground cover from adjacent stands.

Cumulative Effects on Fisheries Habitat under Alternative C (Beneficial use "COLD")

See discussion under Alternative B because it is equally applicable to Alternative C. The differences in cumulative effects on fish between the action alternatives are discountable. Based on the same rationale presented for Alternative B, cumulative effects, including the proposed treatments, are considered to be minor.

Direct and Indirect Effects on Municipal / Domestic Uses of Water under Alternative C (Beneficial Use "MUN")

Direct effects on municipal/domestic uses of water are unlikely. Damage to impoundments or delivery infrastructure or introduction of pollutants at points of diversion are the most likely processes fitting the definition of "direct effect." Under Alternative C, no activities are proposed near known points of diversion or use that could produce such direct effects. Indirect effects would most likely be associated with accelerated sediment delivery to streams. Accelerated erosion and sedimentation can result in sediment deposition that damages diversion structures or renders them inoperative. High turbidity in water indicates the presence of particulates that can serve as substrates (and nutrients) for harmful microorganisms. Indirect effects on municipal/domestic use are evaluated in the bulleted items that follow:

- Construction of new temporary roads and re-opening of former logging access routes have the potential to increase sedimentation in streams resulting in damage to water delivery systems or rendering water unfit for consumption. Alternative C does not propose construction of the 1.03 miles of temporary roads, but the 0.98 mile of former logging access routes would still be re-opened. Based on the same rationale presented for Alternative B, it is concluded that the potential adverse effects on municipal use from road-generated sediment would be negligible to minor. The duration of effects would not exceed one decade.

- Mechanical treatments, mastication, and use of skid trails and landings could potentially increase the amount of soil disturbance, erosion, and sediment delivery to streams. Alternative C contains 99 fewer acres of thinning, thus slightly reducing the magnitude of this impact. The rest of the discussion under this heading for Alternative B is equally applicable to Alternative C.

This potential adverse effect that would result from implementation of Alternative C was judged to be negligible to minor. With even fewer acres receiving mechanical treatment under Alternative C, it is concluded that potential adverse effects on municipal/domestic use from these treatments would be negligible to minor, with full recovery to pre-project conditions within a decade.

The prescribed underburning could potentially result in localized loss of soil and canopy cover, which would be of special concern in Riparian Reserves—Approximately 822 acres of Rx Units have been eliminated from Alternative C. This change, when taking into consideration the overall amount of proposed underburning, would result in a negligible difference between the effects of Alternatives B and C, as is the conclusion that the magnitude of effects would be negligible to minor; therefore, the rest of the discussion under this heading for Alternative B is equally applicable to Alternative C. The duration of effects is expected to be 5–10 years due to rapid re-establishment of ground cover from adjacent stands.

Cumulative Effects on Municipal/Domestic Uses of Water under Alternative C (Beneficial Use "MUN")

See discussion under Alternative B as it is equally applicable to Alternative C. The differences in cumulative effects to municipal/domestic uses between the action alternatives are discountable. Based on the same rationale presented for Alternative B, cumulative effects including the proposed actions are considered to be minor.

3.5.4.4 Summary of Effects on Special-Status Fish Species and Their Habitat

The BA/BE (Berg 2009) prepared for the Eddy Gulch LSR Project Proposed Action contains a detailed analysis of effects on the following ESA-listed species, critical habitat, Essential Fish Habitat, and Sensitive Species:

Endangered:	None
Threatened:	Southern Oregon / Northern California Coast (SONCC) Evolutionary Significant Unit coho salmon (*Oncorhynchus kisutch*) and their designated critical habitat
Proposed:	None
Sensitive:	Upper Klamath-Trinity Rivers Chinook salmon (*O. tshawytscha*) Klamath Mountains Province steelhead trout (*O. mykiss*)
Essential Fish Habitat:	Coho salmon and Chinook salmon (specifically SONCC coho salmon and Upper Klamath-Trinity Chinook salmon for this project)

ESA-listed Fish Species

The fish BA/BE for this project (Berg 2009) determined that, in summary, all the actions, when considered collectively and individually, would have either no effect (as described in the efficiency measures section of the BA/BE) or are not likely to adversely affect coho salmon and their critical habitat. The project has indirect beneficial effects that would result in increased protection from wildfire. The one activity that was determined “May Affect, Not Likely to Adversely Affect” is water drafting. Thus, the final ESA determination for the Eddy Gulch LSR Project’s insignificantly negative effects of water drafting on peak/base flows and coho salmon that may be in the vicinity of water drafting sites was “May Affect, but is Not Likely to Adversely Affect” SONCC coho salmon. The BA/BE also determined that the Eddy Gulch LSR Project “May Affect, but is Not Likely to Adversely Affect” SONCC coho salmon critical habitat.

Forest Service Sensitive Fish Species

The BA/BE (ibid.) determined that the Eddy Gulch LSR Project would likely not result in a trend towards listing or loss of viability of steelhead or Chinook salmon and may have beneficial effects on watershed conditions that support these species.

A trend toward listing under the ESA is not anticipated and viability is not at risk because the Eddy Gulch LSR Project meets Klamath LRMP Standards and Guidelines, does not adversely modify its habitat in the long term, and individual Chinook salmon and steelhead trout are not expected to be adversely impacted by project activities, and there are beneficial effects on habitat in the long term, as analyzed in the fish BA/BE. Biodiversity of aquatic species is maintained through the use of Standards and Guidelines in the Klamath LRMP, including development of resource protection measures, compliance with the ACS objectives, use of Riparian Reserve buffers, and evaluation at the 5th-field watershed scale. Effects on 7th-field watersheds were also considered.

Essential Fish Habitat Assessment

The BA/BE (ibid.) used the Klamath National Forest fish distribution GIS map, as well as other surveys and field observations to analyze effects on salmonid habitat and to identify Essential Fish Habitat for Chinook and coho salmon within the Eddy Gulch LSR. The Klamath National Forest fish distribution map includes all streams that are used by steelhead, coho salmon, and Chinook salmon. The Klamath National Forest and fish BA/BE analysis for the Eddy Gulch LSR Project used the fish distribution map to identify critical habitat for SONCC coho salmon and Chinook and coho salmon Essential Fish Habitat since it is the most complete and conservative information relative to estimating the extent of anadromous habitat. However, because coho salmon and Chinook salmon do not typically migrate or rear as high up in stream systems as steelhead, the fish distribution map used for this analysis overestimates the extent of SONCC coho salmon critical habitat and Chinook and coho salmon Essential Fish Habitat because it is based on steelhead and resident trout distribution. Thus, steelhead may occupy some reaches not accessible to coho and Chinook salmon. However, effects were considered for all anadromous species, and habitat for all anadromous species was assumed to occur where steelhead and rainbow trout occur. The effects analysis in the fish BA/BE (ibid.) considers effects on Pacific salmonid habitat in general, and since habitat requirements and effects mechanisms for coho and Chinook salmon are similar, the effects of the project analyzed previously are identical for Essential Fish Habitat. The BA/BE (ibid.) determined that the Eddy Gulch LSR Project will not adversely affect, and may have long-term positive effects on coho salmon and Chinook salmon Essential Fish Habitat. Beneficial effects would include increased watershed resiliency to future wildfires and promotion of late-successional vegetation, which would increase large woody debris in forests and streams.

Management Indicator Species

The MIS Report determined that the no-action alternative would not result in direct effects on resident trout or steelhead or their habitat. Watershed and aquatic habitat conditions will continue to respond to climatic and other environmental changes and will continue to recover from past flood and fire events until reset by a future natural event such as wildfire. The no-action alternative would not directly affect stream shade, water temperature, sedimentation rates, or large woody debris.

The MIS Report determined that the proposed actions, when considered collectively and individually, would either have no effect or negligible effects (as described in the efficiency measures section of the project fish BA/BE). Water drafting is the one Project Element that could directly affect steelhead and rainbow trout and their habitat. However, potential adverse effects of water drafting will be minimized through implementation of NMFS (2001) Water Drafting Guidelines that maintain instream flows and require screening of pumps. The project will have indirect beneficial effects that would result in increased protection from wildfire.

3.6 Soils and Geology

3.6.1 Introduction

The role of the soil scientist for the Eddy Gulch Late-Successional Reserve (LSR) Project is to ensure that the methods used to achieve project objectives would maintain the productive capacity of the soil resource, as defined in the Klamath National Forest Land and Resource Management Plan (Klamath LRMP) and regional Soil Quality Analysis Standards (SQAS). Maintaining the long-term soil productivity in the Assessment Area will be accomplished through project design features and the Resource Protection Measures (RPMs) that ensure the project will meet the Klamath LRMP's soil resource Standards and Guidelines (USFS 1995a) and the regional SQAS (USFS 1995b).

The role of the geologist is to evaluate potential risks to geologic resources from project activities and to recommend RPMs to eliminate or minimize those risks. Of special interest are Riparian Reserve lands, particularly those that might pose elevated landslide risk. It is of the utmost importance that project activities do not significantly increase landslide-related sediment. By meeting this requirement, project implementation will fully protect all Riparian Reserves and prevent impairment of beneficial uses of water in streams and other water bodies.

3.6.2 Methodology: Soils

A unit selection strategy was used to determine which units should have site-specific data collected. Selection was based on soil sensitivity and type of management activities planned. Units that had the potential to be treated with ground-based yarding systems were a priority for field review. All proposed ground-based yarding units, 50 percent of the cable units, and most of those units proposed for mastication or roadside hazard tree removal were field reviewed. Field observations were done by making one to three traverses across each treatment unit, depending on the unit's shape and size. Site and soil data were collected from plots along these traverses. The following types of existing site disturbances were identified in the field during the traverses: landings, skid trails, full-bench skid trails, skid trail displacement, old roads, and skid roads. The level of detrimental soil disturbance was estimated for each soil disturbance type. This data was used to develop the existing condition, as well as the cumulative effects of the Proposed Action. Soil data noted during the field assessment included shallow soil areas, rock outcrops, and areas of surface rock, rock lithology, general soil depth, and taxonomic features. Existing soil survey information was used unless field observations revealed significant differences between mapped soils and the actual site-specific soils.

Also included with each transect or ocular estimate was a general discussion of the treatment unit that addressed issues such as potential mass instability areas, sensitive riparian locations, or the feasibility of the treatment method proposed. These observations helped develop specific management recommendations for the assessed treatment unit.

3.6.2.1 Analysis Methods and Assumptions

Numerous data sources were provided by Klamath National Forest staff and incorporated into this analysis; some of the more relevant information specific to the soil resource included the following:

- Klamath National Forest Area Soil Survey (Foster and Lang 1994),

- Soil profile descriptions developed during the active soil survey located within the Assessment Area,
- Klamath LRMP Standards and Guidelines pertaining to the soil resource, and
- Estimates of basic erosion rates based on the Universal Soil Loss Equation (USLE) (Laurent 2001).

Computer-based Geographical Information Systems (GIS) technology was used to organize and synthesize digital data provided by both the Klamath National Forest and the contractor's GIS specialist. By incorporating numerous digital databases (such as soils, geology, slope and aspect, existing land instability, the preliminary treatment units, and 1-meter resolution digital aerial imagery), the existing condition began to emerge. Although not a substitute for field-level assessments, this approach provided baseline information that defined the level and extent of analysis necessary to define the environmental consequences of the Proposed Action.

Once generated, digital background images of the Assessment Area were incorporated into a Global Positioning System field data logger prior to field work. This technology was especially vital in the location of treatment units, roads and skid trails, and other areas of concern such as unstable landforms and riparian complexes.

3.6.2.2 Scope of the Analysis

Analysis Area. The soil resource analysis area is very site specific. Unlike a broader watershed approach, individual treatment units were evaluated and the data correlated. At the time of field data collection (June and July of 2008), the soil resource analysis area was approximately 30,000 acres. Appendix A of the Soil Resource Report graphically portrays this analysis area.

Analysis Period. The timeframe for the effects analysis is less than 10 years for short-term effects and up to 75 or more years for long-term effects on soil productivity.

3.6.2.3 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout this effects analysis are described below.

Negligible. Soils would not be affected, or the effects on soils would be below or at levels of detection. There would be no discernable effect on the rate of soil erosion and/or the ability of the soil to support native vegetation.

Minor. The effects on soils would be detectable, but effects on soil productivity or fertility would be small. There would be localized, detectable effects on the rate of soil erosion and/or the ability of the soil to support native vegetation.

Moderate. The effect on soil productivity or fertility would be highly variable due to differences in soil type, topography, and site-specific treatments. The rate of soil erosion and/or the ability of the soil to support native vegetation would be measurably changed, especially within the main skid trail corridors and landings. Detrimental disturbance in the form of soil compaction (greater than 10 percent decrease in soil porosity) and displacement (greater than 15 percent loss of soil organic matter in upper 12 inches of soil) are approaching threshold values.

Major. The effect on soil productivity or fertility would be highly variable due to differences in soil type, topography, and site-specific treatments, but readily apparent and would substantially change the character of the soils over a large area within the treatment unit. The actions would have substantial, highly noticeable influence on the rate of soil erosion and/or the ability of the soil to support native vegetation. The impacts would be most noticeable within main skid trails, landings and cable corridors. Detrimental disturbance in the form of soil compaction (greater than 10 percent decrease in soil porosity) and displacement (greater than 15 percent loss of soil organic matter in upper 12 inches of soil) would exceed threshold values, and most likely require on-site mitigation.

3.6.3 Methodology: Geology

The geologic assessment followed guidance for project-level investigations given in Methods for Mapping Unstable Lands. This is an internal guidance document prepared by Klamath National Forest geologists.

3.6.3.1 Analysis Methods and Assumptions

The primary steps for this geologic analysis involved

1. reviewing existing data, including the Geo13 map layer that exists on the Klamath National Forest's GIS;

2. reviewing the geology sections in the three watershed analyses (USFS 1994b; USFS 1995b; USFS 1997) that cover the Assessment Area;

3. reviewing published geologic maps to understand the distribution of rock types;

4. examining air photo coverage for potential landslides or unstable features not already mapped; and

5. conducting field reviews of proposed treatment units with the purpose of identifying site features that might indicate instability.

The site features include hummocky or broken slope topography (scarp-bench-toe sequences), mid-slope or near-channel deposits of colluvium, area-wide patterns of springs and seeps, jack-strawed trees, and currently active scarps or ground fracture. Debris slide and debris torrent events will often be marked by drainages scoured to widths far greater than the active channel, with clear and abrupt changes in type or age class of vegetation. Field assessment also requires an understanding of the structural properties of various rock types and their relative potentials for producing unstable slopes.

Where confirmed or suspected unstable slopes were encountered but not already mapped on Geo13, their locations were noted, the feature was reviewed on air photos, and its estimated boundaries drawn on a field map.

Information on bedrock and geomorphic features is taken from the Klamath National Forest GIS coverages. Landslide sediment model coefficients were taken from studies in the Salmon River watershed (USFS 1994b).

This investigation focused on slope stability issues related to project activities. The geologic assessment involved the geologist spending 20 days conducting field reviews and 15 office days. With only a few exceptions, the project geologist, hydrologist, and soil scientist conducted field reviews and evaluated all proposed thinning units, new temporary road locations, former logging access routes, and existing landings. Findings from the field reviews are documented in the project geology notes and unit descriptions (contained in the project record) and in Section 3.5 or the Aquatic Resources Report. The unit descriptions include recommendations for changes to Riparian Reserve boundaries and any slope instability features that were not previously mapped. The Klamath National Forest geomorphology and bedrock layers were updated as part of this project.

The geologic evaluation included modeling of wildfire effects on geologic resources under the no-action alternative. The Klamath National Forest's cumulative watershed effects (CWE) model was used to evaluate the effect of modeled wildfires on the potential for landslide-related sediment production.

3.6.3.2 Scope of the Analysis

Analysis Area. The analysis area was defined by the project's Assessment Area boundary, although areas outside the boundary were examined on air photos to better understand patterns in the occurrence of unstable slopes in the area. Field review was confined to the immediate vicinity of project treatment units.

Analysis Period. The timeframe for the effects analysis is 0–3 years for short-term effects and up to 10 years for long-term effects on geology.

3.6.3.3 Intensity of Effects

Negligible. Slope stability and landslide risk would not be affected. There would be no discernable effect on landslide-related sediment or other effects on beneficial uses of water or other aquatic resources.

Minor. There could be a very small and short-term increase in landslide risk. The duration of increased risk is so short that triggering climatic or seismic events would have a very low probability of occurrence. There would be low probability of landslide-related sediment delivery to streams or other effects on beneficial uses of water.

Moderate. Increased landslide risk is more extensive across the Assessment Area. The duration of effects lengthens, allowing a high probability of triggering climatic or seismic events. Project-related landslide sediment would be detectable at the 7th-field watershed scale but not at 6th-field or larger scales. Effects on beneficial uses or other aquatic resources would be localized and short duration.

Major. Significantly increased landslide risk is common throughout the Assessment Area. Landslide-related sediment would be a significant concern at the 5th-field watershed scale.

3.6.4 Affected Environment (Existing Conditions): Soils

Soils in the Eddy Gulch LSR Project Assessment Area were dominantly developed from metasedimentary or metaschist parent materials, with inclusions of serpentinized peridotite (ultramafics) and metavolcanics. The Assessment Area is characterized by gently to very steeply sloping topography, including stabilized landslide benches and scarps. The major soils formed from the metasedimentary materials ranged from the shallow Woodseye family to the moderately deep Jayar and deep Clallam families. Of lesser extent are the Inville and Wintoner families that developed in the metavolcanics, and the Lithic Mollic Haploxeralfs-Dubakella families' complex that developed from the ultramafics. Soil textures in the Assessment Area were dominated by gravelly to very gravelly loams, sandy loams, or sandy clay loams.

Calculated from approximately 1,200 data plots (which are detailed in Table B-1, Appendix B of the Soils Resource Report), 28.7 percent of the Assessment Area has been disturbed from past activities, excluding system roads. Approximately 2.6 percent of this disturbance exceeds the Forest's soil quality thresholds for detrimental disturbance. The majority of the disturbance was in main or constructed skid trails and landings. Percent soil cover range was 10–100 percent (Klamath LRMP Standards and Guidelines for effective soil cover ranges between 70 and 80 percent), with an overall average of 72 percent in the proposed treatment units. There was a variation in soil cover between transects sampled, but when averaged with other transects, the forest standard was met in most cases. The following M Units averaged well below the 70 percent ground cover minimum: 19 (cable), 21 (cable and tractor), 24 (cable), 35, and 36. Slope range was 2–80 percent, with an average percent slope of 42 percent. Using calculated soil erosion rates for average soil cover and slope developed for the Klamath National Forest (Laurent 2001), the estimated soil erosion rates ranged 0.4–0.8 ton per acre per year. Based on the small percentage of sheet and rill erosion observed during the field assessment, the actual range would be closer to 0.15–0.25 tons per acre per year.

The current detrimental disturbance threshold (in existing landings, skid trails, and new temporary roads) is 15 percent. If skid trails and landings occupy greater than 15 percent of a unit, then the unit exceeds the detrimental disturbance threshold. Presently, M Unit 21 and M Unit 24 (both tractor units) exceed the detrimental disturbance standards.

In virtually all of the treatment units assessed, coarse woody material was lacking spatially and in the range of decomposition classes.

3.6.5 Environmental Consequences: Soils

This section describes the anticipated effects on the environmental indicators. There are three measures (or indicators) that were used to assess current soil conditions in the Assessment Area. The same indicators were used to assess effects of taking no action and effects that could result from implementation of either Alternative B or Alternative C.

- Soil cover,
- Detrimental disturbance (detrimental compaction and detrimental soil displacement), and
- Organic matter (includes fine organic matter and CWD).

3.6.5.1 Alternative A: No Action

Soil Cover

Direct and Indirect Effects—A wildfire would result in loss of soil cover, which would adversely affect soil productivity and water quality. The continued accumulation of organic matter on the forest floor would contribute to increased ground fuel loads. No mechanical treatment or prescribed fire would occur, leading to increased fire severity and intensity during a fire event. Fire simulation models predict that under 90th percentile weather conditions, approximately 7,200 acres could potentially be affected by various burn intensities. As a result of decreased soil cover following a fire, the risk of soil erosion would increase on forested hill slopes. Soil erosion would contribute to a loss of soil nutrients and favorable growth medium on site and increased sediment delivery to stream channels.

Conclusion—There would be a higher risk of wildfire occurrence because no treatments would be implemented to reduce fuel loading. A wildfire would create short-term adverse effects on soil productivity and water quality due to the immediate loss of soil cover, causing a measurable increase in surface erosion and delivered sediment.

Cumulative Effects—A loss of soil cover would adversely affect long-term soil productivity. Soil cover can be expected to increase as organic materials accumulate on the soil surface. However, a future high-severity wildfire would likely consume organic materials on the forest floor and reduce soil cover below the Klamath LRMP Standard in the affected area. If soil cover is reduced to bare soil following a wildfire, the soil would be more susceptible to erosion. In addition, fire can volatilize organic compounds in the soil, some of which migrate down a temperature gradient and condense on soil particles below the surface. As a result, a non-wettable layer can develop below the surface. Creation of a water repellant layer has been described as a "tin roof" effect because infiltration rates are greatly reduced at the water repellant layer. During a precipitation event, soil above the non-wettable layer can become saturated and erode downslope due to rill formation and raindrop splash. Factors such as soil texture, slope, and post-burn precipitation intensity can affect the degree and type of post-fire erosion. Dry, coarse-grained soils are particularly susceptible to this type of fire-induced hydrophobic condition (not absorbing or mixing easily with water) (USFS 2005).

Conclusion. There would be a higher risk of wildland fire occurrence because no treatments would be implemented to reduce fuel loading. Taking no action would lead to long-term adverse effects on soil productivity in the uncontrolled fire-affected areas. Recovery from measurable surface erosion and subsequent delivered sediment would take approximately 5–6 years (USFS 1981). Full recovery of the organic fraction of ground cover would take decades.

Detrimental Disturbance (Detrimental Compaction and Detrimental Soil Displacement)

Direct and Indirect Effects—The extent and degree of detrimental disturbance (especially detrimental compaction) are expected to decline slowly over time. This process may take several decades in forested environments (USFS 2002). Root penetration, extension, and decay, along with the burrowing action of soil-dwelling animals, would contribute to the increase in soil porosity and decrease in compaction. In addition, incorporation of organic matter into the soil by biological processes (such as invertebrate and vertebrate soil mixing and decomposition) would help reduce soil bulk density and the degree of compaction in affected areas over time. As the degree and extent of soil compaction is reduced slowly, soil productivity would increase. Soil infiltration would be enhanced as porosity is increased. Increased infiltration may reduce surface runoff and subsequent erosion and sedimentation.

Conclusion. There would be a higher risk of wildland fire occurrence because no treatments would be implemented to reduce fuel loading. The effects of soil compaction would remain short term, localized, and negligible, mostly related to minor activities outside those areas identified under the existing condition. In the event of a future wildfire of moderate severity (up to 40 percent of an area where surface litter and humus have been consumed and surface soil horizons subjected to intensive heating), severe soil heating would cause physical changes in soils, including a reduction in soil porosity, mirroring the effects of soil compaction (Debano et al. 2005). This affect would occur primarily in locations where 1,000-hour fuels exceed 5–10 tons per acre (the current condition for the Eddy Gulch LSR Project Assessment Area is 5–30 tons per acre). This would lead to short-term adverse effects on soil productivity and water quality due to the immediate loss of infiltration capacity, causing a measurable increase in surface erosion and delivered sediment.

Cumulative Effects—The extent and degree of detrimental disturbance are expected to continue to decline in the absence of future timber harvests, road construction, or other ground disturbing activities.

Conclusion. Recovery from detrimental disturbance, especially soil compaction would continue in areas previously affected, with short-term localized negligible compaction occurring due to activities such as roadside hazard tree removal. There would be a higher risk of wildfire occurrence because no treatments would be implemented to reduce fuel loading, leading to long-term adverse effects on soil productivity and water quality due to the loss of infiltration capacity and causing a measurable increase in surface erosion and delivered sediment. Recovery from measurable surface erosion and subsequent delivered sediment would take approximately 5–6 years (USFS 1981).

Organic Matter (Fine Organic Matter and CWD)

Direct and Indirect Effects—A wildfire would result in loss of organic matter, which would adversely affect soil productivity and water quality. Surface organic matter, including fine organic matter and coarse woody debris (CWD), can be expected to increase as organic materials accumulate on the soil surface.

Conclusion—The continued accumulation of organic matter on the forest floor would contribute to increased ground fuel loads, leading to increased fire severity and intensity during a fire event. Based on fire return intervals stated earlier, the loss of surface organic matter and CWD would have short-term adverse effects on both soil productivity and water quality because organic matter and CWD are essential elements for both soil fertility and ground cover.

Cumulative Effects—A loss of organic matter would adversely affect long-term soil productivity. Surface organic matter can be expected to increase as organic materials accumulate on the soil surface. Referring to the earlier discussion of direct and indirect effects for detrimental disturbance, areas within a wildfire that are subjected to moderate fire intensity would have at least 40 percent of the affected area where all surface litter and humus would be consumed and would likely fall below the 50 percent desired condition for fine organic matter (USFS 1981). Under the moderate intensity scenario, it can be expected that some passive crown fire would also occur, leaving pockets of scorched trees and shrubs. Within several months, a thin layer of needle cast and leaf fall from scorched trees would begin to increase the percent of organic matter in the affected areas (Pannkuk and Robichaud 2003). Fires short-circuit the decomposition pathway, rapidly oxidizing organic matter and releasing available nutrients to plants and soil organisms. When organic matter burns, essential nutrients can be transferred to the atmosphere through volatilization and ash convection (Raison et al. 1985).

Nutrients may also be lost following fire due to leaching (Miller et al. 2006). Some nutrients are returned relatively quickly by terrestrial cycling pathways. Compared to the pre-burn condition, a large reduction in the organic matter covering the soil would reduce the insulating effect this layer has on soil temperature. Under a reduced organic layer, soils experience greater temperature extremes. Soil temperatures may be elevated for months or years, depending on the degree of organic matter consumed by a wildfire (Debano et al. 2005). Such changes in the soil temperature regime would affect rates of biological activity in the soil, resulting in altered nutrient cycling regimes.

Conclusion. There would be a higher risk of wildland fire occurrence because no treatments would be implemented to reduce fuel loading, leading to long-term adverse effects on soil productivity in the areas affected by uncontrolled wildfire. Recovery from measurable surface erosion and subsequent delivered sediment would take approximately 5–6 years (USFS 1981), but full recovery of the organic fraction of ground cover would take decades. The amount of CWD, as a result of fire, would begin to increase due to snag fall and would further increase total fuel loads.

3.6.5.2 Alternative B: Proposed Action

By following the Standards and Guidelines contained in the Klamath LRMP, and staying at or below the disturbance thresholds (described in Section 1.5.6 of the Soils Resource Report), there would be a low risk that soil productivity would be impaired. Alternative B proposes a moderate amount of mechanical treatments, so there would be a measurable amount of ground disturbance from equipment, skid trails, and landings. A combination of soil protection measures, normal erosion control, and conduct of logging timber sale contract provisions, are expected to provide adequate soil protection so that productivity is maintained.

Soil Cover

Direct and Indirect Effects—It is difficult to accurately predict treatment effects on effective ground cover and is reliant on professional experience of the observer, and available post-thinning monitoring in similar settings. Thinning operations would likely increase activity fuels and effective ground cover, while pile burning and underburning have the greatest potential to reduce soil cover. Mastication would increase soil cover as materials are broadcast away from the equipment. Post-activity monitoring (from 1998 to 2004) on various treatments (prescribed fire, mastication, and handpiling with pile burning on the Klamath National Forest had an average percent ground cover ranging between 45 and 96 percent, with an overall average of 79 percent (Laurent 2007). Present percent soil cover average for all treatment units evaluated in the Eddy Gulch LSR Project Assessment Area is 72 percent. Comparing this value to the 79 percent average for previously monitored areas on the Klamath National Forest, one could reasonably expect soil cover to remain static or slightly increase (due to needle cast and leaf fall) for the mechanically treated units that will also be underburned.

Presently, M Units 19 (cable), 21 (cable and tractor), 24 (cable), 35, and 36 fall well below the 70 percent desired ground cover standard and would likely see further reductions. Additionally, M Units 3, 4 (cable and tractor), 15 (cable and tractor), 17 (cable), 23, 38 (cable), 52, 54, and 65 are border-line and would likely fall below the 70–80 percent standard after treatment. For the FRZs, especially those areas that are to be masticated, percent ground cover would likely increase. A 2001 masticated plantation in the Shadow Creek area averaged 88 percent ground cover after completion (Laurent 2007). Because of the size and landscape diversity of the underburn-only treatment units (the prescribed burn units [Rx Units]), the introduction of low-intensity prescribed fire would create a burn mosaic of variable ground cover percentages. Overall, the entire Assessment Area would meet or exceed ground cover standards. Ground cover in all treatment units would recover quickly as leaf fall and needle cast contribute to the litter layer. A reduction in effective ground cover would increase the risk of erosion in affected areas. The amount and type of erosion depends on the character of the area. For example, patches of ground cover across a large area would be more effective at intercepting surface water than large areas devoid of cover.

Conclusion. Treatment activities would result in short-term localized negligible adverse effects on soil cover because the Proposed Action is designed to limit or restrict ground disturbance. This is particularly true with the use of prescribed fire because it is used under a more controlled environment, lessening the probability of higher intensity burns. The effects of wildland fire, on the other hand, would create long-term adverse effects on soil productivity and water quality due to the immediate and substantial loss of soil cover, causing a measurable increase in surface erosion and delivered sediment.

Cumulative Effects—A reduction in ground cover, as a result of the proposed treatments, would likely be short-lived because nearby overstory trees will remain intact. Over time, litter from trees and shrubs would contribute to the development of effective ground cover in bare areas. A wildfire entering a treated area would result in a greater reduction in ground cover than the proposed treatments alone. See the soil cover discussion under Alternative A above.

Conclusion. Effects on soil cover related to the Proposed Action would be significantly reduced in less than 5 years, with the exception of some of the treatment units mentioned in the earlier narrative, where the effects would be long term but localized and negligible.

Detrimental Disturbance (Detrimental Compaction and Detrimental Soil Displacement)

Direct and Indirect Effects—

Implementation of the Proposed Action would not significantly increase detrimental disturbance—The Eddy Gulch LSR Project includes project design criteria and other soil protection measures to minimize detrimental soil compaction and detrimental displacement. However, the use of heavy ground-based equipment and frequent stand entries would increase the potential for soil compaction (Powers 2002). Compacted and heavily disturbed ground can cause soil productivity to decline over time (Grigal 2000). Recent research suggests however, that compaction does not necessarily lead to productivity declines (Gomez et al. 2002; Powers et al. 2005). These studies show that in California’s Mediterranean climate, the effects of compaction are dependent on soil texture.

The studies show that compaction of sandy loam and coarser textured soils can actually increase productivity because compaction increases available water holding capacity. Compaction in loamy soils can have a neutral or insignificant effect, but in clayey soils, compaction has a detrimental effect. Since the project soils are mostly gravelly sandy loams to clay loams, the applicable standard limiting main skid trails and landings to 15 percent of an area are relatively conservative in protecting the soils from productivity loss due to compaction.

For any mechanical harvest, the extent and degree of detrimental soil disturbance (especially compaction) depends on site-specific soil conditions such as texture and stoniness, moisture content at the time of operations, and harvest equipment features. For the Eddy Gulch LSR Project, the detrimental disturbance threshold is 15 percent. If main skid trails and landings occupy greater than 15 percent of a treatment unit, then the unit exceeds the detrimental disturbance threshold. As part of the project design, units that are predicted to exceed 15 percent would be reevaluated after treatment. Currently, the following M Units are at or exceed the 15 percent threshold standard: 15, 17, 21, 22, 30, and 80. Some compaction (reduced soil porosity) would occur in other areas where equipment makes one or two passes, but this increased compaction would not exceed threshold values (Powers 2002). Subsoiling has been shown to be an effective method of reducing compaction and restoring porosity to the soil (Andrus and Froehlich 1983; Kolka and Smidt 2004). If post-project monitoring shows that these units exceed the detrimental disturbance threshold due to compaction, then subsoiling of their main skid trails would be done. Mechanical ground disturbance in the remaining treatment units has a high probability of not significantly impairing soil productivity because only those areas with slopes generally less than 35 percent would be treated using ground-based equipment.

Conclusion. Mechanical treatments would result in short-term site-specific adverse negligible effects on the soil resource as a result of heavy equipment operations outside of existing skid trails and landings. This action alternative will protect long-term soil productivity by measurably reducing fire severity through the reduction of existing fuel loading.

Cumulative Effects—Long-term soil productivity would be maintained with implementation of the Proposed Action. With the implementation of project design criteria, especially the use of existing skid trails and landings, all treatment units are expected to remain at existing levels.

Conclusion. Through the use of existing skid trails and landings (especially when landings are existing road surfaces), total-affected area would remain at background levels, and overall adverse effects would be long term but localized and negligible.

Organic Matter (Fine Organic Matter and CWD)

Direct and Indirect Effects—It can be difficult to accurately predict treatment effects on surface fine organic matter or CWD, and is reliant on the experience of the observer, and available post-harvest evaluations in similar settings. Mastication treatments are expected to increase cover of organic matter as masticated debris is broadcast away from the equipment. Past soil cover monitoring on the Forest (Laurent 2007) showed that mastication resulted in 79 to 99 percent total organic soil cover and averaged 94 percent. Underburn treatments may reduce organic matter, but burning is expected to occur under prescribed conditions that would not result in complete combustion of the duff and litter layers, or measurable reduction in existing CWD. Past soil cover monitoring of underburning (Laurent 2007) under forested stands showed that underburning resulted in 56 to 98 percent total organic soil cover and averaged 84 percent. Within underburned areas not all of the surface materials are burned. In some monitored stands 31 to 65 percent of the area within the burned boundaries remained unburned. Pile burning would decrease surface fine organic matter locally, but over time, adjacent trees and shrubs would provide litter to cover the burned area. Handpiling and subsequent burning of the piles retained on average 86 percent soil cover (Laurent 2007). In some cases 44 percent soil cover was retained within the burned pile areas due to incomplete consumption of the larger material within the piles. Fire line construction around prescribed burn areas and hand piles would create bare soil conditions. Cover of fine organic matter is expected to remain within acceptable threshold values. Local reductions in surface fine organic matter would have local minor, short term effects on soil temperature. Large reductions in organic matter would result in greater temperature extremes in the soil, as previously discussed earlier. Removal of canopy cover may result in increased temperatures at the forest floor, as well as reduced moisture content of surface fine organic matter (Erickson et al. 1985).

Conclusion. Implementation of the Proposed Action would result in short-term negligible adverse effects on the soil resource due to localized removal of organic matter by heavy equipment and prescribed fire. Without implementation, continued accumulation of organic matter on the forest floor would contribute to increased ground fuel loads, which may lead to increased fire severity during a fire event. Based on the fire return intervals stated earlier, the loss of surface organic matter and CWD would have short-term adverse effects on both soil productivity and water quality because organic matter and CWD are essential for both soil fertility and ground cover.

Cumulative Effects—Loss of organic matter would adversely affect long-term soil productivity. Following implementation of the proposed treatments, organic matter on the soil surface would decrease in some areas due to mechanical displacement or consumption by fire, while organic matter would increase in other areas due to additions of masticated material, needle and leaf cast, and some increase in CWD due to the collapse of standing dead or dying trees. This may result in greater heterogeneity (diversity) of the forest floor. Patches of organic matter would provide habitat for soil invertebrates and microorganisms, and patches of bare areas would be susceptible to local erosion. Increases in woody materials on the forest floor due to mastication may cause short-term changes in decomposition, carbon, and nutrient dynamics in affected areas. Microorganisms that decompose wood would immobilize nitrogen and other nutrients while decaying the woody material. As the wood decomposes, those nutrients would be released and made available to plants and other organisms (Swift 1977). Microclimate changes at the forest floor (due to reduced canopy cover) can alter rates of decomposition and nutrient turnover in the surface fine organic matter of harvested stands (Erickson et al. 1985).

Conclusion. The effects of mechanical treatment and prescribed fire on the organic matter component would have localized minor to negligible, adverse effects on the soil resource due to the continuous recruitment of organic matter from needle cast, leaf fall, and snags falling to the ground. This action alternative will protect long-term soil productivity by measurably reducing fire severity through the reduction of existing fuel loading.

3.6.5.3 Alternative C: No New Temporary Roads Constructed

Alternative C would have a moderate amount of mechanical treatments, so there would be a measurable amount of ground disturbance from equipment, skid trails, and landings. A combination of soil protection measures in the project design criteria and normal erosion control measures are expected to provide adequate soil protection so that productivity is maintained. By following the standards contained in the Klamath LRMP, and staying at or below the disturbance thresholds, there would be a low risk that soil productivity would be impaired.

Soil Cover

Direct and Indirect Effects—Implementation of this alternative would treat slightly less acres than Alternative B by mechanical methods, but the overall fuel reduction would be similar.

Conclusion. Treatment activities would have localized short-term negligible effects on soil cover because, as with Alternative B, Alternative C is designed to limit or restrict ground disturbance. This is particularly true with the use of prescribed fire because it is used under a more controlled environment, lessening the probability of higher intensity burns. The effects of wildfire, on the other hand, would create long-term adverse effects on soil productivity and water quality due to the immediate and substantial loss of soil cover, causing a measurable increase in surface erosion and delivered sediment.

Cumulative Effects—A reduction in ground cover as a result of the proposed treatments is likely to be short-lived because nearby overstory trees would remain intact. Over time, litter from trees and shrubs would contribute to the development of effective ground cover in bare areas. A wildfire entering a treated area would result in a greater reduction in ground cover than the proposed treatments alone (see the soil cover discussion under Alternative A).

Conclusion. Effects on soil cover related to the Alternative C would be significantly reduced in less than five years, with the exception of some of the treatment units mentioned in the earlier discussion in Alternative B, where the effects would be long term but localized and negligible.

Detrimental Disturbance (Detrimental Compaction and Detrimental Soil Displacement)

Direct and Indirect Effects—Implementation of Alternative C would not significantly increase detrimental disturbance. This alternative would treat fewer acres by cable yarding because new temporary roads would not be constructed, resulting in less potential for disturbance in the form of soil compaction and measurable soil displacement. The same number of tractor yarding acres would occur. The post-project soil compaction monitoring and potential subsoiling of units estimated to exceed the detrimental disturbance threshold would occur as described under Alternative B.

Conclusion. Mechanical treatments would result in site-specific short-term negligible adverse effects on the soil resource as a result of heavy equipment operations outside of existing skid trails and landings. Detrimental disturbance is estimated to be approximately 5–8 percent less than under Alternative B.

Cumulative Effects—Long-term soil productivity would be maintained with implementation of Alternative C. With the implementation of project design criteria, especially the use of existing skid trails and landings, all treatment units are expected to remain at existing levels.

Conclusion. Through the use of existing skid trails and landings (especially when landings are existing road surfaces), total-affected area would remain at background levels, and overall adverse effects would be long term but localized and negligible.

Organic Matter

Direct and Indirect—Implementation of this alternative would have similar effects on soil productivity and water quality as discussed under Alternative B.

Conclusion. Implementation of Alternative C would result in short-term negligible adverse effects on the soil resource due to localized removal of organic matter by heavy equipment and prescribed fire. Without implementation, continued accumulation of organic matter on the forest floor would contribute to increased ground fuel loads, which would lead to increased fire severity during a fire event. Based on fire-return intervals stated in Alternative A, the loss of surface organic matter and CWD would have short-term adverse effects on both soil productivity and water quality because organic matter and CWD are essential for both soil fertility and surface ground cover.

Cumulative Effects—Implementation of this alternative would have similar effects as discussed under Alternative B.

Conclusion. The effects of mechanical treatment and prescribed fire on the organic matter component would have localized minor to negligible adverse effects on the soil resource due to the continuous recruitment of organic matter from needle cast, leaf fall, and snags falling to the ground. This action alternative will protect long-term soil productivity by measurably reducing fire severity through the reduction of existing fuel loading.

3.6.6 Affected Environment (Existing Conditions): Geology

Two geologic formations (distinct accreted terrains) comprise the vast majority of the Assessment Area. The Western Paleozoic and Triassic Belt is a complex of mostly meta-sedimentary argillites and phyllites with interbedded cherts. This formation also includes metavolcanic rocks, blueschist facies (low-temperature, high-pressure metasediments), slightly metamorphosed volcanic breccias, and small bodies of peridotite in the complex. This formation occurs in the Assessment Area west of Black Bear Summit in the Black Bear Creek / Argus Gulch area. The argillite component of this formation is a relatively weak rock, which can pose slope stability risks. This formation also occurs just north of the divide between the North and South Forks in Eddy Gulch and Whites Gulch.

The adjacent Stuart Fork Formation is dominated by phyllites and schists with varying degrees of structural competence and fracture spacing from massive boulder-sized material to intensely sheared and fractured. The contact between the Stuart Fork Formation and the Western Paleozoic and Triassic Belt is marked by numerous springs and seeps. The Stuart Fork Formation occurs in upper Crawford Creek, Shadow Creek, and Sixmile Creek. Where highly sheared and weathered, these rocks can pose significant landslide risk.

Serpentinized peridotite is found in lower Crawford Creek and in small, scattered pockets in the Western Paleozoic and Triassic Belt.

Abrams mica schist occurs in a small pocket south of Grouse Point. Hydration of mica minerals during weathering causes expansion and weakening of the rock's internal structure. This rock type is very weak and can be broken apart by hand. This structural incompetence also poses slope stability problems, but its occurrence is very limited in the Assessment Area.

A small pocket of dioritic rocks occurs in Callahan Gulch. Elsewhere, granodiorite occurs in Upper South Russian Creek, grading to granite in the Russian Peak Wilderness. Deeply weathered rocks of this type form very noncohesive soils (typically silty sand soils) that tend to produce shallow-seated failures such as debris slides and debris torrents when saturated. In 1996, a debris torrent originating in granitic rocks of upper South Russian Creek scoured the channel down to its confluence with the North Fork. The point of origin of this debris torrent was well above the project Assessment Area and near the Russian Peak Wilderness boundary. Only roadside fuel reduction and underburning are proposed in the South Russian Creek watershed, and those are in the lower reaches of the watershed on mostly nongranitic geology.

Landslides are the major geologic hazard in the Assessment Area, and their occurrence is related to the structural competence of the underlying rocks, pore pressures of water in rocks and soil, and triggering mechanisms. Triggering mechanisms are usually one or more of the following: (1) seismic activity, (2) removal of toe-slope buttressing, and (3) saturation by major rainfall/runoff events.

Active landslides (active within the last 400 years) are scattered widely throughout the Assessment Area. The largest is approximately 40 acres in size and occurs in the west branch of Shadow Creek.

Toe zones of old slides represent a landform with high risk for subsequent landslides. Toe-zone landforms are clustered in Argus Gulch and upper Eddy Gulch but are mostly absent elsewhere in the Assessment Area. All mapped toe zones are in areas proposed for underburning only. No road construction or timber harvest is proposed on toe-zone areas.

Recently active landslides were encountered in upper Eddy Gulch and along the Grouse Point Fault in Crawford Creek. Another very small (0.10 acre) slump was located along National Forest System (NFS) road 39N20 in lower Shadow Creek.

The Klamath National Forest CWE model includes a component that estimates potential sediment delivery to streams from management-induced landslides. Currently, only two 7th-field watersheds with significant areas in proposed treatment units have GEO risk ratios in a moderately elevated range: Upper North Russian Creek (risk ratio = 0.87) and Eddy Gulch (0.79). Two other 7th-field watersheds have elevated risk ratios (Indian Creek, 0.87 and Kanaka Olsen, 1.53), but those drainages are scheduled for only very minor amounts of underburning that will not affect their risk ratios.

Areas With Watershed Concerns (AWWC) were identified in the Watershed Analyses covering the Assessment Area. Black Bear Creek watershed west of the main channel of Black Bear Creek was identified in the Lower South Fork Salmon Watershed Analysis (USFS 1997) as an AWWC in 1995. Substantial recovery has occurred in the intervening years as evidenced by low CWE risk ratios for all components.

Limestone Bluffs Research Natural Area occurs along the South Fork Salmon River between Cecilville and the Matthews Creek campground. The majority of this outcropping occurs south of the river in the St. Claire and French Creek drainages. The nearest project activity is a Fuel Reduction Zone (FRZ) more than 0.25 mile from the Bluffs.

Airborne asbestos can be introduced into the air by road construction, reconstruction, or maintenance on roads underlain by ultramafic rock, or the development of rock quarries in ultramafic rock and placement of such aggregate on roads. Ultramafic rock is concentrated in the southwest corner of the Assessment Area. The community of Cecilville is located in this general area but is at least 2 miles from the nearest project activity.

No domestic water wells are known to exist in or near the project boundary. There are numerous springs in the Assessment Area. Seeps and springs are especially common along both sides of the divide between the North and South Forks of the Salmon River, above 5,000 feet in the vicinity of the Eddy Gulch Lookout. Campbell Springs is the most prominent of these springs, but many others exist in this zone.

3.6.7 Environmental Consequences: Geology

3.6.7.1 Alternative A: No Action

Geology Program Goals. The no-action alternative has a high probability of meeting all of the five geologic goals.

Direct and Indirect Effects—Landslide Risk—Under this alternative, there would be no new soil or vegetation disturbances, and consequently, no direct or associated indirect effects from project-related activities. With no action taken, the existing risk of road-related landsliding would remain the same, and the adverse effects of past harvest and fire would decrease over time as vegetation continues to grow. In the long term, the risk of a large stand-replacing fire would continue to increase. Fire modeling (refer to Section 3.3 or the Fuels and Air Quality Resource Report) indicates that the effects of failing to reduce this risk can potentially result in significant increases in landslide-related sediment. Under wildfire conditions, adverse effects on geologic resources from high fire severity would be compounded by the impacts resulting from suppression equipment accessing the area and fireline construction under demanding circumstances.

Failing to reduce fuel loads in the Assessment Area would result in continued high risk of stand-replacing wildfire and the accompanying loss of rooting strength on unstable slopes. This, in turn, would increase the potential for accelerated sediment delivery to streams. A dense network of tree roots can add to the shear strength of potentially unstable slopes. This effect is limited to slopes prone to shallow-seated debris slide slope failures. Such slopes typically have thin soil profiles and relatively noncohesive soils. Following stand-replacing wildfire, the root network begins to decay, leading to a condition of minimum shear strength a few years following the fire. The direct effect of this process is the loss of soil productivity at the site of the landslide and sediment delivery to immediately adjacent stream channels. Because shallow-seated debris slides or debris flows can transport landslide debris and sediment long distances down slope, such processes can profoundly affect sediment transport dynamics, channel stability, and the abundance and quality of aquatic habitat.

Cumulative Effects—Landslide Risk—Existing cumulative effects are entirely the result of previous disturbances such as road construction, timber harvest, and mining. These are discussed and displayed under Alternative B below. Adverse cumulative effects could result from failure to reduce the risk of stand-replacing wildfire. The CWE analysis of the results of wildfire behavior modeling shows that wildfire under existing fuel conditions clearly has the potential to produce detectable adverse cumulative effects.

Failing to reduce frequency of stand-replacing fires would increase landslide potential through loss of rooting strength, loss of vegetative soil water withdrawal, and creation of hydrophobic soils. Wildfire-related soil disturbance which, when added to that created by past actions, may exceed disturbance thresholds established to prevent long-term adverse changes to rates of landslide initiation.

A CWE model run was generated from a modeled wildfire, with ignition in lower Shadow Creek. A marked increase in the GEO risk ratio is apparent for Shadow Creek, with the wildfire scenario pushing it above the inference point of 1.0. The amount of increase would be large (0.41 to 1.07), but the amount by which the fire exceeds threshold is not great. This suggests that effects from increased potential for landslide-generated sediment are likely to be detectable but not of such extent or severity as to significantly degrade water quality or aquatic habitat.

Overall, cumulative effects on landslide-generated sediment delivery are expected to be minor to moderate, depending on the actual location and severity of wildfire. Were such effects to occur, they would be expected to persist for a decade or more until delivered sediments move through the stream network and landslide scars slowly revegetate.

Conclusion. Landslide potential associated with existing roads would remain unchanged, but that associated with previous timber harvest would continue to decline as revegetation progresses. The no-action alternative, with the included modeled wildfire scenario, is likely to produce minor to moderate effects on rates of landslide initiation, water quality, and aquatic habitat. The exact magnitude of effects is wholly dependent on the spatial pattern of high-intensity fire. Were the entire 7,200 acres of predicted wildfire to occur mostly within one 7th-field watershed, effects would be concentrated within that drainage. Otherwise, effects would be substantially less because the effects would be dispersed across multiple drainages. Recovery of rooting strength and natural soil moisture regimes can take a decade or more in areas of high fire intensity. Areas of lesser fire intensity are likely to recover within a decade.

3.6.7.2 Alternative B: Proposed Action

Geology Program Goals. Alternative B has a high probability of meeting all of five geologic objectives at a high level, provided geological RPMs are applied.

Direct and Indirect Effects—Landslide Risk—A dense network of tree roots can add to the shear strength of potentially unstable slopes. This effect is limited to slopes prone to shallow-seated debris slide slope failures. Such slopes typically have thin soil profiles and relatively noncohesive soils. Thinning stands can result in a short-term decline in root shear strength as the roots of removed trees begin to decay, leading to a condition of minimum shear strength a few years following a fire. Slope failures can also originate in over-steepened fill slopes of roads and landings where they are situated on intrinsically unstable slopes. The direct effect of this process is the loss of soil productivity at the site of the landslide and sediment delivery to immediately adjacent stream channels.

All fuel reduction treatments and thinning prescriptions leave substantial live vegetation, especially larger trees with deep, extensive root systems. Vegetative treatments are unlikely to significantly reduce the contribution of roots to soil shear strength or lessen soil water withdrawal from evapotranspiration. Proposed road alignments for new temporary roads are in stable, upper slope locations with no stream crossings. For these reasons, project effects from Alternative B are expected to be negligible relative to landslide risk and thus landslide-generated sediment delivery to streams.

Direct and Indirect Effects by Project Activity—Direct and indirect effects associated with project activities are described below. It is assumed that geologic RPMs are implemented in all applicable situations. Refer to Appendix G of the Geology Report for further information on direct and indirect effects by management activity.

Thinning—931 acres. These activities will result in a very small short-term decrease in root support, but most likely will not cause an increase landslide rates. In the longer term, stand vigor will be increased, and root support re-established.

Tractor Yarding—361 acres. By restricting tractors to slopes less than 35 percent slope, and controlling skid trail locations (avoiding full-bench trails), ground disturbance on unstable lands would be avoided, and these activities would likely not increase landslide rates.

Cable Yarding—570 acres. Ground disturbances associated with cable yarding will be excluded from unstable areas and, as a result, would not increase landslide rates.

Construction of New Temporary Roads / Closure—1.03 miles. The new temporary roads would be closed upon project completion. There would be a reduction in root support and local evapotranspiration associated with clearing. Road segments are short, cross no major drainages or wet areas, and are generally located near ridgetops. All new temporary road alignments were inspected for landslide potential in the field and landslide potential evaluated.

Use of Former Logging Access Routes / Closure—0.98 mile. Former logging access routes in varying states of revegetation would be reused. There would be a reduction in root support and local evapotranspiration, particularly where older vegetation is removed. All of these routes were inspected for landslide potential in the field and landslide potential evaluated. Potential for road-related landsliding is considered to be very low. Closure following use would eliminate any pre-existing drainage problems and remove fill placed in draws, thereby restoring hydrologic conditions and reducing landslide risk.

Use of Short Spurs—340 feet. The spurs proposed for use were inspected for landslide potential in the field and landslide potential evaluated. Since spurs are, in most cases, on gentle ground and near ridge crests, the risk of road-related landsliding is considered to be very low. Closure following use would reestablish hydrologic conditions that existed prior to project implementation and allow revegetation to commence.

Road Maintenance. All haul roads will be maintained. This action would decrease the potential for road-related landslides, by better controlling road surface drainage.

Landings. Approximately 73 existing landings would be used for the thinning units. All are associated with tractor yarding. Cable yarding would use the road prism for "hot decking" of logs such that no additional landings are proposed for cable units. (Basically, hot decking occurs when the running surface of the road is not wide enough for both the cable yarder and the logs. The logs have to be moved out of the way so another load can be brought to the road, where trucks haul them away—this eliminates the need for landing construction because the road prism itself serves as the landing.) The total area of the existing 73 landings is estimated to cover 18 acres over the entire Assessment Area. Landing locations are mostly along existing roads and were used in previous harvest operations. Locations have been placed on the project GIS coverage and are shown in the Logging Systems Report contained in the project record. No landings are proposed in Riparian Reserves or other sensitive lands.

Landing size could vary according to such factors as local conditions and the amount of timber volume being handled, but none are expected to exceed 0.5 acre. By limiting landings to gentler slopes, minimizing cut heights, and constructing stable fills, applying timber sale contract clause CT 6.602 Special Erosion Prevention and Control (May 4, 1998), landslides associated with landings are not anticipated.

Mastication in FRZs. Alternative B includes mechanical mastication of fuels on flatter areas (under 45 percent) along ridgetops. This is estimated to occur on 3,184 acres. The use of small, low-ground-pressure equipment will limit soil disturbance and compaction. Residual soil cover will be left following treatment, which would minimize effects of soil disturbance. The ridgetop location of treatments will limit adverse effects on Riparian Reserves.

Hand Piling and Burning. Hand piling would be applied to steeper portions of the 16 miles of roadside treatment that occur outside of FRZs and Rx Units. This treatment may also be applied as part of preparing underburn units. In areas currently supporting heavy fuels, this activity would greatly reduce the risk of high-severity fire. This is particularly true where accumulations of down saplings and poles are present.

Underburning. This is the dominant treatment proposed in this alternative. Underburning will occur in cable portions of thinning units (post-harvest) and in FRZs and Rx Units. Thinning, mastication, and hand thin/pile represent preparatory steps to allow the introduction of prescribed fire without catastrophic consequences. This activity would reduce the potential for stand-replacing wildfire. However, there is always some risk of local high-severity fire occurring during implementation of prescribed burns, and if this should occur on unstable areas, it could increase landslide potential. Application of geologic RPMs is expected to minimize the risk of high-severity fire in unstable areas.

The direct and indirect effects of various management activities are summarized in Tables 3-42 and 3-43. The tables provide a brief description of the effect and an evaluation of its intensity, as previously defined.

Table 3-42. Direct effects of Alternative B on geologic resources and hazards.

Management Activity	Type of Direct Effect	Intensity	Determination
Thinning	Reduced vegetation density	*Negligible to minor*. Remaining trees rapidly occupy available canopy and root space.	Professional judgment / experience
Tractor yarding	Soil disturbance and compaction; loss of organic matter	*Negligible to minor*. Tractor yarding limited to gentle slopes near ridgetops. RPMs require residual groundcover and erosion control on skid trails and landings.	Professional judgment / experience
Cable yarding	Soil disturbance; erosion	*Negligible to minor*. Limited soil disturbance. RPMs require residual soil cover and limit openings in Riparian Reserves.	Professional judgment / experience
Landings	Cuts and fills	*Minor*. Most landings pre-existing with no evident problems. Minimal cut and fill required as most landings are located adjacent to existing roads.	Professional judgment / experience
Mastication in FRZs	Mechanical soil disturbance; possible small changes in slope hydrology; short term reduction in evapotranspiration	Negligible to minor. Low-ground-pressure equipment will be used and limited to 45 percent slopes. Mastication leaves considerable soil cover.	Professional judgment / experience
New temporary road construction or use of former logging access routes	Cuts and fills	*Minor*. Very little construction proposed. All segments short. No segments on unstable slopes. All will be closed.	Professional judgment / experience
Road closure	Pulling of fills, outsloping, rocking of crossings; stabilizing existing landslides	*Minor short-term* effects of creating bare soil. RPMs require mulch or other soil cover and erosion control. Long-term beneficial effects.	Professional judgment / experience
Road maintenance	Cleaning of culverts, blading, ditch clearing	*Negligible*. Beneficial effects.	Professional judgment / experience
Hand piling and burning	Reduction of organic material, local areas of high intensity fire, loss of fine organic matter	*Negligible*. Insignificant ground disturbance.	Professional judgment / experience
Underburning	Reduction of fine organic material; local hot fire; loss of fine organic matter	*Negligible to minor*. Burn prescription will include measures for maintenance of canopy, soil cover, and root density where slope stability is a concern.	Professional judgment / experience

Table 3-43. Indirect effects of Alternative B on geologic resources and hazards.

Management Activity	Type of Indirect Effect	Intensity	Determination
Thinning	Minor short-term reduction in root support and evapotranspiration; minor increased landslide potential.	*Negligible to minor*. Remaining trees rapidly occupy available canopy and root space	Professional judgment / experience
Tractor yarding	Changes in soil permeability and runoff patterns, local changes in mass balance; potential to channel water and increase landslide potential.	*Negligible to minor*. Tractor yarding limited to gentle slopes near ridgetops. RPMs require residual groundcover and erosion control on skid trails and landings. No tractor yarding proposed on or near unstable slopes.	Professional judgment / experience
Cable yarding	Local changes in soil permeability and channeling of water; potential to increase landslide potential.	*Negligible to minor*. Limited soil disturbance. RPMs require residual soil cover and limit openings in Riparian Reserves.	Professional judgment / experience
Landings	Large changes in slope hydrology; potential for fill and cut failure landsides.	*Minor*. Most landings pre-existing with no evident problems. Minimal cut and fill required as most landings are located adjacent to existing roads. No landings proposed on or near unstable slopes.	Professional judgment / experience
Mastication in FRZs	Soil compaction and reduction in evapotranspiration could produce increases in surface runoff, potentially generating sediment to streams.	Negligible to minor. Low-ground-pressure equipment will be used and limited to 45 percent slopes. Mastication leaves considerable soil cover. Tree canopy will be retained.	Professional judgment / experience
New temporary road construction or use of former logging access routes and spurs	Large changes in slope hydrology; potential for fill and cut failure landslides.	*Minor*. Very little construction proposed. All segments short. No segments on unstable slopes. No road alignments intersect springs, seeps, or cross any stream channels. Special C-clause required for stabilization of cuts and fills. All will be closed.	Professional judgment / experience
Road closure	Restoration of slope hydrologic patterns; large reduction in risk of stream crossing and fill failures; reduction in landslide failure.	*Minor short-term* effects of creating bare soil. RPMs require mulch or other soil cover and erosion control. Long-term beneficial effects.	Professional judgment / experience
Road maintenance	Reduction in potential for stream crossing fill failure.	*Negligible*. Beneficial effects.	Professional judgment / experience
Hand piling and burning	Reduction of fire risk.	*Negligible*. Insignificant ground disturbance. Beneficial effects.	Professional judgment / experience
Underburning	Reduction of fire risk; local increase in landslide potential where hot fire inadvertently occurs on unstable land.	*Negligible to minor*. Burn prescription will include measures for maintenance of canopy, soil cover, and root density where slope stability is a concern. Critical areas will be reviewed for pretreatment of fuels where necessary to prevent flare ups.	Professional judgment / experience

Asbestos Hazard Associated with Roads and M Units. There are outcrops of ultramafic rock along some roads, and this rock type often contains asbestos. Table 3-44 lists such roads and identifies those that are closer than one mile to sensitive receptors (residences or campgrounds). Harvest units are similarly listed in the table. Listings are based on the Klamath National Forest bedrock coverage in the Klamath National Forest GIS library and supplemented by field survey. Also, see the Geology Report, Appendix I, for the report titled, "Naturally Occurring Asbestos in Eddy Gulch LSR Project."

Table 3-44. Locations of treatment units and roads underlain by ultramafic rocks.

Road or Unit	Sensitive Receptor	Junction with Paved Road?	Location
FRZ 9	No	N/A	Lower portion of FRZ 9 south of unit M Unit 66.
Rx Unit 4	No	N/A	Southern half of this Rx Unit along west branch of Crawford Creek.
39N23	No	1C02 (South Fork Salmon Road)	From Cecilville north to intersection of 38N17.
FRZ 2	Black Bear Ranch	N/A	Small pockets of um west of M Unit 51. Um rocks prevalent vic. Blue Ridge Lookout.
Rx Unit 1	Black Bear Ranch	N/A	Belt of um rocks underlies approximately 10% of unit.

Cumulative Effects—Cumulative effects on geologic resources are gauged by evaluating GEO risk ratios produced by the CWE model. Input to the model for each treatment unit or road consists of physical attributes (slope gradient, soil type, bedrock type, and geomorphic terrain type) that are generally compiled from GIS coverages. The type of treatment or disturbance is also part of model input. Field assessments served to validate or upgrade mapped information and to arrive at a qualitative assessment of the potential impacts of the proposed treatment. The presence of indicators (such as nearby landslide features, abundant seeps and springs, structurally weak bedrock, hummocky slopes, irregular stream drainage patterns, or very steep slopes) would lead to a higher qualitative rating of the potential landslide risk. These ratings are also part of the input to the CWE model.

GEO risk ratios for Alternative B are shown in Table 3-45. The column titled “Current” represents existing conditions. “Post-project” includes natural recovery of existing disturbances and the addition of project (Alternative B) disturbances. The last column includes effects of foreseeable future actions plus recovery projected out to 2021, the expected date of project completion.

Only the Kanaka-Olsen watershed shows a risk ratio above 1.0 (GEO = 1.43), and that denotes the existing condition. Only 18 acres of FRZ treatment are proposed within the Kanaka-Olsen watershed. Note also that the risk ratio would improve steadily over the life of the project, going below threshold upon project completion. All other risk ratios would be quite low, and most are lower upon project completion than under existing conditions.

Areas With Watershed Concerns. The GEO component of the CWE model indicates that under existing conditions, the potential for adverse CWE (landsliding) is highest in Kanaka-Olsen and Indian Creeks. Moderately high-risk ratios (0.8–0.9) are reported for Eddy Gulch and Upper North Russian Creek. In each instance, implementation of Alternative B, in combination with natural recovery processes, result in significantly reduced risk ratios upon project completion. The reason that the model predicts a drop in risk, despite the fact that the project involves thinning and some road activity, is as follows: (1) The model assumes that there will be no measurable increase in landslide potential associated with thinning; and (2) It assumes that opening and then closing currently abandoned roads will reduce landslide risk. This reduction in risk offsets the adverse effects of new temporary road construction. As a result, the mix of road activities results in a net reduction in CWE risk.

Table 3-45. Alternative B GEO risk ratio data from the CWE model run of October 20, 2008.

Watershed	Background Sediment	Current Sediment	Current Plus Future Actions Sediment	Current	Post-project	Post-project Plus Future Actions
	Cubic Yard			Risk Ratio		
7th-field watersheds						
Black Bear Creek	19,070	35,962	34,059	0.44	0.44	0.39
Cody-Jennings Creek	20,997	41,734	39,171	0.49	0.49	0.43
Crawford Creek	15,321	24,121	23,489	0.29	0.29	0.27
Eddy Gulch	6,412	16,606	14,158	0.79	0.62	0.60
Gooey-Ketchum Creek	6,289	12,537	12,525	0.50	0.50	0.50
Gould-East Fork South Fork Salmon River	5,963	11,375	11,343	0.45	0.45	0.45
Indian Creek	9,818	26,995	22,831	0.87	0.87	0.66
Kanaka-Olsen Creek	18,606	75,429	51,933	1.53	1.43	0.90
Lower North Russian Creek	6,898	13,443	12,530	0.47	0.41	0.41
Lower South Russian Creek	3,424	7,189	5,773	0.55	0.36	0.34
Matthews Creek	8,229	15,891	15,797	0.47	0.47	0.46
Robinson-Rattlesnake Creek	7,621	12,761	12,345	0.34	0.32	0.31
Shadow Creek	10,437	18,971	18,963	0.41	0.41	0.41
Sixmile Creek	7,536	13,022	12,945	0.36	0.36	0.36
Tanner-Jessups Creek	9,580	21,274	16,783	0.61	0.41	0.38
Taylor Creek	8,440	11,847	11,009	0.20	0.15	0.15
Timber-French Creek	12,872	20,849	20,625	0.31	0.31	0.30
Upper North Russian Creek	4,959	13,610	10,728	0.87	0.60	0.58
Whites Gulch	11,581	19,662	15,439	0.35	0.19	0.17
5th-field watersheds						
North Fork Salmon	392,308	690,282	650,418	0.38	0.38	0.33
South Fork Salmon	232,540	488,838	390,997	0.55	0.48	0.34

Indian Creek and portions of Black Bear Creek are classified as AWWC. Reported risk ratios suggest that substantial recovery has occurred since these designations were made in the mid-1990s. The Kanaka-Olsen watershed meets screening criteria for AWWC status (GEO = 1.53). However, Kanaka-Olsen is a watershed area of slopes draining directly to the North Fork Salmon River from both sides of the river and the watershed conditions driving the high-risk ratios stem from fire and other disturbances occurring on granodiorites on the north side of the river. As mentioned earlier, Indian Creek and Kanaka-Olsen are scheduled to receive very minor amounts of fuel reduction treatments only, with no road construction of any kind proposed.

In summary, the potential for adverse CWE exists in some watersheds, due to existing road densities. New temporary road construction and opening of former logging access routes, followed by closure of all temporary roads/routes, results in a complex set of offsetting effects. The CWE model predicts a reduction in risk of adverse effects. However, there may be some small adverse effects associated with the reopening of former logging access routes that are in various states of revegetation. These adverse effects are not reflected by the model and would gradually recover as the closed roads revegetate.

Conclusion. Alternatives B would likely not produce detectable adverse effects on rates of landslide initiation or landslide-generated sediment delivery to streams. Conversely, fuel treatments would likely reduce the potential for accelerated landslide rates by reducing the risk of stand-replacing wildfire on potentially unstable slopes. This conclusion is based on (1) limited vegetation removal under fuel reduction and thin-from-below prescription; (2) limited road construction—all of it is on stable, upper slope locations; and (3) GEO risk ratios well below threshold with no increase during the life of the project. Direct, indirect, and cumulative effects on slope stability from project activities are expected to be negligible.

3.6.7.3 Alternative C: No New Temporary Roads Constructed

Geology Program Goals. Alternative C has a high probability of meeting all five geologic objectives at a high level, provided geological RPMs are applied.

Direct and Indirect Effects—Landslide Risk—The direct and indirect effects of Alternative C are not significantly different from Alternative B. The effects of new temporary road construction are eliminated, but the effects of these were judged insignificant under Alternative B. Landslide risk from road construction is even less under Alternative C. The tables describing the direct and indirect effects of Alternative B (Tables 3-42 and 3-43 above) are equally applicable to Alternative C and, for the sake of brevity, are not repeated here. The elimination of fuels treatment on 99 acres of potential thinning units and 822 acres of Rx Units poses some small but elevated risk of wildfire and its related impacts to landslide potential, as previously described. This increase in risk is judged to be negligible.

Direct and Indirect Effects by Project Activity—The direct and indirect effects associated with Alternative C are described below. These descriptions highlight the differences between the two action alternatives.

Thinning—832 acres. This is 99 acres less than Alternative B.

Tractor Yarding—361 acres. No change from Alternative B.

Cable Yarding—471 acres. No change from Alternative B.

Construction of New Temporary Roads / Closure. None.

Use of Former Logging Access Routes / Closure—0.98 mile. No change from Alternative B.

Use of Short Spurs—340 feet. No change from Alternative B.

Road Maintenance. No change from Alternative B.

Landings. The number of tractor acres (361 acres) would be the same under Alternatives B and C, which means Alternative C also proposed to use approximately 73 existing landings. As with Alternative B, by limiting landings to gentler slopes, minimizing cut heights, and constructing stable fills, applying timber sale contract clause CT 6.602 Special Erosion Prevention and Control (May 4, 1998), landslides associated with landings are not anticipated.

Mastication in FRZs. The type and extent of this treatment is unchanged from Alternative B.

Hand Piling and Burning. Unchanged from Alternative B, so effects would be the same.

Underburning. Total area of underburning is reduced by 822 acres under Alternative C. Application of geologic RPMs is expected to minimize the risk of high-severity fire in unstable areas.

Asbestos Hazard Associated With Roads and M Units. The description of the asbestos hazard is unchanged from Alternative B.

Cumulative Effects—A CWE model run was conducted for Alternative C. The results were virtually identical to those for Alternative B. The reason for this is that the largest reduction in treatment acres under Alternative C occurred for Rx Units where the model assigns very low disturbance factors. The elimination of new temporary roads under Alternative C results in very slight reductions in predicted sediment yield in the Shadow Creek and Black Bear watersheds. The changes are so small that calculated risk ratios remain unchanged to two decimal places and are thus judged to be inconsequentially different from the risk ratios reported for Alternative B. As such, the cumulative effects discussion of Alternative B is equally applicable to Alternative C. Since the table of risk ratios is essentially identical between action alternatives, it is not repeated here.

Areas With Watershed Concerns. None of the temporary roads deleted under Alternative C were located within AWWCs. The discussion of this topic under Alternative B is equally applicable for Alternative C.

Conclusion—The thinning and fuel treatments associated with Alternative C are not likely to cause landsliding due to the prescriptions required for unstable lands, low severity of prescribed fire, and the avoidance of unstable lands by temporary roads. It involves very little change in potential for adverse CWE. In fact, the landslide model indicates a slight reduction in this potential associated with the alternative. A small increase in wildfire potential and its related effects on slope stability results from reducing fuel treatment acres but this effect was judged to be negligible.

3.7 Botanical Resources and Noxious Weeds

3.7.1 Introduction

This document describes the existing conditions of Threatened, Endangered, and Sensitive plant species, Other Species of Interest (formerly Survey and Manage species), and noxious weeds of record for the Eddy Gulch Late-Successional Reserve (LSR) Project. The environmental consequences section presents an analysis of the effects on botanical resources and noxious weeds that would result from taking no action (Alternative A: No Action) or from implementation of Alternative B: Proposed Action or Alternative C: No New Temporary Roads Constructed. The objective of the effects analysis is to

- ensure that Forest Service actions do not contribute to loss of viability of any native or desired nonnative plant or animal species;
- ensure that Forest Service actions do not hasten the federal listing of any species; and
- ensure that Forest Service actions do not contribute to the introduction or spread of noxious weed species in the project area.

3.7.2 Methodology: Botanical Resources

3.7.2.1 Pre-Field Botanical Review

A preliminary pre-field review was conducted to determine if the project Assessment Area is within the range of any federally listed Threatened, Endangered, or Proposed species, Forest Service Sensitive species, or Other Species of Interest (formerly known as the Survey and Manage "Manage Known List"), or if suitable habitat is present in the project Assessment Area. Surveys are not required for species for which suitable habitat is not present, or if the Assessment Area is outside the currently known range of the species.

The pre-field review determined that the Eddy Gulch LSR Project Assessment Area is not within the range of, nor does it include habitat for, the four Klamath National Forest listed federal *Endangered* plant species, any of the Other Species of Interest, formerly known as the Survey and Manage "Manage Known List," and there are no federally *Threatened* plant species on the forest. These species are not addressed further in this document.

It was further determined that the project Assessment Area contains documented occurrences or potential suitable habitat for 23 of the 51 Forest Service Sensitive vascular and nonvascular plant species, and 6 Sensitive fungi species that were previously listed as "Survey and Manage Category B, Pre-Disturbance Surveys Not Practical or Category E, Status Undetermined." Pre-disturbance surveys for the 6 Sensitive fungi are not required because it was determined that surveys would not be practical due to seasonal timing, difficulty in identification, or lack of habitat specificity, or because there was not adequate information available to conduct targeted field surveys (USDA, USDI 2004). Although no fungi surveys were conducted, an analysis of species habitat associations, presence of suitable or potential habitat, and a review of the literature on the effects to the Sensitive fungi were used to determine effects.

Of the 23 Forest Service Sensitive species, 10 Sensitive species were determined to not have potential to occur in the proposed treatment units. It was further determined that 4 of the 13 species (*Cypripedium fasciculatum*, *Cypripedium montanum*, *Ptilidum californicum*, and *Hydrothyria venosa*) were most likely to occur in the Assessment Area. The Assessment Area is within the range of the remaining 9 (of the 13) target Forest Service Sensitive species and potential suitable habitat appears to be present. To determine effects, the 9 species are assumed to be present in the Assessment Area. Table 3-46 is a summary of the 13 target Forest Service Sensitive species and assessment methods.

Table 3-46. Summary of target Sensitive species and assessment methods, in the Eddy Gulch LSR Project Assessment Area.

SPECIES	CODE	Assessment Method
Vascular Species:		
Botrychium virginianum Rattlesnake fern	BOVI	Assume presence
Campanula wilkinsiana Wilkin's harebell	CAWI8	Assume presence
Chaenactis suffrutescens Shasta chaenactis	CHSU	Assume presence
Cypripedium fasciculatum Clustered lady-slipper orchid	CYFA	Field survey
Cypripedium montanum Mountain lady-slipper orchid	CYMO2	Field survey
Eriogonum hirtellum Klamath Mountain buckwheat	ERHI7	Assume presence
Eriogonum ursinum var. *erubescens* Blushing buckwheat	ERURE	Assume presence
Eucephalis vialis Wayside *aster*	EUVI8	Assume presence
Minuartia stolonifera Scott Mountain sandwort	MIST9	Assume presence
Pedicularis howellii Howell's lousewort	PEHO	Assume presence
Smilax jamesii English Peak greenbriar	SMJA	Assume presence
Bryophyte Species		
Ptilidium californicum Pacific fuzzwort (liverwort)	PTCA5	Field survey
Lichen Species		
Hydrothyria venosa (syn. *Peltigera hydrothyria)* Waterfan lichen	HYVE7	Field survey
Fungi Species		
Boletus pulcherrimus Red Pore bolete	BOPU4	Assume presence (Fungi species: habitat evaluation only, no surveys required.)
Cudonia monticola Mains	CUMO2	
Dendrocollybia racemosa	DERA5	
Phaeocollybia olivacea	PHOL	
Sowerbyella rhenana	SORH	
Tricholomopsis fulvescens	TRFU3	

3.7.2.2 Field Surveys

Field surveys were conducted in August 2008 in the 1,887 acres of the Assessment Area identified as the highest potential habitat for the four species most likely to occur in the proposed treatment units (*Cypripedium fasciculatum, Cypripedium montanum, Ptilidium californicum*, and *Hydrothyria venosa*). Following the field surveys, the locations of new and previously documented Forest Service Sensitive plant sites were added to the Geographic Information System (GIS) to analyze proximity of Sensitive plant sites to project treatment units to identify potential effects. Modifications were made to treatment units and incorporated in the final Proposed Action. See Resource Protection Measures in Section 2.9 of Chapter 2 of this final environmental impact statement (EIS).

3.7.2.3 Intensity of Effects

"Intensity" refers to the severity of effects or the degree to which the action may adversely or beneficially affect a resource. The intensity definitions used throughout this analysis are described below.

Negligible. Effects would be at the lowest levels of detection and would have no appreciable effect on resources, values, or processes.

Minor. Effects would be perceptible but slight and localized.

Moderate. Effects would be readily apparent and widespread, and would result in a noticeable change to resources, values, or processes.

Major. Effects would be readily apparent and widespread, and would result in a substantial alteration or loss of resources, values, or processes and would likely be permanent.

3.7.2.4 Scope of the Analysis

Analysis Area. The entire Eddy Gulch LSR totals approximately 61,900 acres. The Assessment Area is defined as the 37,239-acre portion of the LSR west of Etna Summit. The analysis area for botanical resources includes the proposed treatment units within the Assessment Area. Treatment units include those acres proposed for some type of on-the-ground treatment under the Proposed Action.

Analysis Period. "Duration" of effects refers to the time period that the effects would affect plants or habitat, whether beneficial or adverse. The time period of effects has been classified into "short term" or "long term."

Short Term. Effects would be present or apparent for approximately 1 to 10 years (or less).

Long Term. Effects would be present or apparent for more than 10 years.

3.7.3 Affected Environment (Existing Conditions): Botanical Resources

Previous district surveys and the results of August 2008 surveys include 36 sites of three Forest Service Sensitive vascular species and one bryophyte species in treatment areas:

- 11 previously documented and 10 new sites of Clustered Lady-Slipper Orchid (*Cypripedium fasciculatum*);
- 6 previously documented and 6 new sites of Mountain Lady-Slipper Orchid (*Cypripedium montanum*);
- 1 new site of English Peak Greenbriar (*Smilax jamesii*); and
- 2 new sites of Pacific fuzzwort (*Ptilidium californicum*)

For detailed species accounts of the above four species, see the Botanical Resources Report or Biological Assessment/Biological Evaluation for Threatened, Endangered, Proposed, and Sensitive Plant Species included in the project record.

A summary of the 36 Forest Service Sensitive plant sites in the proposed treatment units by population, location, and occurrence is presented in Table 3-47.

Table 3-47. Summary of Forest Service Sensitive plant species sites within Eddy Gulch LSR Project proposed treatment units.

Site Number and Legal Description	Site Information[a]	UTM Location[b]	Location Within Proposed Treatment Unit
***Cypripedium fasciculatum* (Clustered lady-slipper orchid)**			
CYFA-198V (new site, temporary number assigned) T41N-R10W, S.21, SW of SE ¼	2 plants located in 2008	500421, 4581337	Within Fuel Reduction Zone (FRZ) 20. On a northwest-facing upland slope, at -5,600 feet, 1 mile south of Etna Summit. 2008 Botanical Survey Unit #23.
CYFA-200V (new site, temporary number assigned) T41N-R10W, S29, NW of SE ¼	6 new plants located during 2008 surveys	498462, 4580369	Within FRZ 20 in RS Treatment, in a shallow, northwest-facing draw above Sawyer's Bar Road, at 3,600 feet. 2008 Botanical Survey Unit #21.
CYFA-201V (new site, temporary number assigned) T40N-R10W-S.20, SE of SW ¼	14 new plants located during 2008 surveys	496993, 4573520	Within Rx Unit 8, on a northwest-facing slope along John's Meadow Creek (a tributary of South Russian Creek) at 3,300 feet. 2008 Botanical Survey Unit #18.
CYFA-202V (new site, temporary number assigned) T40N-R10W-S.20, SW of SW ¼	2 plants located during 2008 surveys	496717, 4573698	Within Rx Unit 8, on a west-facing slope along John's Meadow Creek (a tributary of South Russian Creek) at 3,200 feet. 2008 Botanical Survey Unit #18.
CYFA-203V (new site, temporary number assigned) T39N-R11W-S8, NW of NW ¼	68 plants located during 2008 surveys	488009, 4568030	Within Rx Unit 12 on a northeast-facing slope east of Black Bear Summit, from 3,640 – 4,000 feet. 2008 Botanical Survey Unit #16-North.
CYFA-RAW1 (new site, temporary number assigned) T40N-R10W, S. 9, NW of NW ¼	2 plants located during 2008 surveys	498399, 4578170	Within Rx Unit 9, on steep, northeast-facing draw above Cow Creek, at 4,300 feet. 2008 Botanical Survey Unit # 19-North.
CYFA-GSV2 (new site, temporary number assigned) T40N-R10W-S.20, NE of SW ¼	7 plants located during 2008 surveys	496775, 4573804	Within Rx Unit 8, on a northwest-facing convex slope above South Russian Creek, at 3,200 feet. Population overlaps with CYMO2-#GSV3. 2008 Botanical Survey Unit #18.

Table 3-47. Summary of Forest Service Sensitive plant species sites within Eddy Gulch LSR Project proposed treatment units (continued).

Site Number and Legal Description	Site Information[a]	UTM Location[b]	Location Within Proposed Treatment Unit
CYFA KM7 (new site, temporary number assigned) T40N-R10W-S.19, NE of SW ¼	73 new plants located during 2008 surveys	496290, 4573984	Within Rx Unit 8 in an RS treatment, on a north-facing convex slope above South Fork Music Creek, at 3,000 feet. 2008 Botanical Survey Unit #18.
CYFA-RB2A (new site, temporary number assigned) T39N-R11W, S.18, NE of SE ¼	15 plants located in 2008 surveys	487391, 4565613	Within Rx Unit 2, on a northeast-facing toe slope above Callahan Gulch, at 3,450 feet. 2008 Botanical Survey Unit #14.
CYFA-RB2B (new site, temporary number assigned) T39N-R10W, S.18, NE of SE ¼	2 plants located in 2008 surveys	487234, 4565613	Within Rx Unit 2, on a northeast-facing toe slope above Callahan Gulch, at 3,450 feet (site is 450 feet west of CYFA-RB2A, and same location as CYMO2 RB03). 2008 Botanical Survey Unit #14.
CYFA-5-6 T39N-R11W, S.7, NE of NE ¼	17 plants located in 2006 Area not surveyed in 2008		Within FRZ 3 in a RS Treatment, on a northwest-facing slope southwest of Black Bear Summit. Outside 2008 Botanical Survey Units. (Population is in 2004 prescribed burn and overlaps with CYMO2-5-58A.)
CYFA-5-7A,B T39N-R11W-S8, NW of NW ¼	12 plants located in 2006 11 plants located during 2008 surveys	487750, 4567935	Within Rx Unit 12 in a RS Treatment on a northeast-facing slope southeast of Black Bear Summit. 2008 Botanical Survey Unit #16-North. Same site as CYMO2-5-58B.
CYFA-5-9 T38N-R11W-S.5, SE of SE ¼	54 plants located in 1991 Area not surveyed in 2008		Within Rx Unit 4, in riparian area of 4th of July Gulch. (Site overlaps with CYMO2-5-59). Outside 2008 Botanical Survey Units.
CYFA-5-16A T38S-R11W-S.34, SE of SW ¼	2 plants located in 1981 Area not surveyed in 2008		Within Rx Unit 4, along the riparian zone of upper Crawford Creek (along trail). Outside 2008 Botanical Survey Units.
CYFA-5-16B T38N-R11W-S.3, NE of NE ¼	1 plants located in 1981 Area not surveyed in 2008		Within Rx Unit 4, along the riparian zone of upper Crawford Creek (along trail, approx. 0.5 mile north of CYFA-16A). Outside 2008 Botanical Survey Units.
CYFA-5-39A,B T39N-R11W-S34, NW of NE ¼ and T39N-R11W-S27, SW of SE 1/4	72 plants located in 2002 Area not surveyed in 2008		Within Rx Unit 4, on a northwest-facing slope above Crawford Creek (southeast of trail), at 3,600 – 3,700 feet. Outside 2008 Botanical Survey Units.
CYFA-5-69 T41N-R10W, S.21, NE of SE ¼	11 plants located in 1991 1 plant relocated in 2008	500651, 4581662	Within FRZ 20 at southern boundary of M Unit 31. On a shady west-facing concave slope, (at the head of a small intermittent creek), at 5,600 feet, 1 mile south of Etna Summit. 2008 Botanical Survey Unit #23.

Table 3-47. Summary of Forest Service Sensitive plant species sites within Eddy Gulch LSR Project proposed treatment units (continued).

Site Number and Legal Description	Site Information[a]	UTM Location[b]	Location Within Proposed Treatment Unit
CYFA-5-70 T41N-R10W, S.21, SE of SE ¼	24 plants located in 1991 Site not surveyed during 2008 surveys		Within FRZ 20. On a northwest-facing slope at 5,200 feet, 1 mile south of Etna Summit. Outside 2008 Botanical Survey area.
CYFA-5-73 T40N-R10W-S.20, SE of SW ¼	65 plants located during 1991 Site not relocated during 2008 surveys		Within Rx Unit 8, on a west-facing draw (John's Meadow Creek) above South Russian Creek. This site overlaps with CYMO2# 5-9. 2008 Botanical Survey Unit #18.
CYFA-5-78 T41N-R10W, S.28, NE of NW ¼	No plants located in 2004 Site not relocated during 2008 surveys		Within FRZ 20 in a RS Treatment, on a northwest-facing slope at 5,600 feet, south of Etna Summit. 2008 Botanical Survey Unit #22.
CYFA-5-81 T39N-R12W-S.13, NW of SW ¼	10 plants located in 1995 Area not surveyed in 2008		Within Rx Unit 1, along a north-facing side draw of Argus Creek. Outside 2008 Botanical Survey Units.
***Cypripedium montanum* (Mountain lady-slipper orchid)**			
CYMO2-GSV1 (new site, temporary number) T41N-R10W-S.29, SE of SW ¼	1 plant located during 2008 surveys	498115, 4579930	Within FRZ 20 and RS Treatment, on a NW-facing convex slope above Sawyer's Bar Road, at 3,600 feet. 2008 Botanical Survey Unit #21.
CYMO2-KM1 (new site, temporary number) T41N-R10W-S.32, S/E of NW ¼	12 plants located during 2008 surveys	497977, 4579145	Within Rx Unit 9 on a north-facing slope above Taylor Creek road, 3,640 feet. Near 2008 Botanical Survey Unit #20-East.
CYMO2-GSV3 (new site, temporary number assigned) T40N-R10W-S.20, NE of SW ¼ continuing to SW of SW ¼	13 plants located during 2008 surveys	496719, 4573933	Within Rx Unit 8, on a north-facing slope above South Russian Creek, at 3,200 feet. [Site overlaps with CYFA-GSV2]. 2008 Botanical Survey Unit #18.
CYMO2-204V (new site, temporary number assigned) T39N-R11W-S8, NW of NW ¼,	10 plants located during 2008 surveys	488007, 4568047	Within Rx Unit 12 on an upland northeast-facing slope southeast of Black Bear Summit, and north of CYFA-7A. [Population has been monitored after previous 2004 prescribed underburn]; 2008 Botanical Survey Unit# 16-North.
CYMO2-RB3 (new site, temporary number assigned) T39N-R10W, S.18, SW of NE ¼, and NW of SE ¼	125 plants located in 2008 surveys	487347, 4565613	Within Rx Unit 2, on a northeast-facing toe slope above Callahan Gulch, at 3,350–3,650 feet (at same location as CYFA- RB2B). 2008 Botanical Survey Unit #14.
CYMO2-JS1 (new site, temporary number assigned) T39N-R12W-S.24, SE of NE ¼	25 plants located in 2008 surveys	486577, 4565602	Within Rx Unit 2 on a northwest-facing slope above Callahan Creek. 2008 Botanical Survey Unit #14.

Table 3-47. Summary of Forest Service Sensitive plant species sites within Eddy Gulch LSR Project proposed treatment units (continued).

Site Number and Legal Description	Site Information[a]	UTM Location[b]	Location Within Proposed Treatment Unit
CYMO2-5-9 T40N-R10W-S.20, SW of SE ¼ and SE of SW ¼	12 plants located during 1981 Site not relocated during 2008 surveys		Within Rx Unit 8, on southwest-facing draw and slopes above John Meadows Creek. (Site overlaps with CYFA-5-73). 2008 Botanical Survey Unit #18.
CYMO2-5-30A,B,C T39N-R11W-S.34, NE of NE ¼, and S.27, SE of SE 1/4	7 plants located in 2002 Area not surveyed in 2008		Within Rx Unit 4, on a northwest-facing slope above Crawford Creek (southeast of trail), at 3,700 feet. Outside 2008 Botanical Survey Units.
CYMO2-5-32 T39N-R11W-S.35, SW of SW ¼	50 plants located in 1985 Area not surveyed in 2008		Within FRZ 10 and northern edge of M Unit 52, on ridgeline, south of Grouse Point, in unique habitat of conifer-oak woodland. Outside 2008 Botanical Survey Units.
CYMO2-5-49 T38N-R11W-S2, NW of NW ¼ and S.3, NE, SE and SW of NE ¼, and NE and NW of SE ¼	1,000+ plants located in 1991 Area not surveyed in 2008		Within FRZ 10, Rx Unit 4 at southern boundary of M#52, on ridgeline and western slopes below Grouse Point, in unique habitat of conifer overstory/oak understory. Outside 2008 Botanical Survey Units.
CYMO2-5-58A T39N-R11W-S7, NE of NE ¼	25 plants located during 2006 Area not surveyed in 2008		Within FRZ 3 on an upper west-facing slope south of Black Bear Summit. (Site within 2004 prescribed burned area.) Site overlaps with CYFA-5-6. 2008 Botanical Survey Unit #16-North.
CYMO2-5-58B T39N-R11W-S8, NW of NW ¼	2 plants located during 2006 Area not surveyed in 2008		Within Rx Unit 12 on a northeast-facing slope south of Black Bear Summit. 2008 Botanical Survey Unit #16-North. Same site as CYFA-5-7A,B.
CYMO2-5-59 T38S-R11W-S.5, NE of SE ¼	24 plants located in 1995 Area not surveyed in 2008		Within Rx Unit 4 and RS Treatment, on north-facing slope above 4th of July Gulch, Site overlaps with CYFA 5-9. Outside 2008 Botanical Survey Units.
***Ptilidum californicum* (Pacific fuzzwort)**			
PTCA5-TE1 (new site, temporary number assigned) T39N-R11W-S.28, SW of NW ¼	2-inch x 4-inch area of plants located in 2008 on one ABCO	487991, 4562459	Within FRZ 5 and RS Treatment, on a northwest-facing flat slope, at 4,940 feet. 2008 Botanical Survey Unit #13. Lafayette Point.
PTCA5-RB1 (new site, temporary number assigned) T39N-R10W, S17, SE of SW ¼	1-foot by 1-foot area; approximately 1,000 individual shoots on one ABCO; 2008 Botanical Survey Unit #2-East	496747, 4564884	Within Rx Unit 6, at western boundary of M 24, on a northwest-facing slope north of Grasshopper Ridge at 5,460 feet.

Table 3-47. Summary of Forest Service Sensitive plant species sites within Eddy Gulch LSR Project proposed treatment units (continued).

Site Number and Legal Description	Site Information[a]	UTM Location[b]	Location Within Proposed Treatment Unit
***Smilax jamesii* (English Peak greenbriar)**			
SMJA-JS152 (new site, temporary number assigned) T41N-R10W, S.19, NE of SE ¼	7 new plants located in 2008 surveys	496040, 4574052	Within Rx Unit 8, along South Russian Creek, at 2,800 feet. 2008 Botanical Survey Unit #18.

Notes:

a. The surveys were conducted in August 2008.

b. Universal Transverse Mercator (UTM) coordinates available only for sites located (or re-located) during 2008 project botanical surveys.

The 36 sites of the four Forest Service Sensitive plant species are distributed within various project treatment types in the Assessment Area:

- 6 CYFA sites occur in FRZs, of which 4 are inside RS treatment areas; and 15 sites occur in Rx Units, of which 2 are within RS treatments.
- 4 of the CYMO2 sites occur in FRZs—1 of the 4 is in an RS treatment; 8 CYMO2 sites occur in Rx Units, 1 of the 8 occurs in an RS treatment.
- 1 SMJA site is located in the Riparian Reserve of Rx Unit 8.
- 1 PTCA5 site occurs within FRZ 5 and within an overlapping RS treatment; a second site occurs in Rx Unit 6, west of M Unit 24.

3.7.4 Environmental Consequences: Botanical Resources

3.7.4.1 General Direct, Indirect, Cumulative Effects

The general direct, indirect, and cumulative effects of project-related activities on Sensitive plants are described below.

Direct Effects. Sensitive plants can be directly affected when they are driven over, covered, have trees fall on them, or are burned. These actions can physically break, crush, or uproot the plants, and the effects on individual plants can reduce their growth and development, population size, and potentially, the viability of the species across the landscape. The plants may also experience reduced or eliminated seed-set and reproduction. If the disturbance is severe, plants can be killed. For annual plant species, the timing of effects is critical. Management actions that take place after annuals have set seed have much less effect than management actions performed prior to seed-set. For perennial species, the timing of effects can be equally critical. Management actions that take place after the active growing season have less effect than management activities performed during the active growing season.

Indirect Effects. Indirect effects (both beneficial and adverse) on Sensitive plants may be caused by alteration to habitat and typically include changes in vegetation composition, solar exposure, hydrologic patterns, fire regime, or soil characteristics. Indirect effects can also occur from noxious weed invasion or from effects on pollinators or mycorrhizae associated with the various species.

Cumulative Effects. The Klamath National Forest Schedule of Proposed Actions was reviewed to identify current and reasonably foreseeable future projects on the Salmon River and Scott River Ranger Districts that should be included in the cumulative effects analysis for the Eddy Gulch LSR Project. Ongoing projects include annual road maintenance, improvements to existing mining claims, hiking, and appropriate responses for fire suppression. Additional reasonably foreseeable future projects are listed above in Section 3.1.4.

Cumulative, direct, and indirect effects will be minimized by conforming to Klamath LRMP Standards and Guidelines and implementing the resource protection measures developed for this project. With those measures in place, cumulative effects are less likely to be adverse. Current management direction is designed to eliminate or reduce possible negative cumulative effects by protecting Sensitive plant species from direct and indirect effects.

3.7.4.2 Alternative A: No Action

Sensitive Vascular Plant Species

- *Cypripedium fasciculatum*—Clustered Lady-slipper Orchid—CYFA
- *Cypripedium montanum*—Mountain Lady-slipper Orchid—CYMO2
- *Smilax jamesii*—English Peak Greenbriar—SMJA

Direct and Indirect Effects. Twenty-one populations of CYFA, 12 populations of CYMO2, and 1 population of SMJA occur in the Assessment Area. The effects of a wildfire on these species are dependent on the intensity and type of fire, as well as the timing of the fire. A low or moderate surface fire (19 percent of the fire) that occurs after the growing season would result in some damage to an unknown number of CYFA and CYMO2 plants at each of the population sites (Harrod et al. 1996; USDA, USDI 1998; Knight 2008). An unknown number of damaged plants would recover, and populations in these areas would recover in the short term. A hot surface fire, or a fire that occurs during the CYFA and CYMO2 growing season, would damage or destroy an unknown number of CYFA and CYMO2 plants at each population site. Damaged and any unaffected plants would eventually recover and recolonize the affected populations in the long term. Recovery and recolonization is more likely to occur in populations with large numbers of individual plants. A moderate to hot surface fire could also indirectly affect CYFA and CYMO2 populations by reducing or eliminating critical mycorrhizal associations. Like other orchids, CYFA and CYMO2 seeds germinate in association with certain fungi that aid the developing embryo by providing nutrients necessary for development. (Orchid seeds, unlike those of other flowering plants, lack a seed coat, differentiated embryo, and endosperm.) Young orchid plants are also dependent upon mycorrhizal associations for several months or years before above-ground growth begins (USDA, USDI 1998). A surface fire that is hot enough to sterilize the soil would destroy associated mycorrhizae and seeds, indirectly affecting CYFA and CYMO2 viability and recovery after a wildfire.

A surface fire would damage above-ground portions of some or individual SMJA plants, while underground portions would be unaffected, and plants would recover in the short term. SMJA is a vine-like perennial that grows along the forest floor in riparian habitat. A surface fire within SMJA habitat would benefit SMJA populations indirectly by reducing riparian vegetation cover and competition for understory resources (moisture, substrate, soil minerals, understory light), resulting in increased viability of the SMJA population, until riparian vegetation recovers.

A passive crown fire (70 percent of the fire) would result in effects similar to a surface fire, except the overstory could also be removed in scattered locations. The opening of canopy cover in CYFA and CYMO2 habitat would alter important habitat factors and decrease population viability. These two species require shade and the associated higher soil and duff moisture and humidity. The loss of canopy cover would result in the long-term loss of CYFA and CYMO2 plants until there is restoration of the canopy cover and important habitat characteristics. The scattered removal of overstory trees in SMJA habitat and the resulting increased sunlight would increase understory vegetation and competition. This would result in the long-term decline of SMJA plants until canopy cover is restored and understory vegetation is reduced.

An active crown fire (11 percent of the fire) would burn with greater intensity and remove all canopy cover in the area affected. This would result in the direct loss of CYFA, CYMO2, and SMJA populations. Recovery of these CYFA and CYMO2 populations will not occur until a mature closed-canopied forest is re-established. Recovery of SMJA should be sooner, as riparian areas typically recover faster than mature conifer forests.

As local populations are a minor fraction of occurrences throughout the region (northwestern California and southwestern Oregon), the loss of CYFA and CYMO2 plants or populations in the Assessment Area would have a negligible effect on the viability of the two species and would be less than significant at a regional level and across the range of the two species.

While SMJA is limited to the four far-northwest counties of California, and the SMJA population in the Assessment Area represents 1 of only 17 sites in the Siskiyou County area, SMJA is currently secure in number of populations. The loss of the individual project populations would not affect viability of the species.

Cumulative Effects. The previous history of fire suppression has resulted in a build up of ground and ladder fuels in the Assessment Area. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations can compete directly with Sensitive plant populations and can permanently alter natural plant communities. Dyer’s woad is the most likely noxious weed species to invade CYFA, CYMO2, and SMJA habitat. This species is frequently found on roadsides and in open, disturbed dry sites, although at least one site in the Assessment Area continues down into a riparian area. An established infestation of Dyer’s woad (or other noxious weed species) in a CYFA, CYMO2, or SMJA project population would lead to a long-term decline of the Sensitive plant population over the long term. Noxious weed infestation is also a likely result of disturbance from annual road maintenance, fire suppression activities, and other future district projects, including the digging of a roadside trench for telephone and fiber-optic line installation, and the North Fork Roads Stormproofing Project. Each of these projects involves ground disturbance, which creates conditions for noxious weed infestations along roadsides and can permanently alter natural plant communities. Once noxious weed species are established, it can be costly to manage and remove them.

Conclusion—A surface fire and portions of a passive crown fire that remain on the surface would result in minor adverse short-term direct effects on CYFA, CYMO2, and SMJA as plants are initially damaged and then recover. A surface fire hot enough to sterilize the soil would result in long-term moderate adverse indirect effects on CYFA and CYMO2 as mycorrhizae are eliminated and recolonization, seed germination, and juvenile plant development are reduced. Where the overstory is removed as a result of a passive or active crown fire, the indirect loss of CYFA, CYMO2, and SMJA plants from habitat alteration would result in a moderate long-term adverse indirect effect until mature forest canopy cover recovers. The cumulative effects of previous fire suppression management, associated high fuel loads, and increased fire ignitions from ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area would increase risk of stand-replacing fire and create conditions for the spread and introduction of noxious weeds into the Assessment Area and CYFA, CYMO2, and SMJA populations—the result would be a long-term moderate, adverse indirect effect as weed infestations out-compete CYFA, CYMO2, and SMJA plants and other native vegetation over time. The distribution and abundance of the three species would result in a negligible change from the current distribution and abundance.

Nine Sensitive Target Species Assumed to be Present

The pre-field review determined that potential suitable habitat occurs in the proposed treatment units for 13 Forest Service Sensitive vascular and nonvascular species. Surveys were conducted for the 4 species most likely to occur in the proposed treatment units. The remaining 9 Forest Service Sensitive species are assumed to be present in the project Assessment Area and include:

- 3 species of moist environments: *Botrychium virginianum* (Rattlesnake Fern) (BOVI), *Campanula wilkinsiana* (Wilkin's harebell) (CAWI8), and *Smilax jamesii* (English Peak Greenbriar) (SMJA);

- 3 species serpentine environments: *Chaenactis suffrutescens* (Shasta chaenactis) (CHSU), *Eriogonum hirtellum* (Klamath Mountain Buckwheat) (ERHI7), and *Minuartia stolonifera* (Scott Mountain sandwort) (MIST9);

- 2 species of canopy gaps and forest edge environments: *Eucephalis vialis* (Wayside Aster) (EUVI8) and *Pedicularis howellii* (Howell's lousewort) (PEHO); and

- 1 species of montane chaparral and mixed-conifer forest environments: *Eriogonum ursinum* var. *erubescens* (Blushing Buckwheat) (ERURE).

This effects analysis assumes some number of sites of the nine additional sensitive species may occur in the proposed treatment units outside of the 2008 botanical survey areas. One site of the sensitive species (*Smilax jamesii*) was located in a treatment unit during 2008 surveys. No sites of the remaining eight additional sensitive species were located during the 2008 surveys.

Species of Moist (and Riparian) Environments—

- *Botrychium virginianum* (Rattlesnake Fern)—BOVI
- *Campanula wilkinsiana* (Wilkin's harebell)—CAWI8
- *Smilax jamesii* (English Peak Greenbriar)—SMJA

BOVI is a small fern with seasonal leaves appearing in spring and dying back in late summer. BOVI occurs in moist environments, including bogs, fens, seeps and riparian forests within lower montane coniferous forests, While the coarse-grained GIS analysis identified no acres of suitable BOVI habitat in the project treatment units, potential BOVI habitat is expected to occur in moist environments that the GIS query could not identify, including bogs, fens, seeps, and riparian habitat throughout the Assessment Area.

CAWI8 is a rhizomatous herb that occurs in meadows and seeps in upper montane coniferous forests. The GIS query identified 43 acres of suitable CAWI8 habitat in proposed treatment units. Additional potential CAWI8 habitat is expected to occur in moist environments that the GIS query could not identify, including bogs, fens, seeps, and riparian habitat throughout the Assessment Area.

SMJA is perennial trailing vine that occurs along streambanks in lower and upper montane coniferous forests. An expanded SMJA effects analysis is described here, as additional sites may occur in proposed treatment units outside of the 2008 botanical survey areas. The GIS query identified 3,080 acres of suitable SMJA habitat in the proposed treatment units. The effects of fire on BOVI, CAWI8, and SMJA have not been reported.

Direct and Indirect Effects. A surface fire would damage above-ground portions of some BOVI, CAWI8, and SMJA plants, while underground portions would be unaffected. BOVI, CAWI8, and SMJA sites would recover in the short term. A surface fire within BOVI, CAWI8, and SMJA habitat would benefit plants indirectly by reducing riparian vegetation cover and competition for understory resources (moisture, substrate, soil minerals, understory light), resulting in increased viability of any BOVI, CAWI8, and SMJA sites until riparian vegetation recovers.

A passive crown fire (70 percent of the fire) would result in effects similar to a surface fire, except the overstory would also be removed in scattered locations. The scattered removal of overstory trees in BOVI, CAWI8, and SMJA habitat would increase sunlight and competition from understory vegetation. This would result in an indirect long-term decline of BOVI, CAWI8, and SMJA plants until canopy cover is restored and understory vegetation is reduced.

An active crown fire (11 percent of the fire) would burn with greater intensity and remove all canopy cover in the affected area. This would result in the long-term direct loss of any BOVI, CAWI8, and SMJA sites until riparian overstory recovers.

Cumulative Effects. The previous history of fire suppression has resulted in a build up of ground and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations can compete directly with Sensitive plant sites and can permanently alter natural plant communities. Dyer's woad is the most likely noxious weed species to invade BOVI, CAWI8, and SMJA habitat. While this weed species is frequently found on roadsides and in open, disturbed dry sites, at least one site in the Assessment Area continues down into a riparian area. An established infestation of Dyer's woad (or other noxious weed species) in a BOVI, CAWI8, or SMJA project site would lead to a long-term decline of the Sensitive plant site over the long term. Noxious weed infestation is also a likely result of disturbance from annual road maintenance, fire suppression activities, and other future district projects, including the digging of a roadside trench for telephone and fiber-optic line installation, and the North Fork Roads Stormproofing Project. Each of these projects involves ground disturbance that creates the conditions for noxious weed infestations along roadsides that can permanently alter natural plant communities. Once noxious weed species are established, management and removal can be costly.

Conclusion—A surface fire and portions of a passive crown fire that remain on the surface would result in short-term minor adverse direct effects on BOVI, CAWI8, and SMJA as plants are initially damaged and then recover. If the overstory is removed as a result of a passive or active crown fire, the loss of BOVI, CAWI8, and SMJA plants from habitat alteration would result in a long-term moderate adverse indirect effect until mature forest canopy cover recovers. The cumulative effects of previous fire suppression management, associated high fuel loads, and increased fire ignitions from ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area would increase risk of stand-replacing fire and create conditions for the spread and introduction of noxious weeds into the Assessment Area and BOVI, CAWI8, and SMJA sites. The result would be a long-term moderate adverse indirect effect as weed infestations out-compete BOVI, CAWI8, and SMJA plants and other native vegetation over time. The distribution and abundance of the three species would result in a negligible change from the current distribution and abundance.

Species of Serpentine Environments—

- *Chaenactis suffrutescens* (Shasta chaenactis)—CHSU
- *Eriogonum hirtellum* (Klamath Mountain buckwheat)—ERHI7
- *Minuartia stolonifera* (Scott Mountain sandwort)—MIST9

The pre-field review GIS query identified 41 acres of potential suitable CHSU habitat in the treatment units. Additional potential CHSU habitat is expected to occur in the project Assessment Area in serpentine habitat that the GIS query could not identify.

The GIS query identified no acres of potential suitable ERHI7 habitat in the treatment units. Potential ERHI7 habitat is expected to occur in the project Assessment Area in serpentine habitat that the GIS query could not identify.

The GIS query identified only 3 acres of potential suitable MIST9 habitat in the treatment units. Additional MIST9 habitat is expected to occur in serpentine habitat in the project Assessment Area that the GIS query could not identify.

The effects of fire on CHSU, ERHI7, and MIST9 have not been reported in the literature. Although the ecology of serpentine ecosystems in California has been the subject of many dozens of scientific studies, the fire ecology of serpentine habitats has remained largely unexplored, and the role of fire in serpentine ecosystems is poorly understood. Wildfire frequency and intensity in serpentine habitats is generally considered to be lower than in surrounding non-serpentine habitats due to lower availability and continuity of woody fuels (Safford and Harrison 2008).

Direct and Indirect Effects. A surface fire would burn above-ground portions (leaves, flowers/fruits, or stems) but not damage below-ground (caudex, roots) portions of CHSU, ERHI7, and MIST9. Surface fires, however, would also cause an increase in competing early seral vegetation cover (such as grass species), with a resulting decrease in plants at any CHSU, ERHI7, or MIST9 sites. The result of a surface fire on CHSU, ERHI7, and MIST9 in serpentine habitat include (1) a short-term minor adverse direct effect as burned plants would recover in the short term, and (2) a long-term moderate adverse indirect effect because the increase in competing early seral vegetation (that is, grass species) would out-compete some CHSU, ERHI7, and MIST9 plants for resources.

Passive and active crown fires would remove some or all canopy cover in CHSU, ERHI7, and MIST9 habitat. The physical removal of canopy would result in minimal effects because all three species occur in open overstory habitats. However, crown fires in serotinous cone species in the overstory (that is, *Pinus sabiteana* or *P. contorta*) would increase seed supply and germination, resulting in an increase in seedlings of these species that would compete with CHSU, ERHI7, and MIST9. Passive and active crown fires would result in (1) a long-term negligible adverse direct effect as canopy cover is reduced; and (2) a long-term moderate adverse indirect effect where an increase in serotinous pine seedlings would out-compete some CHSU, ERHI7, and MIST9 plants for resources.

Cumulative Effects. The previous history of fire suppression has resulted in a build up of surface and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations can compete directly with Sensitive plant sites and can permanently alter natural plant communities. Dyer's woad, yellow starthistle, and meadow knapweed are the most likely noxious weed species to invade serpentine habitat. An established infestation of noxious weeds in any CHSU, ERHI7, and MIST9 sites would lead to a long-term decline of these three serpentine species. Noxious weed infestation is also a likely result of disturbance from annual road maintenance, fire suppression activities, and other future district projects, including the digging of a roadside trench for telephone and fiber-optic line installation, and the North Fork Roads Stormproofing Project. Each of these projects involves ground disturbance that creates the conditions for noxious weed infestations along roadsides. Once noxious weed species are established, management and removal can be costly.

In addition to the indirect effects of noxious weed infestations, the increase in fuels in serpentine habitats above historic levels would result in an increase in fire intensity. The increased fire intensity would create hotter surface fires, resulting in damage and possible destruction of the three serpentine plants, as high soil temperatures destroy underground portions of plants. The result would be a long-term moderate adverse direct effect.

Conclusion. A surface fire would result in a short-term minor adverse direct effect as burned plants would recover in the short term, and a long-term moderate adverse indirect effect because the increase in competing early seral vegetation (such as grass species) would out-compete some CHSU, ERHI7, and MIST9 plants for resources. Passive and active crown fires would result in a long-term negligible adverse direct effect as canopy cover is reduced; and (2) a long-term moderate adverse indirect effect where an increase in serotinous pine seedlings would out-compete some CHSU, ERHI7, and MIST9 plants for resources. The cumulative effects of previous fire suppression management, associated high fuel loads, and increased fire ignitions would (1) increase the risk of stand-replacing fire and create conditions for the spread and introduction of noxious weeds—the result would be a long-term moderate adverse indirect effect as weed infestations out-compete CHSU, ERHI7, and MIST9 plants and other native vegetation for resources; and (2) create hotter surface fires, with damage and possible destruction of CHSU, ERHI7, and MIST9 plants, resulting in a long-term moderate adverse direct effect.

Species of Canopy Gap and Forest Edge Environments—

- *Eucephalis vialis* (Wayside Aster)—EUVI8
- *Pedicularis howellii* (Howell's lousewort)—PEHO

EUVI8 is a perennial herb with a thickened woody stem (caudex) and rhizomes. EUVI8 sites occur in canopy gaps, clearcuts, forest edges, and on roadsides. The species' preferred habitat is thought to have been historically sustained by frequent fire return intervals that created open forest conditions with widely spaced conifers. EUVI8 flowers in late summer to early fall and occurs from eastern Del Norte to southern Humboldt counties and north to Oregon. The coarse-grained GIS query identified no potential suitable EUVI8 acres in the treatment units, but potential suitable EUVI8 habitat is expected to occur along roads (including roads outside of and within RS treatments), and in forest edge / canopy gap habitat within FRZs and Rx Units.

PEHO is an herbaceous perennial green root parasite in the Scophulariaceae (figwort) plant family. This species is found in partial shade or along the edges of forest openings in a variety of conifer/shrub plant associations. PEHO is most abundant where the mixed-conifer canopy is less than 40 percent, created by either natural forest processes (fire, windthrow, disease) or manmade forest edges such as trails, roads, or other openings. This species flowers in June and July and is found only in the Siskiyou Mountains of southwestern Oregon and northwestern California. The coarse-grained GIS query identified no potential suitable PEHO habitat in the treatment units, but potential suitable PEHO habitat is expected to occur in forest edge / canopy gap habitat within FRZs and Rx Units.

Direct and Indirect Effects. A surface fire would burn above-ground portions (leaves, flowers/fruits or stems) but would not damage below-ground portions (caudex [stem], roots) of any EUVI8 and PEHO plants. Both species are associated with canopy gap habitat and are likely tolerant of surface fires. The results would be a very short-term minor adverse direct effect (as plants resprout and recover) and a long-term minor beneficial indirect effect as competing vegetation decreases and EUVI8 or PEHO site vigor increases.

A passive crown fire would result in effects similar to a surface fire, except the overstory could also be removed in scattered locations. The removal of some canopy overstory would improve any EUVI8 and PEHO site conditions by creating more edge-canopy gap habitat, resulting in a long-term minor beneficial indirect effect as EUVI8 and PEHO site vigor increases.

An active crown fire would burn with greater intensity and remove all canopy cover in the affected area. This would result in the direct loss of some EUVI8 or PEHO sites—the preferred habitat for both species includes some canopy overstory. The result would be a long-term moderate adverse indirect effect until some canopy overstory is re-established.

Cumulative Effects. The previous history of fire suppression has resulted in a buildup of ground and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations can compete directly with Sensitive plant sites and can permanently alter natural plant communities. Dyer's woad, yellow starthistle, and meadow knapweed are the most likely noxious weed species to invade EUVI8 and PEHO habitat. An established infestation of noxious weeds in these species' sites would lead to a long-term decline of the sites. Noxious weed infestation would also be a likely result of disturbance from annual road maintenance, fire suppression activities, and other future district projects, including the digging of a roadside trench for telephone and fiber-optic line installation and the North Fork Roads Stormproofing Project. Each of these projects involves ground disturbance, which creates conditions for noxious weed infestations along roadsides and can permanently alter natural plant communities. Once noxious weed species are established, management and removal can be costly.

Conclusion. A surface fire and portions of a passive crown fire that remain on the surface would result in a very short-term minor adverse direct effect (as plants resprout and recover) and a long-term minor beneficial indirect effect as competing vegetation is reduced and EUVI8 or PEHO site vigor increases. A passive crown fire would result in a long-term minor beneficial indirect effect as EUVI8 and PEHO site vigor increases from overstory canopy opening. An active crown fire would result in a long-term moderate adverse indirect effect until some canopy overstory is re-established. The cumulative effects of previous fire suppression management, associated high fuel loads, and increased fire ignitions would result in a long-term moderate adverse indirect effect as conditions are created for the spread and introduction of noxious weeds that would outcompete EUVI8 and PEHO plants and other native vegetation.

Montane Chaparral and Mixed-Conifer Environments—

- *Eriogonum ursinum* var. *erubescens* (Blushing Buckwheat)—ERURE

ERURE is a spreading, matted perennial herb that occurs in gravelly metavolcanic soils in montane chaparral and conifer/mountain mahogany plant communities. ERURE flowers from June through September and is localized and rare, and known only to occur in Siskiyou County west of Yreka and the Shasta County / Trinity County line. The coarse-grained GIS query identified no potential suitable ERURE acres in the treatment units, but potential suitable ERURE habitat is expected to occur in the project Assessment Area in chaparral habitat that the GIS query could not identify.

Direct and Indirect Effects. A surface fire would burn above-ground portions (leaves, flowers/fruits, or stems) but not damage below-ground portions (roots) of ERURE. The result would be a short-term minor adverse direct effect on any ERURE sites as plants would recover in the short term.

A passive or active crown fire would have the same effects as a surface fire, with additional effects resulting from canopy removal. ERURE occurs in open chaparral and conifer / mountain mahogany habitat. Passive and active crown fires would remove some or all chaparral, hardwood, and conifer canopy cover. The result would be a long-term minor adverse indirect effect because any shade provided by the canopy would be lost, and surface temperatures would increase, resulting in some minor damage to any ERURE sites until chaparral or conifer canopy cover recovers.

Cumulative Effects. The previous history of fire suppression has resulted in a build up of ground and ladder fuels in the Assessment Area. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations can compete directly with Sensitive plant sites and can permanently alter natural plant communities. Dyer’s woad, yellow starthistle, and meadow knapweed are the most likely noxious weed species to invade ERURE chaparral habitat. An established infestation of noxious weeds in any ERURE sites would lead to a long-term decline of the site as plants are outcompeted by invasive weeds. Noxious weed infestation is also a likely result of disturbance from annual road maintenance, fire suppression activities, and other future district projects, including the digging of a roadside trench for telephone and fiber-optic line installation, and the North Fork Roads Stormproofing Project. Each of these projects involves ground disturbance, which creates the conditions for noxious weed infestations along roadsides that can permanently alter natural plant communities. Once noxious weed species are established, management and removal can be costly.

In addition to the indirect effects of noxious weed infestations, the increase in fuels in ERURE chaparral habitat above historic levels would result in an increase in fire intensity. The increased fire intensity would create hotter surface and canopy fires, resulting in damage and possible destruction of any ERURE plants because high soil temperatures can destroy underground portions of plants. The result would be a long-term moderate adverse direct effect.

Conclusion—A surface fire and portions of a passive crown fire that remain on the surface would result in a short-term minor adverse direct effect on any ERURE sites because plants would recover in the short term. Passive and active crown fires would result in a long-term minor adverse indirect effect until destroyed canopy cover recovers. The cumulative effects of previous fire suppression management, associated high fuel loads, and increased fire ignitions would (1) increase risk of stand-replacing fire and create conditions for the spread and introduction of noxious weeds—the result would be a long-term moderate adverse indirect effect because weed infestations would out-compete any ERURE plants and other native vegetation over time; and (2) create hotter surface fires, resulting in damage and possible destruction to ERURE plants and resulting in a long-term moderate adverse direct effect.

Sensitive Fungi Species

- *Boletus pulcherrimus*, *Cudonia monticola*, *Dendrocollybia racemosa*, *Phaeocollybia olivacea*, *Sowerbyella rhenana*, *Tricholomopsis fulvescens*

There is no species-specific information available for the above 6 Sensitive fungi species that may be present within the project Assessment Area. General information is available, however, for the two major groups of fungi (mycorrhizal and saprophytic). Fungi differ from vascular plants (flowering plants) in several important ways that affect their response to management activities. Fungi do not have roots, but rather depend upon an extensive network of fungal mycelium to support the plants. Mycelia are fine, net-like structures that penetrate the soil, rotting wood, duff, or other substrates. Mycelia that penetrate the roots of vascular plants form mycorrhizae. The fruiting structure of a fungus can form anywhere along the network of mycelia. When the substrate within which the mycelial network occurs is disturbed, the fungus is not necessarily killed. Rather, the network will be broken into many fragmented parts that will continue to live and fruit as long as a nutrient source—vascular plants for mycorrhizal species or rotten wood for saprophytic species—and a moisture source persists. Specifically, this means that ground disturbance from logging and fuel treatments, and changes in moisture levels from canopy removal (direct effect), will not necessarily kill fungi populations unless critical habitat elements are removed to an extent that the habitat can no longer support the fungi species (indirect effect) (USDA 2007).

The following effects analyses are based primarily upon references provided in a literature review conducted by Lisa Hoover, Forest Botanist, Six Rivers National Forest (USDA 2007). There is little information available about species-specific effects, but information has been gathered about the effect of management actions upon ectomycorrhizal (ECM) fungi in general. While not eliminating potential effects to target fungal taxa, it is assumed that by managing for habitat elements, adverse effects on communities supporting any one of the target fungi will be reduced.

Mycorrhizal Fungi Species—

- *Boletus pulcherrimus*, *Phaeocollybia olivacea*

Direct and Indirect Effects. Because there is an overall low probability that *Boletus pulcherrimus* (BOPU4) and *Phaeocollybia olivacea* (PHOL) are present within the project Assessment Area, there is also a low potential for an effect to individual fungi populations. The suitable habitat for these species is located along wet, north facing riparian areas within 25 feet of perennial streams, at the lower to mid-elevations, and within mature timber stands. A surface fire in these areas would generally be of low-intensity due to the higher moisture levels present. There is potential that a population could be affected if a portion is burned, but it is unlikely that a surface fire would burn at high intensity throughout the entire population. Because these species are not killed when a portion of a population is affected, this would not affect the entire population or habitat. Additionally, a surface fire would still retain important habitat elements including adequate mature live overstory and understory trees, substrate recruitment trees, and coarse and fine woody debris. The retention of these habitat elements would ensure that potential populations of these species would be maintained. A surface fire would result in a direct short-term minor adverse effect as individuals are destroyed but any entire population would be unaffected and/or recover in the short term.

A passive or active crown fire would indirectly affect these two fungi species if suitable habitat elements are impacted. Because these two fungi are mycorrhizal with mixed-conifers and hardwood tree roots, if a passive or active crown fire destroys or damages mature overstory substrate trees (or substrate recruitment trees), and/or if canopy removal is extensive enough to significantly reduce adequate moisture levels, and/or if coarse woody debris is consumed, individuals would be indirectly affected. Individuals might be burned, but, as with a surface fire, because these species are not killed when a portion of a population is affected, this would not affect the entire population or habitat. The overstory within the fungi's riparian habitat, however, would burn with lower intensities than in upland stands and elements of suitable fungi habitat would be retained. The retention of these habitat elements would ensure that any populations of these species would be maintained. A passive or active crown fire would result in an indirect minor long-term adverse effect as some suitable fungi habitat would be damaged or destroyed and individual BPOU4 and PHOV would be impacted but any populations would remain or recover in the long term, and any impacted habitat elements would recover in the long term.

Cumulative Effects. The previous history of fire suppression has resulted in a buildup of ground and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the project Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. The direct and indirect effects of wildfire are discussed above. Future district projects expected to occur in the short- and long-term include annual road maintenance, fire suppression activities, the installation of telephone and fiber-optic lines (and associated disturbance from roadside trenches), and the North Fork Roads Stormproofing Project. Each of these district projects involves ground disturbance near road sides or other upland site locations, outside of BOPU4 and PHOV riparian habitat. Mining activities, however, do occur near streams and may occur within the riparian habitat of these two species. Ground disturbance from mining would damage or destroy individual BOPU4 or PHOV but any populations would be maintained. No cumulative effects are expected from effects from wildfire and mining.

Conclusion—A surface fire would result in a direct short-term minor adverse effect as individuals are destroyed but any entire population would be unaffected and/or recover in the short term. A passive or active crown fire would result in an indirect minor long-term adverse effect as some suitable fungi habitat would be damaged or destroyed and individual BPOU4 and PHOV would be impacted but any populations would remain or recover in the long term, and any impacted habitat elements would recover in the long term. And mining activities would result in direct short-term negligible adverse effects as individual BOPU4 and PHOV may be destroyed but any populations would be maintained. No cumulative effects to these two fungi species are expected from wildfire and mining activities.

Saprophytic Fungi Species—

- *Cudonia monticola*, *Dendrocollybia racemosa*, *Sowerbyella rhenana*, *Tricholomopsis fulvescens*

Direct and Indirect Effects. Because there is an overall low probability that *Cudonia monticola* (CUMO2)*, Dendrocollybia racemesas* (DERA5)*, Sowerbyella rhenana* (SORH)*,* and *Tricholomopsis fulvescens* (TRFU3) are present within the proposed project activity areas, there is also a low potential for an effect to individual fungi populations. The suitable habitat for these species is located along wet, north facing riparian areas within 25 feet of perennial streams, at the lower to mid-elevations, and within mature timber stands. A surface fire in these areas would generally be of low-intensity due to the higher moisture levels present. There is potential that a population could be affected if a portion is burned, but it is unlikely that a surface fire would burn at high intensity throughout the entire population. Because these species are not killed when a portion of a population is affected, this would not affect the entire population or habitat. Additionally, a surface fire would still retain important habitat elements including adequate coarse and fine woody debris as fungi substrate and stand and surface moisture levels. The retention of these habitat elements would ensure that potential populations of these species would be maintained. A surface fire would result in a direct short-term minor adverse effect as individuals are destroyed but any entire population would be unaffected and/or recover in the short term.

A passive or active crown fire would indirectly affect these four fungi species if suitable habitat elements are impacted. The four saprophytic fungi obtain nutrients from the decomposition of dead organic matter and are dependent upon adequate amounts of leaves, needles, limbs, large woody debris, other decomposing forest litter, or even dead animal carcasses to provide a substrate and to supply a continuous source of nutrients. Soil moisture is also important. The removal of canopy cover itself from a passive or active crown fire would not affect these species directly. If canopy cover is extensive enough to significantly reduce adequate soil moisture levels, and/or if coarse woody debris is also consumed, individuals would be indirectly destroyed or damaged, but because these species are not killed when a portion of a population is affected, this would not affect the entire population or habitat. The overstory within the fungi’s riparian habitat, however, would burn with lower intensities than in upland stands and elements of suitable fungi habitat would be retained. The retention of these habitat elements would ensure that any populations of these species would be maintained. A passive or active crown fire would result in an indirect minor long-term adverse effect as some suitable fungi habitat would be damaged or destroyed, individual CUMO2, DERA5, SORH and TRFU3 would be impacted but any populations would remain or recover in the long term, and impacted habitat elements (soil moisture) would recover in the long term.

Cumulative Effects. The previous history of fire suppression has resulted in a buildup of ground and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the project Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. The direct and indirect effects of wildfire are discussed above. Future district projects expected to occur in the short- and long-term include annual road maintenance, fire suppression activities, the installation of telephone and fiber-optic lines (and associated disturbance from roadside trenches), and the North Fork Roads Stormproofing Project. Each of these district projects involves ground disturbance near road sides or other upland site locations, outside of CUMO2, DERA5, SORH and TRFU3 riparian habitat. Mining activities, however, do occur near streams and may occur within the riparian habitat of these two species. Ground disturbance from mining would damage or destroy individual fungi but any populations would be maintained. No cumulative effects are expected from effects from wildfire and mining.

Conclusion—A surface fire would result in a direct short-term minor adverse effect as individuals are destroyed but any entire population would be unaffected and/or recover in the short term. A passive or active crown fire would result in an indirect minor long-term adverse effect as some suitable fungi habitat would be damaged or destroyed, individual CUMO2, DERA5, SORH and TRFU3 would be impacted but any populations would remain or recover in the long term, and impacted habitat elements (soil moisture) would recover in the long term. And mining activities would result in direct short-term negligible adverse effects as individual fungi would be destroyed but any populations would be maintained. No cumulative effects to these four fungi species are expected from wildfire and mining activities.

Sensitive Bryophyte Species

- *Ptilidium californicum* (Pacific Fuzzwort)—PTCA5

Direct and Indirect Effects. Two populations of PTCA5 occur in the Assessment Area on northwest aspects, at the base of large-diameter white fir trees in upper elevation forests. The effect of a wildfire on this species is dependent on the intensity of the fire. A surface fire (19 percent of the fire) would result in damage to or loss of some or all PTCA5 plants. Where all plants are destroyed, recolonization is not likely to occur because PTCA5 does not recolonize over long distances and does not occur on burned substrates. Where a portion of a PTCA5 population remains, recolonization would occur slowly, with a short- to long-term recovery. A surface fire that also consumes PTCA5 microhabitat components (duff layers and coarse woody debris, logs, associated bryophyte populations) would have an adverse indirect effect on PTCA5; the loss of microhabitat components that regulate humidity, temperature, and shade would lessen or slow the recovery and recolonization of PTCA5.

A passive crown fire (70 percent of fire) would have the same effects as a surface fire with the additional loss of canopy trees in scattered locations. The loss of scattered canopy cover would alter critical PTCA5 habitat components (increased solar radiation, increased temperature, decreased soil moisture, decreased humidity, and a decrease in potential substrate tree bases), and unburned PTCA5 populations would decline because recovery and recolonization of burned plants would be significantly reduced.

An active crown fire (11 percent of the fire) would include the same effects as a surface fire and burn with greater intensity and remove all canopy cover. The active crown fire would result in the loss of all PTCA5 plants. PTCA5 recolonization would be unlikely or negligible and would not occur until a mature, closed-canopy forest is re-established.

PTCA5 ranges from southeast Alaska, south to northern California. The loss of Assessment Area PTCA5 plants would result in a negligible adverse effect on the viability of this species. However, because the northern California PTCA5 populations represent the southern extent of the species and may be a fragment of a relict population, these populations should be managed to maintain the genetic diversity of this species (USFS 1997a, 2006b).

Cumulative Effects. The previous history of fire suppression has resulted in a build up of ground and ladder fuels in the treatment units. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Competition from invasive noxious weeds would affect other vegetation (herbaceous and shrub layers) in PTCA5 stands, but would have a minor effect on the recovery or recolonization of PTCA5. District projects that include roadside disturbance (such as annual road maintenance and hazard tree removal, the digging of a roadside trench for telephone and fiber-optic line installation, and fire suppression activities) could damage PTCA5 plants or alter habitat as roadside trees are removed or disturbed. Disturbances would affect the roadside PTCA5 population (PTCA5-#TE1) located on the northwest side of a roadside tree, approximately one mile south of Bacon Rind. If the substrate tree is removed, and no other disturbance occurs, the PTCA5 population would have no immediate adverse effects. As the stump dies and bark sloughs off, the PTCA5 population would slowly decline and eventually die as the plant's substrate deteriorates. If project activities along roads disturb the substrate tree or the PTCA5 plants directly, the population is likely to decline or be destroyed, and recolonization would be slow if at all. Where project activities along roads alter overstory habitat or other critical PTCA5 habitat features (humidity, soil moisture, shade, and associated bryophyte cover), individual PTCA5 plants and the population viability would decline over time.

Conclusion—A surface fire and portions of a passive crown fire that remain on the surface would damage or destroy PTCA5 plants and result in short- and long-term minor to major adverse direct effects. A surface fire and portions of a passive crown fire would also alter important PTCA5 habitat microhabitat features that would damage PTCA5 plants or slow the recovery/recolonization of PTCA5—the result would be short- and long-term minor to major adverse indirect effects on PTCA5. Where the overstory is removed as a result of a passive or active crown fire, PTCA5 habitat would be altered and PTCA5 plants would decline or die—the result would be a long-term moderate adverse indirect effect on PTCA5. The cumulative effects of increased fire ignitions and increased fuel loads from previous fire suppression management would increase the risk of stand-replacing fire and conditions for noxious weeds infestation into PTCA5 populations; the result would be a long-term minor adverse indirect effect on PTCA5. Cumulative effects from other district projects that disturb roadsides would result in a long-term moderate adverse direct effect from removing or damaging the PTCA5 substrate tree, and a long-term moderate adverse indirect effect from habitat alteration leading to the decline or loss of PTCA5 plants.

Sensitive Lichen Species

- *Hydrothyria venosa* (syn. *Peltigera hydrothyria*) (Waterleaf Lichen)—HYVE7

Direct and Indirect Effects. No sites of *Hydrothyria venosa* (HYVE7) are known to occur in the Assessment Area. Surveys in 2008 included a number of streams with low to moderate potential HYVE7 habitat. Additional potential habitat may occur outside of the 2008 survey areas.

A surface fire (19 percent of a wildfire) would have no direct effect on this species because it occurs on rocks in perennial streams. Surface fires would, however, burn small understory trees and ground fuels along riparian areas, which would improve HYVE7 riparian habitat by (1) removing fuels and avoiding the potential for a destructive wildfire, and (2) increasing resources for riparian overstory trees that contribute shade and moderate stream temperatures important to HYVE7 viability. The improved riparian habitat would result in a moderate short-term beneficial indirect effect until understory vegetation recovers and ground fuels are replaced.

A passive or active crown fire (70 and 11 percent, respectively) would also not affect HYVE7 directly, but would indirectly affect HYVE7 habitat. Passive and active crown fires would destroy some or all overstory trees along HYVE7 riparian habitat, which would result in a loss of important overstory shade and an increase in stream temperatures as solar radiation increases. The increased solar radiation would result in a moderate indirect adverse long-term effect until overstory canopy is restored.

Cumulative Effects. The previous history of fire suppression has resulted in a build up of ground and ladder fuels in the Assessment Area. The ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area create potential for fire ignitions; these combined factors would increase the risk of stand-replacing wildfire in the treatment units. A frequent result of stand-replacing wildfires, and the corresponding suppression activities, is the formation of conditions favorable to noxious weed invasion. Noxious weed infestations are unlikely to directly affect any HYVE7 sites. Stand-replacing fires often result in post-fire increases in stream flows and siltation when large amounts of upland vegetation are consumed. The increase in stream flows and siltation would directly destroy HYVE7 plants and HYVE7 habitat, resulting in long-term moderate adverse indirect effects on HYVE7 until stream flows and siltation levels recover. Mining activities along streams with any HYVE7 sites are also likely to affect this aquatic lichen by disturbing HYVE7 substrate habitat (rocks) and destroying plants and indirectly increasing stream siltation. Mining activities in HYVE7 sites would result in (1) a long-term moderate adverse direct effect if HYVE7 substrate or plants are destroyed or disturbed, and (2) a long-term moderate adverse indirect effect if siltation levels increase and destroy plants.

Conclusion—A surface fire would result in no direct effect on HYVE7 and a moderate indirect beneficial short-term effect until understory vegetation recovers and ground fuels are replaced. A passive or crown fire would increase solar radiation along HYVE7 riparian habitat and result in a moderate indirect adverse long-term effect until overstory canopy is restored. Cumulative effects of Alternative A include the likelihood of a stand-replacing fire with (1) an increase in noxious weeds and stream flows and stream siltation levels following the stand-replacing wildfire. The results include (1) no short-term or long-term direct effect on HYVE7 plants from weed infestations, and (2) a long-term moderate adverse indirect effect until stream flows and siltation levels recover. Mining activities would also have a cumulative effect by disturbing or destroying HYVE7 plants or habitat, resulting in (1) a long-term moderate adverse direct effect if HYVE7 substrate or plants are destroyed or disturbed, and (2) a long-term minor to moderate adverse indirect effect if siltation levels increase and indirectly destroy plants.

3.7.4.3 Alternative B: Proposed Action

Sensitive Vascular Species

- *Cypripedium fasciculatum*—Clustered Lady-slipper Orchid—CYFA
- *Cypripedium montanum*—Mountain Lady-slipper Orchid—CYMO2
- *Smilax jamesii*—English Peak Greenbriar—SMJA

Direct and Indirect Effects: CYFA and CYM02. Twenty-one CYFA and 12 CYMO2 sites occur in the Assessment Area, within all treatment types (FRZs and Rx Units, RS treatments in FRZs, and within Riparian Reserves in both FRZs and Rx Units). The resource protection measures for CYFA and CYM02 have been designed into the Proposed Action (refer to Table 3-3). The resource protection measures (RPMs) are intended to protect individual plants and maintain habitat characteristics that are critical to the maintenance of long-term viable plant populations, in accordance with the desired conditions of the Standards and Guidelines contained in the Klamath

National Forest Land and Resource Management Plan (Klamath LRMP) (USFS 1995). While it is assumed that CYFA and CYMO2 have evolved with wildfire in the landscape, the levels of ground and ladder fuels in these sites is considered outside the historic range due to fire suppression. The resource protection measures, therefore, allow fuel reduction treatments to occur in stands containing CYFA and CYMO2 sites when it is outside the active growing period, or if within the growing period, those sites will be protected from treatments with a 25-foot buffer. With the implementation of the resource protection measures, Alternative B would enhance CYFA and CYMO2 habitat and protect plants from potential mortality from a stand-replacing fire and likely lead to long-term viability of the CYFA and CYMO2 populations in the Assessment Area.

Cumulative Effects: CYFA and CYM02. Ongoing district projects and projects scheduled for the foreseeable future include annual road maintenance, improvements to existing mining claims, hiking, and appropriate responses for fire suppression, installation of utility lines with associated roadside trenching, the North Fork Roads Stormproofing Project, and the construction of a fuelbreak system west of Black Bear Ranch. The Proposed Action would prevent the risk of stand-replacing fire from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The prevention of stand-replacing fire would benefit these two species by preventing the direct loss or damage of CYFA and CYMO2 plants and habitat from fire.

A secondary benefit of the prevention of stand-replacing fire is the prevention of a potential weed infestation—a frequent result of stand-replacing wildfires and the corresponding suppression activities. The prevention of a weed infestation would directly benefit CYFA and CYMO2 by avoiding competition that could lead to a decline in native vegetation and CYFA and CYMO2 populations. Other district projects, however, may increase the potential for noxious weed invasion through ground disturbance (that is, disturbance from annual road maintenance, fire suppression activities, the digging of a roadside trench for telephone and fiber-optic line installation, and the North Fork Roads Stormproofing Project). A weed infestation would compete with native vegetation and CYFA and CYMO2 populations and lead to a decline in population viability. Dyer’s woad is the most likely local noxious weed species to invade CYFA and CYMO2 habitat. While this weed is frequently found on roadsides and in open, disturbed dry sites, at least one site in the Assessment Area continues down into a riparian area.

Conclusion: CYFA and CYMO2—The Proposed Action, with the implementation of resource protection measures, would result in long-term moderate beneficial direct and indirect effects on CYFA and CYMO2 populations as long-term population viability is enhanced, and plants and habitat are protected from a stand-replacing wildfire and secondary weed infestation. The cumulative effects of district projects that create ground disturbance may increase weed infestations in CYFA and CYMO2 habitat that would out-compete native vegetation and CYFA and CYMO2 plants and contribute to the decline of CYFA and CYMO2 populations; the result would be a long-term moderate adverse indirect effect on CYFA and CYMO2 populations.

Direct and Indirect Effects: SMJA. One SMJA site occurs in a Riparian Reserve within an Rx Unit. The prescribed fire treatments in Riparian Reserves have been modified to protect riparian resources and include the following: (i) the building of handlines will stop within 25 feet of the wetted edge of channels; (ii) prescribed fires will be ignited to minimize potential for moderate- or high-intensity burns; and (iii) when underburning, at least 90 percent of the large woody debris will not be consumed, both standing and on the ground. The low-intensity fires proposed for the SMJA habitat in the Riparian Reserve would directly burn above-ground portions (leaves, flowers/fruits, or stems) but not damage below-ground portions (caudex, roots) of SMJA. SMJA plants would recover in the short term. The low-intensity fires would enhance SMJA habitat by removing low to moderate amounts of competing vegetation and ground fuels and small-diameter trees. The removal of competing vegetation and understory fuels would reduce competition for resources until vegetation recovers and fuel loads eventually increase.

Cumulative Effects: SMJA. The Proposed Action would reduce the risk of stand-replacing fire that would result from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The prevention of stand-replacing fire would benefit this species by avoiding the direct loss or damage of SMJA plants and habitat from fire. A secondary benefit of the prevention of stand-replacing fire is the prevention of a potential noxious weed infestation—a frequent result of stand-replacing wildfires and the corresponding suppression activities. The prevention of a weed infestation would directly benefit SMJA by avoiding competition that could lead to a decline in native vegetation and the SMJA population. Other district projects, however, that create disturbance along riparian areas (that is, improvements to mining claims) could destroy or damage SMJA plants directly or indirectly through alteration of riparian habitat.

Conclusion—The proposed fuel reduction treatments under the Proposed Action would result in (1) a short-term negligible adverse direct effect if plants burn and then recover, and (2) a long-term moderate beneficial indirect effect as SMJA riparian habitat is enhanced and competition for resources is reduced, and plants and habitat are protected from a stand-replacing fire and secondary weed infestation. Cumulative effects from mining claim improvement activities in riparian areas may result in long-term minor to moderate adverse direct and indirect effects on SMJA as plants and/or habitat are destroyed or damaged.

Additional SMJA sites may occur in proposed treatment units outside of the 2008 survey areas. Any new SMJA sites would occur in riparian habitat within FRZs or Rx Units. This species is unlikely to occur in RS treatments or in mechanical thinning units in FRZs, which are located on uplands and ridgetops. Any SMJA sites in riparian zones of FRZs or Rx Units would have the same effects as the known SMJA site described above.

Nine Sensitive Target Species Assumed to be Present

Species of Moist (and Riparian) Environments—

- *Botrychium virginianum* (Rattlesnake Fern)—BOVI
- *Campanula wilkinsiana* (Wilkin’s harebell)—CAWI8
- *Smilax jamesii* (English Peak Greenbriar)—SMJA

The effects on SMJA from implementing Alternative B is included in the section above.

Direct and Indirect Effects. No BOVI or CAWI8 sites are known to occur in the proposed treatment units. This effects analysis assumes that some number of BOVI and CAWI8 sites may occur in proposed FRZs or Rx Units outside the 2008 botany survey areas. BOVI and CAWI8 occur in moist habitats including meadows, seeps, bogs, and streamsides. This habitat is common in both FRZs and Rx Units within Riparian Reserves. BOVI and CAWI8 habitat is less likely to occur in mechanical thinning units located along upland and ridgeline areas and is unlikely in proposed RS treatments. The proposed treatments in Riparian Reserves in FRZs include mastication (on slopes less than 45 percent) or hand thinning and piling (on slopes greater than 45 percent) to remove small trees in FRZs. Within Riparian Reserves in Rx Units, low-intensity backing fires are proposed.

The implementation of mastication or hand-thinning and piling of small trees in FRZs would damage or destroy BOVI and CAWI8 plants and result in a long-term minor to moderate adverse direct effect as few plants would recover or recolonize. The use of low-intensity backing fires in Rx Units would damage some above-ground portions of any BOVI or CAWI8 plants and would result in a short-term minor adverse direct effect as plants would recover and recolonize. The post-treatment reduction in ground and small ladder fuels in stands where these two species might occur would result in long-term moderate beneficial indirect effects because the likelihood of stand-replacing wildfires would be reduced, and BOVI and CAWI8 site stability and vigor would be maintained in the long term.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fire resulting from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. A secondary benefit is the avoidance of potential noxious weed infestations—a frequent result of stand-replacing wildfires and the corresponding suppression activities. The prevention of a weed infestation would directly benefit BOVI and CAWI8 sites by avoiding competition that could lead to a decline in native vegetation and the BOVI and CAWI8 plants. Other activities (such as improvements to mining claims), however, that create disturbance along riparian areas could destroy and/or damage BOVI or CAWI8 plants.

Conclusion—The implementation of proposed fuels reduction treatments would result in long-term minor to moderate adverse direct effects as mastication destroys BOVI and CAWI8 plants and short-term minor adverse direct effects from low-intensity backing fires. The reduction in fuels and the avoidance of stand-replacing fire and weed infestation would result in long-term moderate beneficial indirect effects as BOVI and CAWI8 site stability and vigor in increased or maintained. Cumulative effects from mining claim improvement activities within riparian areas may result in long-term minor to moderate adverse effects if BOVI and CAWI8 plants and riparian habitat are destroyed or damaged.

Species of Serpentine Environments—

- *Chaenactis suffrutescens* (Shasta chaenactis)—CHSU
- *Eriogonum hirtellum* (Klamath Mountain Buckwheat)—ERHI7
- *Minuartia stolonifera* (Scott Mountain sandwort)—MIST9

No CHSU, ERHI7, or MIST9 sites are known to occur in the proposed treatment units. This effects analysis assumes that some number of CHSU, ERHI7, or MIST9 sites may occur in proposed FRZs or Rx Units outside the 2008 botany survey areas. These three species occur in serpentine or ultramafic soils. These soil types are known to occur in FRZs and Rx Units in the Matthews Creek area, in the far southwestern region, and on FRZs on two ridgelines located west and east of East Crawford Creek.

Direct and Indirect Effects. Implementation of prescribed fire to reduce fuels in FRZs and Rx Units would burn above-ground portions (leaves, flowers/fruits, or stems) but not damage below-ground portions (caudex, roots) of CHSU, ERHI7, and MIST9 plants. The result would be a short-term minor adverse direct effect on any CHSU, ERHI7, and MIST9 sites as plants would recover in the short-term. The implementation of prescribed fire would have a secondary indirect effect on the habitat of these species. Prescribed fire would cause, (to a lesser degree than a wildfire), an increase in competing early seral vegetation cover (such as grass species), with a resulting decrease in plants at any CHSU, ERHI7, or MIST9 sites. The result is an indirect long-term minor adverse effect as the increase in competing early seral vegetation would out-compete some CHSU, ERHI7, and MIST9 plants for resources. Mastication treatments (on slopes less than 45 percent) would damage or destroy to CHSU, ERHI7, and MIST9 plants from mechanical disturbance and result in long-term minor to moderate adverse direct effects as some plants would slowly recover and others would be lost. The reduction in ground and small ladder fuels in stands where these three species might occur would result in long-term moderate beneficial indirect effects because the likelihood of stand-replacing wildfires would be reduced, and CHSU, ERHI7, or MIST9 site stability and vigor would be maintained in the long term.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fire resulting from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The avoidance of stand-replacing fire would benefit CHSU, ERHI7, and MIST9 sites by avoiding the direct loss or damage of plants and habitat. A secondary beneficial effect would be the avoidance of potential noxious weed infestations—a frequent result of stand-replacing wildfires and the corresponding suppression activities. The prevention of a weed infestation would directly benefit sites by avoiding competition that could lead to a decline in native vegetation and CHSU, ERHI7, and MIST9 plants.

Conclusion—The implementation of prescribed burning in proposed FRZs and Rx Units would result in (1) short-term minor adverse direct effects if CHSU, ERHI7, or MIST9 plants are damaged and recover in the short term, and (2).an indirect long-term minor adverse effect as the increase in competing early seral vegetation would out-compete some CHSU, ERHI7, and MIST9 plants for resources. Mastication treatments (on slopes less than 45 percent) would damage or destroy to CHSU, ERHI7, and MIST9 and would result in long-term minor to moderate adverse direct effects if plants are damaged or destroyed but result in some level of recovery. Post-treatment reductions of fuel loads and avoidance of stand-replacing fire and weed infestations would result in long-term moderate beneficial indirect effects on CHSU, ERHI7, and MIST9 site vigor and stability.

Species of Canopy Gap and Forest Edge Environments—

- *Eucephalis vialis* (Wayside Aster)—EUVI8
- *Pedicularis howellii* (Howell's lousewort)—PEHO

No sites of EUVI8 or PEHO are known to occur in the proposed treatment units. This effects analysis assumes that some number of EUVI8 and PEHO sites may occur in treatment units outside the 2008 botany survey areas. These two species occur in canopy gaps and forest edge habitat, including habitat maintained by fire. EUVI8 also occurs in manmade openings along roads. Canopy gap and forest edge habitat occurs in proposed FRZs and Rx Units and RS treatments along emergency access routes.

Direct and Indirect Effects. Implementation of prescribed fire to reduce fuels in FRZs and Rx Units would burn plants above-ground potions (leaves, flowers/fruits, or stems) and leave below-ground portions (caudex, roots) undamaged. Both species occur in habitat maintained by fire; plants burned in a prescribed fire would re-sprout, and EUVI8 or PEHO plant vigor and long-term site stability would be increased or maintained. Prescribed fire would, therefore, result in a long-term moderate beneficial direct effect. Mastication (on slopes less than 45 percent) and mechanical thinning treatments in FRZs would damage or destroy EUVI8 and PEHO plants and result in long-term minor to moderate adverse direct effects as some plants would slowly recover and others would be lost. Mechanical thinning would also increase suitable EUVI8 and PEHO habitat by opening overstory canopy cover, resulting in a long-term moderate beneficial indirect effect on any EUVI8 or PEHO site not destroyed by the mechanical disturbance of the thinning treatment.

Cumulative Effects. The cumulative effects of district projects with mechanical disturbance to roadsides have the potential to create long-term minor to moderate adverse direct effects if roadside EUVI8 or PEHO plants are disturbed or destroyed. The Proposed Action would reduce the risk of stand-replacing fire resulting from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The avoidance of stand-replacing fire would benefit EUVI8 and PEHO sites by avoiding the direct loss or damage of plants and habitat. A secondary beneficial effect would be the avoidance of potential noxious weed infestations—a frequent result of stand-replacing wildfires—and the corresponding suppression activities. The prevention of a weed infestation would directly benefit sites by avoiding competition that could lead to a decline in native vegetation and EUVI8 and PEHO plants.

Conclusion—The implementation of proposed FRZs and Rx Units would result in long-term minor to moderate beneficial direct effects, and mastication and mechanical thinning treatments would result in both long-term minor to moderate adverse direct effects and minor to moderate beneficial long-term indirect effects. The post-treatment reduction in fuels and the avoidance of stand-replacing fire and weed infestation would result in long-term moderate beneficial indirect effects as EUVI8 and PEHO site vigor is increased or maintained over the long term.

Species of Montane Chaparral and Mixed-Conifer Forest Environments—

- *Eriogonum ursinum* var. *erubescens* (Blushing Buckwheat)—ERURE

No ERURE sites are known to occur in the proposed treatment units. This effects analysis does assume that some number of ERURE sites occur in proposed treatments units outside the 2008 botanical survey areas. ERURE occurs in chaparral and open conifer/mountain mahogany habitat. This habitat type is most likely to occur in FRZs where prescribed burn and mastication treatments are proposed.

Direct and Indirect Effects. The implementation of prescribed fire treatments to reduce fuels in FRZ and Rx Units would burn above-ground portions (leaves, flowers/fruits, or stems) of plants and leave below-ground portions (caudex, roots) undamaged. The result would be a short-term minor adverse direct effect as burned ERURE plants would re-sprout in the short term. Mastication (on slopes less than 45 percent) or mechanical thinning in FRZs would damage or destroy EUVI8 and PEHO plants and result in long-term minor to moderate adverse direct effects as some plants would slowly recover and others would be lost.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fire resulting from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The avoidance of stand-replacing fire would benefit ERURE sites by avoiding the direct loss or damage of plants and habitat. A secondary beneficial effect would be the avoidance of potential noxious weed infestations—a frequent result of stand-replacing wildfires—and the corresponding suppression activities. The prevention of a weed infestation would directly benefit sites by avoiding competition that could lead to a decline in native vegetation and ERURE plants.

Conclusion—The implementation of proposed FRZs and Rx Units would result in short-term minor adverse direct effects, and mastication and mechanical thinning treatments would result in long-term minor to moderate adverse direct effects on ERURE sites. The post-treatment reduction in fuels and the avoidance of stand-replacing fire and weed infestation would result in long-term moderate beneficial indirect effects as ERURE site vigor is increased or maintained over the long term.

Sensitive Fungi Species

- *Boletus pulcherrimus*, *Cudonia monticola*, *Dendrocollybia racemosa*, *Phaeocollybia olivacea*, *Sowerbyella rhenana*, *Tricholomopsis fulvescens*

Several studies that have examined the effects of prescribed fire have found that the effects to mycorrhizal fungal species are related to the intensity of the fire within the species' habitat. Fires that do not fully consume the large woody debris, litter, and organic layers and also retain moisture have reduced effects on fungi (USDA 2007). Fuel treatment prescriptions that retain adequate live overstory, understory, and shrub species would retain sufficient host species to form mycorrhizal connections. No specific studies have been found that have examined the effects of fuel treatments specifically upon *saprophytic* species. The effects are likely to be similar to those seen upon mycorrhizal species, which require canopy cover and large woody material to retain moisture levels within their habitat. This effects analysis is based on the assumption that the relationships will be similar to that seen in the studies cited above. Because there is an overall low probability that the

6 Sensitive fungi species are present within the proposed project activity areas, there is also a low potential for an effect to individual fungi populations.

The Proposed Action includes mechanical and fuels treatments to reduce fuels. Suitable habitat in the project Assessment Area for the 6 Sensitive fungi species is located along wet, north-facing riparian areas within 25 feet of perennial streams, at the lower to mid-elevations, and within mature timber stands. Suitable habitat for the 6 Sensitive fungi does not occur within the proposed mechanical treatment units (M Units), located on ridges and upper slope positions.

Direct and Indirect Effects

Mechanical Treatments—The implementation of proposed mechanical treatments will have no effect on the 6 Sensitive fungi species as these species do not occur in the M Units.

Prescribed Fire Treatments—Suitable habitat for the 6 fungi is restricted to Riparian Reserves within the project Assessment Area. Prescribed burn activities in FRZ and Rx Units will be modified in these areas to reduce effects, i.e., underburning will be allowed to back into the Riparian Reserves down to the riparian area (see the Resource Protection Measures in Chapter 2, Section 2.10 of this final EIS or refer to the Botanical Resources Report). The prescription will retain an adequate percentage of the live tree overstory that will ensure the preservation of shade and a diverse mix of tree species to support underground ectomycorrhizal linkages, and will maintain mycorrhizal species. Understory trees, shrubs, and coarse woody debris will be reduced, but maintained at adequate levels to support the fungi that depend upon these vascular plant species. Saprophytic fungi species will be maintained by underburn prescriptions that ensure a low-intensity burn that will retain adequate woody debris. Best Management Practices (BMP) are being applied to provide adequate soil cover to prevent erosion, which will retain additional coarse woody debris and duff as a substrate for saprophytic fungi. There would be a long-term beneficial effect to the fungi species habitat through the maintenance of suitable habitat and by reducing the risk of stand-replacing wildfires.

Underburning would burn some number of individual fungi populations. Because mycorrhizal and saprophytic fungi have large underground systems, any entire populations of the fungi would not be affected. Fungi species readily regenerate after impacts to a portion of the population as long as adequate vegetative cover, species diversity, soil cover and coarse woody debris is maintained. The habitat would not be affected to the extent that it would no longer be suitable for the fungi. In summary, prescribed burn activities in FRZ and Rx Units would result in (1) a direct short-term negligible adverse effect to individual fungi as underburning destroys some number of individuals (but entire populations are not impacted), and (2) an indirect long-term moderate beneficial effect as suitable fungi habitat is maintained and the risk of stand replacing wildfires are reduced.

Mastication Treatments—Mastication treatments are proposed to occur, within 875 acres of Riparian Reserves within FRZs on slopes less than 45 percent and within 0.25 mile of roads. No specific studies have been found that have examined the effects of mastication activities specifically upon fungi species. While mastication activities would likely destroy or damage some individuals and/or the substrate of some saprophytic fungi, the fungi populations would not be killed. When the substrate within which the mycelial network occurs is disturbed, the fungus is not necessarily killed. Rather, the network will be broken into many fragmented parts that will continue to live and fruit as long as a nutrient source—vascular plants for mycorrhizal species or rotten wood for saprophytic species—and a moisture source persists. Mastication treatments also include leaving mulched coarse and fine woody debris on site. The increase in fine and coarse woody debris is expected to have a negligible to beneficial impact on fungi individuals. The increased woody debris is expected to increase forest floor moisture that would benefit both saprophytic and mycorrhizal fungi, and would increase substrate source for the saprophytic species. In summary, proposed mastication treatments would result in (1) a direct short-term minor adverse effect as individual fungi would be destroyed or damaged but any populations would persist and recover in the short term, and (2) an indirect short-term minor beneficial effect as increased fine and coarse woody debris cover would increase forest floor moisture and provide increased substrate for saprophytic fungi species.

Roadside Fuels Treatments—Roadside (RS) treatments are proposed for 69.5 acres of Riparian Reserves. A masticator would be used on slopes less than 45 percent to remove trees less than 10 inches dbh, and hand thinning and pile burning would be used to remove trees up to 6 inches dbh on slopes greater than 45 percent. Hand thinning and pile burning would likely destroy or damage some fungi individuals and/or the substrate of some saprophytic fungi, the fungi populations would readily regenerate as long as adequate vegetative cover, species diversity, soil cover and coarse woody debris is maintained. The RS treatments would result in direct short-term minor adverse effects as individual fungi and/or substrate for saprophytic fungi species would be destroyed or damaged but any populations would persist and recover in the short term.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fire resulting from the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The avoidance of stand-replacing wildfire would result in an indirect long-term moderate beneficial effect by avoiding the direct loss or damage of fungi populations and habitat.

Future district projects expected to occur in the short- and long-term include annual road maintenance, fire suppression activities, the installation of telephone and fiber-optic lines (and associated disturbance from roadside trenches), and the North Fork Roads Stormproofing Project. Each of these district projects involves ground disturbance near road sides or other upland site locations, outside of the 6 Sensitive fungi species' riparian habitat. Mining activities, however, do occur near streams and may occur within riparian habitat of these species. Ground disturbance from mining would damage or destroy some fungi individuals, but any populations would be maintained. No cumulative effects are expected from effects from wildfire and mining.

Conclusion. Effects from the proposed action include the following: (1) no effects would result from mechanical treatments as the 6 Sensitive fungi species do not occur in M Unit habitat; (2) prescribed fire fuels treatments would result in a direct short-term negligible adverse effect to individual fungi as underburning destroys some number of individuals (but entire populations are not impacted), and an indirect long-term moderate beneficial effect as suitable fungi habitat is maintained and the risk of stand replacing wildfires are reduced; (3) mastication fuels treatments would result in (*i*) a direct short-term minor adverse effect as individual fungi would be destroyed or damaged but any populations would persist and recover in the short term, and (*ii*) an indirect short-term minor beneficial effect as increased fine and coarse woody debris cover would increase forest floor moisture and provide increased substrate for saprophytic fungi species, and (4) roadside fuels treatments would result in direct short-term minor adverse effects as individual fungi and/or substrate for saprophytic fungi species would be destroyed or damaged but any populations would persist and recover in the short term.

Sensitive Bryophyte Species

- *Ptilidium californicum* (Pacific Fuzzwort)—PTCA5

Direct and Indirect Effects. Two sites of the Sensitive liverwort PTCA5 occur in Rx Units, one of the two is also located in an RS treatment (PTCA5-#TE1). Resource protection measures for the two PTCA5 populations have been designed into the Proposed Action (refer to Table 3-3). The resource protection measures are intended to protect individual plants and to maintain habitat characteristics that are critical to the maintenance of long-term viable plant populations, in accordance with the desired conditions of the Standards and Guidelines from the Klamath LRMP (USFS 1995a). Fuel reduction treatments proposed in both sites include broadcast burning to remove ground and small ladder fuels (less than 4 inches dbh).

PTCA5 is a liverwort that occurs in patches on the base of Douglas-fir and true fir trees in upper-elevation conifer forests. It is assumed that populations in northern California have evolved in spite of fire in the landscape; that is, individual plants or populations, once destroyed by fire, recover or recolonize slowly, if at all, at the same location, depending upon the severity of fire. In addition the levels of ground and ladder fuels in these sites are considered outside the historic range due to past fire suppression. The resource protection measures, therefore, allow the broadcast burning within the two PTCA5 stands but exclude burning of the substrate trees. The resource protection measures also exclude the harvesting of the substrate trees. With the implementation of the protection measures, the Proposed Action would result in a long-term indirect beneficial effect as PTCA5 habitat and plants are protected from mortality in a stand-replacing fire and would lead to long-term viability of the PTCA5 populations in the Assessment Area.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fire that may occur given the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. The avoidance of stand-replacing fire would benefit this species by preventing the direct loss or damage of PTCA5 plants and habitat. The Proposed Action's reduction of the potential for stand-replacing fire would also prevent the secondary effects from a weed infestation—a frequent result of stand-replacing wildfires and the corresponding suppression activities. The direct benefit to PTCA5 would be minor. PTCA5 is a small liverwort that grows in patches on the base of large trees and is not in direct competition with herbaceous or shrubby weeds. The avoidance of weed competition for herbaceous and shrub vegetation in PTCA5 habitat, however, would be an indirect benefit to this species' habitat.

Future district projects expected to occur in the short- and long-term include annual road maintenance, fire suppression activities, the installation of telephone and fiber-optic lines (and associated disturbance from roadside trenches), and the North Fork Roads Stormproofing Project. Each of these district projects involves ground disturbance near road sides, and cumulative adverse effects are expected with the multiple roadside disturbances from the district projects. If the

PTCA5-#TE1 tree is damaged or removed, PTCA5-#TE1 would be damaged or destroyed. If habitat is altered (that is, canopy cover and stand humidity is reduced, and/or if suitable substrate mature overstory tree species are removed), PTCA5-#TE1 plants would decline or be killed. In summary, cumulative effects of the proposed action would result in a long-term moderate beneficial indirect effect because species habitat would be maintained as result of reduced risk of wildfire and noxious weed infestation. The cumulative effects from ongoing and future district projects along roadsides would result in long-term moderate direct and indirect adverse effects if the PTCA5-#TE1 tree is removed or damaged and/or surrounding habitat is altered.

Conclusion—The Proposed Action would result in a long-term beneficial indirect effect as PTCA5 habitat and plants are protected from mortality in a stand-replacing fire (and avoiding a secondary noxious weed infestation), and would lead to long-term viability of the PTCA5 populations in the Assessment Area. Cumulative effects from ongoing and future district roadside-disturbing projects would result in a long-term moderate adverse direct and indirect effect if the PTCA5-#TE1 substrate tree is removed or damaged, and/or surrounding habitat is altered, leading to the decline or loss of PTCA5-#TE1 plants.

Sensitive Lichen Species

- *Hydrothyria venosa* (syn. *Peltigera hydrothyria*) (Waterleaf Lichen)—HYVE7

No sites of HYVE7 are known to occur in the Assessment Area. Surveys in 2008 included a number of streams with low to moderate potential HYVE7 habitat. Additional potential habitat may occur outside of the 2008 survey areas. Potential HYVE7 sites of this aquatic lichen would occur in Riparian Reserves of Rx Units.

Proposed treatments in Riparian Reserves include removal of small trees by hand thinning and pile burning and with low-intensity backing fires. Resource protection measures for Riparian Reserves are intended to maintain existing shade and moisture levels, litter, duff, and large woody debris components, and species composition. The protection measures include the following: (i) avoid construction of handlines within 25 feet of a watercourse; (ii) ignite prescribed fires to minimize the potential for burning material to increase the potential for moderate- or high-intensity burns; (iii) when underburning in Riparian Reserves, at least 90 percent of the large woody debris will not be consumed, both standing and on the ground; (iv) where more than 80 percent shade exists, at least 80 percent shade on the water will be retained after treatment; (v) larger conifers (greater than 20 inches dbh) felled within perennial stream channels or inner gorges will be left in place; however, slash will be minimized in the stream channel.

Direct and Indirect Effects. Proposed treatments in Riparian Reserves that maintain overstory shade, reduce understory fuels, and avoid disturbance to streams would result in short-term moderate indirect beneficial effects to any HYVE7 sites until riparian habitat fuels recover. Proposed treatments would result in no direct effects on any HYVE7 plants.

Cumulative Effects. The Proposed Action would reduce the risk of stand-replacing fires that may occur given the cumulative effects of a previous history of fire suppression, a build up of ground and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities in the Assessment Area. A stand-replacing fire would affect HYVE7 habitat by reducing upland vegetation and increasing stream flows and silt loads. The result would be an indirect long-term moderate adverse effect until upland vegetation recovers and stream flows and silt loads stabilize. Cumulative effects of mining activities would be similar to Alternative A described above.

Conclusion—The Proposed Action would result in a long-term moderate beneficial indirect effect, as HYVE7 habitat components (shade, stream temperature) are maintained. By reducing or avoiding the cumulative effects of a stand-replacing fire, the Proposed Action also would result in a long-term moderate beneficial indirect effect until upland vegetation recovers and stream flows and silt loads stabilize. The cumulative effects of mining activities along streams with any HYVE7 sites would result in (1) a long-term moderate adverse direct effect as HYVE7 substrate or plants are destroyed or disturbed, and (2) a long-term moderate adverse indirect effect as siltation levels increase and destroy plants.

3.7.4.4 Alternative C: No New Temporary Roads Constructed

Sensitive Vascular Species

- *Cypripedium fasciculatum* (Clustered Lady-slipper Orchid)—CYFA
- *Cypripedium montanum* (Mountain Lady-slipper Orchid)—CYMO2
- *Smilax jamesii* (English Peak Greenbriar)—SMJA

Direct and Indirect Effects. Direct and indirect effects for the three Sensitive vascular species would not change from Alternative B, described above. The shift in treatment locations in Alternative C (as mechanical units are dropped) would be accounted for with the RPMs.

Cumulative Effects. Cumulative effects for the three Sensitive vascular species would not change from Alternative B.

Conclusion—Alternative C, with implementation of resource protection measures, would result in long-term moderate beneficial direct and indirect effects on CYFA and CYMO2 populations as long-term population viability is enhanced, and plants and habitat are protected from stand-replacing wildfire and secondary weed infestation. The cumulative effects of projects that create ground disturbance may increase weed infestations in CYFA and CYMO2 habitat, causing an adverse indirect effect as invasive weeds out-compete native vegetation and CYFA and CYMO2 plants, contributing to the decline of CYFA and CYMO2 populations; the result would be a long-term moderate adverse indirect effect on CYFA and CYMO2 populations.

Alternative C, with the proposed fuel reduction treatments, would enhance SMJA riparian habitat; the result would be a long-term moderate beneficial indirect effect on the SMJA population in the Assessment Area as SMJA riparian habitat is enhanced, and plants and habitat are protected from a stand-replacing fire and secondary weed infestation. Cumulative effects from mining claim improvement activities within riparian areas may result in long-term minor to moderate adverse effects on SMJA as plants and habitat are destroyed or damaged.

Nine Sensitive Target Species Assumed to be Present

- *Botrychium virginianum* (Rattlesnake Fern)—BOVI

- *Campanula wilkinsiana* (Wilkin's harebell)—CAWI8
- *Chaenactis suffrutescens* (Shasta chaenactis)—CHSU
- *Eriogonum hirtellum* (Klamath Mountain buckwheat)—ERHI7
- *Minuartia stolonifera* (Scott Mountain sandwort)—MIST9
- *Eucephalis vialis* (Wayside Aster)—EUVI
- *Pedicularis howellii* (Howell's lousewort)—PEHO
- *Eriogonum ursinum* var. *erubescens* (Blushing buckwheat)—ERURE
- *Smilax jamesii* (English Peak Greenbriar)—SMJA

The effects of Alternative C for SMJA is included in the section above; the remaining 8 species are discussed below.

Direct and Indirect Effects. Direct and indirect effects to the 8 Sensitive vascular species would not change from those discussed for Alternative B. See discussions of effects on individual species within the Alternative B section above.

Cumulative Effects. Cumulative effects to the 8 Sensitive vascular species would not change from those discussed for Alternative B. See discussions of effects on individual species in the Alternative B section above.

Conclusion—See discussions of effects on individual species in the Alternative B section above.

Sensitive Fungi Species

- *Boletus pulcherrimus*, *Cudonia monticola*, *Dendrocollybia racemosa*, *Phaeocollybia olivacea*, *Sowerbyella rhenan*a, *Tricholomopsis fulvescens*

Direct and Indirect Effects. Direct and indirect effects for the 6 Sensitive fungi species would not change from Alternative B, described above.

Cumulative Effects. Cumulative effects for the 6 Sensitive fungi species would not change from Alternative B described above.

Conclusion—See Conclusion summary in Alternative B section above.

Sensitive Bryophyte Species

- *Ptilidium californicum* (Pacific Fuzzwort)—PTCA5

Direct and Indirect Effects. Alternative C proposes no new construction of the 1.03 miles of new temporary roads and no underburning treatments in portions of Rx Units 5 and 6. One known PTCA5 site (PTCA5-#TE1) occurs in an RS treatment within FRZ 5. The direct and indirect effects for this site would not change from Alternative B, as described above.

A second PTCA5 site (PTCA5-#RB1) occurs within the portion of untreated Rx Unit 6. The effects of no underburning in Rx Unit 6 would not change from Alternative A, the no-action alternative, as described above.

Cumulative Effects. Cumulative effects for the PTCA5-#TE1 site would not change from Alternative B, as described above. Cumulative effects for the PTCA5-#RB1 site would not change from Alternative A, as described above.

Conclusion for PTCA5-#RB1: Alternative C proposes no underburning to Rx Unit 6 where PTCA5-#RB1 is located. Given the fuel hazard in the Eddy Gulch LSR, it is assumed at least one wildfire will escape initial attack and would burn with surface fires, passive crown and/or active crown fires. A surface fire and portions of a passive crown fire that remain on the surface would damage or destroy plants at PTCA5- #RB1 and result in short- and long-term minor to major adverse direct effects. A surface fire and portions of a passive crown fire would also alter important PTCA5 habitat microhabitat features that would damage plants or slow the recovery/recolonization of PTCA5 plants—the result would be short- and long-term minor to major adverse indirect effects to PTCA5-#RB1 site. Where the overstory is removed as a result of a passive or active crown fire, habitat would be altered and PTCA5 plants would decline or die—the result would be an indirect long-term moderate adverse effect to PTCA5-#RB1.

Conclusion for PTCA5-#TE1: Alternative C would enhance PTCA5 habitat, increase population viability, and protect plants from destruction in a stand-replacing fire; the result would be a moderate beneficial long-term indirect effect on PTCA5 populations. Cumulative effects from district roadside-disturbing projects could result in a long-term moderate adverse direct effect from removing or damaging the PTCA5-#TE1 substrate tree, and a long-term moderate adverse indirect effect from habitat alteration, leading to the decline or loss of PTCA5-#TE1 plants.

Sensitive Lichen Species

- *Hydrothyria venosa* (syn. *Peltigera hydrothyria*) (Waterleaf Lichen)—HYVE7

Direct and Indirect Effects. Direct and indirect effects for HYVE7 would not change from Alternative B, described above. HYVE7 is an aquatic lichen limited to perennial streams, and the lack of new temporary road construction would not change the direct or indirect effects on this species.

Cumulative Effects. Cumulative effects for HYVE7 would not change from Alternative B, described above. HYVE7 is an aquatic lichen limited to perennial streams, and the lack of new temporary road construction would not change the cumulative effects on this species.

Conclusion—A surface fire would result in no direct effect on HYVE7 and a short-term moderate beneficial indirect effect until understory vegetation recovers and ground fuels are replaced. A passive or crown fire would increase solar radiation along HYVE7 riparian habitat and result in a long-term moderate adverse indirect effect until overstory canopy is restored. Cumulative effects of Alternative C include the likelihood of a stand-replacing fire with (1) an increase in noxious weeds and stream flows and stream siltation levels following the stand-replacing wildfire. The results include (1) no short-term or long-term direct effects on HYVE7 plants from weed infestations, (2) long-term moderate indirect adverse effects until stream flows and siltation levels recover. Mining activities would also have a cumulative effect by disturbing or destroying HYVE7 plants or habitat, resulting in (1) long-term moderate adverse direct effects as HYVE7 substrate or plants are destroyed or disturbed, and (2) long-term minor to moderate indirect adverse effects as siltation levels increase and indirectly destroy plants.

3.7.5 Methodology: Noxious Weeds

Noxious Weed List. The Klamath National Forest Noxious Weed List includes high-priority plants from the state and county lists that are known or expected to occur on the Klamath National Forest. Based on inventories and current understanding of species' ranges, a total of 24 high-priority weeds are on the Klamath National Forest Noxious Weed List.

3.7.5.1 Weed Risk Assessment

Forest Service Manual 2080 Noxious Weed Management (USFS 1995b) includes a policy statement calling for a risk assessment for noxious weeds to be completed for every project. The risk assessment process has been standardized to determine the risk of introducing or spreading noxious weeds within a project and includes a Weed Risk Assessment document. For projects having moderate to high risk of introducing or spreading noxious weeds, the project decision document must identify noxious weed control measures that must be undertaken during project implementation. The Weed Risk Assessment identified this project as having high risks associated with all factors (known species, habitat vulnerability, nonproject-dependent vectors, habitat alteration, and increased vectors as result of project implementation).

3.7.5.2 Pre-Field Review

A pre-field review of noxious weed sites included a review of the Klamath National Forest Noxious Weed GIS Database, and weed site data from atlases and maps located at the office of the Salmon River and Scott River Ranger Districts, in Ft. Jones, California.

3.7.5.3 Field Surveys

The project Assessment Area is considered to have a low infestation of noxious weed sites with all but one known noxious weed site occurring along roadsides. Field surveys for noxious weeds were conducted in August 2008, along main roads and concurrent with botanical survey units.

Following the field surveys, the locations of new and previously documented target noxious weed sites were added to the GIS to analyze proximity of noxious weed plant sites to project treatment units to identify potential effects. See Resource Protection Measures in Chapter 2, Section 2.9 of this final EIS.

3.7.6 Affected Environment (Existing Conditions): Noxious Weeds

Noxious weed sites in the project area are listed in Table 3-48 and include:

- 4 previously documented sites and 8 new sites of Dyer's woad (*Isatis tinctoria*),
- 1 previously documented site and 4 new sites of yellow starthistle (*Centaurea solstitialis*),
- 3 previously documented site of Scotch broom (*Cytisus scoparius*), and
- 13 previously documented sites of spotted knapweed (*Centaurea maculosa*).

Table 3-48. Summary of noxious weed sites in the Eddy Gulch LSR Project proposed treatment units, August 2008.

Species Site Number*	Number of Plants/Area	Location (TRS)	Location (UTM)	Location in Proposed Treatment Unit
***Isatis tinctoria* L. – Dyer's Woad - ISTI**				
ISTI-TE1	15 plants in 6 ft x 50 ft	T38N-R11W, S.32 NW of SE ¼	487446, 4560425	RS treatment in FRZ 6, along National Forest System (NFS) Road #39N23, due south of Windy Gap.
ISTI-#55,	Unavailable Data	T40N-R10W, S.19, West ½ of NW ¼	Shape files available	A linear roadside population, along the 40N54 road, that occurs in a RS treatment area outside of FRZs or Rx Units.
ISTI-RAW2 (re-visit to previous site, no #)	3.8 acre area	T40N-R10W, S.19, SE of NW ¼	495304, 4574562	A linear roadside population, along the 40N54 road, that occurs in a RS treatment area outside of FRZs or Rx Units. Located south of ISTI#55.
ISTI-RAW3	2,000 plants in 5 acres	T41N-R10W, S.22, SW of SW ¼	501097, 4581354	RS treatment in Rx Unit 9 (northern), between NFS Road #41N18 and spur road heading south (1 mile southeast of Etna Summit)
ISTI-GSV1	50 plants in 15 ft x 5 ft	T41N-R10W, S.28, NE of NW ¼	499785, 4581205	RS treatment in FRZ 20, on old roadbed in 2008 Botanical Survey Unit #22 South.
ISTI-KM2	200 plants in 2 acres	T41N-R10W, S.32,31	497729, 4579764	RS treatment in Rx Unit 9, scattered in riparian area in 2008 Botanical Survey Unit #20-West
ISTI-KM5	200 plants in 1 acre	T41N-R10W, S. 32	498502, 4579045	RX Unit 9, scattered in riparian area in 2008 Botanical Survey Unit #20-East
ISTI-RB4	1 plant in 1 ft x 1 ft	T39N-R11W, S.6, SE of SW ¼	487541, 4568107	RS Treatment in FRZ 2, along NFS road #1E001, due west of Black Bear Summit and M Units 51.
ISTI-no site #	0.1 acre or less, most likely eradicated or one or two plants present.	T40N-R11W-S.5	unavailable data	Multiple sites in a RS treatment in Rx Unit 12, along NFS Road 39N60, northeast of Black Bear Summit.
ISTI-no site #	0.1 acre or more, rock pit, at saddle; many plants, pre-treatment being attempted.	T39N-R12W, S.12, SE of NW ¼	Shape files available	Within FRZ 2 and adjacent to M Unit 32 (and continuing north outside any project treatment areas), at saddle and on multiple roads, located approximately one mile east of Blue Ridge Lookout
ISTI-141	0.1 acre or less, most likely eradicated or one or two plants present.	T40N-R10W-S16, SW ¼ and center	Unavailable data	RS treatment in FRZ 12 and M Unit 13: multiple sites along the main 39 road in the Klamath Basin area.
ISTI-GC1	45 plants in 20 ft x 25 ft	T39N-R11W, S.16,	490298, 4565625	RS treatment area in FRZ 12, along NFS Road #39 due north of Klamath Basin. This site could be combined with ISTI-141 above.
***Centaurea solstitialis* L. – Yellow starthistle – CESO3**				
CESO3- no site #	1.24 acre area	T39N-R11W, S.26, NE of SW ¼	Shape files available	In FRZ 11, on a saddle at junction of NFS roads 39N74 and 39N51, and due south of M Unit 19.
CESO3-JV1	100 plants in 10 ft x 100 ft	T39N-R11W, S29, NW of SE ¼	497217, 4562358	In RS treatment area outside of and due east of FRZ 15, linear population along Siskiyou County Cecilville Road east of Grasshopper Ridge.

Table 3-48. Summary of noxious weed population sites in the Eddy Gulch LSR Project proposed treatment units, August 2008 (continued).

Species Site Number[a]	Number of Plants/Area	Location (TRS)	Location (UTM)	Location in Proposed Treatment Unit
CESO3-JV2	1,500 plants in 10 ft x 1,000 ft	T39N-R10W, S30, SE of SW ¼ to S. 31, NE of NW ¼	494780, 4561723	RS treatment area in FRZ 15, linear population along a 0.25-mile area of Siskiyou County Cecilville Road, south of Grasshopper Ridge.
CESO3-GC1	600 plants in 0.2 acre	T38N-R12W-S16, NW ¼ of NE ¼	482259, 4557065	In RS treatment area within Rx Unit 3, on the Cecilville Road approximately 1 mile south of Matthews Creek.
CESO3-JDS10	50 plants in 40 ft x 20 ft	T38N-R12W, S.22, SE of NW ¼	482549, 4556296	Just outside of RS treatment area in Rx Unit 3, along County Cecilville Road due west of Butcher Creek.
Cytisus scoparius **(L.) Link. Scotch Broom - CYSC4**				
CYSC4-no site #	0.10 acre area	T40N-R10W, S.19, NW of NW ¼	Shape files available	Within a RS treatment area (outside of FRZ or Rx Unit) west of the 40N54 road 0.10 mile south of Idlewild Campground.
CYSC4- no site #	0.10 acre area	T40N-R10W-S19, SE of NW ¼	Shape files available	Within a RS treatment area and outside of any FRZ or RX Unit, along the 40N54 road, above South Fork Russian Creek, approximately 0.50 mile south of Idlewild Campground, due south of ISTI#RAW2.
CYSC4-no site #	0.10 acres	T40N-R10W-S19,	Shape files available	Within a RS treatment area just outside of Rx Units 8, along the 40N54 road above South Fork Russian Creek.
Centaurea maculosa **Lam. Spotted Knapweed CEMA4**				
CEMA4-#22.6	0.10 acre	T40N-R10W-S6, NW ¼ of SW ¼	Shape files available	Along county road, outside of, but on the far SW edge of Rx Unit 9.
CEMA4-#RN28	0.10 acre	T41N-R10W, S.28, NE of NW ¼	Shape files available	Along county road in FRZ 20 and RS treatment area.
CEMA4-#RN145	0.10 acre	T41N-R10W, S.29, SW of NE ¼	Shape files available	Along county road in FRZ 20 and RS treatment area.
CEMA4-#RN88	0.10 acre	T41N-R10W, S.29, NE of SW ¼	Shape files available	Along county road in FRZ 20 and RS treatment area.
CEMA4-#RN87	0.10 acre	T41N-R10W, S.31	Shape files available	Along county road in Rx Unit 9 and RS treatment area.
CEMA4-#RN24.5	0.10 acre	T41N-R10W, S.32	Shape files available	Along county road in Rx Unit 9 and RS treatment area.
CEMA4-#RN24.4	0.10 acre	T41N-R10W, S.32	Shape files available	Along county road in Rx Unit 9 and RS treatment area.
CEMA4-#118	0.10 acre	T39N-R10W-S.4, SE ¼ of SW ¼	Shape files available	RS treatment area in FRZ 15, along Siskiyou County Cecilville Road, south of Grasshopper Ridge.
CEMA4-#122	0.10 acre	T40N-R10W-S18, SE of NE ¼	Shape files available	Along county road in Rx Unit 8 and RS treatment area.
CEMA4-#123	0.10 acre	T40N-R10W-S18, NE of SE ¼	Shape files available	Along county road in Rx Unit 8 and RS treatment area.
CEMA4-#125	0.10 acre	T40N-R10W-S18, SW of SE ¼	Shape files available	Along county road in Rx Unit 8 and RS treatment area.
CEMA4-#127.1	Approximately 5 acres	T40N-R10W-S18, NE of NW ¼	Shape files available	Outside of any proposed treatment units or areas, but in the LRS boundary and adjacent to private ownership 1 mile south of Idlewild Campground
CEMA4-#138	0.10 acre	T39N-R10W-S5, NE of NW ¼	Shape files available	Within Rx Unit 5, along the 39N73 road (outside of a RS treatment area).

**Note: ***Population/site numbers were temporarily assigned during 2008 field surveys.

Eleven of the 12 Dyer's Woad sites occur along paved or primary gravel roads or decommissioned roadbeds within a range of proposed treatment units, and 1 new site occurs in a riparian area within Rx Unit 9. The 11 roadside sites are distributed in the following treatment unit types: 6 occur in RS treatment areas of FRZs (2 of the 6 also occur within or adjacent to mechanical units), 3 sites occur within RS treatments within Rx Units, and 2 occur in RS treatments outside of any FRZ or Rx Unit.

Four of the five yellow starthistle sites occur along the paved county Cecilville Road on the project's southern and southwest boundaries; three of the four sites occur within proposed RS treatment areas (one of which is also in an FRZ) and the fourth site occurs just outside and south of a RS treatment area and Rx Unit. The fifth site occurs in an FRZ and due south of an M Unit at a saddle at the junction of two Forest Service roads.

Two of the 3 Scotch broom sites occur within RS treatment areas, which are not part of an FRZ or Rx Unit, and 1 site is right on the edge of Rx Unit 8. This last site is also adjacent to private ownership.

Seven of the 13 spotted knapweed sites occur in RS treatments within Rx units, 4 occur in RS treatments within FRZs, and 2 sites occur in RS treatments outside of any FRZ or Rx units.

3.7.7 Environmental Consequences: Noxious Weeds

3.7.7.1 Alternative A: No Action

Direct and Indirect Effects. Weed infestations are likely to follow stand-replacing wildfires and the corresponding suppression activities. Factors like an ideal seed bed, reduced competition from native plants and increased nutrients released by the fire, all combine to make conditions ideal for weed seed to germinate and flourish following fire. Noxious weed infestation can have long-term negative effects on native vegetation, and can create permanent change in natural plant communities. Weed infestations following wildfire follow a typical pattern: modest weed infestation rates typically follow the first year, and dramatic increases in infestation rates occur after the second year, due to weed seed banks and plants re-sprouting (Asher et al. 2001).

The four noxious weed species in the Assessment Area (Dyer's woad, yellow starthistle, Scotch broom and spotted knapweed) all prefer open, disturbed habitat. Following a surface fire (depending upon the fire severity), infestations of the four species would increase most dramatically in burned open habitats, (roadsides, young silviculture stands, shrub communities and other natural openings), near and adjacent to the known sites in the Assessment Area. Weed infestations would increase dramatically within two years following a surface fire and beyond the first few years could quickly and permanently alter the native vegetation in these areas, if no control measures are taken. Open habitat, however, represents a relatively small area of the Assessment Area. Weed infestations would be minimal in shady habitat (mid-seral to mature forests with closed canopies) and would increase modestly within two years following a surface fire. Beyond the first two years, the infestation would continue to spread, although the increase would be modest and, even without control measures, is unlikely to permanently alter the vegetation in shady habitats. Shady habitat (mid-seral and older closed-canopy forests) is a common habitat type in the Assessment Area.

A passive crown fire would have the same effects as a surface fire, with the additional loss of overstory trees in scattered locations. The canopy cover loss would increase the area of open habitat and level of weed infestation in the Assessment Area with the rates of infestation occurring similarly, as described above for surface fires. An active crown fire would create large areas of open disturbed ground and potential for dramatic weed infestations in the Assessment Area. Weed infestations following an active crown fire would increase dramatically within two years following the fire in large areas of the Assessment Area, and without control measures has the potential to quickly and permanently alter natural plant communities over large areas of the Assessment Area.

Cumulative Effects. Ongoing district projects and projects scheduled for the foreseeable future include annual road maintenance, hazard tree removal, improvements to existing mining claims, hiking, appropriate responses for fire suppression, installation of utility lines with associated roadside trenching, the North Fork Roads Stormproofing Project and the construction of fuelbreaks system west of Black Bear Ranch. District projects that disturb known weed sites are expected to spread noxious weeds in the Assessment Area. All Assessment Area weed sites (except one Dyer's woad population) are located along existing or decommissioned roads. The following projects have the potential to spread current infestations: annual road maintenance, fire suppression, hazard tree removal, roadside utility line trenching, and improvements to existing mining claims (that occur along and adjacent to roads). Projects that alter habitat and create more open, disturbed areas (along roads or elsewhere in the Assessment Area) would create additional habitat for the spread of weeds. Fire suppression activities, the roadside utility line trenching, and the fuelbreak projects would all create additional disturbed habitat that is susceptible to weed infestation.

Conclusion—By creating more disturbed open habitat susceptible to infestations, the surface and crown fires of the no-action alternative would increase the abundance of the four noxious weed species (Dyer's woad, yellow starthistle, Scotch broom, and spotted knapweed) in the Assessment Area; the result would be a long-term minor to moderate adverse direct effect on the native vegetation. Post-fire monitoring and control measures would reduce these direct effects.

By directly disturbing known noxious weed sites along roads, the cumulative effects of district projects that include roadside disturbance have the potential to spread infestation of the 32 current roadside noxious weed sites in the Assessment Area; the result would be a long-term moderate adverse direct effect on native vegetation in the Assessment Area. These effects would be reduced by noxious weed control measures, required by the Forest Service Manual (FSM) 2080 Noxious Weed Management (USFS 1995b).

3.7.7.2 Alternative B: Proposed Action

A Weed Risk Assessment was completed for the Proposed Action (see Section 1.9 in the Botanical Resources Report), in accordance with the FSM 2080 Noxious Weed Management (USFS 1995b). The Weed Risk Assessment identified this project as having moderate to high risk of introducing or spreading noxious weeds. For projects having moderate to high risk of introducing or spreading noxious weeds, the project decision document must identify noxious weed control measures that must be undertaken during project implementation. Control measures include post-treatment surveys and site evaluation for treatment. See Section 2.9.6.3 of Chapter 2 of this final EIS.

Direct and Indirect Effects

Mechanical thinning (M Unit) treatments—are planned in 42 units (931 acres) within FRZs. One site of Dyer's woad occurs on a roadside in M Unit 13 near the Klamath Basin area; a second site occurs on a roadside adjacent to M Unit 32 east of Blue Ridge Lookout. The ground disturbance from mechanical treatments has the potential to create ideal conditions for the infestation or spread of Dyer's woad. The risk for increased weed infestations at these two sites would be reduced through implementation of the noxious weed RPMs. The RPMs include the buffering of ground disturbance within known noxious weed sites (all weed sites will be flagged on the ground), the cleaning of all equipment before entering treatment units, post-treatment surveys of each M Unit, site evaluations for treatment of any weed sites located, and the monitoring of weed sites for as long as it takes vegetation to recover from disturbance. With the implementation of the RPMs, there would be a negligible increase in weed infestation at the two known weed sites and any new future sites in the project Assessment Area from mechanical treatments, resulting in a negligible adverse direct or indirect effect on noxious weed sites or native vegetation in the Assessment Area.

Mastication treatments—are planned within the 16 FRZ Units (in 3,207 acres) on slopes with less than 45 percent slope. Mastication treatments would reduce ground and ladder fuels only. Information is lacking on the effects of mastication on noxious weed infestations. Although mastication creates high soil disturbance (and therefore creates the conditions for weed infestation), this risk would be offset by the final treatment result of deep fuelbed loads that suppress germination of noxious weeds. In addition the RPMs require that mastication activities be excluded from weed population sites (all weed sites will be flagged on the ground). All equipment will be cleaned prior to entering treatment units, post-treatment surveys will be conducted in mastication units, and site-specific evaluations will be used to determine treatment of any weed sites that may be located. All weed sites will be monitored following mastication treatments for as long as it takes vegetation to recover from disturbance. With the implementation of the RPMs, there would be a negligible increase in weed infestation sites in the project Assessment Area from mastication treatments, resulting in a negligible adverse direct or indirect effect on noxious weed sites or native vegetation in the Assessment Area.

Roadside treatments—are proposed within FRZs and Rx Units and include a mix of mastication and prescribed burn treatments (depending upon steepness of slope) in FRZs and broadcast burn treatments in Rx Units. The majority of weed sites in the Assessment Area occur within RS treatment units (11 of the 12 Dyer's woad sites, 3 of the 5 yellow starthistle sites, 2 of the 3 Scotch broom sites, and all 13 of the spotted knapweed sites) or along roads within the Assessment Area outside of FRZs or Rx Units. The occurrence of these weed sites within RS treatment areas poses a high risk of spreading noxious weeds to other sites in the Assessment Area. The risk would be offset through implementation of the RPMs incorporated into the Proposed Action. The RPMs require the cleaning of equipment before entering treatment units, that RS treatments be excluded from weed population sites (all weed sites will be flagged on the ground), post-treatment surveys will be conducted in RS areas, site-specific evaluations will be used to determine treatment of any weed sites that may be located, and all known weed sites will be monitored for as long as it takes vegetation to recover from disturbance. With the implementation of the RPMs, there would be a negligible increase in weed infestation sites in the Assessment Area from RS treatments, resulting in a negligible adverse direct or indirect effect on native vegetation in the Assessment Area.

Prescribed burn treatments—are planned in FRZs with slopes above 45 percent (5,107 acres), and in all Rx Units (17,524 acres); treatments include broadcast burning of ground and small ladder fuels and fireline construction (both handline and machine constructed). One Dyer's woad site (ISTI-KM5) occurs within a riparian area of Rx Unit 9, and one yellow starthistle site begins roadside (outside of an RS treatment area) and continues north on a saddle at the junction of National Forest System Roads 39N51 and 39N74, within FRZ 11. Both weed sites occur where broadcast burning and fireline construction activities are expected to occur. While information on fire effects is often conflicting for many noxious weed species, prescribed fire has the potential to create the conditions for new infestations of weed species due to reduced competition from vegetation and litter, increased sunlight and nutrients, and soil disturbance. Possible effects of the broadcast burn treatments include the spread of the existing weeds and the introduction of new weeds into treatment units. Fire can have different effects on the introduction and establishment of different noxious weed species (USFS 2008b; BLM 2008). Where Dyer's woad sites already occur near burned areas, infestations commonly explode in burned areas (Asher 2001). And while fire has been used to control existing infestations of yellow starthistle, fire may also create ideal conditions for the establishment of infestations by reducing competition and litter, exposing soils, releasing nutrients, and possibly even stimulating germination (USFS 2008b).

Prescribed fire has been used to control Scotch broom when used repeatedly to deplete the seed bank (CAL-IPC 2006) and does not appear to increase infestation rates. Low-severity fire is not likely to kill spotted knapweed plants or seeds; fire may top-kill plants, plants can re-sprout from roots, and seeds are persistent to all but severe fire. Based on the species' regeneration strategies, fire could actually promote the establishment and spread of spotted knapweed by creating areas of bare soil and increasing access to sunlight (USFS 2008b).

Both weed species can quickly establish and spread in the disturbed bare ground that would result from prescribed burning and/or fireline construction. The broadcast burn treatments and fireline activities would therefore increase the risk of invasion by these weeds in the Assessment Area. Any increased risk of infestation from the current Dyer's woad and yellow starthistle sites, or introduction of additional noxious weed species in the Assessment Area, however, would be reduced by the project weed RPMs. The RPMs require the exclusion of prescribed burn treatments and fireline construction within weed populations, the cleaning of all equipment before entering treatment units, that post-treatment surveys be conducted in Rx Units and FRZs, site-specific evaluations be used to determine treatment of any weed sites located, and the monitoring of weed sites for as long as it takes vegetation to recover from disturbance. With the implementation of the RPMs, the prescribed burn treatments (including fireline construction) would result in a negligible risk of weed infestation and a long-term negligible adverse indirect effect on native vegetation in the Assessment Area.

Road construction—The Proposed Action includes the construction and closure of 1.03 miles (7 segments totaling 5,443 feet) of new temporary roads to access all or portions of seven M Units and the re-opening and closing of 0.98 mile (5 segments totaling 5,177 feet) of former logging access routes. No documented noxious weed sites occur along proposed temporary roads or existing roads proposed for re-opening, but all four weed species can quickly establish in disturbed ground. The disturbance and habitat alteration from new road construction commonly increases weed infestations. This effect would be reduced through implementation of the weed RPMs that require avoidance of project activities that create ground disturbance within noxious weed populations, the cleaning of all equipment before entering treatment units, post-treatment surveys be conducted, and site-specific evaluations be used to determine treatment of any weed sites located, and the monitoring of any new weed sites for as long as it takes vegetation to recover from disturbance following project completion.

Cumulative Effects. Ongoing district projects, and projects scheduled for the foreseeable future, include annual road maintenance, improvements to existing mining claims, hiking, appropriate responses for fire suppression, installation of utility lines with associated roadside trenching, the North Fork Roads Stormproofing Project, and the construction of a fuelbreak system west of Black Bear Ranch. The Proposed Action would reduce the risk of stand-replacing fire that may occur given the cumulative effects of a previous history of fire suppression, a build up of surface and ladder fuels in the treatment units, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting), and rural community activities in the Assessment Area. The avoidance of stand-replacing fire would prevent an increase in weed infestations that is likely to follow stand-replacing wildfires and the corresponding suppression activities. Noxious weed infestation can have long-term adverse effects on native vegetation and can create permanent change in natural plant communities. The avoidance of increased weed infestations would benefit the native vegetation and contribute to the viability of the natural plant communities in the Assessment Area. Other future district projects that include disturbance to roadside habitat have the potential to increase the spread of known weed sites that occur along roads and to introduce new weeds to the Assessment Area. These effects would be reduced by noxious weed control measures that are required by FSM 2080 Noxious Weed Management (USFS 1995b).

Conclusion—With the implementation of the weed RPMs, direct and indirect effects from the proposed treatments include a negligible increase in weed infestations; the result would be a short-term negligible adverse direct or indirect effect on native vegetation in the Assessment Area. The Proposed Action would reduce the risk of a wildfire resulting from the cumulative effects of fire suppression, the build up of surface and ladder fuels, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities. The avoidance of wildfire would prevent an increase in weed infestations, and the result would be a long-term moderate beneficial indirect effect on native vegetation in the Assessment Area. With the implementation of control measures required by FSM 2080 Noxious Weed Management (USFS 1995b), the cumulative effects from other district projects would be reduced and no effects would be expected.

3.7.7.3 Alternative C: No New Temporary Roads Constructed

Alternative C is similar to the Proposed Action (Alternative B) but without the construction of the 1.03 miles of new temporary roads. The lack of new temporary roads results in the following changes from the Proposed Action: the total acres of mechanical thinning treatments would be reduced by 99 acres in portions of seven M Units, the total acres of fuels treatments in Rx Unit 5 would be decreased by 26 percent (418 acres), the total acres of fuels treatments in Rx Unit 6 would be decreased by 28 percent (404 acres), and the acres of cable yarding would be reduced from 570 to 471 acres (tractor yarding would remain the same).

Direct and Indirect Effects. The direct and indirect effects on noxious weeds would remain the same as described above in Alternative B for mastication treatments, RS treatments, and prescribed burn treatments. Minor differences in effects would occur for mechanical thinning treatments. The reduced acres of mechanical treatments would result in a minor reduced risk of new weed infestations, resulting from fewer acres of ground disturbance. With the implementation of the RPMs, however, there would still be a negligible increase in weed infestation sites in the project Assessment Area from mechanical treatments and negligible adverse direct or indirect effects on noxious weed sites or native vegetation in the Assessment Area.

Direct and indirect effects on noxious weeds would be reduced in areas without construction of new temporary roads. The reduction in road construction would result in a reduced risk of new weed infestations from disturbance and habitat alteration. The (reduced) risk of weed infestation would be further reduced by the weed RPMs, which require avoidance of project-related ground disturbance in noxious weed populations, the cleaning of all equipment before entering treatment units, that post-treatment surveys be conducted, site-specific evaluations be used to determine treatment of any weed sites located, and the monitoring of any new weed sites for as long as it takes vegetation to recover from disturbance following project completion.

Cumulative Effects. The cumulative effects from Alternative C would not differ from Alternative B. See the discussion of cumulative effects under Alternative B above.

Conclusion—With the implementation of the weed RPMs, direct and indirect effects from Alternative C treatments would include a negligible increase in weed infestations for mastication treatments, RS treatments, and prescribed burn treatments; the result would be a short-term negligible adverse direct or indirect effect on native vegetation in the Assessment Area. Alternative C would greatly reduce the risk of a wildfire resulting from the cumulative effects of fire suppression, the build up of surface and ladder fuels, and the potential for fire ignitions from the ongoing recreational (mining, hiking, hunting) and rural community activities. The prevention of wildfire would prevent an increase in weed infestations, and the result would be a long-term moderate beneficial indirect effect on native vegetation in the Assessment Area. With the implementation of control measures required by FSM 2080 Noxious Weed Management (USFS 1995b), the cumulative effects from other district projects would be reduced and no effects would be expected.

3.8 Social Values

3.8.1 Introduction

A social analysis uses social science information to determine how proposed actions affect humans. Because changes in the management policy of the Klamath National Forest established by the Klamath Land and Resource Management Plan (Klamath LRMP) are not proposed, the social effects of this proposal are limited in scope. For the Eddy Gulch Late-Successional Reserve (LSR) Project, effects on social values are discussed in narrative form. Indicators of the social environment are local community capacity, economics, visual quality (scenery), recreation, human health and safety, roadless areas, Wild and Scenic Rivers, transportation, heritage resources, and environmental justice.

3.8.2 Methodology

3.8.2.1 Analysis Methods

The analyses contained in this section are summarized from the following resource reports that were prepared for the Eddy Gulch LSR Project (these reports are on the project website: http://www.eddylsrproject.com):

- Social Assessment
- Economic Report
- Scenery Report
- Recreation Report
- Wild and Scenic Rivers Report
- Roads Report
- Heritage Report

3.8.2.2 Analysis Area

The Klamath National Forest lies in Siskiyou County, California, and a small portion of Jackson County, Oregon. The Eddy Gulch LSR Project Assessment Area is contained entirely in Siskiyou County. The county, the Salmon River subbasin, and Eddy Gulch LSR Project Assessment Area make up the analysis area for determining current conditions and project effects on social values.

3.8.3 Affected Environment and Environmental Consequences

3.8.3.1 Community Capacity

Affected Environment

Community capacity (the community's ability to respond to stresses and take advantage of opportunities to meet community needs) is fluid. The infrastructure (underlying framework) in small communities surrounding the Assessment Area is limited and unemployment and poverty are high (Doak and Kusel 1997).

The Salmon River Subbasin is an unincorporated area of Siskiyou County. Approximately 250 people currently reside in the Subbasin, and residences are dispersed throughout the subbasin, with concentrations located in or near the towns of Sawyers Bar, Cecilville, Somes Bar, and Forks of Salmon. The subbasin also contains several outlying small neighborhoods and isolated forest residencies. The "Social Assessment" provides additional information about community capacity and community well-being and effects on these elements that could result from implementation of the Eddy Gulch LSR Project.

Environmental Consequences

Alternative A

The future social situation in the vicinity of the project would likely be similar to the present. Community capacity and infrastructure would remain limited, and unemployment and poverty would remain high where it is currently high. Wildfires can result in both adverse and beneficial effects on community capacity. Short-term adverse effects on community well-being can occur if residents are temporarily displaced from their homes or communities during wildfire. Fires can also provide employment opportunities for the local community in suppression and rehabilitation activities.

Alternatives B and C

Alternatives B and C would not affect the future social situation in the vicinity of the Eddy Gulch LSR Project. Community capacity and infrastructure would remain limited, and unemployment and poverty would remain high where it is currently high. There would be a contribution to contract work in the local communities from either action alternative, which could result in beneficial effects.

3.8.3.2 Economics

Affected Environment

The analysis area for economics is Siskiyou County. Available employment opportunities include logging, planting, precommercial thinning, masticating, and conducting surveys. People in the area spend money on gas, equipment, clothing, and food, which creates a small multiplier effect in Siskiyou County. People employed by nonprofit groups also work in the county. Activities such as hunting and recreational use can generate direct or indirect employment, which can be cumulative when combined with employment generated by project activities. The median number of households in the county (as of 2000) was 18,556, and the median household income (in 2004) was $32,531. The median per capita income (2004) was $17,570.

Environmental Consequences

Alternative A

Timber or biomass from the Assessment Area would not be available to regional markets, and demands will be satisfied by other domestic or foreign sources. Contract work from awarded timber sales, stewardship contracts, road contracts, and survey work would not be realized. Conversely, there would be no costs associated with hazardous fuels reduction and no funding needs for fuel reduction work proposed throughout the Assessment Area.

The calculated value of benefits is related to the value of timber that would be lost if the 7,200-acre wildfire modeled for Alternative A were to occur. For this analysis, the volume of timber killed in the 7,200 acres was calculated using the 1995 Timber Type Inventory, volumes from stand examination data processed using Forest Vegetation Simulator, and values calculated for the harvest units. The estimated volume lost would be 1,005,400 thousand board feet (MBF), with a current value of $119.18 per MBF. Thus, the total value of lost timber would be $12,828,450. The discounted value would be $11,449,759.

Alternative B

Alternative B would result in a positive residual value and would provide for jobs and the production of wood commodities, which would have economic benefits for the surrounding communities.

With an estimated volume of 10.8 million board feet (MMBF), this alternative could potentially create 108 jobs. It would also provide the wood commodity to support local mills and provide the basis of numerous products sold abroad. The positive residual value from thinning treatments in M Units would be approximately $1,286,301. The total discounted cost for mastication and underburning in FRZs, underburning in Rx Units, and hand cutting, piling, and burning in RS treatments would be approximately $4,976,661. Alternative B would result in beneficial effects on the local communities and Siskiyou County.

Alternative C

Alternative C would also result in a positive residual value and would provide for jobs and the production of wood commodities, which would have economic benefits for the surrounding communities.

With an estimated volume of 9.6 MMBF, Alternative C could potentially create 96 jobs. It would also provide the wood commodity to support local mills and provide the basis of numerous products sold abroad. The total discounted cost for mastication and underburning in FRZs, underburning in Rx Units, and hand cutting, piling, and burning in RS treatments would be $4,953,088. Alternative C would result in beneficial effects on the local communities and Siskiyou County.

3.8.3.3 Environmental Justice

Affected Environment

Executive Order 12898 requires that each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, “disproportionately high and adverse human health or environmental effects” of its programs, policies, and activities on minority populations and low-income populations.

This assessment was conducted using the format described in the “Guide for Environmental Justice Analysis with the Environmental Impact Analysis Process” (USAF 1997). The analysis area for Environmental Justice is Siskiyou County, California.

The census data for Siskiyou County was obtained from the United States Census Bureau (USCB 2005). The data show that the population of Siskiyou County is made up of Caucasians (82 percent), Hispanics (9 percent), Native Americans (4 percent), Blacks (1.4 percent), and Asians or Hawaiians (1.4 percent) (2005 data). Approximately 15.5 percent of the population is below the poverty line (2004 data). There is no specific data for the rural communities in the vicinity of the Eddy Gulch LSR Project Assessment Area. The Salmon River Community Wildfire Protection Plan (CWPP) (SRFSC 2007) contains additional information about the rural communities and neighborhoods in the vicinity of the Eddy Gulch LSR.

Environmental Consequences

Alternative A

No disproportionately high or adverse human health or environmental effects on minority populations and low-income populations would occur under Alternative A.

Alternatives B and C

No disproportionately high or adverse human health or environmental effects on minority populations and low-income populations would occur under Alternative B or C.

3.8.3.4 Human Health and Safety

Affected Environment

The analysis area for health and safety is the Eddy Gulch LSR Project Assessment Area. A number of laws and regulations to protect human health and safety govern forest practices, including the *Federal Highway Safety Act*, Occupational Safety and Health Administration regulations, and air quality regulations.

Environmental Consequences

Alternative A

Alternative A would not implement fuels reduction treatments to improve the safety of travelers on emergency access routes within the Eddy Gulch LSR, as specified in the Salmon River CWPP. This would result in potential adverse effects on residents and suppression crews in the event of a wildfire because roads could be blocked by fires that have jumped the road or by fallen trees. Blocked roads could require residents to take a longer route out of the area or affect the timely access for suppression crews. Refer to "Section 3.2 Forest Vegetation," "Section 3.3 Fire, Fuels, and Air Quality," and the "Recreation Report" for more information on the effects of taking no action under Alternative A.

Alternatives B and C

Alternatives B and C both propose fuel reduction treatments along 44 miles of emergency access routes inside FRZs and Rx Units and 16 miles of RS treatments outside of FRZs and Rx Units. There could be beneficial effects on human safety from providing safe emergency access for residents to evacuate and for suppression forces to safely enter the LSR in the event of a wildfire. Refer to "Section 3.2 Forest Vegetation" and "Section 3.3 Fire, Fuels, and Air Quality" for more information on the effects of implementing Alternative B or C.

3.8.3.5 Visual Quality (Scenery)

Affected Environment

The visual quality analysis area for the Eddy Gulch LSR Project encompasses several Klamath LRMP (USFS 1995) "Management Areas," which establish direction for scenic integrity (Visual Quality Objectives [VQOs]) (see the "Scenery Report" for "Map A-5. Klamath LRMP Visual Quality Objectives, as applied to the Eddy Gulch LSR"). Sensitive viewpoints outside of the Eddy Gulch LSR have been included in the analysis area if proposed treatment areas are visible from those viewpoints.

In Eddy Gulch LSR Assessment Area, *scenic character* is composed of steep rugged mountain landforms, steeply incised stream channels, and diverse mixed-conifer forests. *Scenic attractiveness* varies little throughout the Assessment Area, with the majority of the Eddy Gulch LSR being "Typical or Common." Areas within the Wild and Scenic Salmon River can be classified as "Distinctive." "Indistinctive" areas do not occur in the Assessment Area.

The vast majority of the Eddy Gulch LSR has a *scenic integrity* goal of Partial Retention. Since the overall impression of the Assessment Area ranges from Partial Retention to Preservation, the current condition meets Klamath LRMP VQOs, even though individual disturbances may result in lower ratings in a localized area. The corridor of the "Scenic" segment of the Wild and Scenic South Fork of the Salmon River and the Pacific Crest National Scenic Trail (PCT) both have a Klamath LRMP VQO of Retention. The *scenic stability* of the Eddy Gulch LSR's scenic character is of concern primarily because of the existing excessively dense vegetative conditions, which have largely replaced attractive scenery attributes such as open and diverse forest canopies, large tree prominence, and views to understory vegetation and wildlife. Many of the stands may not be sustainable because they have departed too far from reference/historic conditions. The existing *scenic stability* for the majority of the Assessment Area is low primarily due to the high probability of large stand-replacing fires in the Eddy Gulch LSR, which would further threaten and impair the historic scenery attributes above.

Environmental Consequences

Alternative A

There would be no direct effects on Scenic Stability and Scenic Integrity from the no-action alternative. Indirect effects would result from maintaining current vegetation conditions and fuel loads. Scenic Stability could degrade further from *low* to *low/very low* if future vegetation growth of ladder fuels (overly dense stands of small and intermediate size trees) and lack of open stands increases the wildfire risk. Climate change may result in further drying conditions and an extended dry season, further increasing the risk of fire and lowering the areas of Scenic Stability currently rated as moderate/low to a low/very low level.

Uncontrolled burning of large wildfires that exceeds the area's historic range in terms of size and intensity could result in significant impairments to both Scenic Integrity and Scenic Stability. Due to the density of vegetation growth in the Assessment Area, wildfires covering a projected 5,065 acres of passive crown fire and 780 acres of active crown fire would likely create uncharacteristically large openings in the forest canopy, exposing existing roadway disturbances and the effects resulting from past salvage operations. These effects have a strong probability of lowering the Scenic Integrity levels to "Modification" or "Maximum Modification," which are well outside Klamath LRMP VQOs. Such large fires would also reduce the presence of attractive forest canopy attributes for long periods of time, further impairing the existing poor Scenic Stability conditions. In summary, this alternative continues and increases the likelihood of large wildfires indirectly resulting in long-term major adverse effects on scenery.

Alternatives B and C

The Eddy Gulch LSR Project would result in two primary moderate to major beneficial effects: (1) increase in Scenic Stability due to reduction of fire hazard, and (2) increase in scenic character due to creating more open, park-like forest canopy conditions with larger trees. Potentially adverse effects would generally range from negligible to minor and include scenery disturbance effects such as stump visibility from moderate concern roads, visibility of temporary roads, and visibility of cable corridors. The “Scenery Report” and “Scenery Analysis” provide considerable information about current conditions in the Assessment Area and detailed discussion of how visual quality would be affected by project activities.

The thinning that would occur in FRZs would reduce the likelihood of a large wildfire spreading from one watershed to the next, thereby increasing Scenic Stability throughout the Assessment Area. Reducing ladder fuels through prescribed burning would reduce the likelihood that a large stand-replacing wildfire that exceeds the historic range of variability would occur in the Assessment Area, and as a result increasing resiliency of valued scenic resources and improving Scenic Stability to moderate to high levels. This thinning would also increase the development of large tree character in these stands, which is an important scenery attribute enhancement.

Moderate beneficial effects on scenic character of the PCT foreground views include creating more open, park-like settings with larger trees and better visibility into the forest (middle-ground and back-ground views from PCT and other identified trails would remain within the historical range of variability). Potentially short-term moderate adverse effects on Scenic Integrity include visible disturbance in foreground through stumps, slash, and other debris, and/or evidence of tractor operations and skid and cable corridors. Implementing RPMs (which include flush-cutting and obscuring stumps and removal of debris from the vicinity of the PCT) will reduce these potential effects to minor or negligible levels. The one mastication treatment visible from the PCT is approximately 400 feet below the trail, thus only the tops of the trees would be visible, and treatments within this unit would have negligible affects on PCT users. Effects of fuel reduction treatments on Scenic Integrity occurring in middleground and background views would be negligible.

3.8.3.6 Recreation

Affected Environment

According to an August 2002 National Visitor Use Monitoring Report (USDA 2002), the popular recreational activities in the Klamath National Forest include viewing wildlife and scenery, general relaxing and retreat, pleasure driving, hiking/walking, camping, picnicking, nature study, off-highway vehicle use, fishing, and cross-country skiing / snowshoeing.

Existing camping areas include Shadow Creek and Idlewild (outside, but adjacent to the LSR). Campgrounds outside, but nearby, the LSR include Mulebridge, Shadow Creek, Trail Creek, and East Fork. Matthews Creek and the Matthews Creek river access border the Assessment Area’s southwest corner. Existing recreation / hiking trails include the PCT and numerous trails in and around the Russian Wilderness, along Russian Creek, following the east fork of Whites Gulch, and along Sixmile Creek and Trail Creek. Additionally, the Deacon Lee trailhead provides access to the Deacon Lee trail eastward to the Russian Wilderness. During the summer months, whitewater rafting and kayaking are popular activities on the South Fork of the Salmon River below Matthews Creek. The North Fork of the Salmon River only skirts the Eddy Gulch LSR for a short distance, and no segments of the Salmon River lie entirely within the LSR; however, camping sites located in the Assessment Area could serve as staging areas for boating expeditions.

According to the Klamath LRMP (USFS 1995), 20 percent of visitors engage in recreation at developed sites, with 80 percent participating in dispersed activities such as hiking, fishing, and nature viewing. The Klamath LRMP places emphasis on dispersed recreation, particularly in the LSRs, as well as maintenance of existing developed sites.

Most of the LSR that was inventoried as Roaded Modified in 1990 has regrown sufficiently to be classified today as Roaded Natural. Some of it would be classified as Semi-Primitive Motorized depending on the size of the area and primitive nature of the roads. The inventoried roadless areas retain most of their Semi-Primitive Non-Motorized and Primitive characteristics.

Environmental Consequences

Alternative A

Direct and indirect effects of the no-action alternative on recreation would be negligible and remain within Semi-Primitive or Roaded Natural Recreation Opportunity Spectrum (ROS) classes. Cumulative effects of continuing current vegetation management, combined with a large wildfire, would be major and adverse and result in conditions not meeting Klamath LRMP ROS directives.

Alternatives B and C

Alternatives B and C would have major beneficial effects on recreation setting and experience primarily through reduction of the possibility of a major wildfire. Minor beneficial effects would occur due to creation of a more open, park-like setting with large trees and increased opportunities for wildlife viewing. Temporary adverse effects could occur primarily due to the effect of fuel reduction treatments and prescribed burning. These effects would be reduced to minor levels with proper scheduling and implementation of standard health and safety measures. Except for these temporary effects, the Roaded Primitive and Semi-Primitive Natural ROS classes would continue to be met.

3.8.3.7 Wild and Scenic Rivers

Affected Environment

The *Wild and Scenic River Act* was created in 1968 to preserve selected rivers in a free-flowing condition and to protect their associated river resources. Most of the North and South Forks of the Salmon River, as well as a segment of Russian Creek in the Eddy Gulch LSR, are either Designated as, or Recommended for, future designation as segments of the National Wild and Scenic River (WSR) system, with a “Recreational” WSR classification (USFS 1995). Fisheries is the primary “outstandingly remarkable” value for the North Fork and South Fork of the Salmon. Other WSR values to be protected include free-flowing condition, water quality, and scenery. Fisheries, water quality, and wildlife are the primary “outstandingly remarkable” values for the East Fork South Fork Salmon River. In particular, values to protect include pristine riparian habitat, high quality water, a peregrine falcon eyrie, goshawk territory, fisher, and pileated woodpecker habitat. Outstandingly remarkable values for South Russian Creek include vegetation and water quality, and the specific values to protect are vegetation diversity, including a stand of old-growth Engelman spruce and a pristine watershed.

A section of the North Fork of the Salmon River that flows through the Assessment Area is a Designated “Recreational” WSR. Additionally, a nearby portion of the North Fork of the Salmon River is a Recommended WSR eligible for “Wild” classification, although this area is outside the LSR boundary within the Marble Mountain Wilderness Area. One Designated WSR segment of the South Fork of the Salmon River contains sufficiently primitive and undeveloped character, dramatic scenic bluffs and incised canyons, to be classified as “Scenic.” There is also a portion of the South Fork of the Salmon River that occurs in the Assessment Area that is Recommended as a WSR with a “Recreational” classification. Russian Creek occurs in the Assessment Area and is Recommended as a WSR, with this segment recommended for classification as “Recreational.” Outside of the Assessment Area, within the Russian Wilderness Area, a second nearly pristine segment of Russian Creek has been recommended as a WSR with a “Wild” classification. The few “Distinctive” *scenic attractiveness* areas in the Assessment Area are located in the WSR corridors.

Environmental Consequences

The analysis for Wild and Scenic Rivers focuses on the effects to the integrity of the WSR corridors and protection of their Outstandingly Remarkable Values, and other WSR values (Water Quality, Free-flowing Condition, and Scenery), per requirements of the Klamath LRMP, Aquatic Conservation Strategy Objectives, and other pertinent laws and direction.

Alternative A

Potential benefits of the no-action alternative would be negligible on free-flowing condition, scenery, water quality, fisheries, watershed condition, wildlife/riparian habitat, and vegetation diversity; however, when considered cumulatively with the possibility of future wildfire, the no-action alternative has the potential for major adverse effects on Outstandingly Remarkable Values in fisheries and water quality on the North and South Fork of the Salmon River; pristine watershed condition and vegetation diversity on Russian Creek; and fisheries, riparian habitat, and wildlife on the East Fork South Fork Salmon River. WSR values and resources are fully protected per LRMP direction and associated resource requirements, such as the Aquatic Conservation Strategy, and current/potential WSR classifications may not be perpetuated under the no-action alternative.

Alternatives B and C

Minor beneficial effects on “outstandingly remarkable” values include protection of larger trees and vegetation in and around the riparian corridor and reduction of the risk of the amount of high intensity wildfire in the area. These two alternatives would have no adverse effects on free-flow and the other outstandingly remarkable values of Recommended Rivers (vegetation diversity, watershed condition, fisheries, and wildlife/riparian habitat). All WSR values and resources are fully protected per LRMP direction and associated resource requirements, such as the Aquatic Conservation Strategy, and due to the project design, including current resources protection measures, **would not** "adversely impact the river's eligibility or designation." The current/potential WSR classifications will be perpetuated through implementation of Alternatives B and C. For more information on potential project effects on the North and South Forks of the Salmon River and South Russian Creek, refer to Section 3.5 above and also the Aquatic Resources Report for Water Quality and Fisheries.

3.8.3.8 Transportation

Affected Environment

The Eddy Gulch LSR Assessment Area is well roaded. The road network provides access for management activities, human uses, recreation, firefighting, and other emergency responses. The system roads are very stable with few, if any, problem spots. There is little sediment coming off of the roads in the Assessment Area, and the road system will function for commercial use with only maintenance. The unauthorized roads in the Assessment Area are mostly former logging access routes, abandoned railroad grades, or roads created to access camp sites or water sources.

Environmental Consequences

Alternative A

The no-action alternative would provide for continued routine maintenance on system roads as funding allows. Continued road system improvements by the Klamath National Forest would result in short- and long-term minor to major beneficial effects, depending on the extent of future improvements.

Alternatives B and C

Maintenance of haul roads by the project would improve driver safety and comfort by clearing, blading, and dust abatement where required for haul. Clearing roadside vegetation would improve visibility. Blading would remove rocks and debris and smooth the road surface. Dust abatement would improve user safety on gravel and native surfaced roads. But, the increased truck and heavy equipment traffic during implementation of the project would make the haul routes more hazardous during the life of the project. The Proposed Action is equally more likely to improve user safety and comfort in the years after the project than the no-action alternative, which depends on routine maintenance, as funds allow, for accomplishing maintenance work.

For Alternative B, the effects on resources from construction of 1.03 miles of new temporary roads and use of former logging access routes and operational spurs are discussed in detail in the various resource sections in this final EIS.

3.8.3.9 Heritage Resources

Affected Environment

Topographic conditions and water sources in the Assessment Area have significantly influenced land use of Native Americans and, to a large extent, Euro-Americans. In general, human use in the Assessment Area follows similar patterns of habitation and resource use, so historic and archaeological sites often overlap each other.

American Indian Resources

American Indians resided in the Salmon River drainage for thousands of years prior to contact with Europeans. Areas that sustained American Indian use generally are located within deep canyons adjacent to the Salmon River and secondary streams. These are the areas most likely to contain American Indian cultural resources. Currently, Indian use of the Assessment Area is very low; only one prehistoric site has been recorded. No sacred/spiritual-use sites or traditional plant-gathering sites have been documented.

Members of the Shasta and Karuk tribes continue to be an integral part of communities along the Salmon River and its tributaries. They use the area for gathering of traditional materials and foods, including beargrass, willows, fish, acorns, and mushrooms. Throughout their history, American Indians have used fire to enhance conditions for traditional materials; however, this practice is not currently being used in the Eddy Gulch area.

Historic Resources

Historic resources include trails, mining sites, logging camps, communities, isolated structures, and artifact scatters. Portions of the Live Yankee Gulch and Eddy Gulch watersheds are part of a historic mining district, with numerous mining-related artifacts and sites. Twenty-three historic properties related to mining or other historic uses have been recorded for the Area of Potential Effects (APE) and were visited. Two sites could not be relocated, and one no longer exists. One site (White’s Gulch Arrastra) is on the National Register of Historic Places. No determinations have been made on the other sites.

Environmental Consequences

Alternative A

Direct and Indirect Effects. Direct effects include scorching or loss of resources during a wildfire. Depending on fuel moistures, wooden structures or artifacts can be adversely affected or lost even from a relatively low-intensity surface fire. High-intensity fire can split stone artifacts (such as those made with obsidian). High temperatures can melt solder in cans and other artifacts. Indirect effects include ongoing deterioration of historic artifacts from weathering, which will occur under any alternative.

Under the no-action alternative, fuel levels would support active or passive crown fire over most of the landscape. The high temperatures associated with crown fire would adversely affect historic resources within the fire perimeter. Depending on fire location, this alternative could result in a loss of one structure, loss of wooden artifacts on two other sites, and impacts on the prehistoric site. Stone and metal artifacts would be affected but not lost.

Cumulative Effects. There are no other proposed actions for this area that would affect heritage resources. There are no projected cumulative effects.

Conclusion. The risk of adversely affecting heritage resources is highest under this alternative due to the potential for crown fire throughout most of the APE.

Alternative B

Direct Effects. Direct effects include physical disturbance of heritage resources through site disturbance (road construction), and impacts to or loss of resources to fire during prescribed burns or wildfire.

Resource protection measures would be implemented on three properties within fuel treatment areas. Properties would be pretreated (such as with hand line and removal of fuels within property boundaries) prior to implementation of fuels reduction activities, which would ensure that they are not burned over or otherwise damaged. No properties are within the alignment of temporary roads or former logging access routes; these activities would not affect heritage resources.

Indirect Effects. There are no recorded sites along proposed new road alignments; therefore, there would be no indirect effects from road construction.

Under this alternative, wildfire would burn fewer acres at a lower intensity than under no action, so there would be less risk of losing historic artifacts. Pretreatment of sites should also provide some measure of protection against low-intensity wildfire. Indirect effects include ongoing deterioration of historic artifacts from weathering, which will occur under any alternative.

Cumulative Effects. There are no other proposed actions for this area that would affect heritage resources. There are no projected cumulative effects.

Conclusion. Fuels treatments would reduce fire behavior and rate of spread, which would reduce the risk of a heritage site being burned. Pretreatment of three sites will provide some protection against wildfire effects. Construction/reopening and closure of new temporary roads and former logging access routes would have no adverse effect on heritage resources.

Alternative C

Direct and Indirect Effects. Direct and indirect effects are similar to Alternative B.

Cumulative Effects. There are no other proposed actions for this area that would affect heritage resources. There are no projected cumulative effects.

Conclusion. Effects are similar to those listed for Alternative B.

3.8.3.10 Inventoried Roadless Areas

Affected Environment

The Inventoried Roadless Areas in the Eddy Gulch LSR are not within the boundary of the project Assessment Area.

Environmental Consequences

The project does not propose to construct roads within the Inventoried Roadless Areas, and wildfire does not affect roadless character. There would be no effect on roadless character or the Inventoried Roadless Areas under any alternative.

3.9 Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress under NEPA, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare; to create and maintain conditions under which man and nature can exist in productive harmony; and fulfill the social, economic, and other requirements of present and future generations of Americans.

Short-term uses, and their effects, are those that occur within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project has been implemented. Under the *Multiple-Use Sustained-Yield Act*, and the *National Forest Management Act*, all renewable resources are to be managed in such a way that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. Long-term productivity is maintained through the application of the Resource Protection Measures described in Chapter 2, in particular, those applying to the soil and water resources.

All treatments would contribute to increased tree vigor over the long term, which would reduce the probability of insect attack. The resulting stand conditions would be more sustainable over the long term from the standpoints of vegetative diversity and non-declining flow of timber. Treatments are expected to promote the development of larger trees sooner than if left untreated.

Both action alternatives would experience a short-term period of increased fire hazards immediately after thinning in M Units (approximately 3.5 percent of the treated acres) due to slash, which would increase ground fuels. Subsequent fuels reduction treatments would reduce those ground fuels to a level that would meet the project objective. Broadcast burning is designed to result in mortality to smaller size classes in the treated stands. The loss of these ladder fuels would reduce the potential for a crown fire in the future. Both action alternatives would increase opportunities for successful direct attack tactics during fire suppression and control of fire size. Reductions in fire size and behavior would reduce subsequent post-fire delivery of sediment to streams in the Assessment Area. This would provide long-term benefits to municipal water supplies and aquatic habitat. Both action alternatives would reduce the potential for crown fires, which can reduce the riparian cover that shades aquatic habitat.

The construction of 1.03 miles of temporary roads, re-opening of former logging access routes, and use of the short spurs may increase short-term risks to water quality (refer to the fish BA/BE or Aquatic Resources Report for Water Quality and Fisheries for this project or Section 3.5 above). However, all of the proposed temporary roads and those that would be re-opened are at the highest elevations of the watersheds, reducing the risk of displaced soil becoming a new sediment source that reaches adjacent stream channels. Closure of the temporary roads and former logging access routes following thinning and water-barring roads that are re-opened would preclude the formation of long-term sources of suspended sediment.

Alternatives B and C comply with the *Clean Water Act* through implementation of BMPs, meeting water quality objectives (suspended sediment, turbidity, and temperature), and protecting beneficial uses (USDA Forest Service 2007a). These actions ensure compliance with the *Clean Water Act* and North Coast Regional Water Quality Board Basin Plan. Further, projects must comply with the California Regional Water Board's Categorical Waiver for Discharges Related to Timber Harvest Activities on Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No. R1-2004-0015 (Waiver). The Eddy Gulch LSR Project meets all conditions and eligibility requirements of the Categorical Waiver.

Alternatives B and C may affect forested habitat used by northern spotted owls (NSOs) in the short term; however, most of the affected habitat occurs in home ranges where there is currently surplus nesting/roosting or foraging habitat. Short-term effects would be similar for Pacific fishers. There would be long-term beneficial effects because stands would be less susceptible to the loss of crowns during a wildfire.

Alterations in scenery would be slightly noticeable in the short term under both action alternatives. The scenic mosaic in the two action alternatives would increase as a result of the different treatments and would result in a substantially greater likelihood of being perpetuated, compared to the no-action alternative.

3.10 Unavoidable Adverse Effects

Unavoidable adverse effects would occur during project implementation. There would be some unavoidable short-term adverse effects on soils from equipment, on local communities from smoke, and avoidance of areas by wildlife during project implementation. These activities are necessary to achieve long-term beneficial effects from the project. The Standards and Guidelines contained in the Klamath LRMP, resource protection measures, and Best Management Practices (BMPs) will be implemented to avoid, reduce, or minimize those short term adverse effects to less than significant. Chapter 2 presents the resource protection measures for each resource. The BMPs, by treatment unit, are discussed in the Aquatic Resources Report for Water Quality and Fisheries, the Soils Report, and Geology Report.

3.11 Irreversible and Irretrievable Commitment of Resources

An *irreversible* commitment of resources is a permanent or essentially permanent loss of nonrenewable resources, such as mineral extraction, heritage (cultural) resources, or to those factors that are renewable only over long time spans or at great expense (for example, soil productivity), or to resources that have been destroyed or removed. No irreversible commitments of resources were identified for the project.

Irretrievable commitment applies to losses that are not renewable or recoverable for future use. The loss of production would be irretrievable, but it would not necessarily be irreversible. Under all alternatives, based on modeled wildfire effects, there would be some loss of forest vegetation and wildlife habitat in the event of a wildfire. Under the action alternatives, the risk of wildfire and subsequent loss of forest vegetation would be reduced. Over time, vegetation and NSO habitat components will regrow. None of the alternatives constitutes an irretrievable commitment of resources.

3.12 Cumulative Effects

Cumulative effects have been discussed in the individual resource sections earlier in this chapter. Cumulative effects for this project include past, present, and ongoing actions. The list of actions considered for cumulative effects analyses can be found above in Section 3.1.4. Resource specialists considered the listed actions but may have used only a subset of the listed actions in their effects analysis based on the potential effects on their resource.

3.13 Climate Change

Increasingly, the relationships between human-caused emissions, climate change, and the role of forests as carbon sinks are being documented (IPCC 2007). Although uncertainty exists in quantifying the impact of emissions on climate, a climate change of 1.4 to 5.8 degrees centigrade is projected by 2100 (Millar et al. 2007). Adapting to climate change and its potential impacts poses challenges and opportunities for managing resources, infrastructure, and the economy (ibid). Forests and rangelands are seen as part of the solution to reducing atmospheric carbon dioxide and other greenhouse gases; however, the magnitude of the opportunity for carbon storage and carbon trading is not well quantified or thoroughly understood (ibid; IPCC 2007).

The use of future climate scenarios and ecological models suggests that the impact of climate change in California ecosystems could include increases in ecosystem productivity in the short term and additional shifts in the distribution of plants and animals in by the end of this century (Lenihan et al. 2006; Westerling and Bryant 2006). Changes in distribution of most forests and their associated fauna will result from higher temperatures and increased fires.

Treatments in the Eddy Gulch LSR Assessment Area are designed to reduce competition among mature trees and increase forest health in M Units. The treatments would reduce ground, ladder, and crown fuels so as to change crown fires to surface fires within the treated areas, which would increase resistance to the spread of wildfires in the FRZs. Treatments in the Rx Units are designed to reduce ground and ladder fuels in order to improve resilience to changes associated with wildfires. These planned changes in stand characteristics may not reduce projected direct effects from climate change (for example, increased temperature). They will however, reduce impacts from wildfires that will increase indirectly from the increase in temperatures (longer fire seasons and drier fuels). Managing forests for carbon sequestration is a poorly understood science but utilization of durable wood products and active forest management is believed to be an effective method of carbon sequestration (IPCC 2007). Thinning and fuels treatments would remove some sources of carbon sequestration, and prescribed burning would generate additional emissions. These emissions can be managed and result in fewer annual emissions than a wildfire. Thinning in M Units would increase productivity and carbon sequestration in the residual stand and long-term reductions in acres burned by crown fires would facilitate carbon sequestration and fewer emissions.

For more information on the status and trends of the nation's resources and climate change, please visit the Research and Development Resources Planning Act Assessment website at http://www.fs.fed.us/research/rpa/.

3.14 Energy Requirements, Conservation Potential, Depletable Resource Requirements

Consumption of fossil fuels by vehicles and equipment will occur with the action alternatives during thinning activities and timber hauling, construction and closure of temporary roads, and opening and closing of former logging access routes. No unusual energy requirements are included nor do opportunities exist to conserve energy at a large scale. With the proper application of the Klamath LRMP Standards and Guidelines for soils, soil productivity will be conserved; supporting information can be found in the Soils Report. The project was developed, in part, to promote the conservation and recovery of late-successional-dependent wildlife species, such as the NSO.

3.15 Prime Farmland, Rangeland, and Forest Land

The Eddy Gulch LSR Project Assessment Area does not contain any prime farmland or rangeland. Prime forest land does not apply within the National Forest System.

3.16 Possible Conflicts with Other Land Use Plans

The action alternatives are entirely on National Forest System lands. The project incorporates components of the Salmon River CWPP, which is designed to reduce the threat of wildfire on private lands. The action alternatives are not in conflict with planning objectives for Siskiyou County or local tribes.

3.17 Other Required Disclosures

Consultation with the NMFS and USFWS has been completed as required by the *Endangered Species Act*.

Archaeological field inventories were conducted in the Assessment Area and are recorded in Archeological Reconnaissance Report ARR#2008050517270. No properties eligible for the National Register of Historic Places will be affected.

Chapter 4
Consultation and Coordination

Welcome

You are now in the “Consultation and Coordination” chapter. Here are the topics you can read about.

Chapter 4. Consultation and Coordination

4.1 Preparers and Contributors

4.1.1 Contractor Interdisciplinary Team Members

Contractor: RED, Inc. Communications

Name	Title / Responsibility	Education / Experience
Steve Holl	• Team Leader • Liaison with Forest Service • Project Quality Control (QC) • Senior Ecologist • Developed Proposed Action and Purpose and Need • Citizen collaboration and public involvement	• BS Wildlife and Fisheries • MS Vertebrate Biology • 10 years experience as Forest Service District Resource Officer and Wildlife Biologist • 21 years natural resources and NEPA project and program management, biological surveys and evaluations, ESA compliance, CWPPs and fuel reduction and forest restoration plans
Susan Hale	• Assistant to the Team Leader • Writer/Editor • Citizen collaboration and public involvement • Developed Purpose and Need • Social Assessment	• BA Elementary Education • Environmental and Occupational Health Certification, USAF • 30 years as writer-editor, 20 of those on NEPA documents (EIS focus) • 20 years managing public involvement programs
Ken Denton	• EIS and Project Design Advisor • Developed Proposed Action and Purpose and Need	• BS Natural Resources • 34 years Forest Service experience and served a Regional Silviculturist for Regions 5 and 6 • Northwest Forest Plan USFS/BLM SEIS team member; served on the LSR Workgroup for the Regional Ecosystem Office
Jim Harvey	• Registered Professional Forester (Cal 2121) • EIS and Project Design Advisor • Developed Proposed Action and Purpose and Need	• 35 years Forest Service experiences as certified silviculturist and 6 years experience as a consulting Forester
Ed Matthews	• Registered Professional Forester (Cal 1280) • Developed Proposed Action and Purpose and Need • Forest Vegetation section in EIS • Silviculture Report	• 35 years Forest Service experiences as certified silviculturist and 6 years experience as a consulting Forester
Mike Mateyka	• Silviculturist • QC on Proposed Action • Forest Vegetation section in EIS • Economic Analysis	• BS Forest Management • Graduate Studies in Forest Economics • 31 years Forest Service experience as Forester in timber sale planning and District Silviculturist
Barry Callenberger	• Fire and Fuels Specialist • Stewardship Fireshed Analysis • Developed Proposed Action and Purpose and Need • Fire, Fuels, and Air Quality section in EIS • Fuels and Air Quality Report • FLAMMAP, FARSITE modeling	• 25 years Forest Service experience as District Fuels Officer, Region 5 Fuels / Prescribed Fire Management Specialist • 12 years private consultant in fuels / prescribed fire management

Name	Title / Responsibility	Education / Experience
Brooks Henderson	• Fire and Fuels Specialist • Stewardship Fireshed Analysis • Developed Proposed Action and Purpose and Need • Fire, Fuels, and Air Quality section in EIS • Fuels and Air Quality Report	• AA, emphasis in Forestry and Economics • 27 years Forest Service experience as Fuels Specialist and Division Chief
Brian Williams	• Wildlife Biologist • Developed Proposed Action and Purpose and Need • Wildlife and Habitat section in EIS • Wildlife Biological Assessment / Biological Evaluation • Wildlife and Habitat Report	• BS Biology • MS Biological Conservation • 17 years biological consulting for biological / ecological surveys, monitoring, and research
Stephanie Martin	• Wildlife Biologist • Wildlife and Habitat section in EIS • Biological Assessment / Biological Evaluation • Wildlife and Habitat Report	• BS Wildlife Ecology • MS Wildlife Biology • Over 10 years experience with biological issues in California (biological surveys, EIR/CEQA compliance, population monitoring)
Jim Crane	• GIS Specialist • Developed Proposed Action • Roads Report • Transportation section in EIS	• AS Business and Computer Science • BS Forestry • 23 years Forest Service experience as Natural Resource Information Manager and Geographical Information Systems (GIS) Specialist and Logging Systems / Transportation Planner • 10 years as associate professor in ArcView 3.x, ArcGIS 8.x and ArcGIS 9.x
Alice Berg	• Fisheries Biologist • Aquatic Resources section in EIS • Aquatic Resources Report for Water Quality and Fisheries • Fish Biological Assessment / Biological Evaluation	• AA General Education • BS Biology • MS Natural Resources: Fisheries • 4 years experience as Forest Service Fisheries Biologist • 4 years NMFS Fisheries Biologist • 6 years as consulting Fisheries Biologist
Ken Cawley	• Hydrologist • Aquatic Resources section in EIS • Aquatic Resources Report for Water Quality and Fisheries • Geology section in EIS • Geology Report	• BS in Forest Management • MS Natural Resources, Watershed Management / Forest Hydrology • 17 years experience as Forest Service hydrologist • 8 years as tenured professor of environmental science; taught a wide-ranging curriculum, including watershed management, forestry, soil science, statistics, geology, chemistry • 8 years consulting hydrologist
Denny Churchill	• Soil Scientist • Soils section in EIS • Soils Report	• BS Soil and Water Science • 26 years of experience as Forest Service Soil Scientist, including District Soil Scientist • 4 years consulting soil scientist preparing erosion and sediment control plans and conducting soil interpretations and environmental analysis
Robin Warren	• Geologist (GE Cal 2678; RG-Cal 7541) • Geology section in EIS • Geology Report	• BS Civil Engineering • MS Civil Engineering (Geotechnical Specialty) • 20 years of geotechnical and geologic experience in field investigations, geologic evaluation, engineering supervision

Name	Title / Responsibility	Education / Experience
Gretchen Vos	• Botanist • Botanical Resources section in EIS • Botanical Resources Report • Botany Biological Assessment / Biological Evaluation •	• BA Linguistics • M.Ag. Agroforestry (Botany/Rangeland/Soils) • 12 years consulting botanist, conducting field surveys, NEPA and CEQA documentation [Central Valley, CA to Cascades, OR and WA] • 3 years experience as a Forest Service Temp Botanist (GS-9), SW Oregon
Ed Armstrong	• California Landscape Architect, #4870 • Scenery, Recreation, and Wild and Scenic Rivers section in EIS • Scenery Analysis • Scenery Report • Recreation Report • Wild and Scenic Rivers Report	• BS Physics • Bachelor of Landscape Architecture • Master of Landscape Architecture • 10 years of experience in planning and design for watershed and creek systems; wetland, stream and riparian restoration projects
Cheryl Priest	• Desktop Publishing Director • Format and layout of EIS	• 18+ years experience in word processing and formatting documentation for web- and paper-based publication
Stephannie Lambert	• Website Developer / Graphic Designer • Eddy Gulch LSR Website design development • Front and back cover design	• BFA Graphic Design • 12+ years experience and education in direction and production of effective visual communications
Kris Burnham	• Graphic Designer • The Eddy LSR Project “Pathway to a healthy future” Newsletters design	• BS Fine Arts • Over 23 years experience in fine arts and graphic design

4.1.2 U.S. Fish and Wildlife Representative for Collaboration and Consultation

Name	Title / Responsibility	Education / Experience
David Johnson	• Collaborator with ID Team • Review of wildlife section in EIS and Wildlife Biological Assessment / Biological Evaluation • Issuance of Concurrence Letter or Biological Opinion	• MS in Wildlife Management • 12 years experience in wildlife biology • 8 years experience with consultation under ESA

4.1.3 Forest Service Inspectors and Resource Specialists

Name	Title / Responsibility	Education / Experience
Patty Grantham	• Forest Supervisor / Eddy Gulch LSR Project Decision Maker • EIS review	• Bachelor Degree in Forest Science • 27 years of experience with the US Forest Service in silviculture, timber sale preparation and administration, fuels and fire, land use planning, recreation management, lands and special uses. Notable positions include District Ranger, Forest Staff Officer, Deputy Forest Supervisor, and Forest Supervisor.
Ray Haupt	• Line Officer / District Ranger • EIS review	• AS Biology • BS Natural Resources Management, Forestry Concentration • 31 years experience in fire and fuels management, forestry, silviculture, sale preparation, sale contracting, and as district ranger

Name	Title / Responsibility	Education / Experience
		• Certified as Timber Contracting Officer and Logging Systems Specialist • Provided direction for interdisciplinary team
Julie Perrochet	• Klamath National Forest Liaison • Inspector: Fisheries and Earth/Water Sciences • Resource Specialist: Fisheries	• BA Environmental Studies-Ecology • MA Geography–Fisheries Habitat Relationships • 13 years fisheries and wildlife program manager • 18 years fisheries biologist
Jan Ford	• Inspector: Scenery, Recreation, Roads, Engineering, and Heritage • NEPA and LRMP Compliance	• BS Wildlife Management • 28 years experience in wildlife, minerals, lands, recreation, and planning
Emelia Barnum	• NEPA and LRMP Compliance	• NEPA and NFMA Planning Specialist
Sue Stresser	• Inspector: Wildlife	• BS Biology • 15 years experience in wildlife habitat management • Level 1 Representative for Endangered Species Act consultation • Certified COR
Debi Wright	• Inspector: Fire and Fuels	• 27 years experience in silviculture, timber, and fuels
Clint Isbell	• Resource Specialist: Fire and Fuels	• BS and MS in Natural Resources, Fire Ecology • 3 years as USFS Fire Ecologist
Vicki Stephens	• Resource Specialist: Fire and Fuels	• BS in Resource, Recreation, and Tourism Management • MS in Forest Resources, Fire Ecology and Fire Management • 15 years experience in fire and fuels management
Carl Varak	• Inspector: Silviculture, Forest Vegetation	• BS Forest Management • 31 years forestry experience in timber sale preparation, silviculture and contract administration • Level III Contracting Officers Representative
Dan Blessing	• Resource Specialist: Economics	• BA in Forestry • 30 Years silviculture and timber experience
Greg Bousfield	• Resource Specialist: Hydrology	• MS in Natural Resources, Watershed Management Hydrology • BS in Forestry, emphasis on Forestry Hydrology • 3.5 years as USFS Hydrologist • Assistant Forest Hydrologist, modeling specialist
Tom Laurent	• Resource Specialist: Soils	• BA Geology • MS Soil Science • 29 years experience in soil science
Juan de la Fuente	• Resource Specialist: Geology	• BS Geology • 35 years experience in geology/ geomorphic processes
Marla Knight	• Resource Specialist: Botany	• BS in Renewable Natural Resources • 30 years experience in botanical resources management on the Klamath National Forest

Name	Title / Responsibility	Education / Experience
Candy Cook-Slette	• KNF Heritage Resources Manager / Tribal Relations Program Manager • Prepared Heritage Resources Section and Resource Report	• BA Anthropology • 23 years experience in archaeology • 15 years experience in tribal relations
Richard VandeWater	• Inspector: GIS	• MS in Sociology • 17 years experience in GIS and database management with the U.S. Forest Service
Jerry Mosier	• Resource Specialist: Scenery, Recreation, and W-S Rivers	• BS Landscape Architecture • 32 years experience in landscape architecture
Jim Davis	• Resource Specialist: Roads / Engineering	• BS Wildlife/Fisheries Biology • 34 years experience in engineering

4.2 Federal, State, and Local Agency Collaboration and Consultation

4.2.1 Federal, State, and Local Agencies

The contractor ID team consulted with the following federal agencies during the development of this EIS.

4.2.1.1 United States Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) in Yreka, California, is a collaborating and consulting agency for the Eddy Gulch LSR Project. The USFWS issued the species list for the Klamath National Forest on April 23, 2003, and an updated list was generated from the computer database on May 13, 2009 (reference #52820799-8338). The list fulfills the requirement to provide a current species list pursuant to Section 7(c) of the ESA, as amended.

Wildlife. Communication and consultation between the Contractor Wildlife Biologist, Forest Service, and USFWS began on July 7, 2008 but was postponed until October 2008 when more details of the Proposed Action and northern spotted owl distribution data would become available. Initial communication began on September 25, 2007, when David Johnson, USFWS Level 1 representative, attended the interdisciplinary (ID) team meeting in Yreka, CA, and on September 26, 2007, attended a field trip to review the project Assessment Area to better understand baseline conditions in the Assessment Area, and to determine the probable effects of the project. The September visits initiated ongoing communications between the contractor’s Wildlife Biologist, Forest Service, and USFWS.

The USFWS Level 1 representative on the project attended ID team meetings; reviewed and commented on the Stewardship Fireshed Analysis for the Eddy Gulch LSR Project; assisted with preparation of the purpose and need for the project; reviewed the early design of the Proposed Action and subsequent versions until it was finalized for the draft EIS; reviewed and provided comments on the preliminary draft and draft EIS and this final EIS; and participated in *Endangered Species Act* (ESA) streamlining consultation meetings and conference calls. The purpose for all communications was to ensure that the proposed activities would not adversely affect northern spotted owls (NSOs) or their Critical Habitat.

The ID team biologists and the Klamath National Forest and USFWS Level 1 team discussed the proposed project to review locations of actions relative to NSO habitat, potential effects of the proposed actions, and appropriate measures to minimize adverse effects on NSO and its Critical Habitat (for example, the 2007 programmatic prescribed fire and fuels hazard reduction BA) (USFS 2007). USFWS and Klamath National Forest staff conducted unit-level reviews of proposed activities in NSO core areas and home ranges to determine the potential risks to NSOs and their habitat. USFWS staff has preliminarily concurred that proposed activities are not likely to adversely affect NSOs or their Critical Habitat.

Drafts of the wildlife BA/BE were reviewed by the USFWS Level 1 representative on May 1 and June 1, 2009, and it was approved by Ray Haupt (District Ranger) on June 5, 2009, via email from S. Stresser.

Plants. On November 18, 2008, the Arcata Field Office of the USFWS provided the Klamath National Forest with the list (USFWS 2008) of four federally *Endangered* plant species (the list shows no federally *Threatened* species occurring on the forest) (Reference #443293162-163413).

The Eddy Gulch LSR Project Assessment Area is not within the range of, nor does it include habitat for, the four federally Endangered plant species; therefore, no ESA consultation is required.

4.2.1.2 National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) in Yreka, California, is a consulting agency for the Eddy Gulch LSR Project. The ESA fish species list for the Eddy Gulch LSR Project was obtained online at http://www.nwr.noaa.gov/ESA-Salmon-Listings/upload/snapshot0208.pdf, and the Sensitive species list is from the USDA Pacific Southwest Region Sensitive Species List, June 1998. The list fulfills the requirement to provide a current species list pursuant to Section 7(c) of the *Endangered Species Act*, as amended.

On September 24, 2007, Donald Flickinger, NMFS Level 1 representative, attended a full interdisciplinary team (ID team) meeting in Yreka, California, and on June 3, July 1, and August 14, 2008, attended field trips to review the Assessment Area to better understand baseline conditions in the Assessment Area, and to determine the probable effects of the project. In late September 2008, the Threatened, Endangered, Proposed, Sensitive, and Candidate species with the potential to occur in the Eddy Gulch LSR Project Assessment Area were reviewed with the NMFS representative.

In the summer and fall of 2008, the Klamath National Forest / NMFS Level 1 team discussed the proposed project to review locations of actions relative to SONCC coho salmon habitat, potential effects of the proposed actions, and to include appropriate measures to minimize adverse effects on SONCC coho salmon and its critical habitat. NMFS and Klamath National Forest staff conducted unit- / site-level reviews of proposed activities in the 7th-field watersheds to determine the potential risks to anadromous fish and their habitat. During the site visit on June 3, 2008, NMFS reviewed the northwestern and western parts of the Assessment Area with the Klamath National Forest and stakeholders (field review hosted by Salmon River Restoration Council), specifically to review roadside treatment areas and Riparian Reserves. During the August 14, 2008, site visit, the NMFS and ID team fisheries biologist focused their review on Riparian Reserves in the Assessment Area, including a field review of treatment units in the Shadow Creek watershed, Sixmile Creek watershed, Campbell Springs area, Black Bear Creek watershed, Music Creek watershed, and other areas in the north part of the Assessment Area. Throughout the early coordination and consultation with NMFS, the ID team fisheries biologist discussed, with NMFS, the potential effects determinations for the biological assessment / biological evaluation (BA/BE) and existing guidance that would pertain to the project to minimize effects on aquatic species. That existing guidance is the programmatic pre-commercial thinning and fuel hazard reduction BA (USDA Forest Service 2001b) and Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (USDA Forest Service 2005a), as well as the potential for this Project BA/BE to tier to the Klamath National Forest's *Biological Assessment and Evaluation for Pre-commercial Thin and Release Actions and Fuel Hazard Reduction Actions* (USDA Forest Service 2001b). During the field visit on August 14, 2008, NMFS staff preliminarily concurred that proposed activities were not likely to adversely affect SONCC coho salmon and their critical habitat, and that the fuels reduction actions could tier to the Klamath National Forest programmatic BA (USDA Forest Service 2001b) if guidelines in that programmatic BA/BE are incorporated into the Eddy Gulch LSR Project.

Subsequent to completion of a draft BA/BE for the Eddy Gulch LSR Project, and NMFS and Klamath National Forest review of the draft BA/BE, a conference call was held on December 22, 2008, to discuss comments on the BA/BE. During this conference call between A. Berg (ID team fisheries biologist), D. Flickinger (NMFS), and J. Perrochet (Klamath National Forest), it was determined that ESA consultation for the Eddy Gulch LSR Project could be concluded by using the tier form from the 2004 programmatic BA for the *Facility Maintenance and Watershed Restoration on the Klamath National Forest* for water drafting actions and that all the proposed actions, when considered collectively and individually, would either have no effect (as described in the "Efficiency Measures for Analysis" section of this BA/BE) or are not likely to adversely affect coho salmon and their critical habitat. Thus, ESA consultation for the actions with the ESA determination of "May Affect, Not Likely to Adversely Affect" has been completed using the tiering and compliance forms associated with the 2001 and 2004 programmatic consultation documents in the BA appendices. For this BA/BE, it was determined that the project would have indirect beneficial effects resulting from increased protection from wildfire.

In addition to the ID team and Level I meetings described above and field reviews of the Action Area, the following email and phone correspondences occurred with NMFS during the course of this consultation:

- Phone correspondence with Donald Flickinger, NMFS:
  - June 24, 2008, phone call to Don Flickinger discussed location of coho salmon critical habitat in Action Area relative to proposed actions; mechanical units, prescribed fire, previous Klamath National Forest consultations with NMFS for similar actions, temporary roads, and future field sites to visit.
- Email correspondence with Don Flickinger, NMFS:
  - June 4, 2008, email regarding summary of June 3, 2008, field trip with Klamath National Forest and Salmon River Restoration Council.
  - June 24, 2008, transmittal of Klamath National Forest's programmatic Pre-Commercial Thin and Fuels Hazard Reduction Biological Assessment.

- June 24, 2008, transmittal of Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (USDA Forest Service 2005a).

- June 25, 2008, email to ID team hydrologist regarding field reviews in future.

- July 7, 2008, email to hydrologist regarding NMFS's comments to hydrologist’s field notes from July 1, 2008, field trip.

- August 8, 2008, email regarding meeting location for August 14, 2008, field trip.

Drafts of the BA/BE were reviewed by the NMFS Level 1 representative on December 11, 2008, and BA/BE was approved by Ray Haupt (District Ranger) Level 1 on April 20, 2009, via email from J. Perrochet.

The BA/BE was updated subsequent to NMFS’s December 11, 2008, review to correct treatment acres (less acres than what was described in the BA/BE), and Alternative C was modified to include hand line construction around some burn areas and to reduce the amount of underburning acreage in two Rx Units (Rx Unit 5 reduced by 418 acres and Rx Unit 6 by 404 acres; refer to mapped treatment areas for Alternative C in Appendix A of this EIS). These changes represent a decrease in acreage to be treated and therefore potentially reduced the effects on listed species and their habitat relative to what was analyzed previously in the BA/BE and reviewed by NMFS. However, after consideration of these changes, it was determined that none of the changes to the BA/BE materially changed potential effects on listed species or their habitat, critical habitat, Essential Fish Habitat, or the ESA effects determination. Therefore, additional reviews by NMFS were not required.

4.3 Tribal Consultation

4.3.1 Coordination Meetings

September 13, 2007. A handout titled “Line Direction for the Development of the Eddy Project” was provided and a project overview given. Project will be developed utilizing the guiding principles contained in the handout. Tribal input is important for this project. Project will identify fire sheds that can accept fire. There will be a commercial component in strategic locations.

Klamath National Forest	Karuk Tribe
Alan Vandiver, Happy Camp – Oak Knoll District Ranger	Harold Tripp, Fire Management
Chris Grove, Deputy District Ranger	Bill Tripp, Eco-Cultural Restoration Specialist
Ray Haupt, Scott – Salmon District Ranger	
Bill Rice, Orleans District Ranger	
Gay Baxter, Special Uses	
Brain Thomas, Fisheries	

December 10, 2007. During this summit meeting, it was explained that the Eddy Gulch LSR is using a new approach to planning for wildlife habitat protection through fuels treatments in the Eddy Gulch LSR. The project contractor fire and fuels specialists will be using the latest thinking in computer modeling to help set treatment priorities in the LSR. The priorities will be based on the most valuable wildlife habitat to treat and the most important acres to treat in order to protect local communities from wildfire. Red, Inc. is the contractor that has been hired to do most of the work on this project. The contractor will be working closely with Forest Service specialists.

Klamath National Forest	Karuk Tribe
Peg Boland, Klamath National Forest Supervisor	Leeon Hillman, Treasure, Karuk Tribe of California
Patty Grantham, Klamath National Forest Deputy Forest Supervisor	Florence Conrad, Council Member, Karuk Tribe of California
Don Hall, Happy Camp Ranger District, Acting District Ranger	Alvis Johnson, Council Member, Karuk Tribe of California
Chris Grove, Happy Camp Ranger District, Acting Deputy District Ranger	Roy Arwood, Council Member, Karuk Tribe of California
Gay Baxter, Happy Camp Ranger District, Special Uses	Sandi Tripp, Director Department of Natural Resources, Karuk Tribe
Tyrone Kelley, Six Rivers National Forest Supervisor	Erin Hillman, Director of Administrative Programs and Compliance, Karuk Tribe
Dave Hohler, Six Rivers National Forest, Acting Deputy Forest Supervisor	Dave Wrobleski, Director, People Center
	Bill Tripp, Eco-Cultural Restoration Specialist, Karuk Department of Natural Resources
	Earl Crosby, Watershed Coordinator

June 12, 2008. A Klamath Forest Service / Karuk Tribe coordination meeting for the Eddy Gulch LSR Project was held in Happy Camp, California. Ray Haupt provided handouts and gave a presentation of the Eddy Gulch LSR Project. The Ranger explained that the project is a *Healthy Forests Restoration Act* project, and that the Salmon River Restoration Council, Fire Safe Council, and USFWS are involved. A Fireshed Analysis was conducted for the project, and that modeled what fire would do in certain landscapes. He explained that the Forest wants fire to play a role in the ecosystem, and that the project is proposing to compartmentalize areas and allow fire to do its ecological job, while preventing entire watersheds from burning. Meeting participants included the following:

Klamath National Forest	Karuk Tribe
Ken Harris, Happy Camp-Oak Knoll District Ranger	Leaf Hillman, Vice Chairman Karuk Tribal Council
Ray Haupt, Scott-Salmon River District Ranger	Earl Crosby, Interim Director Department of Natural Resources
Don Hall, Happy Camp / Oak Knoll Deputy District Ranger	Bill Tripp, Eco-Cultural Restoration Specialist
Todd Salberg, Orleans District Silviculturist	Bob Goodwin, Karuk Tribal Council Member
Leroy Cyr, Fisheries Biologist	Florence Conrad, Karuk Tribal Council Member

September 30, 2008. A Klamath Forest Service / Karuk Tribe coordination meeting for the Eddy Gulch LSR Project was held in Somes Bar, California. The Proposed Action was discussed, as was the field trip to the Assessment Area on October 29, 2008. Meeting participants included the following:

Klamath National Forest	Karuk Tribe
Ken Harris, Happy Camp-Oak Knoll District Ranger	Earl Crosby, Interim Director Department of Natural Resources
Ray Haupt, District Ranger, Salmon River and Scott River Ranger Districts	Florence Conrad, Karuk Tribal Council Member
Melissa Schroeder, Deputy District Ranger, Salmon River and Scott River Ranger Districts	
Gay Baxter, Happy Camp-Oak Knoll Special Uses Administrator	
Todd Salberg, Orleans District Silviculturist	
Leslie Goslin-Burrows, Orleans Lands and Minerals	

4.3.2 Other Tribal Communication

The Klamath National Forest sent a letter on March 12, 2008, to Roy Hall, Jr., of the Shasta Nation, with a copy of the first project newsletter.

The scoping letter (the second project newsletter, refer to Chapter 1 for a complete discussion about the scoping process) was mailed to BIA-Quartz Valley; Arch Super, Karuk tribe; Harold Bennett, Quartz Valley; and Howard McConnell, Yurok Tribe.

4.4 Distribution of this Final Environmental Impact Statement

Portable document format (pdf) files of the draft EIS and this final EIS and related resource reports are available on the project website (http://www.eddylsrproject.com). Hard copies or electronic versions of the final EIS will be sent to those who commented on the draft EIS (see Appendix B) or requested a copy.

Chapter 5
Acronyms, Glossary, Literature Cited, Index

Welcome

These are the sections in this chapter.

Acronyms

ACS	Aquatic Conservation Strategy
AMR	Appropriate Management Response
APE	Area of Potential Effect
AWWC	Areas With Watershed Concerns
BA/BE	Biological Assessment / Biological Evaluation
BLM	Bureau of Land Management
BMP	Best Management Practice
CBD	crown bulk density
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH	Critical Habitat
CHU	Critical Habitat Unit
CO	carbon monoxide
CWD	coarse woody debris
CWE	cumulative watershed effect
CWHR	California Wildlife Habitat Relationship
CWPP	community wildfire protection plan
dbh	diameter at breast height
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERA	Equivalent Roaded Acre
ESA	Endangered Species Act
FRCC	Fire Regime Condition Class
FRZ	Fuel Reduction Zone

FSM	Forest Service Manual
FVS	Forest Vegetation Simulator
GIS	geographic information system
HFI	Healthy Forests Initiative
HFRA	Healthy Forests Restoration Act
ID	interdisciplinary
kg/m^2	kilograms per square meter
kg/m^3	kilograms per cubic meter
KMP	Klamath Mountain Province
LOP	Limited Operating Period
LRMP	land and resource management plan
LSR	Late-Successional Reserve
LWD	large woody debris
MOCA	Managed Owl Conservation Area
Mbf	thousand board feet
mi/mi^2	miles per square mile
MIS	management indicator species
mm	millimeter
mph	miles per hour
NEPA	National Environmental Policy Act
NFS	National Forest System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOGO	northern goshawk
NSO	northern spotted owl
NWFP	Northwest Forest Plan

PCT	Pacific Crest National Scenic Trail
PM	particulate matter
psi	pounds per square inch
RAWS	remote automated weather station
ROS	Recreation Opportunity Spectrum
RPM	Resource Protection Measure
RS	roadside
SAF	Society of American Foresters
SDI	stand density index
SFA	Stewardship Fireshed Analysis
SONCC	Southern Oregon / Northern California Coasts
SQAS	Soil Quality Assessment Standards
TOC	threshold of concern
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USLE	Universal Soil Loss Equation
V*	The percentage of residual pool volume occupied by fine sediment. Another measure of stream sedimentation
VQO	Visual Quality Objective
WEPP	Water Erosion Prediction Project
WSR	Wild and Scenic River
WUI	wildland-urban interface
WWOS	Wet Weather Operation Standards

Glossary

90th Percentile Fire Weather — The highest 10 percent of fire weather days. Fuel moisture, temperature, relative humidity, and wind speed are only exceeded 10 percent of the time based on historical weather observations.

Active Crown Fire — A fire that moves into and through the tree crowns, generally due to a combination of fire intensity and ladder fuels.

Activity Fuels — Fuels created by management actions.

Active Landslide — This term is defined in the Klamath LRMP as a landslide feature with evidence of movement within the last 400 years.

Activity Center — The annual location of a nest site or a favored roosting location.

Anadromous Fish — Species of fish that are born in freshwater, move to the ocean to mature, and return to freshwater to reproduce.

Analysis Area — The area around treatment areas to be considered in the effects analysis (the analysis area may be larger than the Eddy Gulch LSR Project Assessment Area). The analysis area varies by resource.

Annosus root disease (*Heterobasidion annosum*) — A fungus that attacks a wide variety of woody plants. Infection may spread by spores that colonize freshly cut stumps or basal wounds, or via root contact.

Aquatic — Living or growing in water.

Aquatic Conservation Strategy (ACS) — A strategy "developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands" (USDA Forest Service and USDI Bureau of Land Management 1994b, B-9).

Aquatic Conservation Strategy Objectives — Objectives that "define the context for the agency review and implementation of management activities. Complying with the Aquatic Conservation Strategy objectives means that an agency must manage the riparian-dependent resources to maintain the existing condition or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a watershed analysis. Improvement relates to restoring biological and physical processes within their ranges of natural variability." (USDA Forest Service and USDI Bureau of Land Management 1994b, B-10).

Areas With Watershed Concerns (AWWC) — Areas identified in the LRMP ROD (USDA Forest Service 1995) because cumulative watershed effects are a special concern due to a combination of high disturbance levels (roads, timber harvest, fire), potential for landslides, potential for surface erosion, and poor aquatic habitat conditions. The LRMP ROD (ibid.) states that a "cautious approach will be taken in AWWC, with respect to future land management activities," and that "Watershed Analysis, as part of ecosystem analysis, will be required prior to implementing site-disturbing activities."

Assessment Area — The 37,239-acre portion of the Eddy Gulch LSR west of Etna Summit where various treatments are proposed. All inventoried roadless areas that occur in the LSR were excluded from planning efforts and are therefore not part of the Assessment Area.

Background (relative to watershed) — A watershed's natural sediment production and delivery, or sediment delivery, assuming no disturbance.

Basal Area (BA) — A measure of stand density that defines the area of a given stand that is occupied by the cross-section of tree trunks and stems at their base.

Beneficial Uses — "Beneficial uses" of the waters of the state that may be protected against water quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves (from Section 13050(f) of California's Porter-Cologne Water Quality Control Act).

Best Management Practices (BMPs) — Measures certified by the State Water Quality Control Board and approved by the Environmental Protection Agency as effective means of reducing water quality impacts from non-point sources of pollution.

Biomass — Limbs and foliage (parts of trees other than logs) that can be collected, chipped, or ground; exported from the forest; and used for power production or manufacture of wood fiber products.

Board Foot — A unit of measurement equal to an unfinished board one-foot square by one-inch thick.

Bole — The main stem of a conifer tree, which becomes a log or logs when the tree is cut.

Burn Severity — Effects of fire on the soil surface. Related to fire intensity and duration.

Cable Yarding System — Moving logs from the stump to the landing either partially or fully suspended by a cable. Also referred to as a skyline system.

Canopy (Crown) — The branches and foliage of trees; does not include stems and boles.

Canopy Base Height — For a single tree, it is the height from an imaginary line drawn across the trunk to the bottom of the obvious lowest live foliage. Stated also as the height above the ground of the first canopy layer where the density of the crown mass within the layer is high enough to support vertical movement of a fire.

Canopy Cover — The ground area covered by tree crowns, or the degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky, expressed as a percent of ground area; also referred to as canopy closer or crown cover.

Capable Lands — Lands where at least 20 cubic feet of commercial wood products can be grown per acre per year.

Classified Road — Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned road, National Forest System roads, and other roads authorized by the Forest Service.

Climate Change — Climate is not the weather—it is the prevailing or general long-term weather conditions for an area, or for the entire planet. Weather is the state of the atmosphere at a particular place and time and is influenced by climate and many local factors. Climate change refers to our long-term weather patterns and, in the environment, is caused by increasing levels of carbon dioxide and other greenhouse gases released into the atmosphere. Greenhouse gases trap heat in the earth's atmosphere. Over time, more and more heat is retained, leading to an increase in the earth's average surface temperature—global warming.

Coarse Woody Debris (CWD) — Large woody material (fallen dead trees, as well as the remains of larger branches) that are at least 15 inches in diameter and 10 feet long. Ideally, these logs are well distributed across the treatment unit or landscape and represent the various decomposition classes. Term used for terrestrial species habitat.

Community Capacity — The collective ability of residents in a community to respond to external and internal stresses, to create and take advantage of opportunities, and to meet the needs of residents. Physical capital, human capital, and social capital are the primary components of community capacity.

Compaction Hazard — Susceptibility of the soil to compaction based on soil properties such as soil texture in the upper 12 inches, percent by volume of cobbles and stones, percent organic carbon in the upper 6–12 inches, duff thickness in inches, and soil structure. Compaction susceptibility fluctuates with the percent of soil moisture.

Critical Habitat — Defined in the ESA as (1) the specific areas within the geographical area occupied by the species, at the time it is federally listed, on which are found those physical or biological features essential to the conservation of the species, and which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, when it is determined by the Secretary of the Interior that such areas are essential for the conservation of the species.

Crown Bulk Density (CBD) — The weight of the canopy per unit volume. A mathematical model taken from cruise/forest inventory data using these measurements: tree diameters at breast height, tree height, ratio of crown height to tree height, and crown width. Species factors are also used, newer inventory methods just use species, basal area, and stand density.

Crown Fire — A fire that advances through the canopy of a forest, either as a passive, active, or independent crown fire. Effective strategies for reducing crown fire occurrence and severity are to (1) reduce surface fuels, (2) increase height to live crown, (3) reduce canopy bulk density, and (4) reduce continuity or density of the forest canopy.

Crown Fuel — Expressed as canopy cover or crown bulk density includes living and dead foliage.

Currently Active Landslide — This term is used by the author to denote landslide features exhibiting fresh scarps, ground facture, or other evidence the slope movement has occurred very recently or is ongoing.

Cumulative Effects — Those effects resulting from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

Cumulative Watershed Effects Model — A model for Cumulative Watershed Effects with three components: Equivalent Roaded Acres (ERA), sediment delivery from surface erosion, and sediment delivery from mass wasting. The model quantifies disturbances and land sensitivity at the 7th field watershed scale and can calculate them at larger scales. The estimated results fall on a continuum. As disturbances increase over time and space, at some point the risk of initiating or contributing to existing adverse cumulative watershed impacts becomes a cause for concern. Concern thresholds have been identified for each component based on field observations in the Forest.

Cytospora Canker (*Cytospora abietis*) — A fungus that infects softwood trees. It kills the cambium, girdling the limb and causing death of infected branches. A secondary infection to mistletoe.

Diameter at Breast Height (dbh) — The diameter of a standing tree at a point 4½ feet above ground level, measured from the uphill side.

Debris slides, debris flows, and debris torrents — These are rapid, shallow-seated slope failures, usually initiated in headwater basins. They often follow the path of existing drainage channels (debris slides can be an exception). Slide debris can travel great distances and often ends up in a receiving channel or valley bottom.

Direct Attack — Any treatment applied directly to burning fuel such as wetting, smothering, or chemically quenching the fire or physically separating the burning from unburned fuel.

Direct Effects — Those effects occurring at the same time and place as the initial cause or action.

Desired Condition — The ecological, economic, and social attributes toward which management of the land and resources in the plan area are directed. Desired conditions are aspirational and are usually long-term in nature. A lengthy period of time may be required to achieve them, and during that time they may be modified, if necessary, to respond to changing conditions and/or improved knowledge.

Detrimental Disturbance — Changes in soil properties and conditions that would result in significant change or impairment of the productivity potential, hydrologic function, or buffering capacity of the soil. Generally occurs when threshold values are exceeded.

Dispersal — The relatively permanent movement of individual animals from one location to another. Usually dispersal is the movement of young animals from where they were born to a site where they eventually settle to breed.

Dwarf Mistletoe (*Arceuthobium* spp.) — A host specific parasitic seed plant found in all the major conifer species (red fir, white fire, Douglas-fir, and incense cedar).

Earthflow or Slump/Earthflow — These are deep-seated, slow movements that often produce one or more scarp-bench-toe slope profile sequence(s). These are often marked by unusually flat areas (benches) on an otherwise steep hillside.

Ecosystem — A dynamic community of biological organisms, including humans, and the physical environment with which they interact.

Ectomycorrhizae — A mycorrhiza (Greek for fungus roots) is a symbiotic (occasionally weakly pathogenic) association between a fungus and the roots of a plant. In a mycorrhizal association, the fungus may colonize the roots of a host plant either intracellularly or extracellularly. Mycorrhizas are commonly divided into ectomycorrhizas and endomycorrhizas. The hyphae (a thread-like part of the vegetative portion of a fungus) of ectomycorrhizal fungi do not penetrate individual cells within the root.

Effects — Impacts; physical, biological, economic, and social results (or expected results) from implementing an activity.

Embeddedness — Degree to which large streambed materials such as cobbles and gravel are surrounded or covered by fine sediment.

Endangered Species — Any species that is in danger of extinction throughout all or a significant portion of its range.

Entrenchment ratio — A measure of channel confinement during flood flows. Values greater than 1.5 indicate presence of a stream terrace or floodplain.

Environmental Justice — Executive Order 12898 requires an assessment of whether minorities or low-income populations would be disproportionately affected by proposed actions.

Equivalent Road Acres (ERA) — An index of average watershed disturbance expressed in road-equivalent acres relative to a “threshold of concern” assigned for the watershed.

Erosion — A general term for movement of soil particles on the surface of the land initiated by rainfall and running water. This includes surface erosion and channel erosion, as opposed to landsliding.

Erosion Hazard Rating (EHR) — Relative risk of accelerated sheet and rill erosion. Factors included in this rating are soil erodibility (soil texture and aggregate stability), runoff production (climate, water movement in the soil, runoff from adjacent lands, and slope length), and soil cover (quantity and quality) and soil cover distribution.

Filtering Capacity — Ability of a riparian reserve to trap sediment and prevent it from reaching a stream.

Fine Fuels — Fuels that ignite readily and are consumed rapidly by fire (for example, cured grass, fallen leaves, needles, small twigs less than 1/4 inch in diameter).

Fir Engraver Beetle (*Scolytus ventralis*) — A burrowing beetle that attacks most true fir species in the western United States. Attacks can result in bark kill around the tree bole, top kill, and tree mortality.

Fire Behavior — The manner in which a fire reacts to fuels, weather, and topography. Flame length, fire type, tree mortality, fuel loading, and canopy base height are all measures used in understanding fire behavior for current conditions and for evaluating pre- and post-treatment conditions.

Fire Frequency — The average number of years between fires.

Fire Intensity — A general term relating to the heat energy released in a fire.

Fire Regime — The combination of fire frequency, predictability, intensity, seasonality, and distinctive characteristics of fire in an ecosystem. Agee (1993) defines three broad categories of fire severity "based on the physical characters of fire and the fire adaptations of vegetation:"

> **Low-Severity Fire Regime** — Effect of typical fire is benign. Fires are frequent (often less than 20 years), of low intensity, and the ecosystems have dominant vegetation well-adapted to survive fire.
>
> **Mixed-Severity Fire Regime** — Fires are of intermediate frequency (25–100 years), range from low to high intensity, and have vegetation with a wide range of adaptation.
>
> **High-Severity Fire Regime** — Fires are usually infrequent (often more than100 years) but may be of high intensity, most vegetation is at least top-killed.

Fire Return Interval — Number of years between two successive fire events in a given area.

Fire Risk — The statistical probability of a fire start occurring over a ten-year period for a given thousand-acre area.

Fire Severity — The degree to which a site has been altered or disrupted by fire; severity is affected by fire intensity and how long the fire remains at the site. In this document, fire severity is defined as tree mortality. A qualitative term used to describe the relative effect of fire on an ecosystem, especially the degree of organic matter consumption and soil heating. Thus, fires are commonly classed as low, moderate, and high severity.

Fire Suppression — All work and activities associated with extinguishing a fire.

Fire Type — Fire type is described in four ways. The first type is a surface fire, which burns only the fuels at or near the surface without torching the trees above—this is the desired condition. The second type is the passive crown fire, which torches out individual or small groups of trees as the surface fuels burning under them provide the convective heat to ignite the above-ground fuels. The third is the active crown fire in which fire is spread from tree to tree in conjunction with the convective heat of the surface fuels burning under them. The fourth is the Independent or running crown fire—this is a very rare occurrence in which the fire is spread from tree to tree independent of the burning surface fuels. This type of crown fire requires extreme weather conditions and contiguous heavy tree canopy.

Fish-bearing Streams — Fish-bearing streams are distinguished from intermittent streams by the presence of any species of fish for any duration. Many intermittent streams may be used as spawning and rearing streams, refuge areas during flood events in larger rivers and streams, or travel routes for fish emigrating from lakes.

Flame Length — The length of flame measured in feet—it is measured from the base of the flame to the tip of the flame. It is an indicator of fire intensity: longer flame lengths increase resistance to control and the likelihood of torching events and crown fires.

Forest Plan (LRMP) — The Klamath National Forest Land and Resource Management Plan, approved in 1995. The Forest Plan provides land allocations, Standards and Guidelines, and direction for management of the Klamath National Forest.

Forest Survey Site Class (FSSC) — Estimate of a site's suitability for commercial conifer production. Based on soil and environmental factors such as soil depth, parent material, water holding capacity of the soil profile, precipitation, temperature, aspect, pH, compaction, and depth to a standing water table.

Fuel Arrangement — Describes how fuels are distributed in the fuel bed.

Fuel Bed — The fuels laying on or very near the forest floor, both living and dead, that are available to burn.

Fuel Load / Loading — Refers to the fuel that would be available for consumption by fire. Fuel load and depth are significant fuel properties for predicting whether a fire will be ignited, its rate of spread, and its intensity. Fuel loading can slow the suppression efforts of firefighters if there are large accumulations of dead and down fuel.

Fuels — Anything within the forest that will burn; usually live and dead woody vegetation.

Fuel Profile — The term used to describe all available fuel, living and dead, including ground, ladder, and crown fuels.

Fuel Treatment — The process of removal, consumption, or rearrangement of naturally or human-created fuels to reduce fire hazard and achieve other resource objectives.

Full-Bench Skid Trails — For ground-based equipment skid trails, the entire trail surface is cut into the hill slope.

Geographic Information System Coverage — Data layer in a geographic information system.

Grapple System — A mechanical method of piling fuels using an articulating arm on a low ground pressure vehicle that picks up the material and places it on the pile.

Green Tree Retention — A regeneration cut in an even-aged silvicultural system that maintains a portion of the existing stand, creating a two-storied structure with two or more age classes present.

Ground-based Equipment — This means equipment that runs on the ground, like tractors, rubber-tired skidders, and masticators.

Hawksworth Rating System — A system developed by Hawksworth in 1977 to rate severity of infection by dwarf mistletoe in a tree or stand. The rating system forms a basis for defining management implications and recommendations.

Hazard — When used in fuels management, refers to the existence of a fuel complex that constitutes a threat of unacceptable fire behavior and severity, or suppression difficulty.

Healthy Stand (for the Project Area) — Exhibits insect and disease levels such that mortality is not substantial (snag and coarse woody debris levels are within Forest standard and guidelines); little decadence (few dead or dying trees, relatively few large down logs or snags) although the area maintains some structural components of older stands; trees per acre (stocking level) within the range that can be supported by the land; and conditions such that wildfire would not burn more than 25 percent of the dominant vegetation at a high intensity.

Heritage Resources — Heritage resources are archaeological, cultural, and historical legacies from our past and are more than 50 years old. Heritage resource information, combined with environmental data, can illuminate past relationships between people and the land.

Historic Resources — Historic-era artifacts occurring in sufficient quantity or complexity, and/or groupings of artifacts and historic features/properties that are in excess of 50 years old.

Hot Deck/Decking — As in "hot-decking" of logs. Basically, hot decking occurs when the running surface of the road is not wide enough for both the cable yarder and the logs. The logs have to be moved out of the way so another load can be brought to the road, where trucks haul them away—this eliminates the need for landing construction because the road prism itself serves as the landing.

Hydrologic — Dealing with the movement and properties of liquid water in environmental systems. Includes the circulation patterns of water in the biosphere from condensation and precipitation to movement both on and under the ground surface to evaporation back into the atmosphere.

Hydrologic Recovery — Harvested timber stand with sufficient canopy closure that snow accumulation, melt rates, and soil protection from raindrop impact are comparable to pre-harvest levels. This typically is achieved when the average tree size is 8 inches diameter breast height or 35 feet tall. Recovery is complete by around 30 years after harvest on the westside of the Forest.

Incorporation by Reference — A technique used to cut down on the bulk in environmental documents without impeding agency and public review of the action. The material included as part of the document must be cited in the document and its content briefly described.

Indirect Effects — Those effects occurring later in time or that are spatially removed from the activity.

Inference Point — The midpoint of a zone where disturbances become great enough to cause concern about initiating or contributing to adverse cumulative watershed effects.

Infiltration (Soil) — The movement of water through the soil surface into the soil.

Interdisciplinary — The utilization of individuals representing two or more areas of knowledge and skills focusing on the same subject.

Intermittent Stream — Intermittent streams are defined as any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria.

Irretrievable — An irretrievable commitment of resources entails a loss of production, harvest, or use of natural resources. Such decisions are reversible, but the production opportunities foregone are irretrievable (50 *Federal Register* 26082).

Irreversible — An irreversible commitment of resources entails a loss of future options. This applies primarily to the effects of use of non-renewable resources such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over a long period of time (50 *Federal Register* 26082).

Issue — Point of discussion, debate, or dispute about the environmental effects of the proposed action.

Ladder Fuels — A vertical continuity in fuel between the ground and the crowns of a forest stand; shrubs or trees that connect fuels at the forest floor to the tree crowns. Ladder fuels are expressed in feet.

Land Allocation — The assignment in the LRMP of a management emphasis to particular land areas with the purpose of achieving goals and objectives.

Large Woody Debris (LWD) — LWD (logs) that are present in the bankfull channel and hydraulically significant in altering flow direction and velocity.

Late-Successional Characteristics — Characteristics of a stand of trees indicative of maturity, including mature and overmature trees in the overstory; multi-layered canopy with trees of several age classes; and standing dead trees and down material.

Late-successional Habitat — Older forested stands with moderate to high canopy closure; often containing a multilayered, multispecies canopy dominated by large overstory trees; large trees with broken tops or other indications of old and decaying wood; numerous large snags; and moderate to heavy accumulations of large logs on the ground.

Late-successional Forest — Forest stands consisting of trees, structural attributes, supporting biological communities, and processes associated with old-growth and/or mature forests. Forest seral stages include mature and old-growth age classes (identified in the Northwest Forest Plan). Age is not necessarily a defining characteristic, but it has been used as a proxy or indicator in some usages. The minimum ages are typically 80 to 130 years, more or less, depending on the site quality, species, rate of stand development, and other factors.

Late-successional Stands — Late-successional stands in the Assessment Area are defined as stands with an average diameter at breast height greater than 24 inches. On the north-and east-facing slopes, theses stands contain a mix of conifer species and generally exhibit complex structure and abundant down woody debris. Late-successional stands on south-and west-facing slopea are typically more open and pine dominated with less down woody debris. True fir late-successional stands are generally single storied with little understory.

Late-Successional Reserves (LSR) — Large blocks of habitat that are distributed across the range of the northern spotted owl and spaced closely enough to facilitate dispersal of owls.
Late-successional reserves are managed to provide habitat for late-successional and “old growth” species.

Log Decomposition Classes —

Class I: Fresh, hard logs or trees with little soil contact.

Class II: Hard logs in partial contact with the soil.

Class III: Intact, soft logs in full contact with the soil.

Class IV: Intact to fractured cubical heartwood and bark, mostly buried in the soil.

Class V: Totally buried, fractured cubical heartwood (low mound on the forest floor).

LRMP — The Klamath National Forest Land and Resource Management Plan, approved in 1995. The Forest Plan provides land allocations, Standards and Guidelines, and direction for management of the Klamath National Forest.

Management Area — A distinct geographical area with specified objectives and prescriptions.

Management Direction — A statement of multiple use and other goals and objectives, along with the associated management prescriptions and Standards and Guidelines to direct resource management.

Mass Wasting — Movement of soil material in landslides and debris torrents.

Mastication — Mastication involves the mechanical chipping, grinding, and scattering of fuels using a rotating hydraulic head attached to a tracked excavator or tractor. Wood chips from mastication provide physical soil cover to disturbed areas and allows a masticator to operate on the layer of wood chips with minimal soil disturbance.

Masticator — Equipment that grinds or chews up vegetative material.

Matrix — Lands outside of reserves and withdrawn areas; lands assigned a regulated timber yield.

Monitoring — Process of collecting information to evaluate if objective and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.

Montane — Pertaining to mountain conditions.

Multilayered — A stand with three or more distinct foliage layers (canopies). Trees in the different layers may or may not be in the same age class.

Mycorrhizae — A beneficial association between a fungus and roots of a plant.

National Environmental Policy Act (NEPA) — The act that governs how federal agencies assess impacts of management actions on public lands. The process is interdisciplinary and requires consideration of the environmental effects of alternatives and disclosure of those effects.

National Forest System Road — A classified Forest road under the jurisdiction of the Forest Service. The term “National Forest System Roads” is synonymous with the term “forest development roads” as used in 23 U.S.C. 205.

Northern Spotted Owl (NSO) Core Area — An area defined by a 0.5-mile radius around a NSO activity center that owls use most often, especially during the nesting season.

NSO Home Range — An area defined by a 1.3-mile radius around a NSO activity center within which owls forage, nest, and roost.

Noxious Weed — Any plant so designated by the Weed Control Regulations and identified on a regional district noxious weed control list. They are generally non-native and resistant to control efforts.

Overstory — The portion of trees in a forest which forms the uppermost layer of foliage.

Particulate Matter (PM) — Particles less than 10 micrometers in diameter (PM_{10}) pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter ($PM_{2.5}$) are referred to as "fine" particles and are believed to pose the largest health risks. Because of their small size, fine particles can lodge deeply into the lungs. Sources of fine particles include all types of combustion (such as motor vehicles, power plants, and wood burning) and some industrial processes. Particles with diameters between 2.5 and 10 micrometers are referred to as “coarse.” Sources of coarse particles include crushing or grinding operations and dust from paved or unpaved roads.

Passive Crown Fire — A fire that remains on the ground surface but exhibits some individual tree or group torching. Fire intensity is still fairly low.

Peak Flow — The greatest stream or river flow occurring in a year from a single storm event.

pH (potential of hydrogen) — It is the measure of acidity or alkalinity of a solution or a damp substance, such as soil. The pH of pure water is 7, with lower numbers indicating acidity and higher numbers indicating alkalinity.

Rain-on-Snow Event — Rain falling on a snowpack and rapidly melting the snow, causing the melt water to be added to the rain, creating flood conditions.

Rate of Spread — The estimated or observed spread distance of a fire. It is expressed generally in chains per hour (ch/hr).

Record of Decision — A document separate from but associated with an environmental impact statement that states the management decision and provides the rationale for that decision.

Reforestation — The natural or artificial restocking of an area with trees.

Resilience — An ecosystem’s ability to maintain structure and patterns of behavior in the face of disturbance.

Resistance to Control — The relative difficulty of constructing and holding a control line as affected by resistance to line construction and fire behavior; also called “difficulty of control.”

Rill — Very small streams occurring during or directly after precipitation, especially on bare soil, often creating a temporary gully and causing rill erosion.

Riparian — In general, characterized by being situated on the bank of a river or other body of water. In ecology, the term is applied both to species that live near streams and to the area adjacent to streams where vegetation and microclimate are influenced by the presence of the stream.

Riparian Reserves — A land allocation in the LRMP that includes an aquatic ecosystem and the adjacent upland areas directly affecting it. It also includes unstable and potentially unstable lands that are not associated with aquatic areas. Specific Standards and Guidelines provide direction for these areas as outlined in Management Area 10 of the LRMP.

Risk — The chance of loss.

Risk Ratio (for cumulative watershed effects model) — The amount of the disturbance in the watershed relative to the hydrologic or sediment inference point.

Road — A motor vehicle travelway over 50 inches wide, unless classified and managed as a trail. A road may be classified, unclassified, or temporary (36 CFR 212.1).

Roads (Classified) — Roads wholly or partially within or adjacent to National Forest System lands that are determined to be needed for long-term motor vehicle access, including State roads, county roads, privately owned roads, National Forest System roads, and other roads authorized by the Forest Service (36 CFR 212.1).

Scenic Attractiveness — The scenic importance of a landscape based upon the intrinsic beauty of landforms, geology, water bodies, and vegetation.

Scenic Character — The combination of physical, biological, and cultural images that give an area its positive scenic identity and sense of place.

Scenic Integrity — The degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance, including any visible disturbances due to human activities or extreme natural events. The Klamath LRMP uses VQOs to measure visual disturbance.

Scenic Quality — The degree to which the appearance of a place, landscape or feature can elicit psychological and physiological benefits to individuals and, therefore, to society in general.

Scenic Stability — The degree to which the valued scenic character can be sustained through time and ecological progression.

Soil Cover — Amount of surface area covered by low growing vegetation (grasses, forbs, and prostrate shrubs), plant litter and debris, and surface rock fragments larger than ¾ inches.

Soil Displacement Hazard — Susceptibility of the soil to mechanical displacement. This assessment is based on soil properties such as surface texture, organic carbon in the surface 6 inches, thickness of the duff layer, percent coarse fragment content by volume, soil structure, bulk density, and cohesion. Generally defined as a loss of either 2 inches or 0.5 inch of the humus enriched topsoil, whichever is less, from a 1-meter square or larger area.

Soil Quality Assessment Standards (SQAS) — Established in June of 1995 (FSH R5 Supplement No. 2509.18-95-1), these standards focus on protection and improvement of National Forest System Lands for continuous forest and rangeland productivity and favorable water flows. Direction for Soil Quality found in the handbook supplements describes the standards and thresholds, provides information about monitoring, examples of practices and mitigation measures, direction for application of the standards, and responsibilities for meeting them.

The term “unstable slopes” is a generic term used for all classes of slope movement. More specific categories include:

Stand — A recognizable area of the forest (either a community of trees or other vegetation) that can be managed as a single unit because it is relatively homogeneous (having uniform composition, constitution, age, spatial arrangement or condition) and distinguishable from adjacent communities.

Stand Characteristics / Attributes — A description of stand characteristics takes into account canopy cover, crown bulk density, stand structure, and density. Stand structure is a description of the distribution of tree size classes (such as saplings, poles, small trees, etc.) within a stand. Understory and overstory are some other terms that are used in referring to stand structure.

Strata — Similar stands of trees that are combined (stratified) for data collection and stand analysis. Stands in the Eddy Gulch LSR Project Assessment Area were stratified by Society of American Foresters (SAF) forest type (for example, Douglas-fir or white fir) and successional stage (such as mid-successional) based on dominant / co-dominant average tree size.

Succession — A series of dynamic changes by which one group of organisms succeeds another through stages leading to a potential natural community or climax (final stage). An example is development of a series of plant communities (called seral stages) following a major disturbance.

Surface Fire — A fire that burns dead and down woody fuel, and smaller vegetation with little to no torching of larger shrubs and conifers. Surface fire activity is described with rate of spread, flame length primarily.

Temporary Roads — Roads authorized by contract, permit, lease, other written authorization, or emergency operation, not intended to be a part of the forest transportation system and not necessary for long-term resource management (36 CFR 212.1).

Toe Zones — Accumulations of colluvium (loose rock and soil), usual originating from slump/earthflow features. The downslope face of this material is usual oversteepened, often wet, with potential for further movement.

Torching — The envelopment in flame of live or dead branches on a standing tree or group of trees.

Treatment Unit — The acres proposed for some type of on-the-ground treatment under a particular alternative.

Unclassified Roads — Roads on National Forest System lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1). The regulations at 36 CFR 223.37 require revegetation within 10 years.

Recreation Opportunity Spectrum (ROS) — A continuum of recreation opportunity settings. A recreation opportunity setting is a combination of physical, biological, social, and managerial conditions that give value to a place. The ROS assumes that recreationists seek a range or spectrum of recreational opportunities from the highly constructed and interactive to the natural and solitude oriented.

Road Cut — Soil or rock material removed during road construction, usually from the upslope side of the road.

Road Fill — Soil or rock material placed on the ground as part of the road surface.

Road Maintenance — The ongoing upkeep of a road necessary to retain or restore the road to the approved road management objective.

Salvage — Removal of recently-dead, dying, or deteriorating trees to minimize the loss of wood products.

Saprophytic — These species obtain nutrients by the decomposition of dead organic matter.

Scoping — The process used to identify the scope of issues to be addressed and to determine the significant issues related to a proposed action.

Sediment — Soil particles in water. Suspended sediment consists of small soil particles carried along by the water's turbulent flow.

Silviculture — The art and science of growing and tending forest vegetation. It includes controlling the establishment, composition, and growth of forests for specific management goals.

Silviculture Prescription — A site-specific operational plan that describes the forest management objectives for an area. It prescribes the method for harvesting the existing forest stand, and a series of silviculture treatments that will be carried out to establish a free-growing stand in a manner that accommodates other resource values as identified.

Site Potential Tree Height — The average maximum height of the tallest dominant trees (200 years or older) for a given site class.

Soil Porosity — State of having pores or holes in the soil that hold air or water; permeability.

Stability rating — A rating system to gauge a stream's susceptibility to scour. It evaluates physical and vegetative conditions on upper and lower stream banks and wetted channels.

Snag — A standing dead tree.

Social Analysis — Analysis that uses social science information to determine how proposed actions would affect humans.

Soil Productivity — The capability of a soil to produce a specific crop such as fiber, forage, etc., under defined levels of management.

Stand — A community of trees or other vegetation uniform in composition, constitution, age, spatial arrangement, or condition to be distinguishable from adjacent communities.

Stand Density Index (SDI) — A relative measure of the amount of stocking on a forest area. Often described in terms of stems per acre.

Standard and Guideline — A principle requiring a specific level of attainment, a rule to measure against. The Klamath National Forest Land and Resource Management Plan contains the Standards and Guidelines for managing the forest.

Stocking — The degree to which trees occupy the land, measured by basal area (BA) and/or number of trees by size and spacing, compared with a stocking standard; that is, the BA and/or number of trees required to fully utilize the land's growth potential. Where tree growth is inhibited due to competition from too many trees, the site is said to be overstocked.

Substrate fines — The percentage of substrate particles less than 2 mm in diameter as determined by an extractive core sampling method.

Suppression Forces — Resources used to fight a fire, consisting of firefighters with hand tools at a minimum. May also include fire engines and bulldozers, helicopters and tanker planes.

Suppressed Trees — Smaller trees in the lower canopy layer.

Surface fines — The percentage of substrate particles less than 2 mm in diameter as determined by a grid tally on the surface of pool tail outs.

Surface Fire — Fire that remains on the forest floor because the combination of fire intensity and ladder fuels is not sufficient to move it into the tree crowns. Only surface fuels and small vegetation are burned.

Surface Fuels — Loose combustible material on the soil surface, consisting of fallen leaves, twigs, bark, and small branches, as well as grasses, small plants, seedlings trees, dead branches, and logs.

Sympatrically — Species that occupy the same area without interbreeding.

Thinning — Removing trees from a stand to redistribute the growth potential or to benefit the quality of the residual stand.

Threatened Species — Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Torching — Ignition and subsequent flare-up of a fire, usually burning from the bottom to the top of a tree or small group of trees.

Tree Crown — Leafy portion.

Turbidity — Deposition of substrate material suspended in water.

Unclassified Road — Roads on National Forest System lands that are not managed as part of the Forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail; and those roads that were once under permit or other authorizations and were not decommissioned upon the termination of the authorization.

Understory — Vegetation (trees or shrubs) growing under the canopy formed by taller trees.

V* — The percentage of residual pool volume occupied by fine sediment. Another measure of stream sedimentation (Hilton and Lisle 1993).

Values at Risk — Any or all natural resources, improvements, or other values that may be jeopardized if a fire occurs.

Vertical Fuels — Standing vegetation, either live or dead.

Visual absorption Class — The relative ability of a landscape to absorb alterations without loss or degradation of scenic quality.

Visual Quality Objectives (VQOs) — Measurable standards for visual resource management based on the acceptable degree of alteration of the characteristic landscape. Levels used in the VQOs are as follows:

VQO	Description
Preservation	Unaltered — Ecological changes only.
Retention	Unnoticeably Altered — Activities are not evident to casual forest visitor.
Partial Retention	Slightly Altered – Activities may be evident but must be subordinate to characteristic landscape.
Modification	Moderately Altered — Activities may dominate, but must utilize naturally-established form and texture. Areas should appear natural when viewed in foreground and middleground.
Maximum Modification	Heavily Altered — Activities may dominate, but must utilize naturally-established form and texture. Areas should appear natural when viewed in background.

Water Repellency (for soils) — Loss of soil porosity, preventing water from infiltrating and causing water to run off.

Watershed — The entire land area that drains to a specific point.

5th-field Watershed — A watershed that ranges from about 40,000 to 250,000 acres in size.

6th-field Watershed — A watershed that ranges from about 10,000 to 40,000 acres in size.

7th-field Watershed — A watershed or drainage that ranges from about 2,500 to 10,000 acres in size.

Watershed Analysis — Watershed analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives.

Wet Weather Operations Standards — Specific information used to help determine when activities are at risk of not meeting BMPs. The guidelines are used to determine if conditions are favorable for wet weather or winter operations, and to provide guidance as to when conditions warrant suspension of operations, when operations may begin or resume, or when and what remedies may be appropriate.

Width / Depth Ratio — An index of channel form. Values greater than approximately 12–15 are indicative of wider, shallower streams.

Wildland-Urban Interface — Commonly referred to as the WUI (woo-ee). This is an area, or zone, where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. It generally extends out for 1.5 miles from the edge of developed private land into the wildland.

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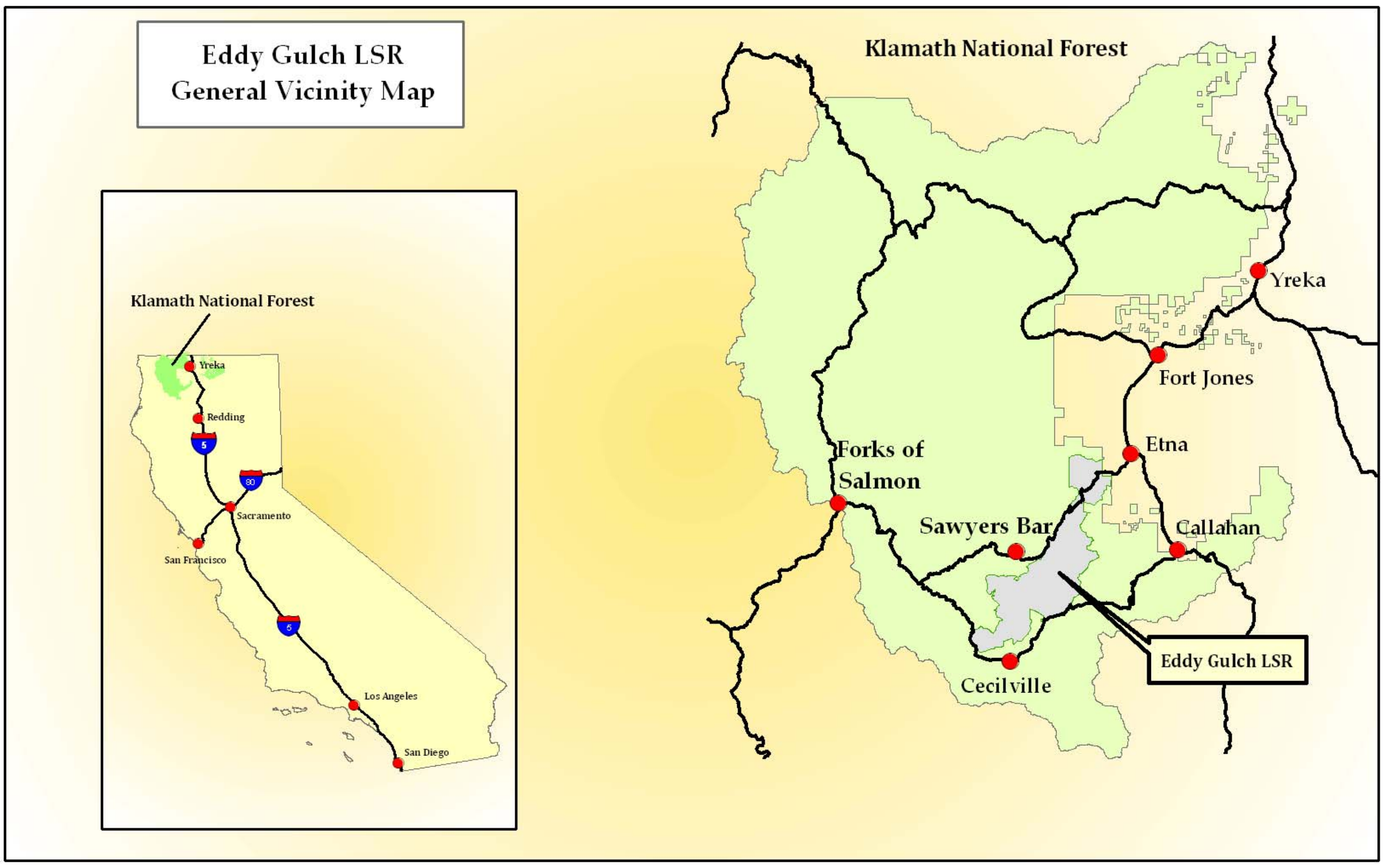
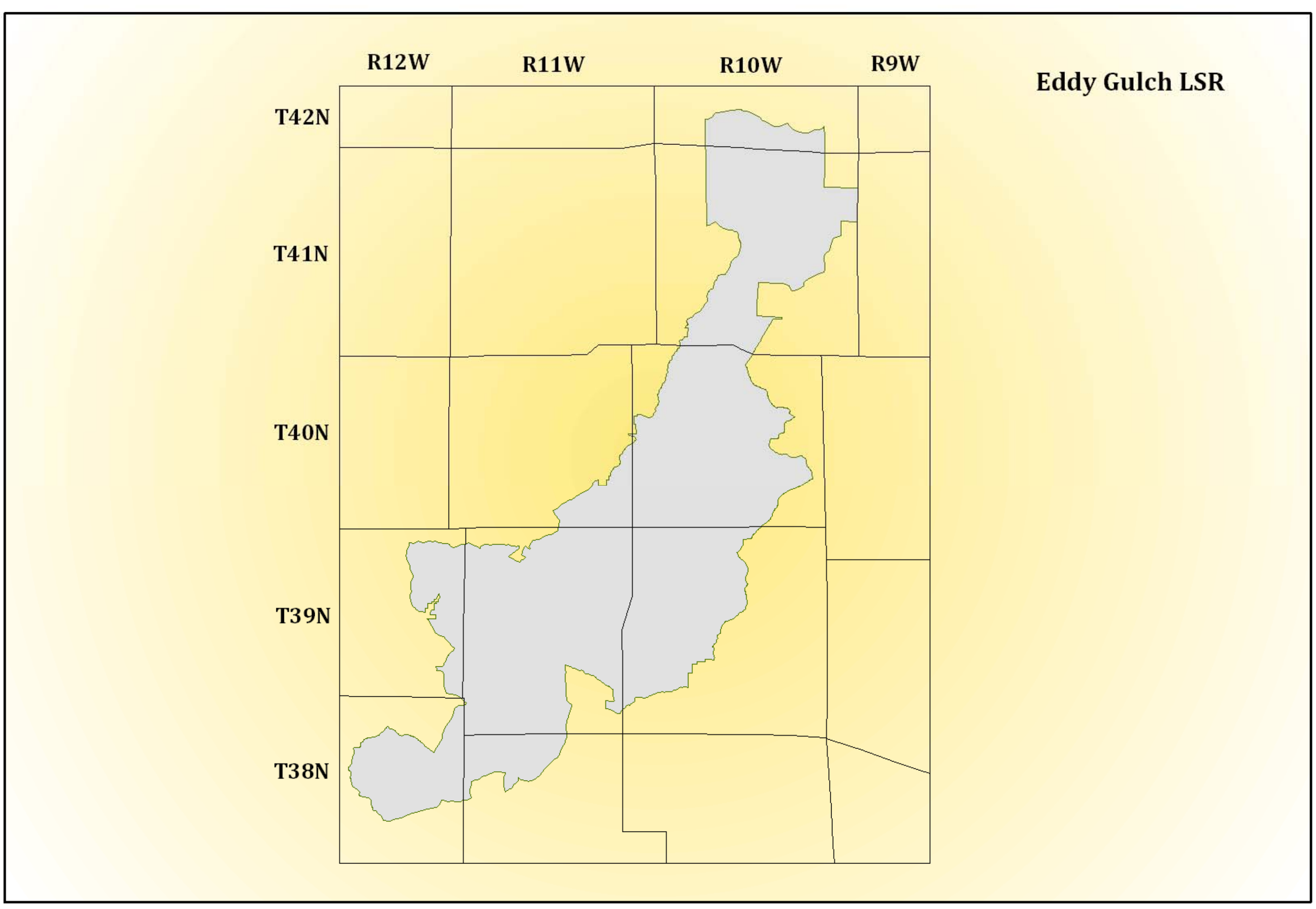
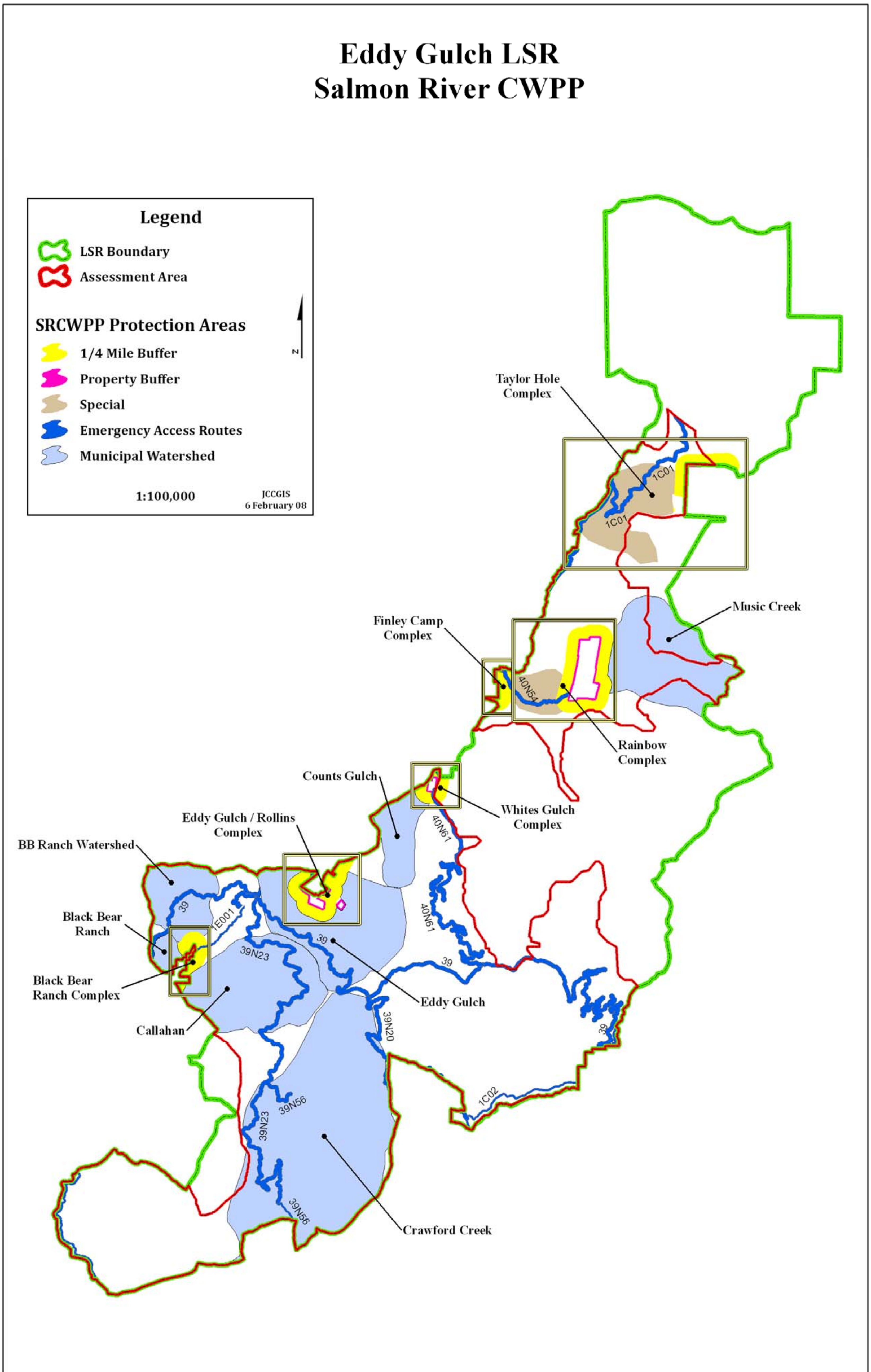
Appendix A
Maps

Map A-1. Vicinity of the Eddy Gulch LSR Project.

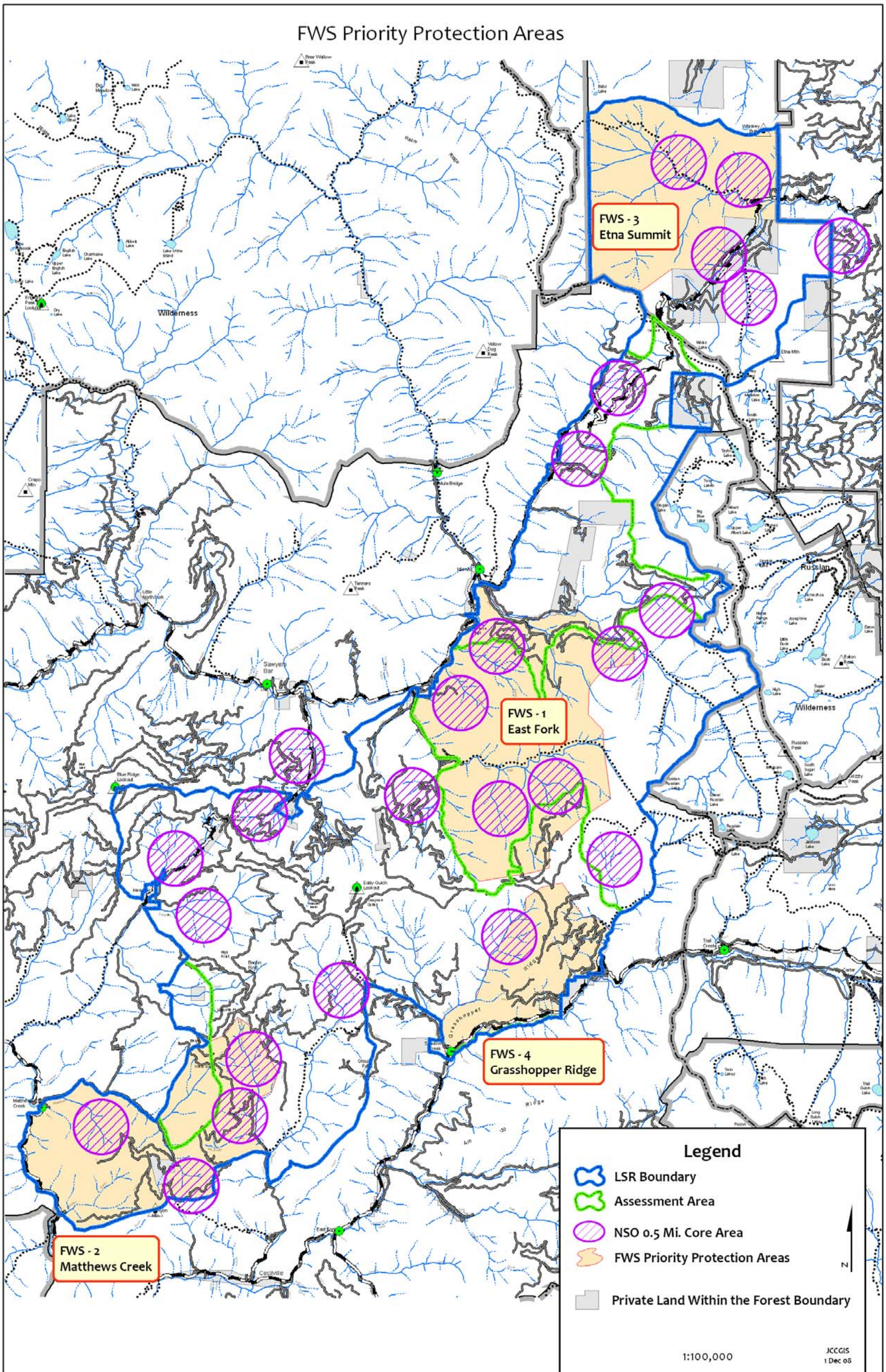




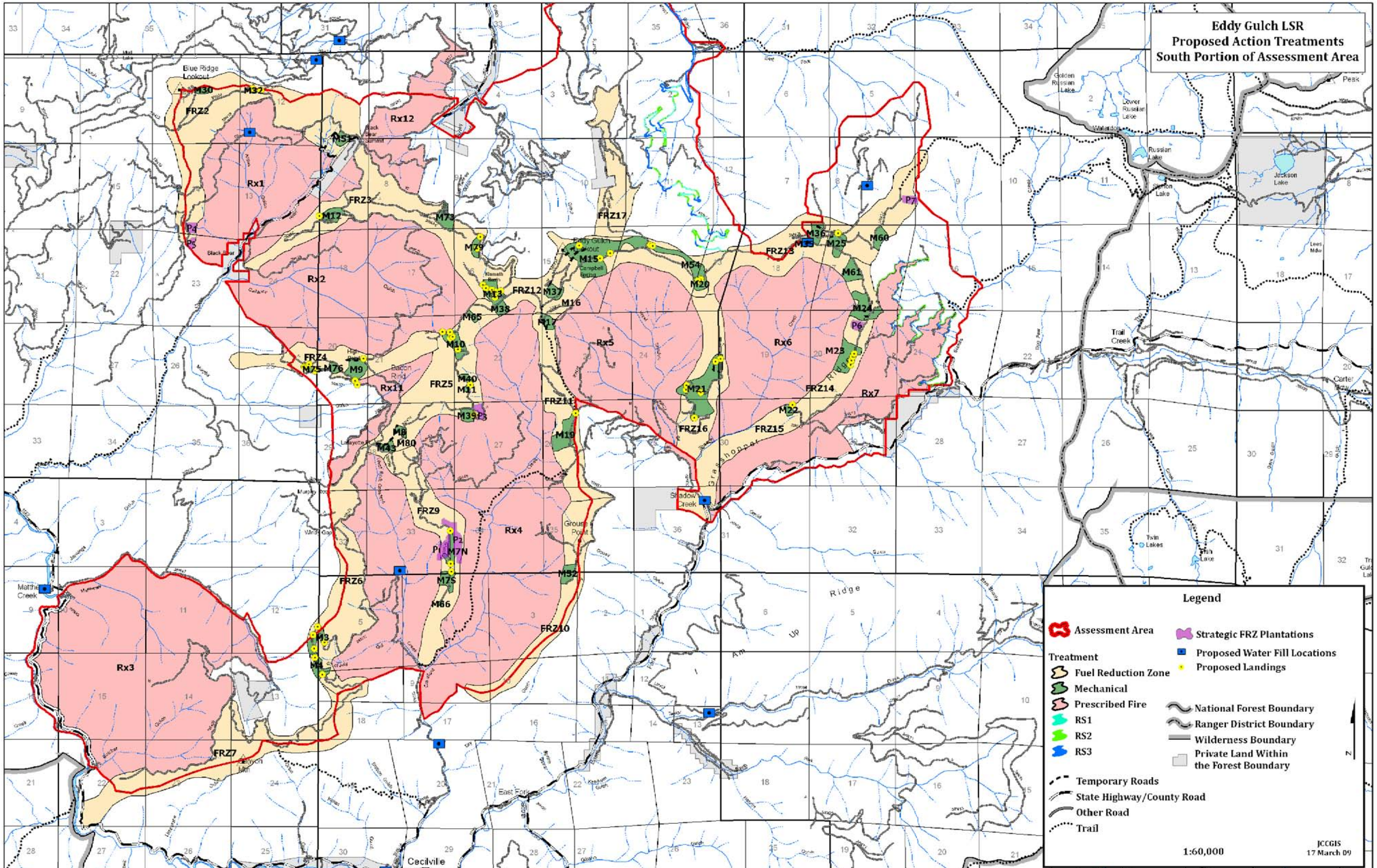
Map A-2. Protection areas identified in the Salmon River CWPP.



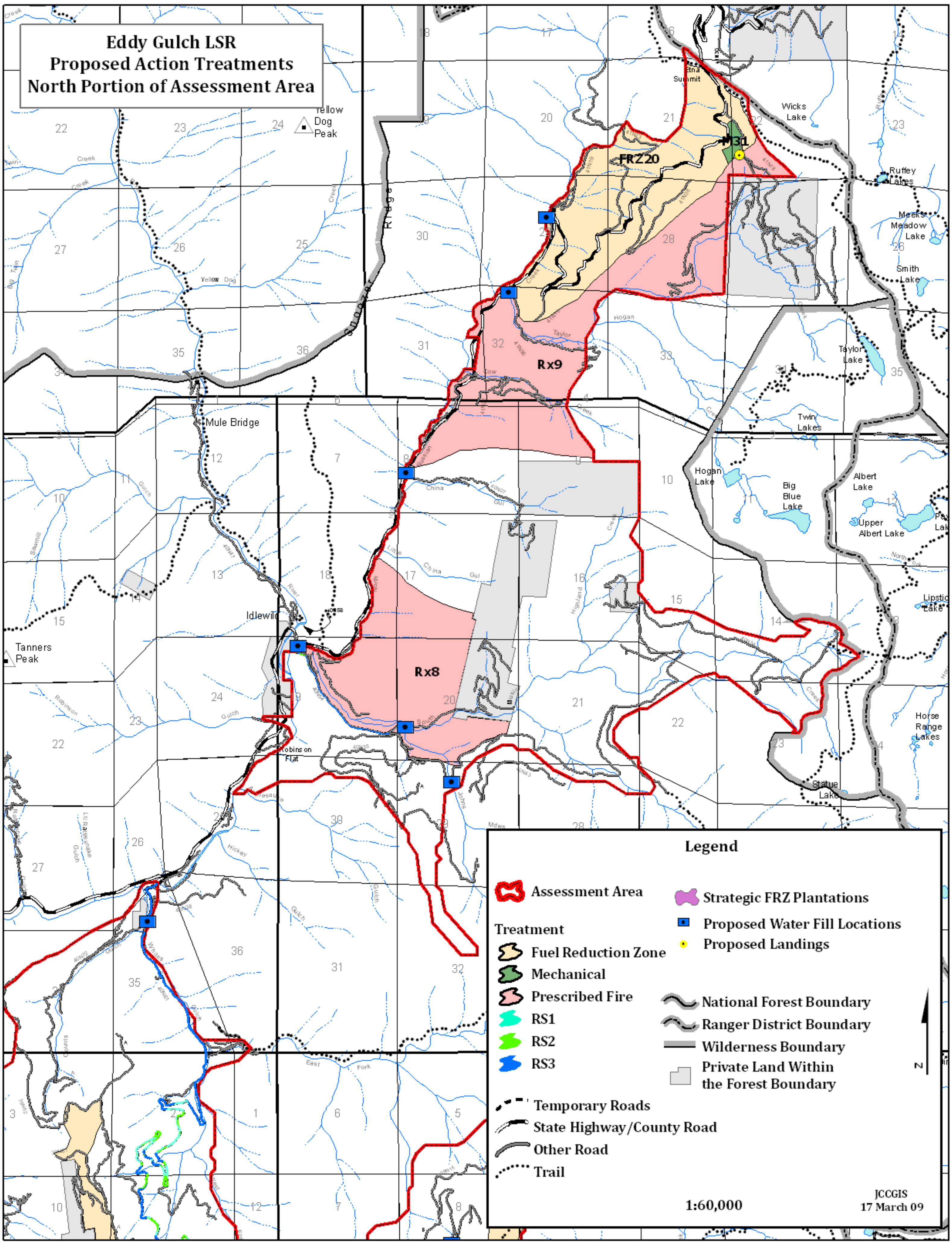
Map A-3. USFWS priority protection areas.



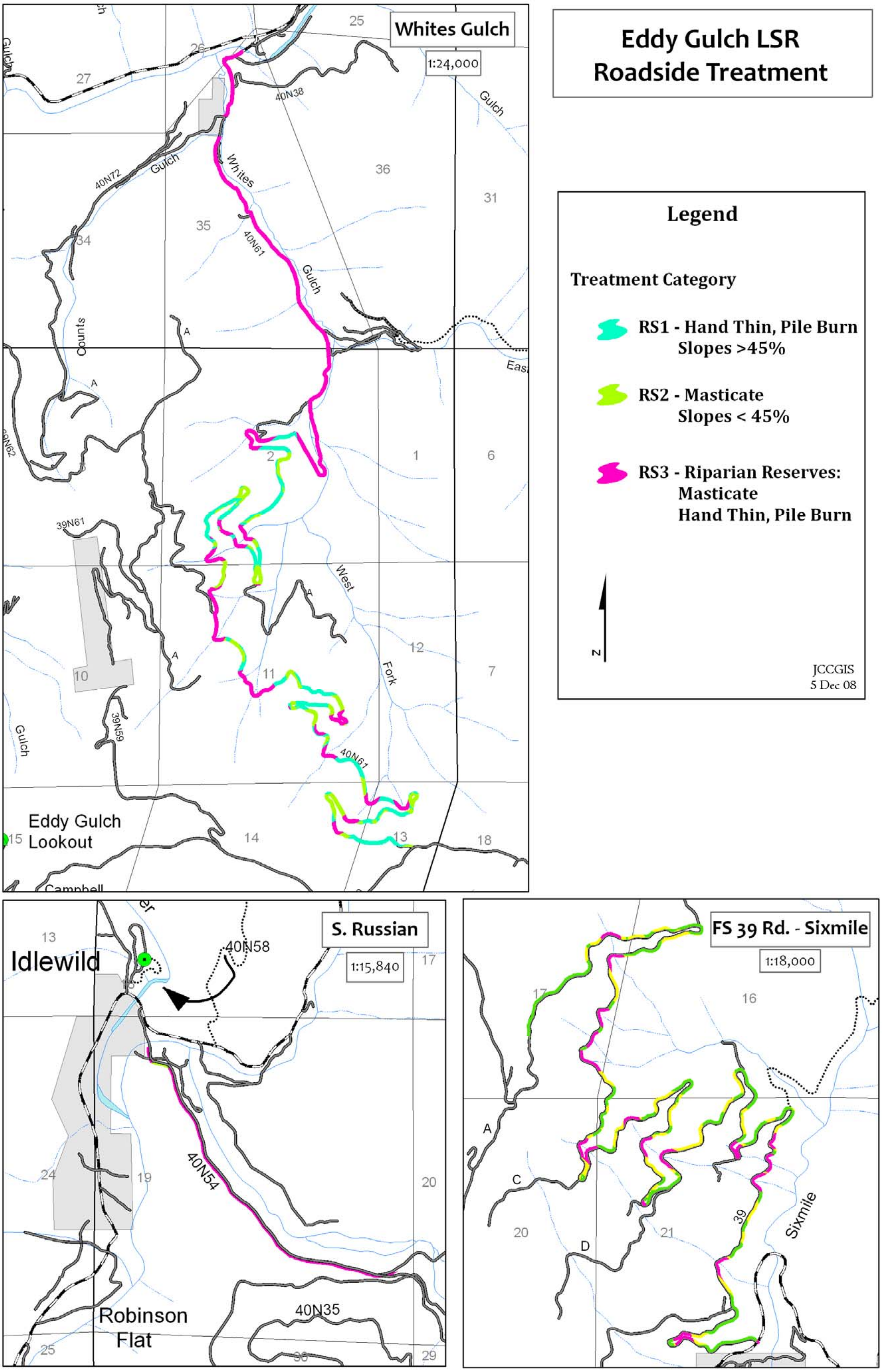
Map A-4a. Proposed treatment units in the south portion of the Eddy Gulch LSR Project Assessment Area.



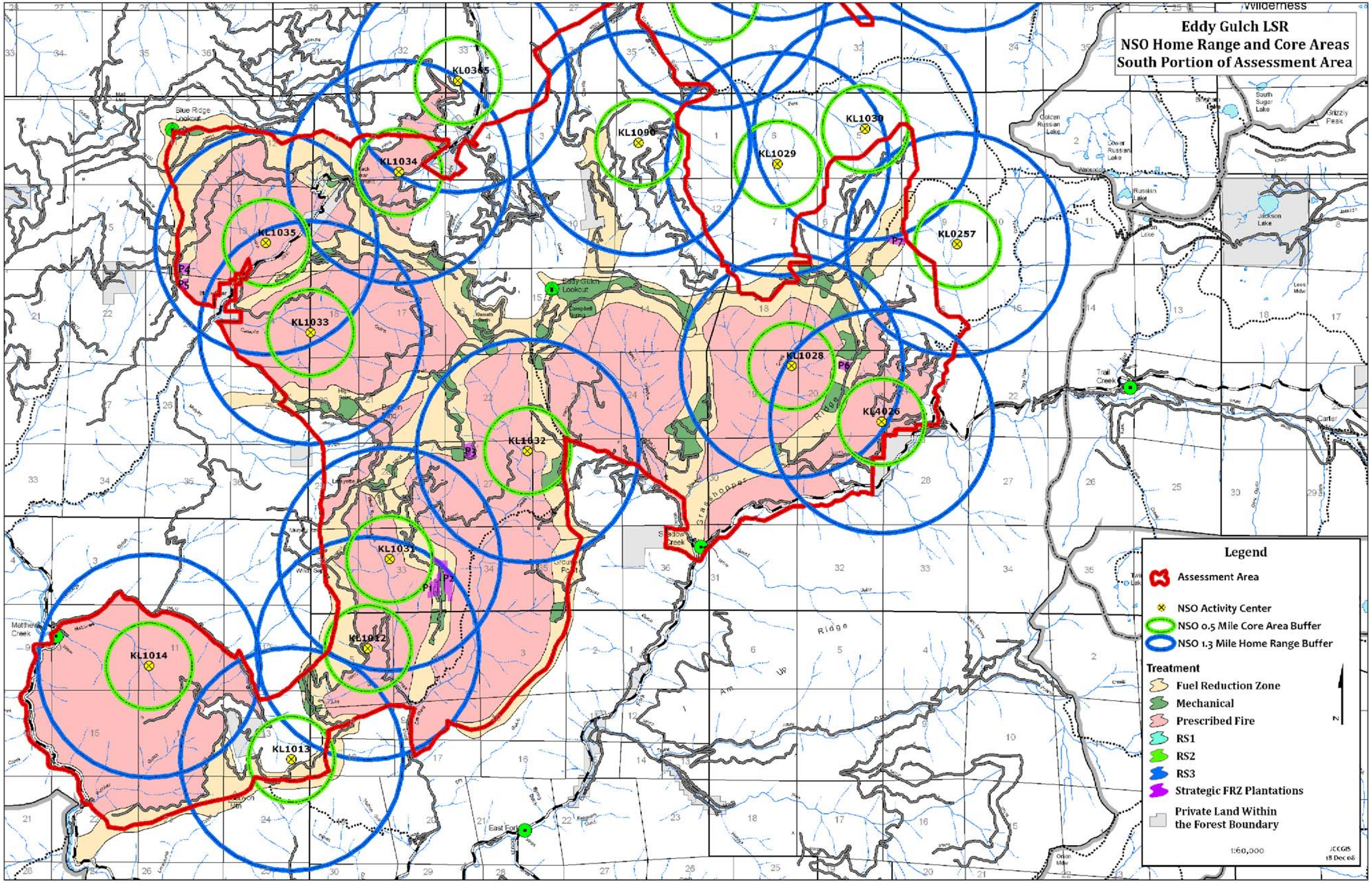
Map A-4b. Proposed treatment units in the north portion of the Eddy Gulch LSR Project Assessment Area.



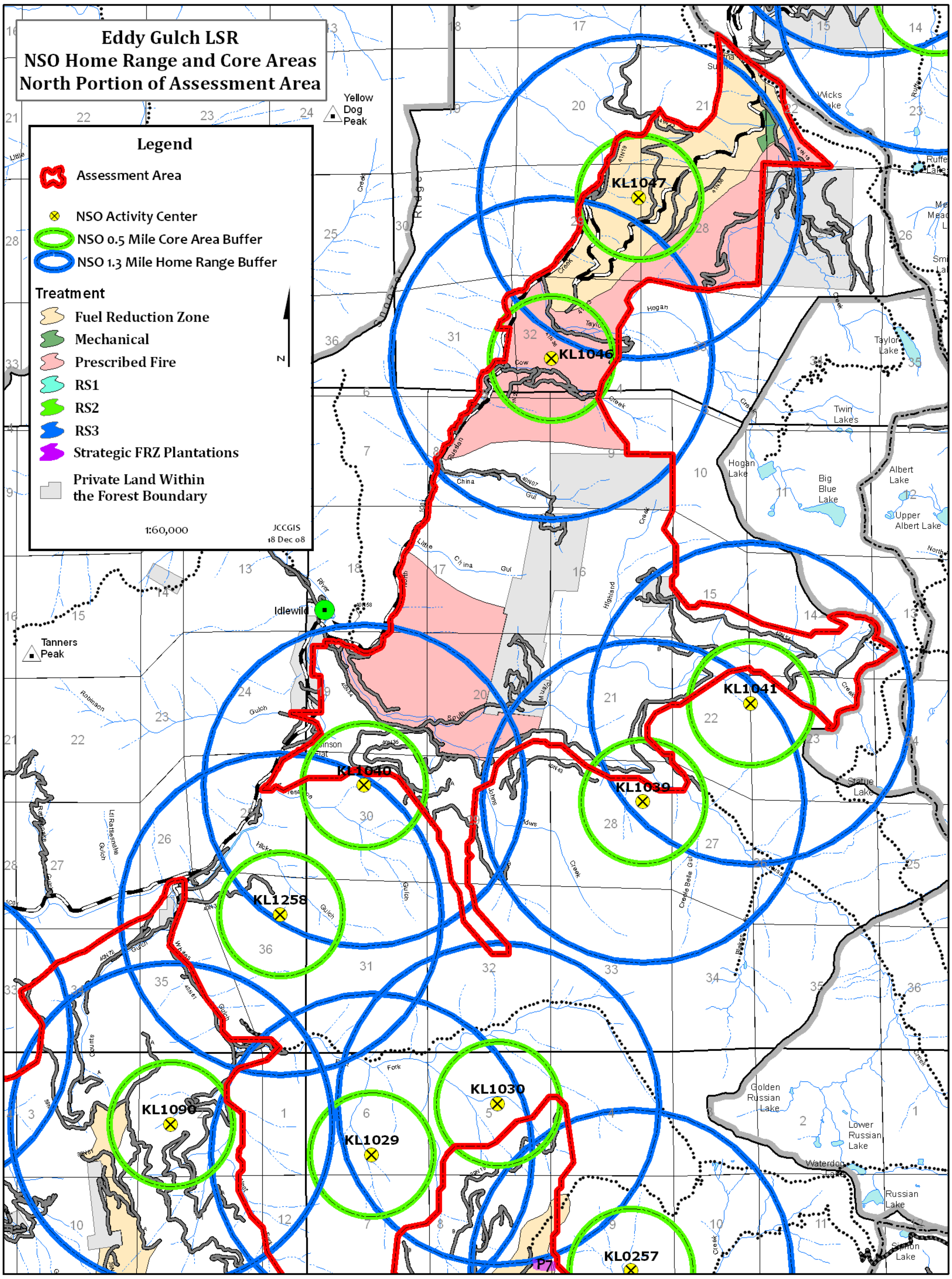
Map A-4c. Roadside treatments along emergency access routes that do not pass through an FRZ or Rx Unit.



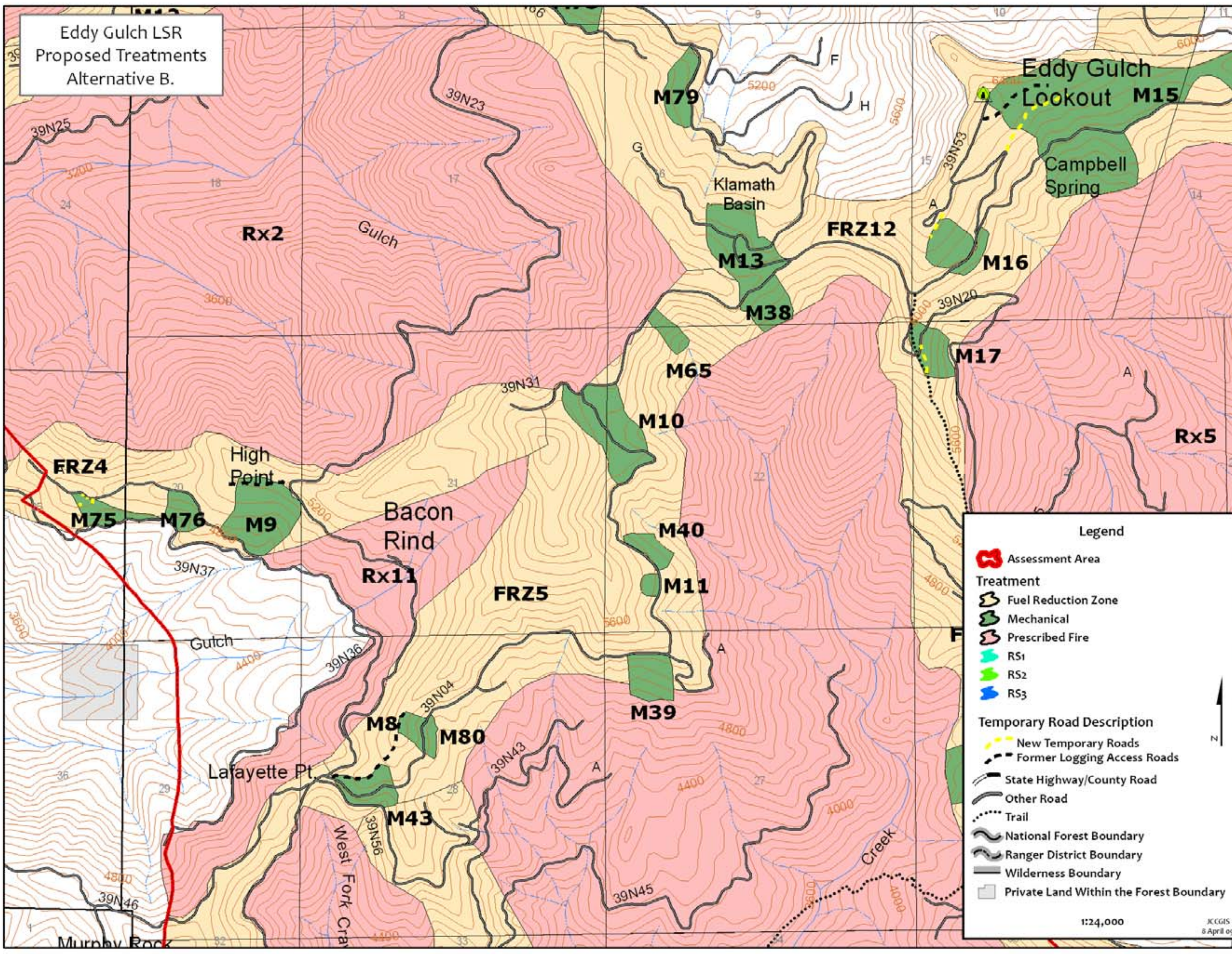
Map A-5a. NSO activity centers, core areas, and home ranges in relation to proposed treatment units—south portion of Assessment Area.

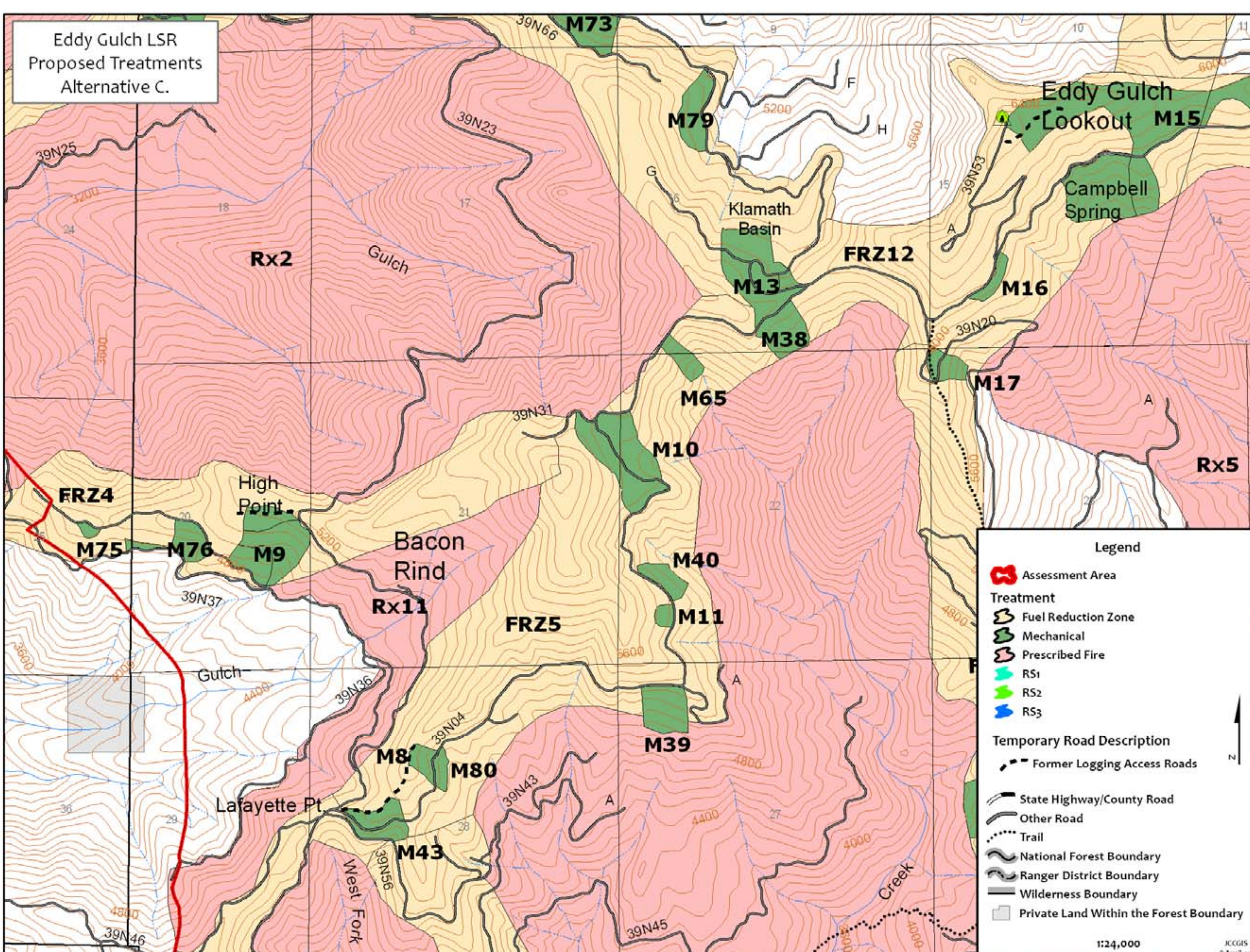


Map A-5b. NSO activity centers, core areas, and home ranges in relation to proposed treatment units—north portion of Assessment Area. portion of Assessment Area.

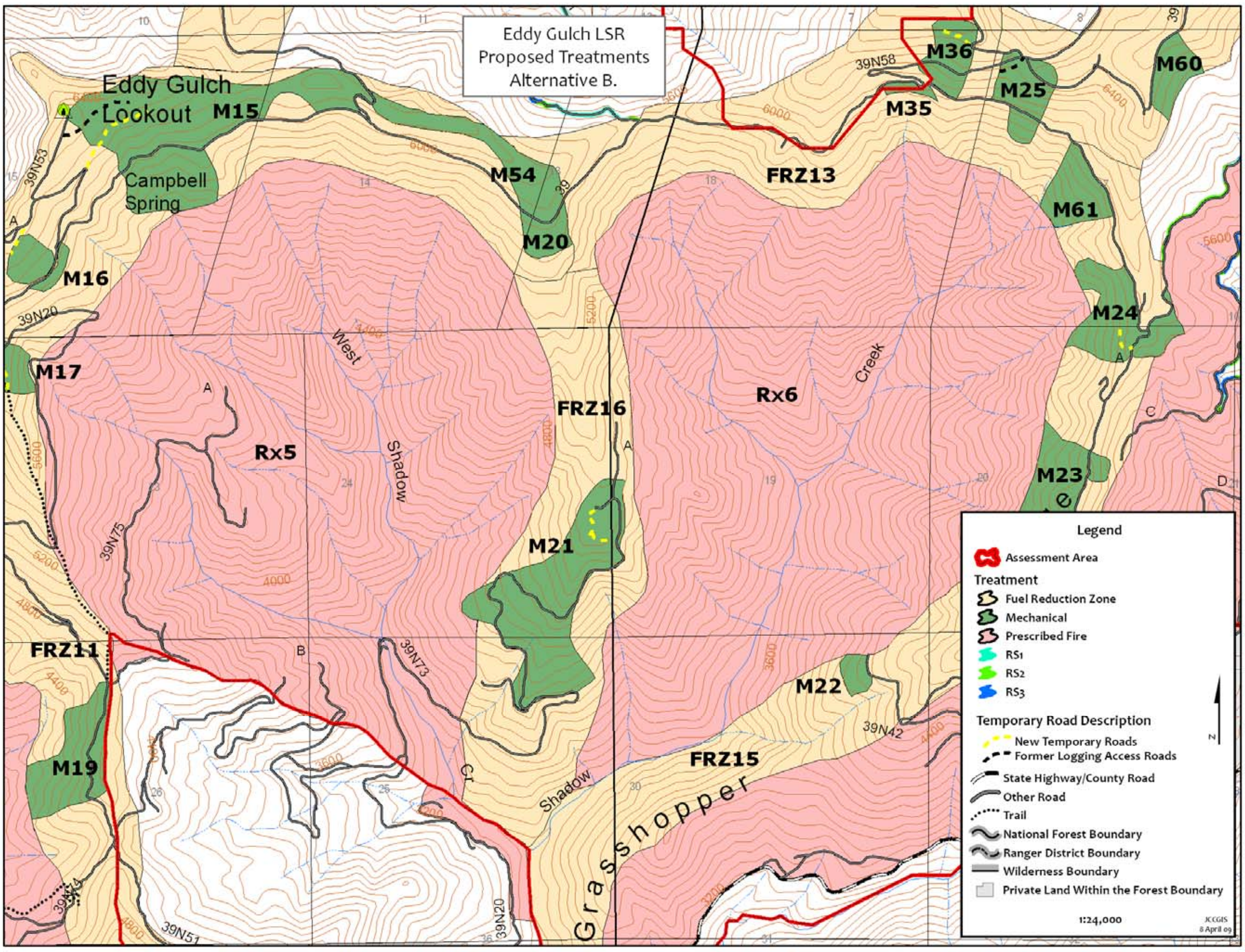


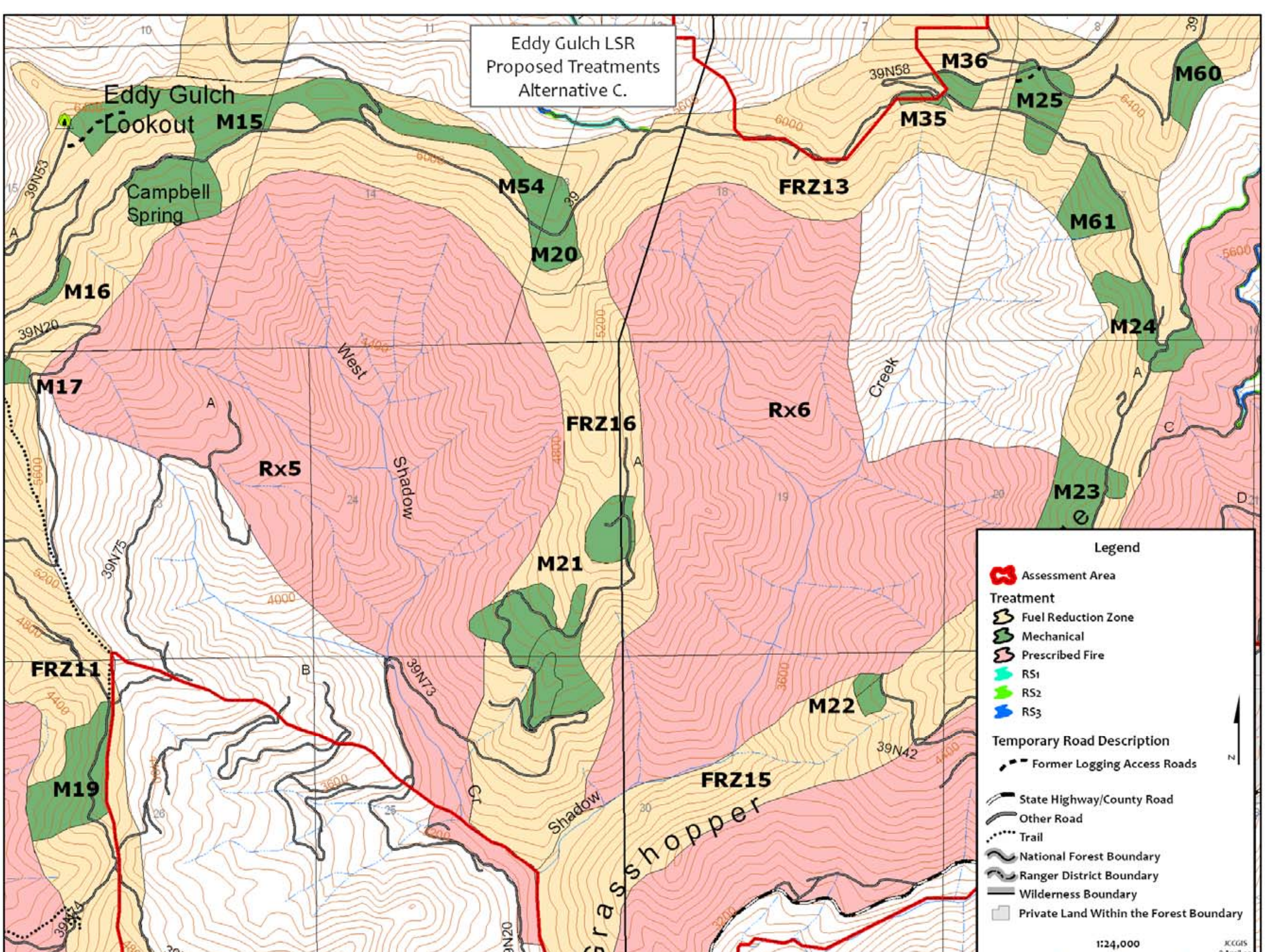
Map A-6a. View 1: Alternative B–configuration of treatment units *with construction* of 1.03 miles of new temporary roads and Alternative C–configuration of treatment units *without construction* of 1.03 miles of new temporary roads.



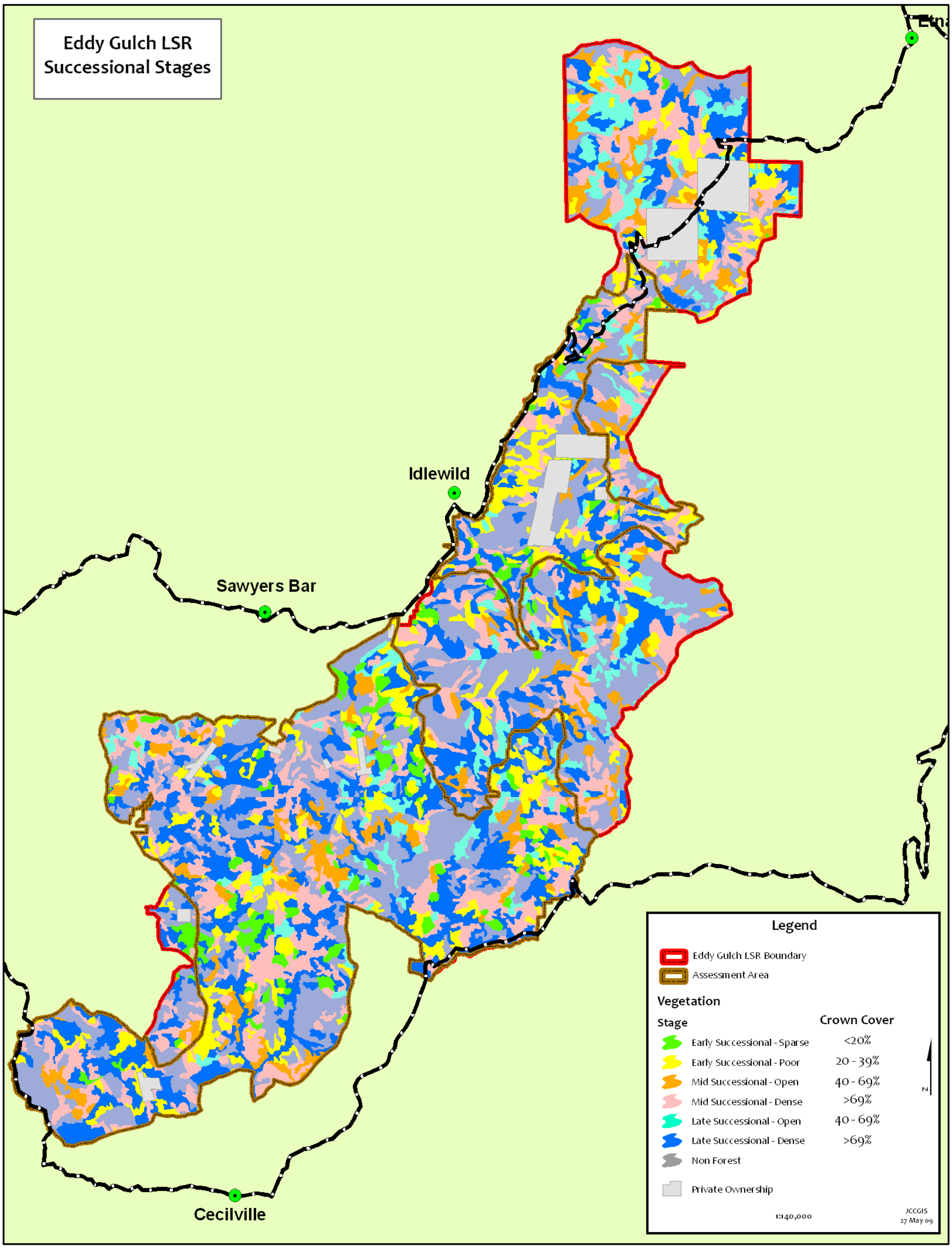


Map A-6b. View 2: Alternative B–configuration of treatment units *with construction* of 1.03 miles of new temporary roads and Alternative C–configuration of treatment units *without construction* of 1.03 miles of new temporary roads.

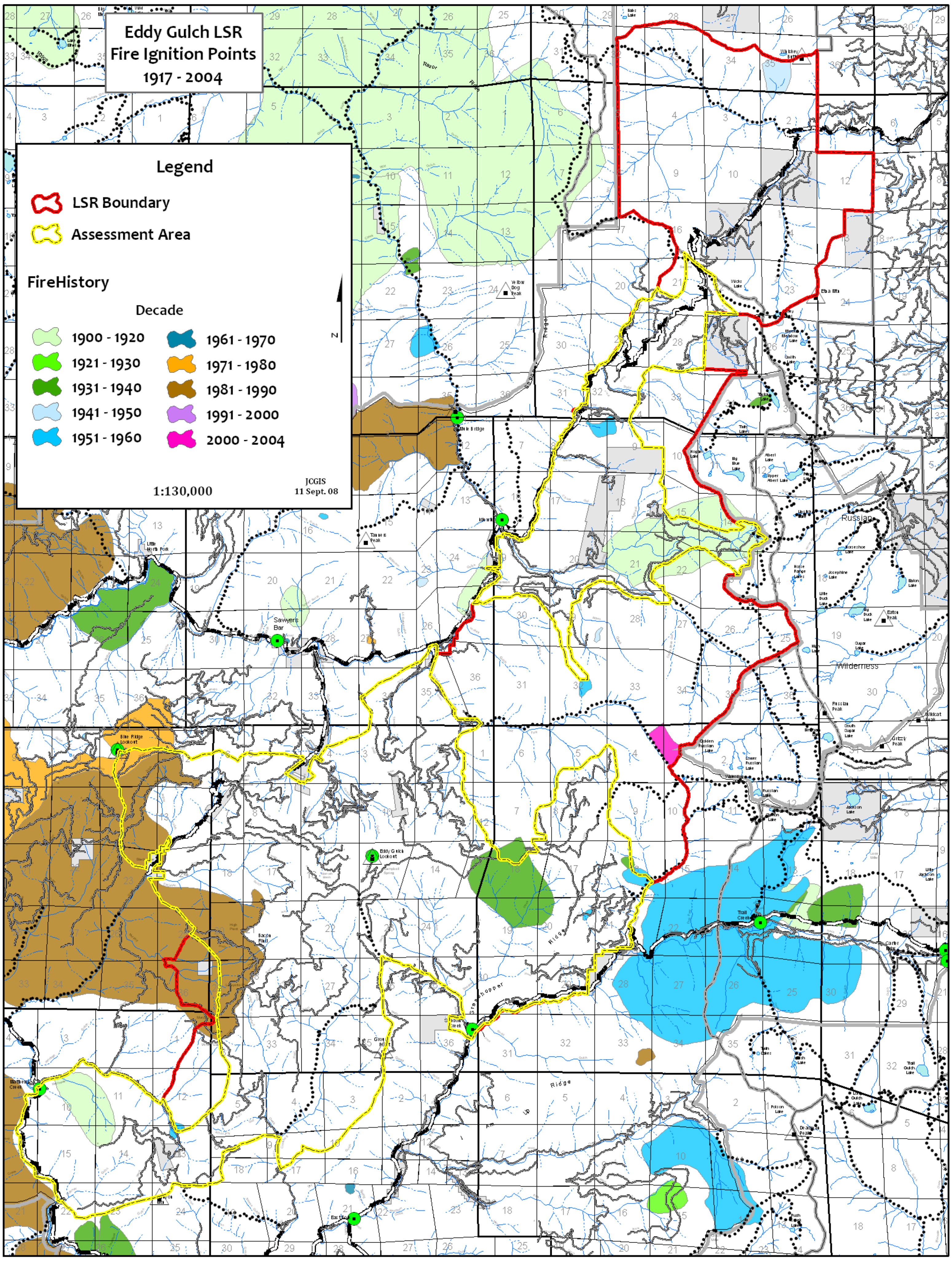




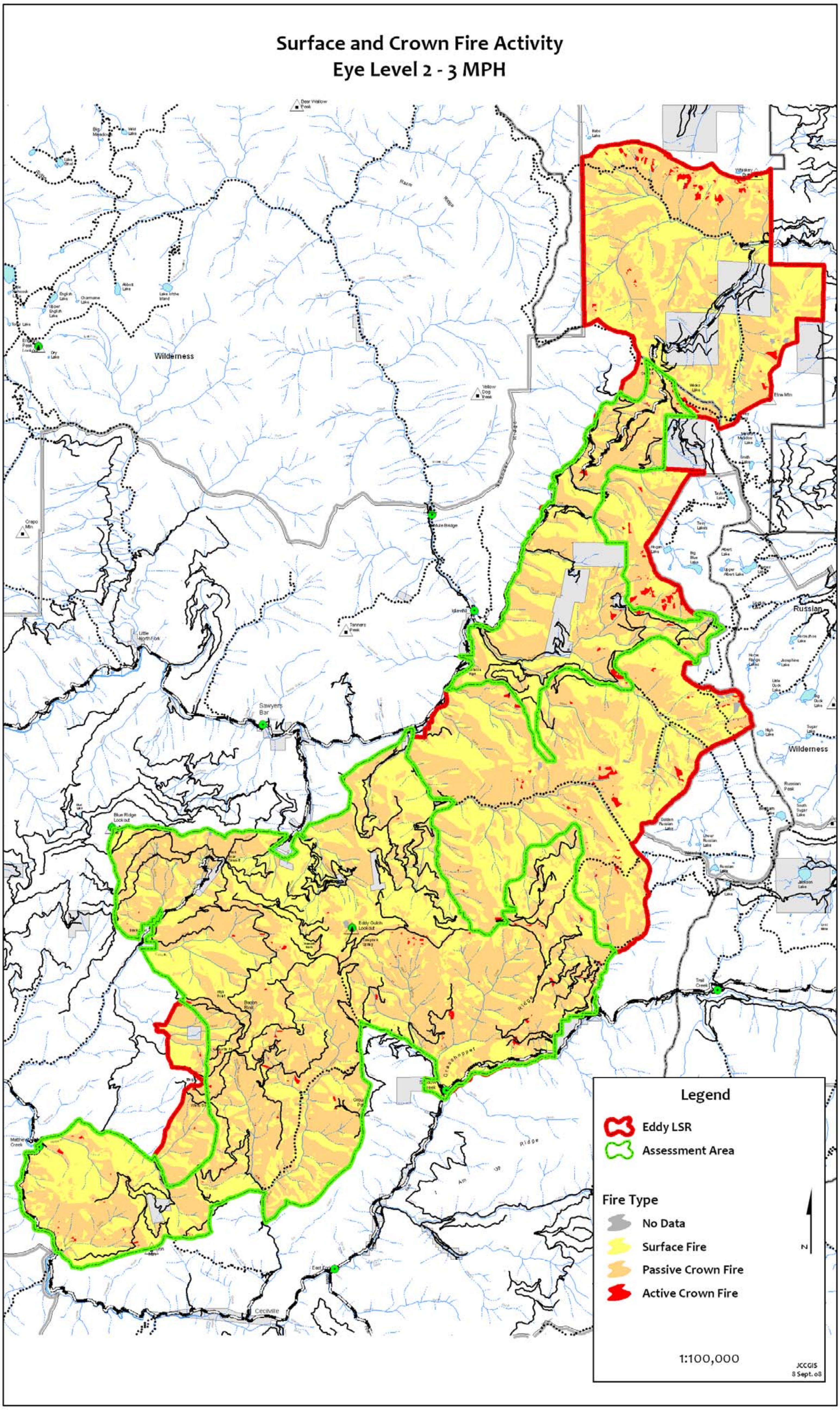
Map A-7. Eddy Gulch LSR successional stages.



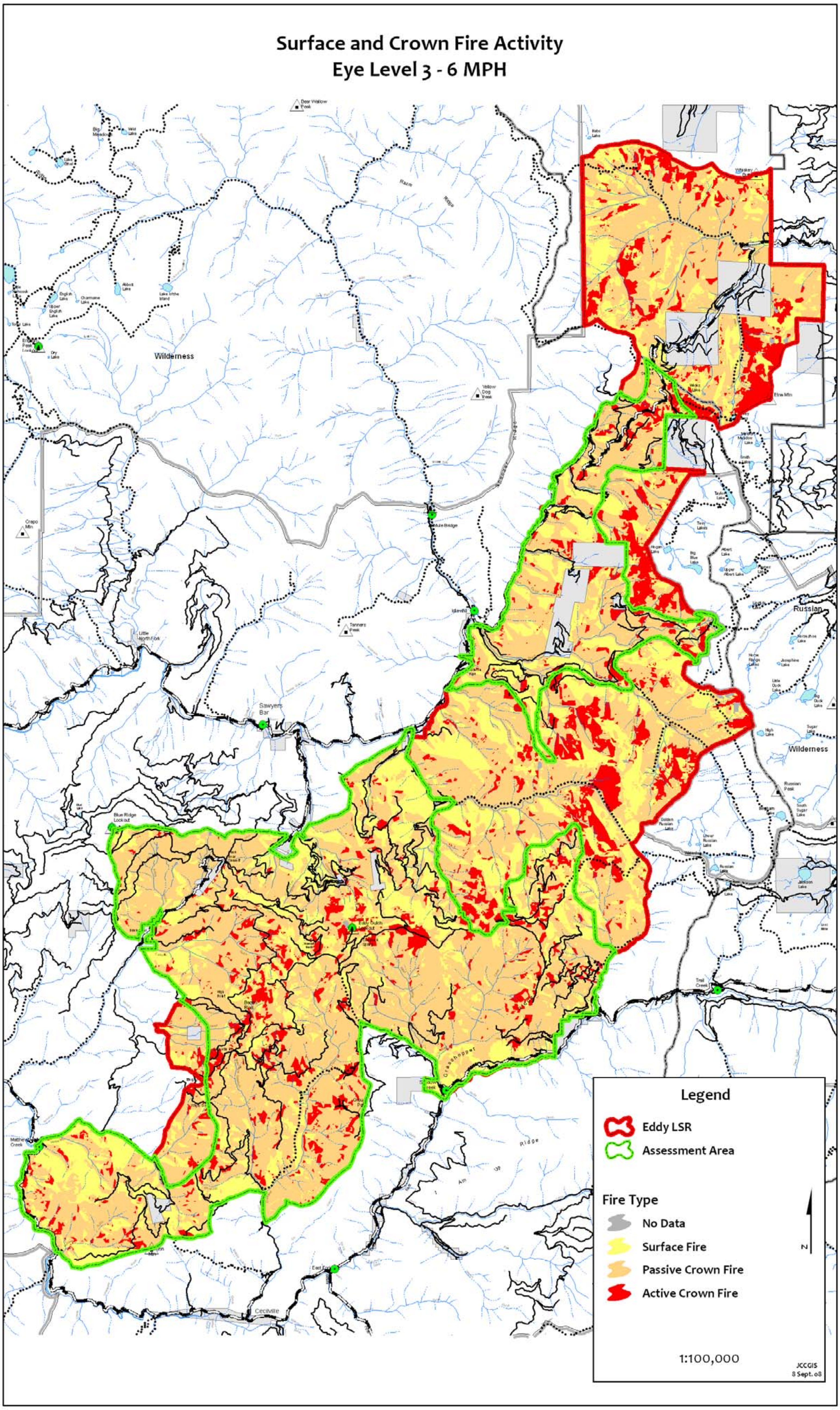
Map A-8. Historical ignitions and large fires in the Eddy Gulch LSR.



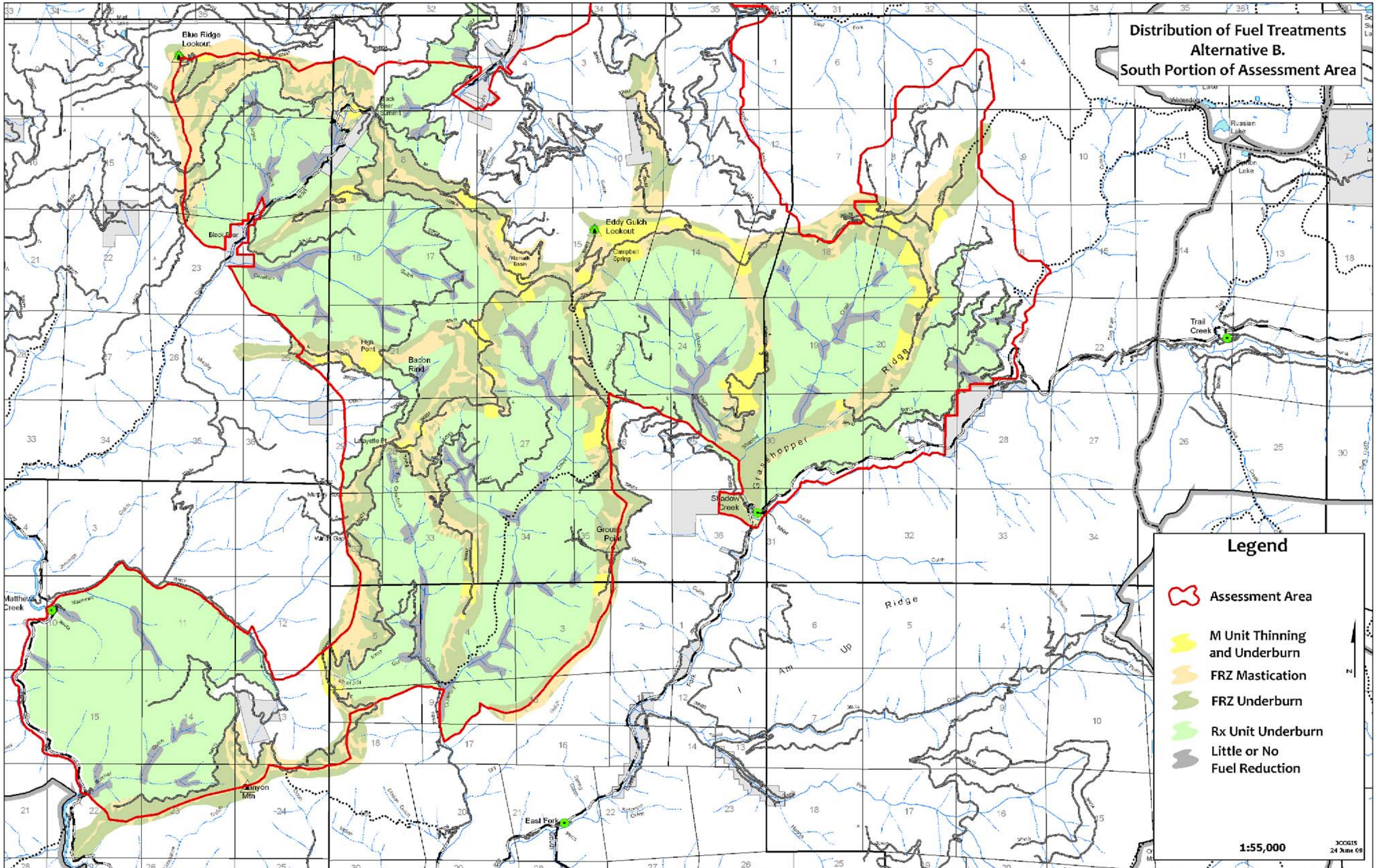
Map A-9a. Surface and crown fire activity, eye level 2–3 mph winds.



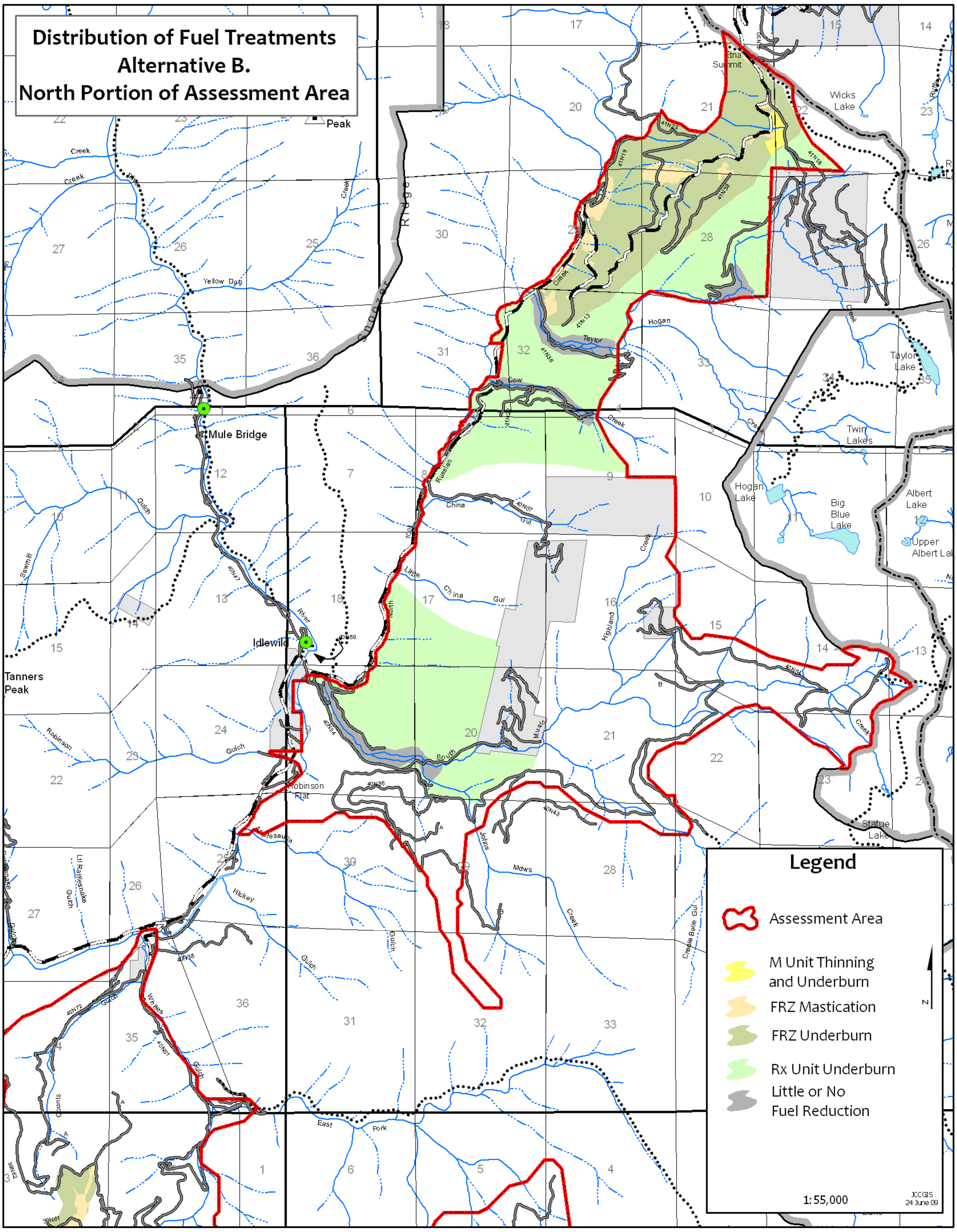
Map A-9b. Surface and crown fire activity, eye level 3–6 mph winds.



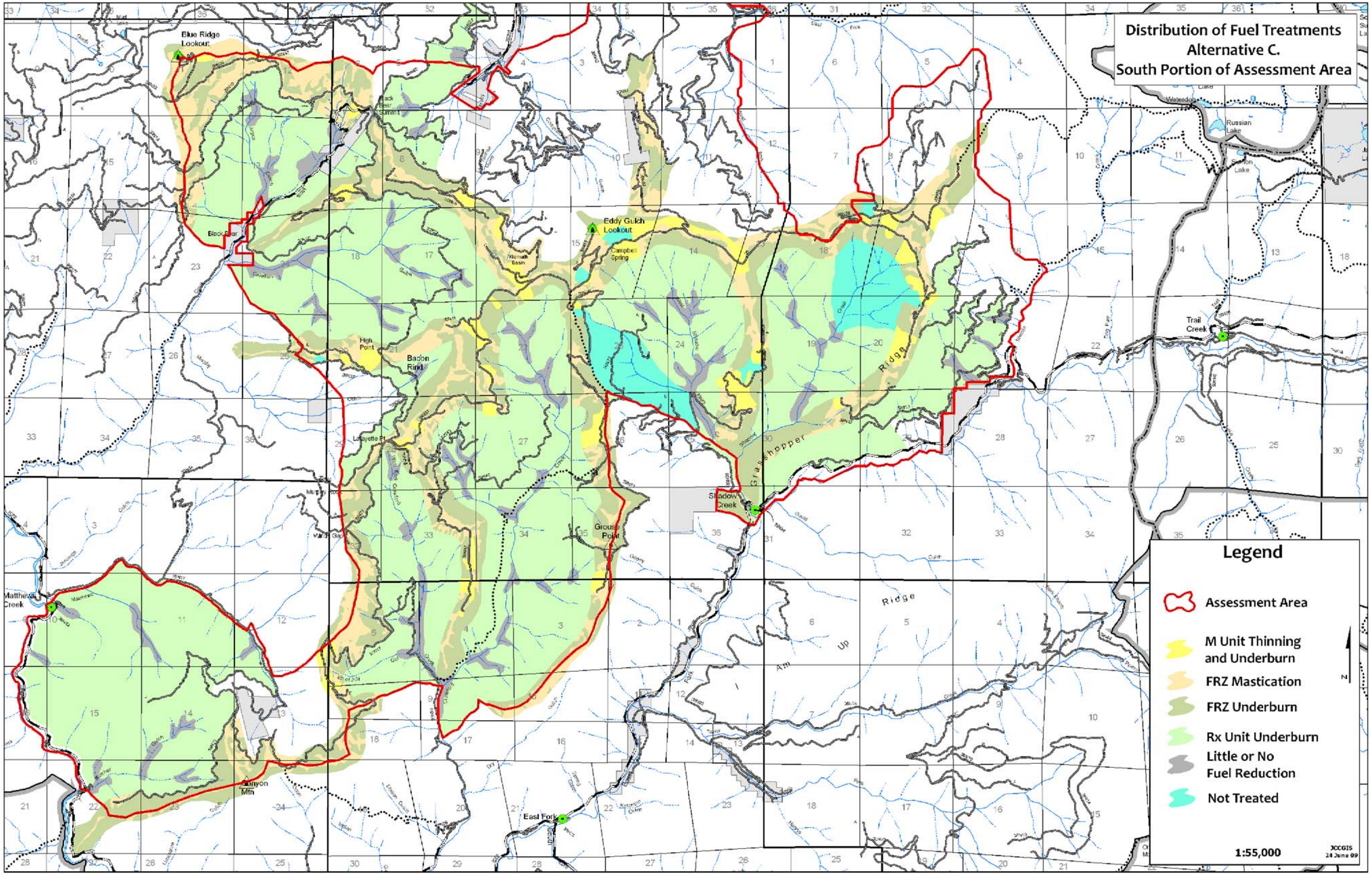
Map A-10a. Alternative B: Distribution of Fuels Treatments, South Portion of Assessment Area.



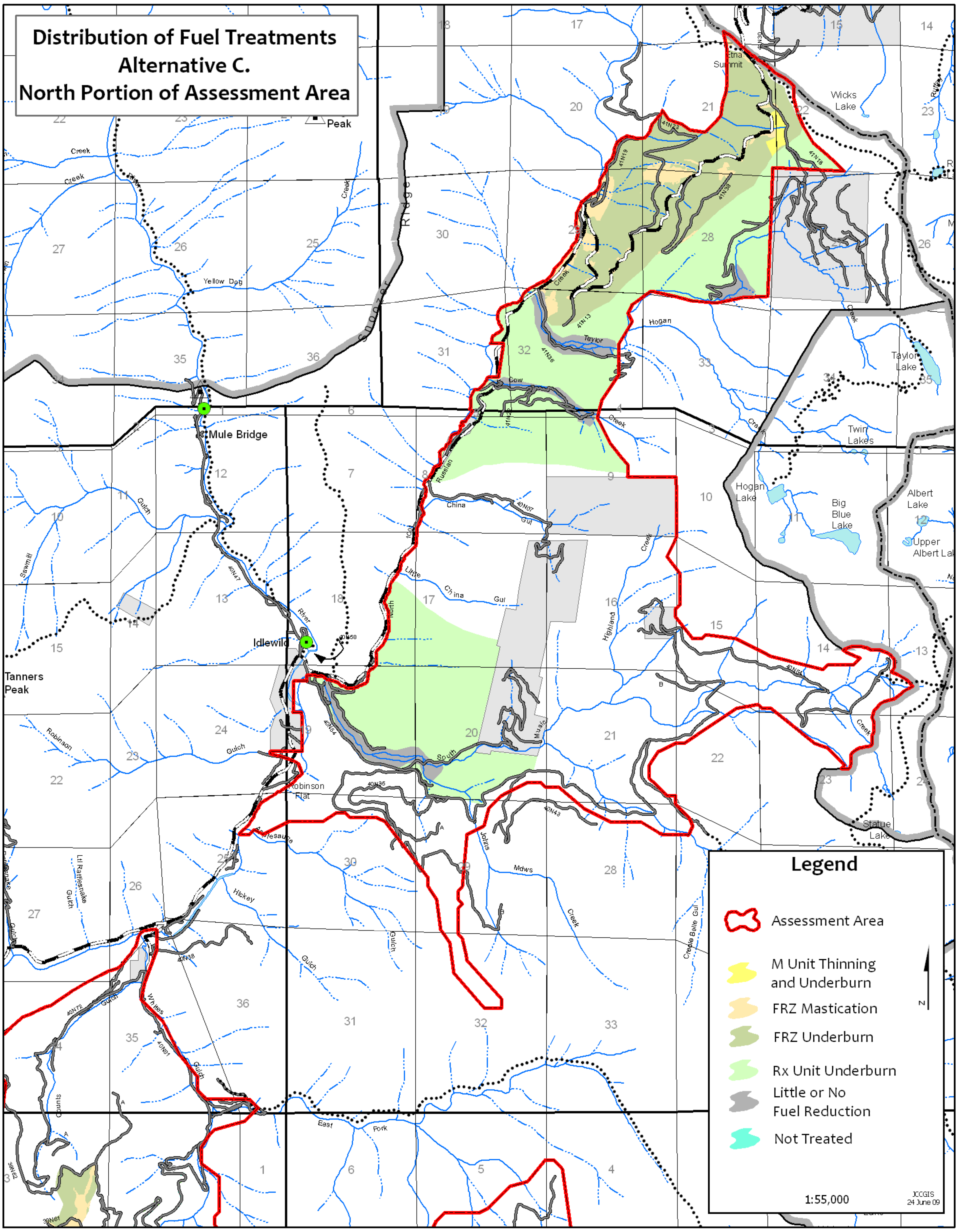
Map A-10b. Alternative B: Distribution of Fuels Treatments, North Portion of Assessment Area.



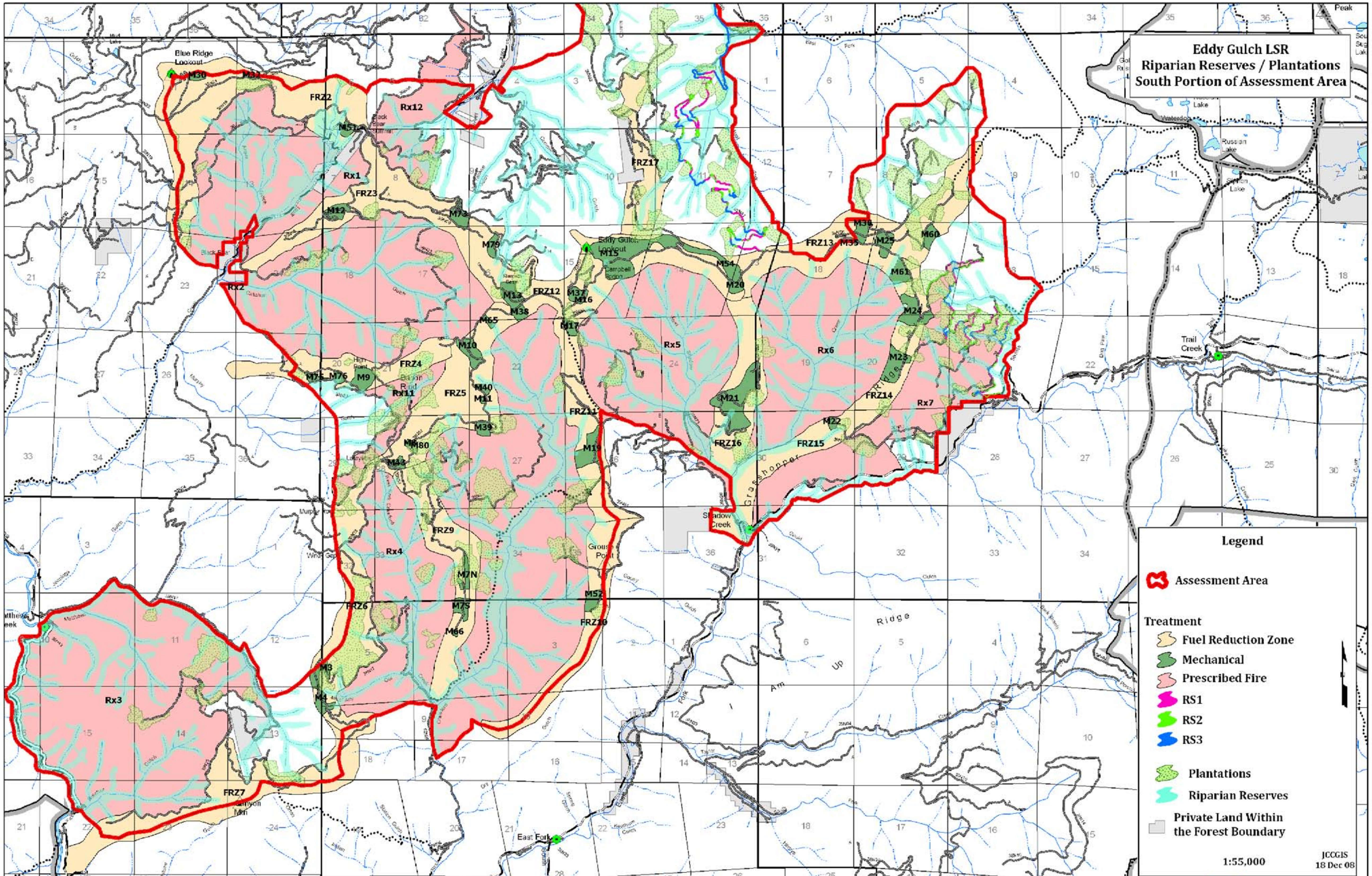
Map A-11a. Alternative C: Distribution of Fuels Treatments, South Portion of Assessment Area.



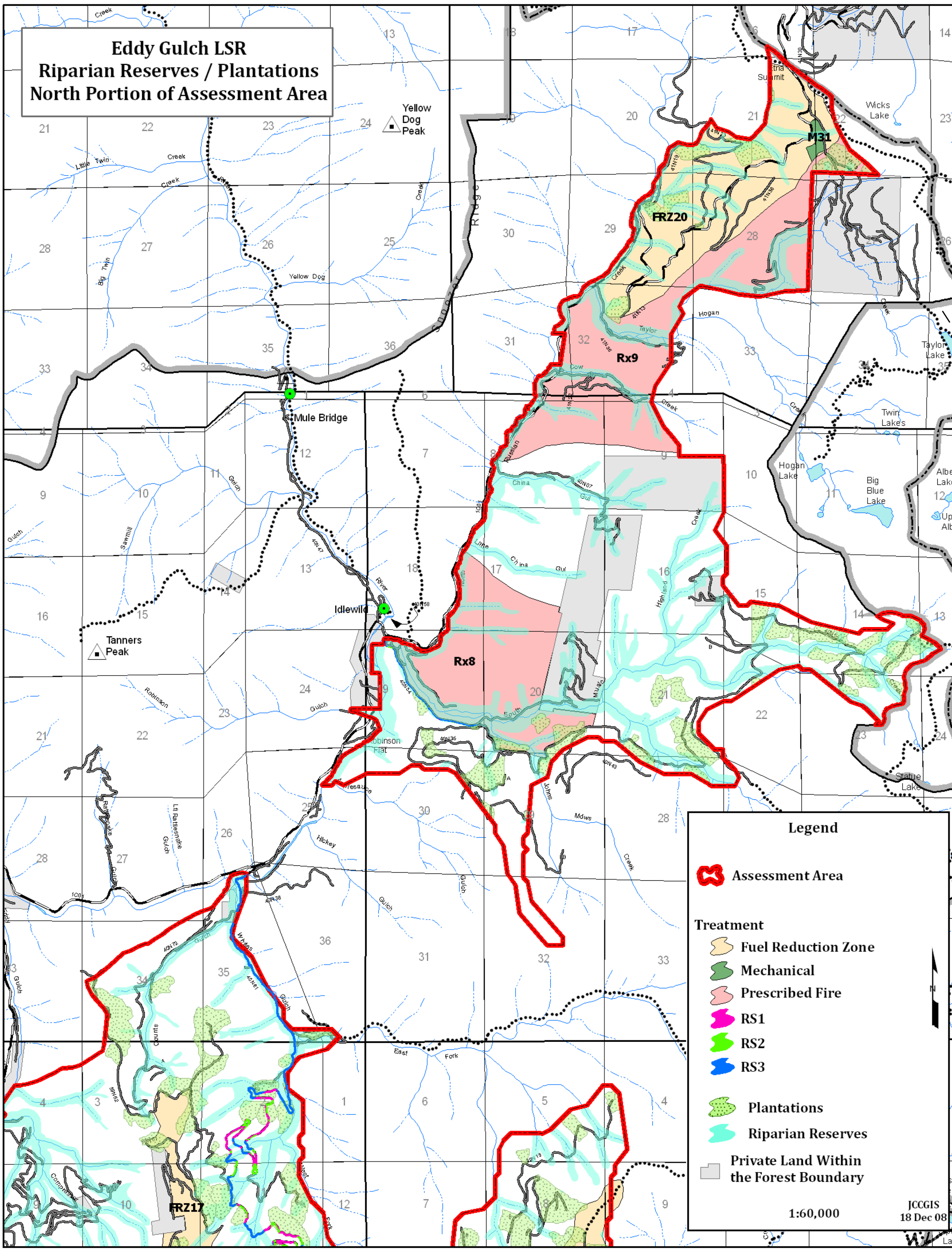
Map A-11b. Alternative C: Distribution of Fuels Treatments, North Portion of Assessment Area.



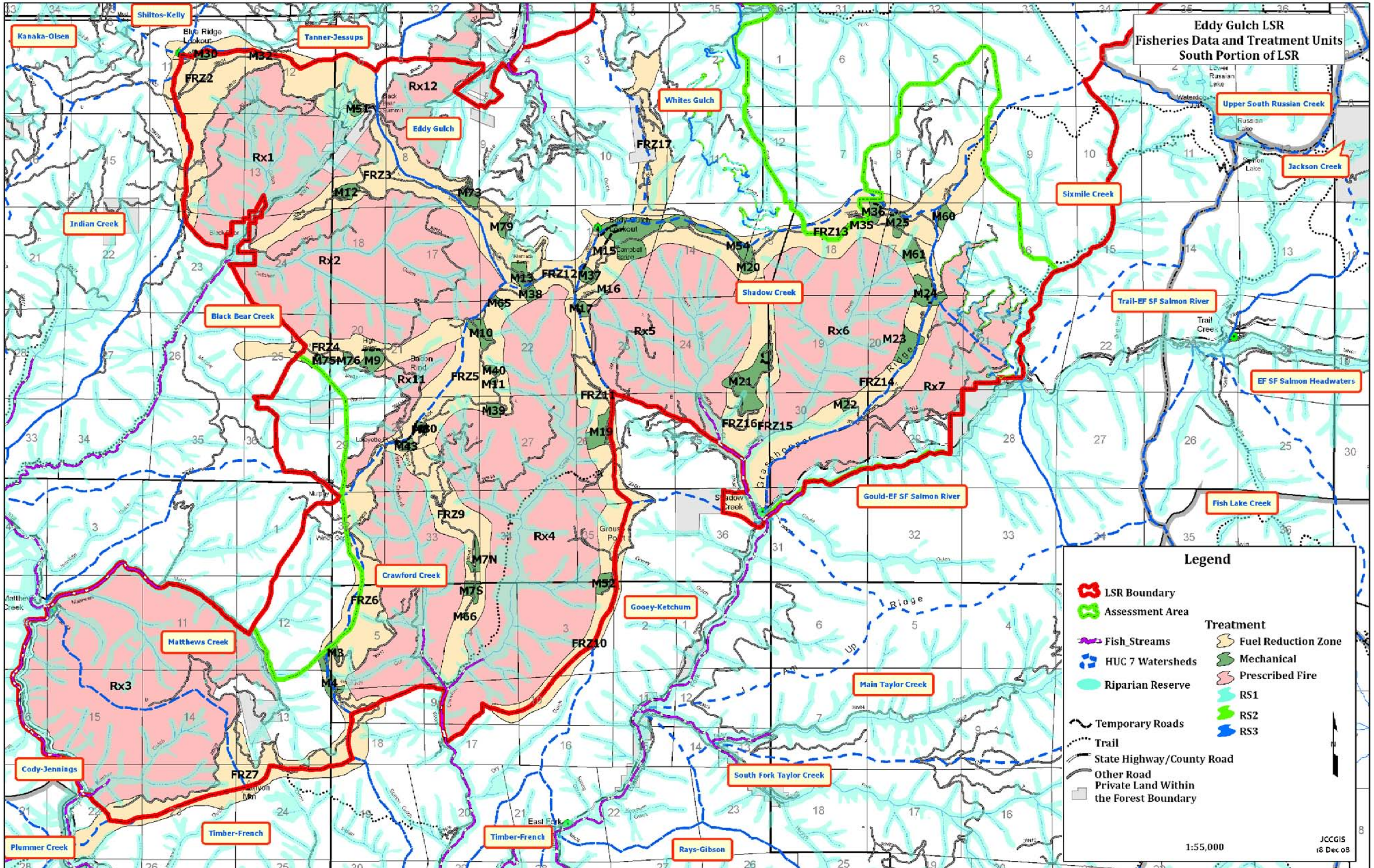
Map A-12a. Locations of Riparian Reserves and plantations in the south portion of the Eddy Gulch LSR Project Assessment Area.



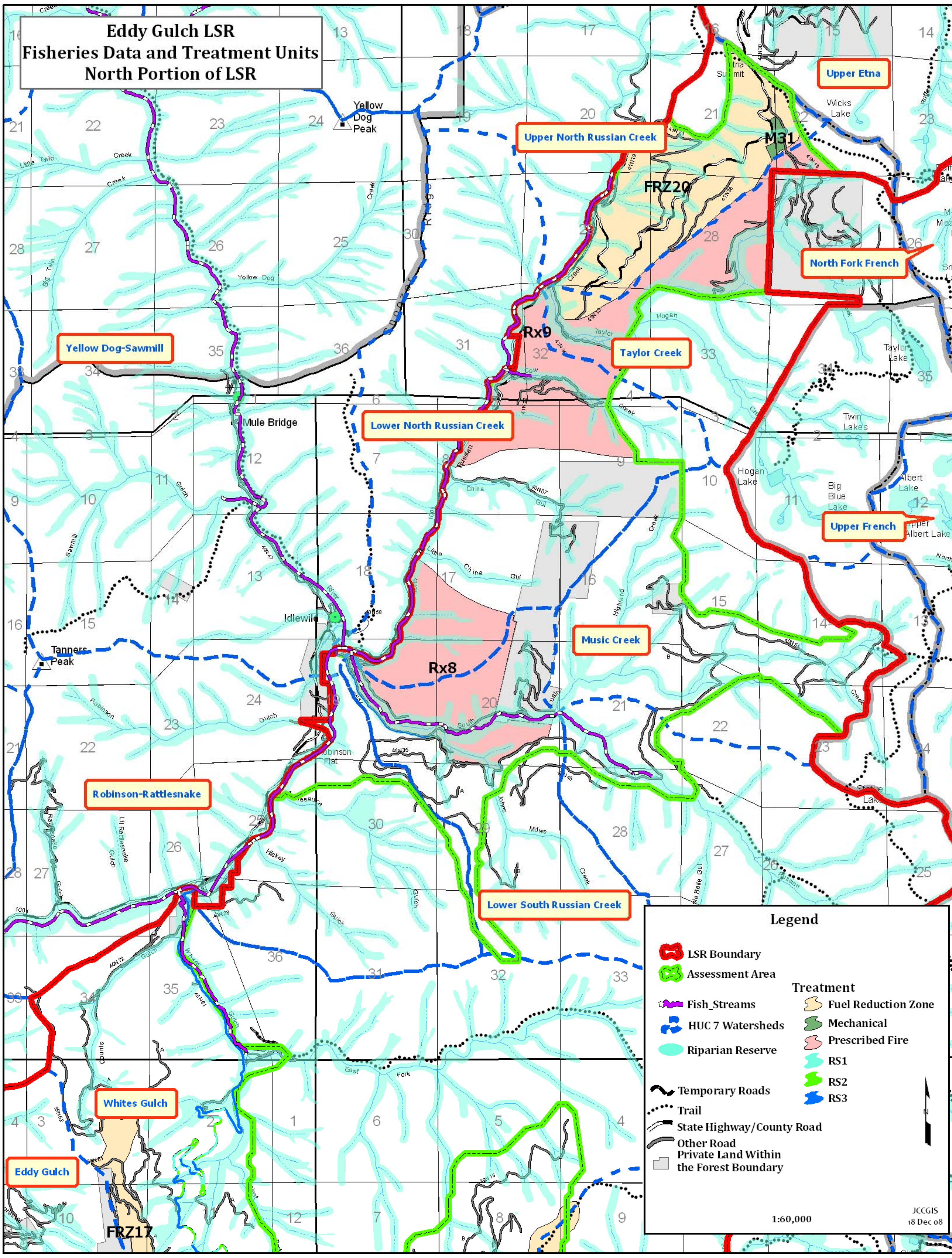
Map A-12b. Locations of Riparian Reserves and plantations in the north portion of the Eddy Gulch LSR Project Assessment Area.



Map A-13a. Fish Distribution, HUC 7 Watersheds, and Riparian Reserves, south portion of Assessment Area.



Map A-13b. Fish Distribution, HUC 7 Watersheds, and Riparian Reserves, north portion of Assessment Area.



Appendix B

RESPONSES TO COMMENTS ON THE EDDY GULCH LATE-SUCCESSIONAL RESERVE FUELS / HABITAT PROTECTION PROJECT DRAFT ENVIRONMENTAL IMPACT STATEMENT

Appendix B
Responses to Comments on the Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Draft Environmental Impact Statement

This appendix summarizes public and agency comments received on the *Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Draft Environmental Impact Statement* (draft EIS). The Notice of Availability for the draft EIS was published in the *Federal Register* on July 24, 2009. All comments on the draft EIS were received within the 45-day comment period, which ended on September 8, 2009.

B.1 Comment Summary

Seven comment documents were received, and most comment documents identified individual concerns. Responses were developed for 68 individual comments. The exact words of each respondent were used rather than summaries of the person's words to ensure accuracy and objectivity. All letters were read once, coded, and then read again by another coder to ensure all issues were highlighted. The actual comment documents can be found in Section B.3. Each of the individual comments has been bracketed (on the comment document), and each bracket corresponds to the numbers assigned to each comment shown in Section B.2.

Of the seven comment documents,

- 1 was from industry (American Forest Resource Council);
- 1 was from a professional resource manager (Dr. John Menke);
- 2 were from environmental groups (Klamath Siskiyou Wildlands Center, Klamath Forest Alliance, and Environmental Protection Information Center; and Klamath Forest Alliance and Environmental Protection Information Center); and
- 3 were from regulatory agencies (United States Department of the Interior, Office of Environmental Policy and Compliance; United States Environmental Protection Agency; and California Water Quality Control Board, North Coast Region).

The focus during the review of public and agency comments was to identify if there was a need to

- modify alternatives, including the proposed action;
- develop and evaluate alternatives not previously given serious consideration;
- supplement, improve, or modify analysis;
- make factual corrections; and
- explain why comments do not warrant further agency response, including reasons that support the agency's position (40 CFR 1503).

Comments that require substantial changes to the Proposed Action, identify significant new circumstances, or that require significant new information will require preparation and recirculation of a supplemental EIS (40 CFR 1502.9). The analysis of comments indicates there are no comments that would trigger preparation of a supplemental draft EIS.

B.2 Individual Comments

Comment Document 1—American Forest Resource Council

Comment 1.1: Insure landing size is adequate to support the proposed harvest systems. "If whole tree yarding is proposed make sure landings can accommodate the merchantable and unmerchantable material."

Response 1.1: Chapter 2 of the draft EIS, page 2-14, third bullet states: "Existing landings would be used. The interdisciplinary (ID) team considered using whole-tree yarding to reduce slash treatments, but it would require larger landings and additional clearing and was therefore not considered further."

Comment 1.2: Following a review of the DEIS and all the associated environmental impacts we see no reason to not decide on Alternative B as the alternative to implement. It appears to be the most logical alternative and the one that most closely meets expectations from the LRMP and project purpose and need.

Response 1.2: Thank you for your comment.

Comment 1.3: We recommend Alternative B and ask you as the decision maker to base your decision on fact, rather than other commenter's lack of understanding of the Forest ecosystem, personal and group agendas and personal biases.

Response 1.3: Thank you for your comment.

Comment Document 2—Dr. John W. Menke

Comment 2.1: I reviewed with interest and joy this potentially outstanding project to reintroduce fire effects on a nearby forest ecosystem of a significant size. The quantity of knowledge presently available to assess potential benefits, positive and negative effects is remarkable.

Response 2.1: Thank you for your comment.

Comment 2.2: In reviewing the draft EIS the only missing analysis I noted was no water yield assessment. With the expected temporal reduction in competitive effects among plants, this implies some increased watershed output albeit probably small. Given the importance of even a small stream flow enhancement, I feel some assessment of water flow is called for.

Response 2.2: The draft EIS, Fisheries BA/BE, and Aquatic Resources Report present the effects of treatments on erosion potential, water drafting on stream flow, and on the flood regime indicator resulting from creation or presence of impervious surfaces such as roads and landings. The possibility of water yield increase from temporal reduction in competitive effects among plants (that is, reducing vegetation density) was not discussed in the draft EIS because any potential water yield increase would most likely be very small and extremely transient.

A large body of literature exists concerning water yield augmentation through vegetation management (for example, Bosch, J.M. and J.D. Hewlett 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration . . . changes on water yield and evapotranspiration. J. Hydrol. 55, pp. 3–23). A number of broadly accepted research conclusions (listed below) argue against any expectation of measurable water yield increase.

- A large amount of regeneration cutting (50 percent or more of small watersheds) is required to achieve measurable water yield increase—no regeneration cutting is proposed in this project.
- In California's Mediterranean climate, most precipitation falls in winter when vegetation is dormant and not transpiring soil water.
- Small increases in soil moisture that result from reducing vegetation density are most likely used by nearby residual vegetation. That is one of the objectives of thinning stands—to improve tree vigor by reducing competition for soil moisture and allowing it to be consumed by fewer, healthier trees. (Please note that for the Eddy Gulch LSR Project, the proposed thinning is to address the need for fuels reduction; however, a beneficial effect of the thinning is a reduction in inter-tree competition levels for resources [nutrients, water, and sunlight]. This was analyzed in the draft EIS (Section 3.2) and presented in the Silviculture Report.)
- Water yield increase in the mountain west is most effectively achieved by changing patterns of snow redistribution into openings created by regeneration cutting—no regeneration cutting is proposed in this project.
- Extrinsic factors (other than vegetation density), such as climate variability, fires, and other unforeseeable disturbances, add so much variability to runoff data that many years (even decades) of paired-watershed studies under controlled conditions are required to validate water yield increases, if any.
- Rapid regrowth of vegetation makes any yield increases transitory unless reductions in vegetation density (usually in the form of maintaining openings clear of forest cover) are maintained over time.

Comment 2.3: Thanks for the opportunity to review the Eddy Gulch Late-Successional Reserve Fuels/Habitat Protection Project. The document was very professionally prepared and clear in is [its] presentation and findings.

Response 2.3: Thank you for your comment.

Comment Document 3—Klamath Siskiyou Wildlands Center, Klamath Forest Alliance, and Environmental Protection Information Center

Comment 3.1: Please note that our organizations support the vast majority of the proposed actions in this project. We are encouraged and supportive of the agency's efforts to conduct small diameter thinning and prescribed fire activities in this fire-suppressed project area.

Response 3.1: Thank you for your comment.

Comment 3.2: Our largest remaining concern involves the logging of "M units" down to 32%-50% canopy. . . We are particularly concerned with the proposed M unit that would remove many of the large trees and snags of an old-growth Shasta Red Fir stand (see the DEIS page 25). [not correct page number]

Response 3.2: Please refer to page 3-26 in the draft EIS and page 29 in the Silviculture Report—crown closure in FRZs is expected to vary and to be lower than crown closure in stands located outside of the FRZs. As stated on page 2-7 of the draft EIS: "The construction of the FRZs would generally be consistent with "Activity Design Criterion 9: Shaded Fuelbreak," as described in the forestwide LSR assessment (USFS 1999). The exception to Criterion 9 is that forest canopy cover may be less than 40 percent in FRZs" (Criterion 9c).

The one red fir unit (M Unit 60 – 17 acres) with a predicted 32 percent crown closure is the result of existing vegetative conditions. The upper portion of the stand is a very old, decadent stand of red fir with a high level of tree mortality. This portion of the stand is currently very open. The lower portion of the stand is younger and denser with more white fir present. Most of the thinning will occur in the lower portion of the stand.

Comment 3.3: We are also very concerned with the intention to meet snag and coarse woody debris requirements on the "landscape level" within this LSR, rather than on the unit level. The standards and guidelines of both the Northwest Forest Plan and the Klamath National Forest LRMP apply to retention of these features at the unit level, rather than the landscape level . . . Page 4-25 of the KNF Forest-wide Standards and Guidelines clearly directs the agency to "maintain 5 to 20 pieces of CWD [coarse woody debris] per acre in various states of decay." C-42 of the Northwest Forest Plan requires that "snags are to be retained within the harvest units at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels." Further, the soil mitigation measures identified in the DEIS (page 2-27) call for retaining CWD at the level identified in the KNF LRMP on a "per acre" basis.

Response 3.3: Since the Klamath National Forest Land and Resource Management Plan (Klamath LRMP) was adopted in 1995, the Klamath National Forest has managed snag numbers on a landscape, rather than a unit level, according to the Standards and Guidelines (S&Gs). The following are from the Klamath LRMP:

- S&G 6-16: "At a minimum . . . consider the amount of materials existing on site, the amount of material needed to provide for nutrient cycling and site productivity, the denning needs of wildlife species, and the fire risk as a result of fuel material on site. (emphasis added)
- S&G 8-22: "Assess the availability of snags within each landscape" and "Provide an **average** of 5 snags per acre…..within each landscape. These snags need not be equally distributed." (emphasis added)
- S&G 8-25: "The number of snags on a given acre will vary, depending on site and on the number of snags within the landscape."

Please refer to page 2-7 in the draft EIS regarding the Eddy Gulch LSR Project's compliance with the S&Gs contained in the Klamath LRMP. Additionally, on page 3-46 of the draft EIS, there are prescriptions aimed at ensuring Klamath LRMP S&Gs are met for snags and CWD for the project across the Rx Units.

As stated on page 2-7 of the draft EIS: "The construction of the FRZs would generally be consistent with "Activity Design Criterion 9: Shaded Fuelbreak," as described in the forestwide LSR assessment (USFS 1999). The exception to Criterion 9 is that, "Densities of snags and downed logs should be kept relatively low and compensated by higher densities outside Shaded Fuelbreaks. Shaded Fuelbreaks should be maintained in low-fuel conditions with periodic re-treatments, targeting especially accumulated surface fuels and new growth of understory vegetation. Dead (snags) or dying trees need to be removed to reduce the safety hazards to firefighters and reduce the prolific fire brands that snags produce (Criterion 9e).

Comment 3.4: We are concerned that the 3,184 acres of proposed machine mastication may inhibit attainment of the purpose and need for the Project.

Response 3.4: The two primary objectives (purposes) of the Eddy Gulch LSR Project are to (1) protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR, and (2) reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

Mastication is used in lieu of prescribed burning and is an effective tool for reducing the standing biomass of shrubs and small trees that contribute to ground and ladder fuels in the project Assessment Area.

Please review Section 3.3 ("Fire, Fuels, and Air Quality") in the draft EIS, which clearly supports the fact that mastication will serve to meet the purpose and need for the Eddy Gulch LSR Project. Chapters 1 and 2 discuss concerns for the LSR and project objectives, Chapter 2 explains why treatments were proposed and the specific protection targets, and Chapter 3 describes the effects of mastication.

On page 3-51, lines 11–24, the analysis states that "Mastication would rearrange ground fuels and reduce ladder fuels up to 10 inches dbh. Treatments in M Units and masticated areas would maintain their effectiveness longer than the prescribed burn treatments because more fuels would be treated.

Comment 3.5: The last "bright line" issue for our organizations is the agency's refusal to implement sub-part (a) of the travel rule at either the Forest or the Watershed scale. During the travel management planning process we have repeatedly been told by the Supervisor's Office that the Klamath National Forest will identify the "minimum road system" and propose needed road decommissioning to bring its road system in line with its maintenance budget during watershed level projects. Yet here, where we have a watershed level project in an LSR planning area that has been severely degraded by roads, the Forest Service states that road management is "outside the purpose and need for the project."

Response 3.5: This project does not analyze the impacts of the current transportation system. That analysis, and decisions on closing and decommissioning existing roads, are outside the scope of this project. The Pacific Southwest Regional Forester has committed to begin addressing Subpart A of the Travel Management Rule within the next 18 months; that process will provide information needed to identify the minimum road system required for management of the Klamath National Forest.

Comment 3.6: The impacts of removing large trees across the LSR (within the harvest units and along 60 miles of roads) has not been adequately analyzed . . . In fact, loss of numerous snags and large trees could have a significant impact on the overall environment, including canopy, shade, and wildlife. The late successional characteristic components in the LSR must be retained. Loss of these old growth features may result in a significant harm of an array of species.

Response 3.6: Please refer to the effects analyses in Section 3.2.5 of the "Forest Vegetation" section and Section 3.4 5 of the "Wildlife and Habitat" section of the draft EIS. See also the Silviculture Report, the Wildlife and Habitat Report, and the Wildlife BA/BE.

Comment 3.7: Where the risk of major disturbance is very high, management activities should still focus on young stands, but activities are permitted in late-successional habitat if they: (1) would clearly result in greater assurance of long-term maintenance of habitat, (2) would clearly reduce risks of major disturbance, and (3) would not prevent the LSR from meeting its intended purpose. Therefore, any action in late-successional habitat must be justified with demonstrated benefits to such habitat in order to comply with the NFP [Northwest Forest Plan].

Response 3.7: The modeled wildfires displayed in the draft EIS indicate that there would be a significant reduction in crown fire following proposed treatments. Because crown fire can result in a high degree of tree mortality, reducing the amount of crown fire would likely result in a greater assurance of long-term maintenance of habitat within the LSR. This is based on the assumption that changing crown fire to surface fire would result in less tree mortality. While thinning in late-successional habitat may not enhance habitat quality, it will help protect existing late-successional habitat. Additionally, the proposed underburning will likely protect and enhance existing late-successional habitat by making these stands more resilient to wildfire. Therefore, proposed actions in late-successional habitat would not prevent the LSR from meeting its intended purpose.

Please refer to Alternative A (page 2-2 of the draft EIS) and the 7,200-acre modeled wildfire, as well as the effects of the modeled wildfire, which begin on page 3-43. An escaped wildfire could adversely affect protection targets (private property, municipal watersheds, infrastructure, and northern spotted owl [NSO] core areas). The high percentage of crown fire (81 percent) could result in . . . long-term losses of late-successional habitat, including NSO core areas.

The long-term benefits of the treatments are of greater conservation value to species (and their habitat) than the short- and long-term adverse effects. The demonstrated benefits to LSR habitat from implementation of the Proposed Action include longevity through a reduction in fuel loads and reduction in the likelihood of stand-replacing fires. Treating significantly fewer acres would not achieve the purpose and need for the project (see Chapter 2 of the draft EIS, which explains the purpose of each FRZ and Rx Unit). Please also refer to the effects analyses contained in Section 3.4 (Wildlife and Habitat) in the draft EIS, the Wildlife and Habitat Report, and the Wildlife BA/BE.

Comment 3.8: We have concerns about the increasing use of the Slashbuster masticator . . . Broadly, we are concerned that there has been little monitoring of the affects of the Slashbuster.

Response 3.8: The project design does not require the use of a Slashbuster for mastication. Soil monitoring on the Klamath National Forest has shown that, overall, masticated units met or exceeded Klamath LRMP S&Gs (Laurent 2007). This soil monitoring report is part of the project record.

Comment 3.9: **Attachment number one** . . . "Ponderosa pine plantation forests cover nearly 400,000 acres of California's National Forests. Fire hazard is extreme both within and adjacent to many of these areas which has led to extensive fuel reduction plans for plantations and other forests on federal public lands. Although fuels treatments have been implemented on a limited basis in California's plantations, the effectiveness of varying methods has only recently received scientific attention. This project analyzed the effectiveness of individual and combination treatments to provide science-based guidance for fire hazard reduction in these areas. Prescribed understory fire, both alone and combined with pre-burn mastication, was most effective for reducing surface fuels and potential fire behavior. Likelihood of active crown fire was reduced in masticated stands because bulk density was decreased. Predicted torching, tree mortality and flame length were higher in masticated units than in prescribed burn units and controls."

Given these findings our organizations suggest the use of prescribed fire rather than mastication for the reduction of fire hazard in plantations . . . The purpose and need for this project could be met via a combination of prescribed burning, understory thinning, and road decommissioning.

Response 3.9: Mastication was included in the alternatives because treatments should last longer than prescribed burning, it provides more flexibility to implement the project because treatments are not constrained by the air district, and it reduces emissions compared to prescribed burning.

Comment 3.10: **Attachment number two** . . . "The potential for soil damage during burning of masticated fuels is substantial."

Response 3.10: Mastication is proposed in lieu of prescribed burning. Thus, burning will not occur where vegetation has been masticated.

Comment 3.11: **The third attachment** . . . "Treated stands had less shrub cover than untreated stands. Three bird species were consistently more abundant on untreated stands. Species that were more abundant on untreated stands were associated with shrub cover, while those that tended to be more abundant on treated stands were associated with open areas, providing further evidence that the treatments were responsible for the observed differences in bird community composition."

Response 3.11: Reducing tree canopy cover increases shrubs and other ground-associated resources, which increases species richness of wildlife. For more information on birds, please see response to Comment 3.17. Please also refer to Section 3.4 (Wildlife and Habitat) in the draft EIS, the Wildlife and Habitat Report, and the Wildlife BA/BE.

Comment 3.12: The widespread use of the Slashbuster may in fact alter soil nutrient cycling . . . Soil biota is another important element of site level conditions that could be impaired by the Slashbuster. Lastly, the Slashbuster could harm mychorizal [mycorrhizal] communities that are known to be important symbiots of many species. This concern is heightened by the proposal to conduct 69.5 acres of mastication within riparian reserves (DEIS page 2-17).

Response 3.12: Chapter 2, page 2-17, line 15 of the draft EIS, states:

- RS [Roadside] 3 treatments are in Riparian Reserves and would only consist of mastication, hand thin, and pile burn (69.5 acres).

The 69.5 acres is the total amount of acres that would be treated in this Roadside treatment unit (RS 3)—not all 69.5 acres would be masticated because a masticator can only be used on slopes less than 45 percent. Please also refer to the Resource Protection Measures (RPMs) in the draft EIS Chapter 2, Section 2.9.2.3 Mastication. Please also refer to the Soils RPMs in Section 2.9.4

There are numerous types of equipment available to achieve the desired condition for masticated units. The draft EIS did not specifically mention the Slashbuster as the equipment of choice (see also response to Comment 3.8).

Section 3.6 of the draft EIS and the Soils Report both discuss the effects on soils from implementation of the proposed treatment methods, including mastication.

Also, in a literature synthesis of over 30 research papers, Sigrid Resh et al. (Colorado State and Rocky Mountain Research Station) found the following results of research regarding the effects of mastication:

[Research] Expectations

- Reduced nutrient availability initially as microbes begin to decompose wood, with a net release in the longer term with population turnover and advanced decomposition.
- Changes in soil physical properties through compaction and disturbance. Also, changes brought by the effect of increased wood debris, such as soil moisture, decreased variability in soil temperature, and changes in soil chemistry. .
- Large additions of carbon will most likely lead to an increase in soil biota, especially fungal species that are the primary wood decomposers.

[Research] Summary of the Findings

- Nutrient immobilization, particularly nitrogen, may occur in the short term, but after a year or two, net mineralization will predominate.
- Soil carbon sequestration is possible, especially where mixing with mineral soil takes place.
- Soil physical properties are likely to be altered but the relative impacts (+ or -) will be site dependent (for example, extent of compaction, soil temperature, and moisture).

Comment 3.13: Native plants could be harmed . . . the amount of masticated material left on the site years after a treatment it is likely that some native understory will be lost.

Response 3.13: Sensitive plant population boundaries will be flagged, and mastication treatments will not occur inside those boundaries.

Mastication is not synonymous with chipping. The slash material produced by a masticator is of a non-uniform particle size and an uneven distribution; thus, water and air are exchanged with the soil. Loose fuels, for instance, are ground up very little and “thrown out.” Therefore, significant adverse effects on native understory vegetation are not anticipated. Please refer to Section 3.7.4.3 in the draft EIS for effects on botanical resources from the proposed treatments. Please also note that the RPMs (refer to Chapter 2, Section 2.9.6 in the draft EIS) are intended to protect individual plants and maintain habitat characteristics that are critical to the maintenance of long-term viable plant populations, in accordance with the desired conditions of the S&Gs contained in the Klamath LRMP.

Comment 3.14: The rampant spread of noxious weeds is a growing problem . . . How does the Forest Service anticipate the response of species such as manzanita and ceanothus to slashbuser treatment?

Response 3.14: Regarding the anticipated response of manzanita (*Arctostaphylos*) and *Ceanothus* to mastication treatments: (*i*) it is anticipated that mastication treatments [of manzanita and *Ceanothus*] will effectively reduce coverage of those species in the short term because re-sprouting of those species after mastication treatments is anticipated to be less than after fire (both prescribed fire treatments and natural fire). This is due to (1) the "mulching effect" of post-mastication treatments upon re-sprouting brush and upon new seedlings, and (2) post-mastication treatments, unlike post-fire conditions, do not provide a "clean seed bed" that encourages the germination of seed in the soil seed bank.

Regarding the spread of noxious weeds from mastication treatments: mastication treatments are not expected to spread or introduce noxious weed sites in the Assessment Area because (*i)* noxious weed sites will be flagged on the ground prior to mastication treatments, and mastication treatments will not occur within the noxious weed population boundaries; (*ii*) mastication treatment areas will be surveyed for new noxious weed populations after mastication treatments occur; and (*iii)* mastication equipment will be brought in clean (debris free), and not be staged in areas known to have noxious weed infestations. New noxious weed populations, resulting from project implementation, will be treated and monitored.

Please refer to the RPMs in Chapter 2, "Section 2.9.6.3 Noxious Weeds."

Comment 3.15: Is there currently a way for the public or the decision maker to anticipate the amount of treatment [Slashbuster use] that is likely to take place across the landscape? We are curious how the Forest Service chooses the sites on which to implement the Slashbuster treatment. Is there currently a prioritization of vegetation density, proximity to the community protection zone, vegetation type, or any other parameters or vectors? What criteria are currently being used to determine the location of proposed slashbuster treatments?

Response 3.15: The project has not limited mastication treatments to the Slashbuster, as there are other types of machinery that can be used (see response to Comments 3.8, 3.9, and 3.12).

Sections 2.5.1 and 2.5.2 in Chapter 2 of the draft EIS provide detail on where and why the treatment units were designed. Regarding mastication, where there is a need to reduce fuels, mastication is proposed in those areas where the slope is less than 45 percent. In areas with slopes greater than 45 percent, prescribed fire is proposed for fuels reduction. Please also review tables 2-1 and 2-5 in Chapter 2 of the draft EIS—these two tables describe what protection target (emergency access route, municipal watershed, NSO activity center, United States Fish and Wildlife Service [FWS] Priority Areas) each treatment unit was designed to protect.

Comment 3.16: Our organizations are very interested in learning about the impacts of slashbuster treatment on such "fire variables" as residence time, short-term fuel loading, long-term vegetative response, and microclimatic conditions on the site. This information is relevant to whether an EA, or EIS, should be prepared for this project.

Response 3.16: The project has not limited mastication treatments to the Slashbuster, as there are other types of machinery that can be used. The effects of mastication on fire behavior and fuel loading were described on page 3-47 and in Figure 3-8. The vegetation response was addressed in the responses to Comments 3-13 and 3-14. The draft EIS presents the effects of mastication.

Comment 3.17: Refugia for many species could be impaired by the widespread and ubiquitous use of the Slashbuster. Please disclose all literature or scientific studies relied upon in the analysis of impacts on Neotropical birds in the EIS.

Response 3.17: The project has not limited treatments to the "Slashbuster," as there are other types of machinery that can be used.

On December 12, 2008, a Memorandum of Understanding (MOU) was signed by the U.S. Department of Agriculture Forest Service and the FWS to promote the conservation of migratory birds. For the Klamath National Forest, the migratory bird species of management concern are those bird species listed under the *Endangered Species Act* as Threatened or Endangered, those species designated by the Regional Forester as Sensitive Species, and those species listed under S&Gs 8-21 through 8-34 of the Klamath LRMP (USFS 1995) as Management Indicator Species (MIS) for project level assessment (see Table 1 in the Wildlife and Habitat Report). Please refer to page 5 of the Wildlife and Habitat Report, Section 1.4.4 Migratory Bird Treaty Act (16 USC Sec. 703, Supp. I, 1989) and the Migratory Bird Conservation Memorandum of Understanding. The Eddy Gulch LSR Project was not designed around individual bird species; however, impacts on specific species were analyzed. The draft EIS (Section 3.4.5), the Wildlife BA/BE, and the Wildlife and Habitat Report discuss potential effects on species listed under the *Endangered Species Act*, Forest Service Sensitive, and MIS species. Please refer to the literature cited sections in the draft EIS, Wildlife and Habitat Report, and the Wildlife BA/BE. See also the response to Comment 3.11.

Comment 3.18: It is reasonable to develop and consider an alternative that would reduce the road density in the planning area . . . Please also note that implementation of an alternative that does not require new road construction would still allow for treatment of 24,894 of the 25,815 acres in the project.

Response 3.18: Reducing road density in the Assessment Area is not within the scope of the Eddy Gulch LSR Project. Alternative C eliminates 1.03 miles of temporary roads—this alternative was developed in response to comments received during collaboration meetings and the scoping process.

Comment 3.19: Please note that page 3-116 of the DEIS states that "Mathews Creek, Shadow Creek, and Whites Creek are all rated as 'at risk' for road density, and Eddy Gulch is rated as 'not properly functioning for road density (road density is 4.44 miles/mile) . . . It is extremely troubling that all of the proposed "temporary" road construction is located in drainages that currently exceed 2.0 miles of road per square mile of forest. (draft DEIS page 3-133) . . . As stated in our scoping comments, rather than decrease road density as recommended in the WA and the LSRA, the DEIS calls for increasing the equivalent roaded area (ERA) through road and landing construction . . . Hence the purpose and need (and the proposed action) arbitrarily limited the action alternatives so as to include road and landing construction while precluding needed road density reductions . . . We urge the Forest Service to follow the findings and recommendations contained in the Was [watershed analyses] and the LSRA [late-successional reserve assessment] by avoiding new road construction and seeking to actively reduce road density in lands designated as LSRs and CHUs.

Response 3.19: The Proposed Action does not add permanent roads to the transportation system. The proposed temporary roads were placed so that no adverse effects on aquatic systems would occur. Although road decommissioning is not part of this Proposed Action for the Eddy Gulch LSR Project, the Forest has an active watershed restoration program that uses information from watershed analyses, as well as the 2002 Salmon River Subbasin Restoration Strategy to implement watershed restoration throughout the Forest to meet multiple objectives, including fish passage, TMDL requirements, and securing Key Watersheds. That 2002 assessment is titled "Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources"—it can be accessed at http://www.fs.fed.us/r5/klamath/publications/pdfs/watershed/salmonriver/Salmon_River_subbasin_main.doc

Some of the Forest's watershed restoration efforts can be found on the Klamath National Forest public website at http://www.fs.fed.us/r5/klamath/projects/restoration/riparian.shtml. The Forest worked with the state of California to implement the Yoakumville and Summerville watershed restoration projects in the Salmon River drainage. The Forest held a public meeting at Sawyers Bar, California, on September 3, 2007, to review road decommissioning options in the North Fork Salmon River watershed and just received funds from the state of California to implement part of the North Fork Roads improvement project. Over the last two years, three fish passage barriers have been removed in Whites Gulch near the Eddy Gulch LSR Project. Throughout the Forest, approximately 192 miles of road have been permanently decommissioned and removed from the National Forest Transportation Systems (2009 DEIS Motorized Travel Management.)

Chapter 2 of the draft EIS, page 2-14, third bullet states: "Existing landings would be used." Alternative C does not propose the 1.03 miles of temporary roads—this alternative was developed in response to comments received during collaboration meetings and the scoping process.

Comment 3.20: It is important to note that the Klamath National Forest's ongoing Travel Management Planning process states that needed road decommissioning will be addressed during site specific planning. The Eddy Gulch project is just such a site-specific opportunity . . . The Forest Service cannot simultaneously refuse to implement Sub-part (a) of the travel rule at both the Forest and the Watershed scale.

Response 3.20: Decommissioning opportunities will be considered and have been considered through other *National Environmental Policy Act* (NEPA) decisions. Consideration of decommissioning in the Salmon River watershed is as described in Salmon River Subbasin Restoration Strategy: Steps to Recovery and Conservation of Aquatic Resources. September 25, 2002, by Don Elder, Brenda Olson, and Alan Olson, Klamath National Forest, 1312 Fairlane Road, Yreka, California 96097. Jim Villeponteaux and Peter Brucker, Salmon River Restoration Council, P.O. Box 1089, Sawyers Bar, California 96027 available at http://www.fs.fed.us/r5/klamath/publications). Not every project will propose road decommissioning, while some projects will focus on watershed restoration, such as the Whites Gulch Dam Removal, Klamath National Forest Fish Passage, the 2002 Yoakumville roads project that reconditioned and decommissioned roads in the Salmon River watershed, and the recent North Fork Roads Stormproofing Project. Approximately 192 miles of road have been permanently decommissioned and removed from the Klamath National Forest Transportation System (2009 Draft EIS for Motorized Travel Management, available at http://www.fs.fed.us/r5/klamath/projects/ohv/09-docs/KNF-MTM-DEIS-Chap1-4.pdf).

Comment 3.21: Finally, we were very concerned to read that the project may authorize "alternate" road construction locations post-NEPA and post-decision. DEIS page 2-28. NEPA does not allow this.

Response 3.21: The RPM referred to by the commenter has been removed. Any alternative road location would require ID team evaluation and a subsequent NEPA decision.

Comment 3.22: The Etna Summit fuel break is not a good idea. This unit is mostly a Northwest facing slope down to the creek. It does not meet the intent to target southerly slopes with prescribed fire that has been expressed by the Forest Service. It also has three

NSO home territories. This area should be dropped as a FRZ. The Sawyers Bar Road should have the road-side, escape route prescription.

Response 3.22: FRZ 20 (the "Etna Summit fuel break") is an important FRZ because it supports both primary objectives (purposes) of the Eddy Gulch LSR Project; that is, to (1) protect existing and future late-successional habitat from threats of wildfire that occur in the Eddy Gulch LSR, and (2) reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

As shown on Table 2-1 in Chapter 2 of the draft EIS, the intent of FRZ 20 is to

1. reduce hazardous fuels on steep western aspect along emergency ingress-egress route along county road, protect Rainbow Ranch, Taylor Hole, and Russian Wilderness;
2. protect County Road 1C01 from Etna Summit to Idlewild and NFS (National Forest System) Roads 40N54 and 41N18; and
3. protect Music Creek Municipal Watershed.

The design and purpose of FRZ 20 also supports the statement found on page 2-5, lines 28–31 in Chapter 2 of the draft EIS: "The FRZs would provide safe locations for fire-suppression personnel to conduct fire-suppression actions during 90th percentile weather conditions, and they would serve as anchor points for additional landscape-level fuel treatments, such as underburning."

Fuel reduction treatments in FRZ 20 would serve to protect NSO activity center KL 1047, and the fuel reduction treatments in Rx Unit 9, which is south of FRZ 20, would protect NSO activity center KL 1046 (refer to Table 2-5 and Map A-5b).

Also, please note that the only thinning that would occur in FRZ 20 would be in the saddle to reduce stand density, but most would be an underburn. Table 2-1 (Chapter 2 of the draft EIS) shows only 20 acres (M Unit 31) in FRZ 20 would be thinned, while 131 acres would be mastication, and 869 acres are proposed for prescribed burning.

Comment 3.23: Please retain all large (>20" dbh) hazard trees that you fell as hazard trees.

Response 3.23: Please refer to Section 2.5.2.3, page 2-16, and lines 7–26 on page 2-18 in Chapter 2 of the draft EIS. This section discusses treatments along emergency access routes wherein the cutting and removal of trees along the 44 miles of road within the FRZs and Prescribed Burn Units (Rx Units) will meet the fuel objectives for those areas. The vegetation prescriptions for the 16 miles of road (emergency routes) outside of the FRZs and Rx Units do not prescribe the removal of larger trees. Lines 11–16 describe the Roadside (RS) treatments for fuels reduction and safety along the 16 miles of emergency access routes. Lines 24–26 on page 2-18 state, "All hazard trees would be identified and removed in accordance with Klamath National Forest Hazard Tree Policy (USFS 2005). To maintain the canopy cover requirements listed in the Salmon River CWPP, only small fuels within 50 feet of the road would be removed."

The prescriptions do include, by reference, direction contained in the Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads, dated May 23, 2005—this Policy has been added to the final EIS as Appendix C.

Comment 3.24: The FEIS/ROD should address the findings contained in Chappell and Agee, 1996, Fire Severity and Tree Seedling Establishments in Abies Magniffica Forests, Southern Cascades, Oregon. Ecological Applications, Vol. 6, No. 2 (May, 1996), 628. A copy of this study accompanies these DEIS comments.

Response 3.24: This topic was not addressed in the draft EIS because establishing conifer regeneration is not an objective of the Eddy Gulch LSR Project. The purpose of the stand treatments in the FRZs is to reduce fuel continuity (fuel ladder and crown contact).

Comment 3.25: Please further note that the Scott and Salmon Mountains NSO Critical Habitat Unit 25 is designed to "maintain habitat that provides the Primary Constituent Elements (PCEs)" of NSO habitat. Snags, CWD and large trees are elements of the CHU PCEs. Removing large tree canopy will result in degradation of the habitat functions of the CHU and the LSR.

Response 3.25: On page 3-74 of the draft EIS, the PCEs are considered under the modeled wildfire and reviewed in terms of loss of elements due to the modeled wildfire. Effects on PCEs were described in the draft EIS on pages 3-88 and 3-89.

The proposed removal of snags and CWD is consistent the Klamath LRMP S&Gs (see response to Comment 3.3) and with the treatment objectives because it would effectively reduce the existing fuel loads and, at the same time, retain (through the S&Gs) these components at an adequate amount and distribution. Additionally, the M Units are located along ridgetops, a physiographic feature not often used for nesting by NSOs (please refer to Section 3.4.5.2 in the draft EIS and then to page 3-64, lines 4 through 14).

The proposed removal of snags and CWD should have minimal impacts on NSOs when these effects are considered at the scale of an NSO home range. Please refer to the effects analysis contained in Section 3.4.5 of the draft EIS.

Regarding larger trees, the density of trees greater than 20 inches in a couple of M Units requires removal of some of these larger trees to meet the FRZ objectives in reducing crown fuels. As noted on page 3-49 (lines 12–17 and Table 3-24) of the draft EIS, "Treatments in the FRZs and Rx Units would shift the fire types in the Assessment Area from being primarily crown fires to primarily surface fires."

This project retains as much high-quality habitat throughout home ranges as possible, while also considering the reduction of fuels as a major fire hazard. The RPMs, as well as the FWS concurrence with its determination in the Wildlife BA/BE, indicate that the project will maintain PCEs across the project Assessment Area. In summary, spotted owl critical habitat was designated based on the identification of large blocks of suitable habitat that are well distributed across the range of the NSO. Critical habitat units were intended to identify a network of habitats that provided the functions considered important to maintaining a stable, self-sustaining, and interconnected populations over the range of the NSO, with each CHU having a local, provincial, and a range-wide role in spotted owl conservation. Specifically, Subunit 35 of the Scott and Salmon Mountains CHU, combined with contiguous habitat in the Marble Mountain Wilderness, is expected to support 22 NSO pairs overtime and provide inter- and intra-provincial connectivity (extrapolated from 1991 the FWS's critical habitat narrative for CA 25) (see also the discussion under "Critical Habitat and Critical Habitat Units" on page 3-68 of the draft EIS and also the discussion contained in the Wildlife BA/BE and Wildlife and Habitat Report). While it is true that the proposed treatments may degrade habitat function within individual, discrete stands, these treatments are not expected to impact the function of CHU 25 subunit 35. For example, the M Units, in which the removal of large tree canopy is expected to be most prevalent, occur along ridgetops or the upper one-third of slopes, areas typically avoided by nesting and roosting NSOs and rarely used by foraging owls. Additionally, canopy cover retention estimates in the M Units would not result in barriers to dispersal. Thus, proposed treatments in the M Units are not likely to reduce the quantity or quality of existing NSO nesting, roosting, foraging, or dispersal habitat at the stand level to an extent that it would be likely to adversely affect the breeding, feeding, or sheltering behavior of an individual NSO. Other proposed actions (roadside treatments, proposed burn areas) may remove discrete components of NSO critical habitat (such as snags or CWD), but they are not expected to change the existing habitat function.

Comment 3.26: Our organizations are very concerned by the proposal to conduct 69.5 acres of mechanical slashbusting mastication within riparian reserves (see DEIS 2-17). Why not manually treat these acres? . . . We are also perplexed by the statement on page 2-26 of the DEIS indicating that some trees greater than 20" dbh may be felled in "perennial stream channels or inner gorges.". . . We believe that slashbusting, and large tree felling, within designated riparian reserves violates both the intent and the letter of the Aquatic Conservation Strategy.

Response 3.26: Fuel reduction treatments within Riparian Reserves are important tools that are used to mimic the effects of fire through reducing ladder fuels, thinning over-stocked stands, and accelerating growth of trees in Riparian Reserves. The Klamath National Forest has previously consulted with the National Marine Fisheries Service on these fuel reduction methods, which can be used to attain Aquatic Conservation Strategy objectives, while minimizing adverse effects on fish and their habitat. Specifically, the Klamath National Forest has completed

Section 7 (of the *Endangered Species Act*) consultation on fuel reduction actions. This consultation included formulating specific RPMs for Riparian Reserves and resulted in actions (hand work, underburning, and machine mastication) that can be implemented without adversely affecting fish and their habitat (please refer to the Fisheries BA/BE).

Comment 3.27: Future, present and the past management actions were not fully disclosed and analyzed in a comprehensive cumulative effects analysis.

Response 3.27: Please see Sections 3.1.3 and 3.1.4 in Chapter 3 of the draft EIS. Section 3.1.4 fully discloses present and future management actions. Each resource section presents a cumulative effects analysis.

Comment 3.28: "M units 21 and 24 (tractor) both currently exceed the 15% disturbance threshold."

-Eddy Gulch DEIS, page 3-149 . . . "Presently M units 19, 21, 24, 35 and 36 fall well below the 70% desired ground cover standard and would likely see further reductions." Eddy Gulch DEIS, page 3-153.

Response 3.28: From Chapter 3 (page 3-152, at line 37) of the draft EIS, "Present percent soil cover average for all treatment units evaluated in the Eddy Gulch LSR Project Assessment Area is 72 percent. Comparing this value to the 66.4 percent average for previously monitored units on the Klamath National Forest, one could reasonably expect a decrease in soil cover of at least 5.6 percent on average for the mechanically treated units that will also be underburned . . . Presently, M Units 19 (cable), 21 (cable and tractor), 24 (cable), 35, and 36 fall well below the 70 percent desired ground cover standard and would likely see further reductions. Additionally, M Units 3, 4 (cable and tractor), 15 (cable and tractor), 17 (cable), 23, 38 (cable), 52, 54, and 65 are border-line and would likely fall below the 70–80 percent standard after treatment. For the FRZs, especially those areas that are to be masticated, percent ground cover would likely increase."

Please refer to the Soil RPMs in Section 2.9, Chapter 2 of the draft EIS. The RPMs are general guidelines meant to protect resources while achieving the objectives of the project (that is, reducing the threat of stand-replacing fire). It is common for RPMs to be more refined when treatment units are physically delineated on the ground prior to implementation. Issues such as skid trail and landing use and cable corridor placement are routinely refined in the field with input from various resource professionals. Therefore, the following RPM has been added to Chapter 2, Section 2.9 in the final EIS and to the Soils Report: "Coordination. During implementation of this project, the project leader will coordinate with personnel from earth science and fire/fuels regarding protection of soils and unstable areas."

Further, M Units 15, 17, 21, 22, 30, and 80 will be monitored for detrimental disturbance and/or compaction and will be subsoiled if detrimental disturbance exceeds 15 percent in each unit.

Comment 3.29: The DEIS at page [2-]26 indicates that some skid trails may be located on slopes greater than 35%. Clearly this type of fudging does not allow the public or the decision maker to assess the cumulative impacts of the project.

Response 3.29: There may be short sections of skid trails that could be over 35 percent slope and that use the scarps (the steeper slope) to connect one flat bench to another flat bench. Please refer to the Soil RPMs in Section 2.9.4 of Chapter 2 of the EIS.

The consideration of resource protection in the design of yarding systems was fully addressed in the draft EIS, specifically in the list of RMPs in Section 2.9.

Comment 3.30: As acknowledged in the DEIS, roadside thinning of hazard trees is known to degrade NSO habitat.

Response 3.30: All hazard trees along emergency access routes will be identified and removed according to the Klamath National Forest Hazard Tree Policy—Safety Provisions on National Forest System Roads (from page 2-7 of the draft EIS). Because this policy effectively limits the number and distribution of trees that can be removed, it is anticipated that removal of hazard trees will not change the function of existing habitat.

Comment 3.31: We are extremely concerned that units M-19 and M-69 are located in NSO cores within the LSR and CHU. Please note these units will substantially reduce forest canopy within the core areas.

Response 3.31: Please refer to Table 3-36 on page 3-84 of the draft EIS (or Table 4 on page 24 of the Wildlife BA/BE; also see Table 3 in the Wildlife BA/BE). M Unit 19 is within core area KL 1032 (refer to Table 3-37 on page 3-85 of the draft EIS). There are zero acres of nesting/roosting habitat within M Unit 19 and 5.7 acres of foraging habitat in that unit; however, zero acres of classified owl habitat will be modified.

M-69 was eliminated from treatment (refer to Table 2.2 on page 2-11 of the draft EIS).

Comment 3.32: It is essential that surveys be conducted for Pacific Fishers and that the Forest Service disclose the impacts of the proposed project on Fisher populations and habitat.

Response 3.32: The draft EIS acknowledges the presence of potential habitat and evaluates impacts on fishers from Alternatives A, B, and C (refer to Chapter 3, pages 3-69 to 3-70, 3-79, 3-98 to 3-100, 3-106 and 3-107,). Also refer to the Wildlife BA/BE, pages 56–60.

The Klamath National Forest has independently surveyed and is working with the FWS to survey fisher and fisher habitat. For example,

- Camera station surveys were conducted on the Happy Camp, Scott River, and Salmon River Ranger Districts in the early 1990s. There has been a re-survey of areas surveyed in the 1990s in the vicinity of the Collins Baldy and Mt. Ashland LSRs (in conjunction with Timber Products and the FWS).

- This is the fourth year of participating in a cooperative fisher genetic survey to determine preliminary population estimates for an area in northern Siskiyou County (in conjunction with Timber Products, California Department of Fish and Game, and the FWS).

- A project to develop a habitat model is called the "Distribution and Habitat Suitability for Fishers in the Eastern Klamath and South Cascades Bioregions in Northern California Study Area." The study area covers approximately 9,800 square kilometers (approximately 6,089 square miles) and includes portions of Siskiyou, Shasta, and Trinity counties in northern California. Public forest lands include wilderness, late successional reserve, and general forest lands of the Klamath, Shasta-Trinity, and Rogue River National Forests. Private holdings vary from large contiguous industrial timberlands to checkerboard patterns and smaller private individual holdings. According to the FWS, the survey protocol is consistent with previous sampling and modeling efforts and ongoing development of landscape habitat models being conducted at USDA Pacific Southwest Research Station. The project used a robust Primary Survey Unit design associated with Forest Inventory and Analysis grid cells. For the project, the current model for the Klamath Region (Carroll et al. 2005) will be used as a launching point in development of a model for the eastern Klamath and southern Cascades bioregion. Information from previous survey efforts, which used other protocols, will be used to evaluate the final FWS model. Jeffrey Dunk, from Humboldt State University, is currently under agreement with the FWS to conduct the habitat modeling and analysis in cooperation with Bill Zielinski, at Pacific Southwest Research Station.

- Another project, which began in October 2009 in the vicinity of the Mt. Ashland Fuels Reduction Project on the Klamath National Forest, is part of a regional study to assess changes in fisher movement patterns and habitat selection between pre- and post-treatment monitoring, at both individual and local population scales and to evaluate the short-term impact of treatments. According to the FWS, this study will be combined with other replicates of the study into a regional analysis on the impacts of treatment alternatives on fishers. The study will be used to generate recommendations on how managers can achieve fuel reduction objectives while minimizing impacts on fishers.

Comment 3.33: We, therefore, believe that the existing regulatory mechanisms are not sufficient to protect the [Pacific fisher] DPS [distinct population segment] as a whole from habitat pressures." Id. at 18792.

Response 3.33: The sufficiency of existing regulatory mechanisms is outside the scope of this project.

Comment 3.34: Please be advised that should this project rely on the Bush Administration's illegal 2007 ROD eliminating the survey and mange program that it is highly likely that implementation of your project will be enjoined by a federal court. We would prefer that the agency take the necessary survey and manage steps to ensure that this project is not halted by the foreseeable injunction of the Bush Administration's 2007 ROD.

Response 3.34: The planning for this project began in 2007. For species formerly designated under the "Survey and Manage" program, an assessment of effects was conducted through the Forest Service Sensitive Species procedures or a separate evaluation, depending on the species.

Comment 3.35: Yet disclosure of the impacts of the proposed logging of large diameter trees to address mistletoe infection is completely lacking. Indeed the DEIS downplays the structure and function provided by dwarf mistletoe. This can be contrasted with the analysis provided by your colleagues in the Rogue River National Forest who initially proposed sanitation logging in the Big Butte Springs DEIS and decided to drop that ill-conceived proposal . . . The DEIS does not analyze or disclose these habitat benefits . . . Large snags are in severe deficit in this planning area. Please allow for snag recruitment by maintaining large mistletoe infected trees in the project area.

Response 3.35: The draft EIS does not address in detail the presence of dwarf mistletoe in the stands to be treated because it is not a factor to be used in selecting trees for removal. Trees to be retained are selected based on tree size and spacing to meet fire behavior objectives. In some cases selection is influenced by tree species, but disease factors are not considered.

Comment 3.36: We believe that the intent of the Northwest Forest Plan, the Klamath LRMP, and the Healthy Forest Restoration Act, is to maintain and increase the amount of late successional forest habitat located within Late Successional Reserves and NSO Critical Habitat. Hence we are concerned by proposals to log large diameter overstory trees within the LSR and CHU.

Response 3.36: The Eddy Gulch LSR Project is designed to protect and maintain late-successional habitat in the event of a wildfire and to mimic the effects of the pre-settlement/historic fire regime. The project design does not compromise the functionality of the LSR (please refer to Section 3.4.5 in the draft EIS and the Wildlife BA/BE; see also response to Comment 3.25). Please note too that the Klamath LRMP incorporates guidance from the Northwest Forest Plan; therefore, it is the Klamath LRMP that provides land management direction for the Forest.

Comment 3.37: Despite the concerns noted above, we think that on balance this project is headed in the right direction. We want to see the effects of Forest Service fire suppression on tree density and seral conditions addressed.

Response 3.37: Section 3.2 in the draft EIS and the Silviculture Report for the Eddy Gulch LSR Project both describe current (existing) conditions that are a result of past fire suppression practices. These two documents then present the effects of each of the three alternatives and how current conditions would be changed by each alternative.

Comment Document 4—Klamath Forest Alliance and Environmental Protection Information Center

Comment 4.1: The DEIS models predict that a total of 7200 acres will burn in the assessment area in the next 20 years, with 720 acres of active crown fire—potentially destroying NSO habitat. However the project proposes to treat 8,291 acres of Fuel Reduction Zones . . . Both outcomes have the potential to substantially affect NSO, but considering another alternative that more seriously weighs disturbance to the owls may protect these owls in one of their last refuges . . . Again, considering the undisputed importance of the Eddy Gulch LSR as a refuge for NSO, every effort should be made to maintain the highest possible quality of habitat in the NSO home ranges.

Response 4.1: The draft EIS states that a 7,200-acre wildfire could occur, given the assumptions used in the model. The draft EIS does not state that a 7,200-acre fire is the only event that would occur during the next 20 years.

The Eddy Gulch LSR Project was designed to both protect and retain as much high-quality habitat throughout home ranges as possible, while also considering the reduction of fuels as the major fire hazard and threat to the Eddy Gulch LSR and the consequences of a stand-replacing fire. The identification and design of treatment units and proposed treatment methods occurred over months of field visits, interdisciplinary team meetings, and collaboration with the FWS. During that time, some preliminary treatment units were dropped from the Proposed Action, and some treatment unit boundaries were modified to ensure that adequate habitat within home ranges and activity centers would be maintained.

The silviculture prescriptions and fuel reduction treatments designed for the project focus on protecting and retaining primary constituent elements (PCEs) at the stand scale. For nesting and roosting habitat, the primary constituent elements include large (greater than 30 inches dbh) trees in stands with 60–90 percent canopy cover, multistoried canopy that allow birds to fly under the canopy, and with abundant large snags and CWD. In foraging habitat, tree height diversity, canopy closure, snag volume, and density of snags are important.

In addition, the FWS-approved RPMs, as well as the FWS concurrence with the determinations in the Wildlife BA/BE, demonstrate that PCEs will be maintained across the project Assessment Area.

From the draft EIS, page 3-66: "The FWS (Johnson et al. 2006) also used a landscape-level analysis to examine eight abiotic factors to help distinguish 36 activity centers from unused sites in three Klamath National Forest LSRs. The FWS found that activity centers were associated with basin-like topography, the lower half of slopes, and streams. Additionally, numerous published articles have demonstrated that NSOs prefer use of lower-slope or mid-slope sites for foraging, roosting, and nesting, especially as sites are related to drainages or surface water (see Solis and Gutiérrez 1990; Blakesley et al. 1992; and Lahaye and Gutiérrez 1999). As might be expected, these abiotic habitat selection features coincide with conditions that favor forest growth and historically were relatively resistant to fire. Most of the activity centers in the Assessment Area are located in areas with similar topographic characteristics; that is, core areas are found no higher than mid-slope and are typically centered on prominent drainages."

From page 3-82 of the draft EIS: "Treatments in M Units would have little effect on individual NSO or their Critical Habitat because

- the M Units are along ridges, and the physiographic features associated with most of the M Units indicate a low probability of use by foraging or nesting/roosting individuals;
- the M Units avoid all but one NSO core area, part of which occurs along a ridgeline; and
- all NSO home ranges in which M Units occur will retain habitat sufficient to support NSOs following treatment."

Please refer to the NSO effects analysis in Section 3.4.3.2 of the draft EIS and the NSO discussions in the Wildlife BA/BE.

Comment 4.2: We have several concerns with the adequacy of the Resource Protection Measures discussed on pages 10 and 11 of the BE/BA . . . 1) The first measure prohibits activity occurring [occurring] from February 1st to September 15 within an active NSO 70-acre nest core. Have all the nest cores been located for all the active activity centers? The Forest should expand this first measure to prohibit activities within the NSO core area in addition to the nest area for these dates in order to protect any unknown nesting locations.

Response 4.2: Please refer to Section 2.9.1 (in Chapter 2 of the draft EIS) for all RPMs for the NSO. All nest cores have been located for known activity centers, and all RPMs for the NSO span biologically significant time frame and distance. Surveys will continue throughout the life of the project; therefore, NSO nest cores will be known and protected within the project Assessment Area. The surveys cover existing suitable habitat, not just historic nest sites, so all active nest sites within or adjacent to proposed actions will be identified prior to the implementation of the treatments.

Comment 4.3: No NSO habitat should be removed or downgraded at anytime.

Response 4.3: Thinning in the M Units in FRZs and construction of temporary roads will not remove or downgrade nesting/roosting or foraging habitat from the estimated core area (0.5-mile-radius circle around an activity center) of any NSO activity centers. However, thinning in FRZs would downgrade approximately 36 acres of nesting/roosting habitat to foraging habitat in the estimated home range (1.3-mile-radius circle around an activity center) of six activity centers (KL1028, KL1031, KL1033, KL1034, KL1035, and KL4026). Despite these reductions, nesting/roosting habitat within these home ranges would remain abundant. Additionally, these acres are situated on the upper one-third of slopes—a topographic feature typically avoided by nesting NSOs (Blakesley et al. 1992; LaHaye and Gutiérrez 1999; Folliard et al. 2000). Construction of temporary roads would remove nesting/roosting or foraging habitat from five NSO home ranges. Because the habitat to be removed (a total of 0.62 acre) occurs on the outer edges of these estimated home ranges and is distributed across five discrete road segments, effects are insignificant at the scale of an NSO home range. Therefore, the proposed treatments would not result in significant impacts on nesting, roosting, or foraging opportunities for NSOs in the project Assessment Area. For the full discussion of project effects on NSOs, please refer to Section 3.4.5.2 in the draft EIS, particularly pages 3-82 through 3-86 and Tables 3-36 and 3-37. This same information is in the Wildlife BA/BE and the Wildlife and Habitat Report.

Comment 4.4: There should be no new roads constructed in the LSR.

Response 4.4: All new roads required for treatment are temporary and will not remain open after the treatments are completed. Alternative C (No New Temporary Roads Constructed) responds to public comments received during collaboration meetings and the scoping process.

Comment 4.5: Studies have shown significantly higher stress levels were found in male NSOs centered on logging roads as compared to owls beyond 0.41 km from a logging road. The costs to the owls of disturbance such as this include energetic demands of avoidance flight and time lost that would be allocated to other activities, as well as increased heat production and heat-related stress due to avoidance flight. If an owl flushes the site due to disturbance, it may also be exposed to predation of diurnal predators. Roads affect not just owls, but dozens of other wildlife species in many different ways, including habitat fragmentation, collision with vehicles, increased human disturbance, etc. The costs of building the 1.03 miles of new temporary roads far outweigh the meager benefits to treat a relatively small amount of area for fire prevention.

Response 4.5: Please refer to the location of the proposed temporary roads on Maps A-4a and A-4b in Appendix A of the EIS. The 1.03 miles of proposed temporary roads are found along ridgetops (where NSOs do not typically occur) and are thus greater than 0.41 km (0.25 mile) from any activity center. The temporary roads are not intended to be opened permanently but only for the treatments required for the project.

Wasser et al. 1997 did detect higher fecal corticosterone (a 21 carbon steroid hormone of the corticosteroid type produced in the cortex of the adrenal glands) levels in male NSOs that were centered within 0.41 km (0.25 mile) of a major logging road versus males that were centered at greater distances from the same logging road. For the Eddy Gulch LSR Project, all proposed temporary spur roads are greater than 0.5 mile from any historical activity centers. Additionally, because all proposed temporary spur roads will be closed after thinning operations, and they occur along prominent ridges, it is highly unlikely that new activity centers will be established adjacent to these roads during the time in which they are open.

The effects from implementation of Alternative C (No new Temporary Roads Constructed) are analyzed for each resource topic in the draft EIS. In particular, please refer to the effects analysis for Alternative C in Section 3.3.5.3 of the Fire, Fuels, and Air Quality (Section 3.3) in the draft EIS and the effects from Alternative C (Section 3.4.5.3) in the Wildlife and Habitat section of the draft EIS. This information can also be found in the Fuels Report and the Wildlife BA/BE and Wildlife and Habitat Report

Comment 4.6: Finally, we fully support re-introducing fire back into the landscape, and support the effort to burn in a mosaic like pattern as discussed in the BA/BE (pg 27). We agree a heterogeneous landscape will provide cover for various wildlife species as well as food for NSO prey species. The prescription burning units should explicitly describe how this mosaic pattern will be created, and what the finally outcome should resemble.

Response 4.6: Please refer to Chapter 2, “Section 2.5.2.1 Fuel Reduction Zones” and “Section 2.5.2.2 Rx Units.” Both sections describe how the prescribed burns would be implemented and the targeted vegetative components. Additional descriptions are provided on pages 3-46 and 3-47 and Table 3-23 in the draft EIS.

Comment 4.7: We disagree that the prescription burning will create many new snags suitable for NSO use (BA/BE pg.27). Most prescription burning is cool enough to kill only small understory trees and NSO utilize large diameter snags. We believe it is feasible that the Forest add an additional mitigation measure to design fire treatments to maintain as many large (greater than 21 dbh) snags as possible. This could be accomplished by directing fire in a way to avoid these snags, or by raking flammable fuels away from the base of them.

Response 4.7: For effects from Alternative B (Proposed Action), page 3-46 in the draft EIS currently states: “Scorching could also result in post-treatment mortality in residual trees greater than 20 inches dbh (Stephens and Moghaddas 2005), which would provide future snags and coarse woody debris (CWD).”

That statement on page 3-46 has been edited in the final EIS to read: In the study conducted by Stephens and Moghaddas (2005a), prescribed burning was effective in reducing tree density in trees 1 inch–10 inches dbh, but further states that prescribed fire treatment did not substantially remove dominant or co-dominant trees because fire behavior was not severe enough to kill many trees over 11 inches dbh. It is important to note that indirect mortality from increased insect activity, periods of drought, and pathogens may increase mortality in larger trees in prescribed fire and mechanical treatments followed by fire treatments. Thus, there is the potential that (depending on different site characteristics) scorching could result in post-treatment mortality in residual trees greater than 20 inches dbh, which would provide future snags and CWD (Stephens and Moghaddas 2005a). However, large trees and snags are typically not lost during prescribed fire. The burn plan (developed prior to implementing any treatments for the Eddy Gulch LSR Project) will design a prescribed fire that consumes smaller-diameter trees.

The effects of prescribed burns in Rx Units, as described in the "Wildlife and Habitat section of Chapter 3 (Section 3.4), page 3-87 has been edited in the final EIS to read: Treatments could potentially consume existing snags but may also create new snags. Typically, large trees and snags are not lost during prescribed fire. The burn plan (developed prior to implementing any treatments for the Eddy Gulch LSR Project) will design a prescribed fire that consumes smaller-diameter trees. Prescribed fire would consume most of the smaller down woody debris and some of the CWD, but much of the CWD would likely remain when burning in spring prescriptions. A study by Stephens and Moghaddas (2005b) noted that the reduction in volume of existing snags and CWD following prescribed fire treatments depended on both tree diameter and decay class (decay classes 1–3 for snags and CWD denote sound structural integrity of the heartwood, wherein decay class 4 denotes rotten heartwood and decay class 5 denotes no structural integrity). For example, total sound CWD (decay classes 1 and 2) was not significantly reduced by treatments. The most dramatic change of CWD in this study was the reduction of rotten CWD, especially in decay class 4, as a result of prescribed fire treatments.

Comment 4.8: Our organizations believe that the Klamath National Forest Land Managers should follow the Salmon River CWPP that calls for 70-100% canopy. Decreasing canopy as is proposed may cause an increased fuels risk and eliminate habitat for fishers.

Response 4.8: The Salmon River Community Wildfire Protection Plan (CWPP) recommendations were used for roads <u>outside the FRZs</u>, and the forestwide LSR assessment recommendations were used for treatments <u>inside the FRZs</u>.

The Salmon River CWPP recommendations for canopy cover were considered during development of the action alternatives, and the rationale for treatments is explained in Chapter 2 of the draft EIS. The majority of treatments would only affect small trees (less than 10 inches dbh) and would have little, if any, effect on canopy cover. Some larger trees may be removed; however, selection of those trees is consistent with approved guidelines. Thus, these treatments would have little or no effect on fisher habitat (please refer to response to Comment 3.32). Fisher habitat is typically characterized as mature, structurally diverse, closed canopy stands. However, fisher will occupy managed or burned stands if remnant structures are maintained (Jones 1991; Yaeger 2005). While thinning may significantly reduce canopy cover in some of the structurally complex stands, other structurally complex stands will retain canopies of 50 percent or more. Additionally, all of the structurally complex stands will retain basal areas in the range of 130-230 square feet per acre and a large tree component. Therefore, impacts to fisher habitat are not expected to be significant. Finally, some of the mature and mid-mature stands in the FRZs are to be treated by underburn only, and thus are not expected to have their canopy cover reduced. These areas should provide habitat connectivity for fisher between the sub basins within the project area.

Comment 4.9: The Etna Summit fuel break is mostly all Northwest facing. It does not meet the intent to target southerly slopes with prescribed fire. It also has three NSO home territories. In our opinion: this area should be dropped as a FRZ. The Sawyers Bar Rd should have the road side, escape route prescription.

Response 4.9: See response to Comment 3.22.

Comment 4.10: There are three units, which the geologists have identified as having "indications of elevated landslide potential." These are M23, M61 and M73 . . . We would suggest looking at these units on the ground and likely get them to reconfigure away from unstable features.

Response 4.10: These units were indeed examined in the field, which lead to their identification. The risk of project actions destabilizing these areas is minimal and warrants no further analysis. The indicators found in these units are mostly based hillslope form and are not in the unstable land component of Riparian Reserves. In each instance, indicators of past slope movement suggest that the events are at least "hundreds" of years old. This is especially true of M Units 23 and 73. For M Unit 61, the RPMs (Section 2.9 in Chapter 2 of the draft EIS) are based on reviews with the earth science staff during unit layout. Conservative thinning guidelines are also recommended to retain sufficient rooting density of large vigorous trees (thinning will target less vigorous, more crowded trees in the stand).

Comment 4.11: In addition to the temporary roads, we are concerned about all the roads they are reopening and all the landings. How many of these landings exist now and how many are new? How does creating new landings in LSRs maintain or restore old growth characteristics? What is the risk of the roads they propose to reopen? If the proposed roads and landings cross/are located on earthflow terrain they should not be constructed or reopened because of the landslide/sediment delivery risk.

Response 4.11: Other than the 1.03 miles of proposed temporary roads, 0.98 mile of former logging access routes would be reopened to treat specific units. No new landings are proposed (see page 2-14 in the draft EIS). The issue of temporary roads was the basis for developing Alternative C (No New Temporary Roads Constructed). The issue has been thoroughly analyzed, and all relevant facts are presented in the draft EIS and relevant resource reports. All temporary road alignments (both new and reopened former logging access routes) were examined in the field. All roads in question are on ridgetops or in near-ridge locations and far from streams or any mapped Riparian Reserve. The draft EIS makes it clear that none of the new roads or reopened former logging access routes cross unstable terrain or Riparian Reserves. Please note the following text from page 3-161 of the draft EIS:

> **Construction of New Temporary Roads / Closure—1.03 miles.** The new temporary roads would be closed upon project completion. There would be a reduction in root support and local evapotranspiration associated with clearing. Road segments are short, cross no major drainages or wet areas, and are generally located near ridgetops. All new temporary road alignments were inspected for landslide potential in the field and landslide potential evaluated.
>
> **Use of Former Logging Access Routes / Closure—0.98 mile.** Former logging access routes in varying states of revegetation would be reused. There would be a reduction in root support and local evapotranspiration, particularly where older vegetation is removed. All of these routes were inspected for landslide potential in the field and landslide potential evaluated. Potential for road-related landsliding is considered to be very low. Closure following use would eliminate any pre-existing drainage problems and remove fill placed in draws, thereby restoring hydrologic conditions and reducing landslide risk.

Please note that logs will be skidded to <u>existing</u> landings (which will be bladed and cleared of brush) or “hot-decked” along roads. Basically, hot decking occurs when the running surface of the road is not wide enough for both the cable yarder and the logs. The logs have to be moved out of the way so another load can be brought to the road, where trucks haul them away—this eliminates the need for landing construction because the road prism itself serves as the landing. The use of existing landings will be subject to current best management practices for erosion control (refer to Section 2.9 in the EIS).

Comment 4.12: During the travel management planning process we have repeatedly been told by the Supervisor’s Office that the Forest Service will identify the “minimum road system.”

Response 4.12: This project does not analyze the impacts of the current transportation system. That analysis and decisions on closing and decommissioning existing roads are outside the scope of the Eddy Gulch LSR Project. The Pacific Southwest Regional Forester has committed to begin addressing Subpart A of the Travel Management Rule within the next 18 months; that process will provide information needed to identify the minimum road system required for management of the Klamath National Forest.

For additional information, please visit http://www.fs.fed.us/r5/klamath/projects/ohv/index.shtml.

Comment 4.13: We would like to express our interest in collaborating with the District and other interested parties in effectiveness monitoring and restoration for the Eddy LSR project.

Response 4.13: The Klamath National Forest is currently coordinating with the California Regional Water Quality Control Board regarding water quality monitoring. Your interest in collaborating with other monitoring efforts is noted.

Comment Document 5— Patricia Sanderson Port, Regional Environmental Officer, Office of Environmental Policy and Compliance. U.S. Department of the Interior, Region IX

Comment 5.1: The Department of the Interior has received and reviewed the subject document and has no comments to offer.

Response 5.1: Thank you for your letter.

Comment Document 6—Kathleen M. Goforth, Manager, Environmental Review Office, United States Environmental Protection Agency, Region IX

Comment 6.1: EPA acknowledges the importance of project goals to improve forest health, reduce fuel loading, and protect communities and watersheds from wildfire threats. We support the best management practices described in the DEIS, such as minimizing new road construction and decommissioning roads after project activities have taken place to help reduce adverse environmental effects.

Response 6.1: Thank you for your input.

Comment 6.2: We have rated the DEIS as Environmental Concerns – Insufficient Information (EC-2) (see enclosed *"Summary of Rating Definitions").* We recommend that the Final Environmental Impact Statement (FEIS) provide additional information concerning a smoke management plan, worker exposure to naturally occurring asbestos, the wildland-urban interface (WUI), and noxious weeds. Please see the enclosed Detailed Comments for a description of these concerns and our recommendations.

Response 6.2: See responses to Comments 6.3, 6.4, 6.5, and 6.6.

Comment 6.3: <u>**Air Quality**</u>

Provide a detailed smoke management plan describing the Siskiyou County Air Pollution Control District (SCAPCD) Smoke Management Program. The U.S. Environmental Protection Agency (EPA) acknowledges the need to reduce fuel, which may lead to a reduction of emissions from wildfires. Emissions from wildfires can be a major contributor of PM10, PM25, and CO (page 3-54, lines 5-6). The DEIS states that the Forest Service would coordinate with the appropriate air quality regulatory agencies during the planning and implementation of its resource management activities that affect air quality (page 1-21, lines 7-16).

Recommendation:

The FEIS should include a detailed smoke management plan describing the SCAPCD's regulations for pile burning and smoke management, an implementation schedule, the responsible parties, and monitoring and reporting requirements.

Response 6.3: Burning will comply with the policy and regulations of the Siskiyou County Air Pollution Control District and Northeast Plateau Air Basin. Burn plans, which include smoke management plans, will be written and submitted to the County Air Pollution Control District for their approval prior to implementation of prescribed burn treatments. The draft EIS states on pages 1-21, under "Section 1.10 Permits, Licenses, and Other Consultation Requirements," that "Smoke permits are required from the Siskiyou County Air Pollution Control District." Also refer to the RPM ("Section 2.9.8 Air Quality" on page 2-31 of the draft EIS), which states, "Burn plans will identify and comply with policies and regulations of the Siskiyou County Air Pollution Control District and Northeast Plateau Air Basin." This statement has been edited as follows: "Burn plans, which include smoke management plans, will be written prior to implementation of prescribe burn treatments. The burn plans will identify and comply with policies and regulations of the Siskiyou County Air Pollution Control District and Northeast Plateau Air Basin."

Please note that page 3-55 in Section 3.3 (Subsection 3.3.8.2) of the draft EIS states, "Effects from project implementation would be short term, and use of RPMs would reduce those effects. The California Air Resources Board has promulgated changes to Title 17 Smoke Management Guidelines for Agricultural Burning and Prescribed Fires. The new regulations require submission of smoke management plans to the local air district for each burn plan and require permitting and increased coordination between burners and the local air district. The Forest Service, Region 5 has also signed a Memorandum of Understanding on Prescribed Burning on July 13, 1999, with the California Air Resources Board." This statement will be clarified in the final EIS by inserting the statement, "prior to on-the-ground implementation of burning" preceding the word "submission."

Comment 6.4: **Naturally Occurring Asbestos**

Limit exposure to Naturally Occurring Asbestos. The DEIS states that asbestos can be introduced into the air by activities that include road construction, reconstruction, or maintenance on roads underlain by ultramafic rock (3-159, lines 5-6). The DEIS also states that ultramafic rock is concentrated in the southwest corner of the Assessment Area, and acknowledges the presence of serpentine geology in the project area (page 3-159, lines 7-9). Although serpentine soils may be limited, it is important to protect human health by limiting the exposure of workers to serpentine soils that may introduce airborne asbestos during vegetation management activities. Very low levels of asbestos in soil can generate airborne asbestos at hazardous levels. We are concerned about the potential exposure of workers to naturally occurring asbestos.

Recommendations:

EPA recommends that the Forest Service determine whether or not naturally occurring asbestos is present in treatment units or along project access routes. If naturally occurring asbestos is found to be present, the FEIS should provide information on exposure mechanisms and assess the potential for exposure to elevated levels of airborne asbestos from proposed activities.

EPA recommends that the Forest Service review the asbestos occurrence information on the California Geological Survey website: http://www.consrv.ca.gov/cgs/minerals/hazardous minerals/asbestos/index.htm and the California Air Resources Board (CARB) regulations and guidance at: http://www.arb.ca.gov/toxics/asbestos/asbestos.htm. The CARB website addresses California's Asbestos Airborne Toxic Control Measures for Surfacing Applications, which apply to unpaved roads. EPA also recommends that the Forest Service review the recommendations presented in the Department of Toxic Substances Control report, “Study of Airborne Asbestos from a Serpentine Road in Garden Valley, California” at http://www.dtsc.ca.goviloader.cfm?url¯kommonspotisecurity/getfile.tfm&pageid =33546.

The FEIS should identify and include commitments for measures that can be implemented to protect human health from naturally occurring asbestos, if appropriate, and include this discussion in the FEIS.

Response 6.4: Timber harvest activities are specifically exempted from asbestos survey requirements under CARB – Final Regulation Order 2002-07-29 Asbestos ACTM for Construction, Grading, Quarrying, and Surface Mining, Section 93105(c)(3). The Klamath National Forest inventoried road segments for naturally occurring asbestos (NOA) during spring 2009 (Bell 2009; the report has been inserted as “Appendix I” to Geology Report), and in most cases, the levels of NOA were below guidelines published by the California Air Resources Board. Although detectable levels of NOA were obtained, the project avoids or minimizes impacts on worker safety because of the following:

- No road construction of any type is proposed in areas underlain by ultramafic rocks.
- No quarrying or road surfacing is proposed anywhere in the project.
- No M Unit occurs on ultramafic bedrock. Therefore, dust from skidding or yarding of logs poses no airborne asbestos hazard.
- The Rx Units will be treated with prescribed fire only and present no significant hazard. The FRZs will be treated with a mix of prescribed fire and mechanical mastication. In the case of FRZ 10, most of the ultramafic rock occurs outside of (but adjacent to) the area where mastication treatment is anticipated. The largest area proposed for mastication on ultramafics is in FRZ 2, where 125 acres fit that description. In those areas where ultramafic rock and mastication occur, an RPM has been added to Chapter 2 (Section 2.9.5) stating the operators will receive a map clearly identifying those locations, a description of the health hazards, and a recommendation that masticators have positive-pressure climate-controlled cabs (see next bullet).
- Section 1.9 of the Geology Report for the Eddy Gulch LSR Project contains an RPM for asbestos. That RPM has been edited in the Geology Report and has also been added to Section 2.9.5 of the final EIS as follows:

  Asbestos**.** The Forest Service will provide a description of health hazards from asbestos exposure and maps to contractors identifying areas that may have asbestos and suggest they may consider sealed cabs on their equipment. If timber haul routes change during project implementation, any additional roads would be checked against the bedrock map to determine if they are underlain by ultramafic rock, and the asbestos standards applied. Dust abatement is required on all roads underlain by ultramafic rocks, and it is recommended that masticators have positive-pressure climate-controlled sealed cabs.

- Portions of the following fuel reduction units do contain areas of ultramafic rock:
  - Rx Unit 1 and FRZ 2 in the Upper Black Bear Creek watershed
  - Rx Unit 3 in the Matthews Creek watershed
  - Rx Unit 4 and FRZ 10 in lower Crawford Creek watershed

The report cited by the commenter (*Study of Airborne Asbestos from a Serpentine Road in Garden Valley, California*) was reviewed. This study pertained to roads <u>surfaced with serpentinite</u> with substantial NOA—this action will not occur in the Eddy Gulch LSR Project Assessment Area.

Comment 6.5: **Wildland-Urban Interface**

Describe how the Community Wildfire Protection Plan relates to the proposed project. A main component of the purpose and need for this project is to provide fire protection for the wildland-urban interface (WIJI) (page 1-11, lines 18-19). The Healthy Forest Restoration Act (HFRA) encourages the development of Community Wildfire Protection Plans (CWPPs) under which communities designate their WUIs and the locations where fuel reduction projects may take place. A summary of the Salmon River CWPP is provided in the DEIS (page 2-4, line 31 through page 2-5, line 10).

Recommendations:

The FEIS should further describe actions that will be taken by the Forest Service and the communities to ensure fire protection efforts are consistent, complementary, and fully integrated with the preferred alternative. For instance, describe whether local building and fire safety ordinances are consistent with the effort to reduce and minimize excessive fuels.

Response 6.5: The Forest Service only has jurisdiction on National Forest System lands. This project was developed in collaboration with the Salmon River Fire Safe Council and include recommendations from their CWPP. The local building and fire safety ordinances deal with private lands, and the state of California (CALFIRE) has jurisdiction.

Comment 6.6: The Forest Service identifies several noxious weed resource protection measures (RPMs) for each treatment activity. For example, if noxious weeds were found in the area during prescribed burn treatments, there would be an omission of prescribed burn treatments and fireline construction within weed populations, cleaning of all equipment before entering treatment units, post-treatment surveys, site-specific surveys, and monitoring of noxious weed sites to ensure that natural vegetation has recovered from the disturbance (page 3-211, lines 29-33). While these measures are commendable, the DEIS does not specifically state what measures the Forest Service would take to manage or eradicate noxious weeds if they were found at the project sites.

Response 6.6: The measures the Klamath National Forest would take to manage or eradicate noxious weeds would be patterned after the measures currently being taken in the Salmon River watershed; that is, nonchemical methods, predominantly hand digging. Currently, the Salmon River Restoration Council provides most of the weed control efforts, in partnership with the Forest Service, as volunteers and recipients of grant funding.

Comment Document 7—Williams, Thomas Engineering Geologist, Northern Timber Unit, California Regional Water Quality Control Board, North Coast Region

Comment 7.1: All forest projects must comply with all substantive and procedural requirements of the Porter-Cologne Act and the Basin Plan. Additionally, the Project must comply with the RWB's Categorical Waiver For Discharges Related to Timber Harvest Activities On Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No. R1-2004-0015 (Waiver).

Response 7.1: The proposed project meets all conditions and eligibility requirements of the Categorical Waiver. Prior to commencement of timber harvest activities, the Forest Service shall, in writing, file with the Regional Board a Notice of Intent, in which the USFS certifies they understand and intend to comply with all criteria and conditions of the Order and applicable water quality regulations. The Notice of Intent shall be signed by the Forest Supervisor or their duly authorized USFS representative.

Comment 7.2: RWB Order No. R1-2004-0015 item C.3 specifies, "The USFS shall submit and comply with a monitoring program prior to commencement of timber harvest activities when: (1) the USFS's cumulative watershed effects analysis indicates that the Project may cause any watershed or sub-watershed to exceed a threshold of concern as determined by various models (i.e., Equivalent Roaded Acres (ERA), Surface Erosion (USLE), Mass Wasting (GEO), etc.); or (2) the cumulative watershed effects analysis indicates that the Project may increase risk values, as determined by various models (Equivalent Roaded Acres (ERA), Surface Erosion (USLE), Mass Wasting (GEO), etc.), in any watershed or subwatershed that already exceeds a threshold of concern prior to project implementation."

The Cumulative Watershed Effects (CWE) modeling done for the Eddy Gulch LSR Project and detailed in the Aquatic Resources Report indicates that Eddy Gulch, Kanaka-Olsen, and Indian 7th Field Watersheds are over the threshold of concern (TOC) of 1.0. The Eddy Gulch 7th Field Watershed had a value of 1.05 for the USLE model. The Kanaka-Olsen 7th Field Watershed had a value of 1.53 for the GEO model. The Indian 7th Field Watershed had a value of 1.04 for the ERA model. In accordance with RWB Order No. R1-2004-0015, a water quality monitoring program is required to be approved for this project by the RWB prior to commencement of timber harvest activities.

Response 7.2: Section C.3 of the categorical waiver does not apply because this project would not cause a watershed to exceed the threshold of concern, nor would it increase the risk value of a watershed currently over the threshold. The CWE model values quoted from the Hydrologists report are for the current condition (2008) and do not include the effects of future actions. When the effects of the North Fork Roads storm proofing project are included in the model, Eddy Gulch has a modeled risk of 0.90 and is not over the threshold of concern. The Kanaka-Olsen and Indian Creek watersheds are over the threshold of concern, but the risk ratios are decreasing and would fall below the threshold of concern by the time the project is fully implemented in 2014 (see Table 3.41 of the final EIS).

Comment 7.3: Basin Plan, Page 4-62.00, "The Regional Water Board encourages parties responsible for vegetation that provides shade to a water body in the Scott River watershed to preserve and restore such vegetation. This may include planting riparian trees, minimizing the removal of vegetation that provides shade to a water body, and minimizing activities that might suppress the growth of new or existing vegetation." To ensure compliance with the Basin Plan temperature objective and the temperature TMDL, the Project should be implemented in a manner that does not reduce shading of any streams.

Response 7.3: The "Aquatic Resources" section in the draft EIS (Section 3.5.4.2), the Aquatic Resources Report (Section 1.8.2), and the Fisheries BA/BE (Section V [Existing Environment and Effects on Anadromous Fish and Their Habitat Indicators]) prepared for this project provide analyses of potential effects on stream shade and water temperature. The analyses conclude that there would be no effects—this determination is based on (1) the proposed project design, and (2) the RPMs that were developed to minimize or avoid adverse effects that could result from project implementation.

Comment 7.4: The potential impact on stream temperature was judged to be very small in the DEIS because the mechanical thinning units and the proposed temporary roads are not within Riparian Reserves and are located on or near ridgetops. The proposed temporary roads would not cross any streams or other Riparian Reserves and are dispersed in a number of short segments across several watershed areas. The temporary roads would be closed, ripped, and re-contoured after use. The greatest potential for adverse stream temperature effects would be related to flare-ups associated with prescribed fire within Riparian Reserves. Flare-ups could remove canopy and create openings adjacent to streams. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance.

Response 7.4: The "Aquatic Resources" section in the draft EIS (Section 3.5.4.2), the Aquatic Resources Report (Section 1.8.2), and the Fisheries BA/BE (Section V [Existing Environment and Effects on Anadromous Fish and Their Habitat Indicators]) prepared for this project provide analyses of potential effects on the Stream Temperature Indicator. The analyses conclude that there would be no effects on this habitat Indicator—this determination is based on (1) the proposed project design, (2) RPMs that were developed to minimize or avoid adverse effects that could result from project implementation, and (3) on the assumption that underburns will be conducted in accordance with burn plans and protocols to minimize escapes and flare ups. Worst-case scenarios are not assumed or analyzed. Burn plans contain measures that minimize the potential for flare ups.

Comment 7.5: Please describe in the Final EIS how the sediment objectives for the Scott River TMDL [Total Maximum Daily Load] described above will be achieved for this Project.

Response 7.5: The sediment objectives of the Scott River TMDL will be met by implementing the TMDL Action Plan and the Memorandum of Understanding (MOU) between the Forest Service and the Regional Water Board. The MOU describes 13 specific implementation actions that the Forest Service is taking to achieve the TMDLs and meet sediment and temperature water quality standards on National Forest System lands. In accordance with section C.5 of the MOU, the project will prevent or minimize road-caused sediment by implementing the Best Management Practices, LRMP Standards and Guidelines, and the RPMs presented in Section 2.9 (chapter 2) of the draft and final EISs.

Section B.3: Comment Documents

Comment Document #1

AMERICAN FOREST RESOURCE COUNCIL

July 29, 2009

Ray Haupt, District Ranger
Scott and Salmon River Ranger District
11263 N. Highway 3
Fort Jones, CA 96032

Dear Ray:

Thank you for the opportunity to comment on the Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project Draft Environmental Impact Statement (DEIS). We have no additional significant comments concerning the DEIS. Our comments highlighted in the April 22, 2008 letter are still applicable.

Two objectives have been identified for the project:

- Objective 1: Habitat Protection—Protect existing and future late-successional habitat from threats of wildfire that occur inside and outside the Eddy Gulch LSR.
- Objective 2: Community Protection—Reduce wildfire threat to communities and municipal water supplies and ensure public and firefighter safety.

Three alternatives have been assessed in detail. They include:

- **Alternative A: No Action.** This alternative is the continuation of the current level of management and public use—this includes road maintenance, dispersed recreation (hunting, fishing, camping, and hiking), mining, and watershed restoration projects and a 7,200-acre modeled wildfire.
- **Alternative B: Proposed Action.** Alternative B proposes 25,969 acres of landscape-level treatments to protect late successional habitat and communities. Within those acres, 16 Fuel Reduction Zones (FRZs), totaling 8,291 acres, would be constructed to increase resistance to the spread of wildfires to adjacent watersheds. The 8,291 acres include 931 acres in 42 M Units (thinning units) and 7,383 acres in fuel reduction areas (outside the M Units) to reduce ground and ladder fuels. The proposal includes 17,524 acres of Prescribed Burn Units (Rx Units) located outside the FRZs to increase resiliency to wildfires and protect habitat for the NSO and other wildlife species that are dependent on late-successional forests. There would be 44 miles of Roadside (RS) treatments along emergency access routes treated in FRZs and Rx Units (treatments would be similar to the FRZ or Rx Unit the route passes through) and 16 miles (154 acres) of RS treatments outside of FRZs and Rx Units—a total of 60 miles of RS treatments along emergency access routes.

1500 SW First Avenue, Suite 765
Portland, Oregon 97201
Tel. (503) 222-9505 • Fax (503) 222-3255

Comment Document #1

- **Alternative C: No New Temporary Roads Constructed.** Approximately 1.03 miles (5,443 feet) of new temporary roads would not be constructed. As a result, no fuel-reduction treatments in 99 acres would occur in portions of seven M Units, which reduces the M Units to 832 acres. There would be 822 fewer acres treated in Rx Units because no treatment would occur in a portion of two M Units. The inability to treat the 921 acres would result in vulnerable areas that could allow wildfires to escape to other areas of the LSR.

ROADS
We are very concerned about any alternative that eliminates the use of temporary roads. No significant impact has been displayed for any resource with the development of an adequate road system. The following highlights our comments from the scoping letter. These concerns still apply today.

"TEMPORARY ROAD CONSTRUCTION AND LANDINGS
We are very aware there will be undue pressure put on the decision maker to not develop any temporary roads for this project. We take the opposite view point. Temporary roads can allow for more effective and efficient management of the publics land. They can provide for better economics and in many cases reduce environmental impacts as compared to alternative treatments such as long skids and large clearings for helicopter landings.

- It is important an adequate road system be developed and utilized in order to effectively and efficiently harvest products from this project. While decommissioning unneeded roads is understandable and supportable we also ask that serious consideration be made for including temporary road construction that will assist with the implementation of this project. We encourage the building of temporary spurs where feasible to reduce the harvest costs and more effectively treat the land base. Closing these roads following treatment should have no additional resource impact when compared to other alternative treatment methods.
- Insure landing size is adequate to support the proposed harvest systems. If whole tree yarding is proposed make sure landings can accommodate the merchantable and unmerchantable material." 1.1

CONCLUSION

Following a review of the DEIS and all the associated environmental impacts we see no reason to not decide on Alternative B as the alternative to implement. It appears to be the most logical alternative and the one that most closely meets expectations from the LRMP and project purpose and need. 1.2

We do not recommend the selection of either Alternative A or C. Neither one of these will come close to meeting the established purpose and need for the project.

We recommend Alternative B and ask you as the decision maker to base your decision on fact, rather than other commenter's lack of understanding of the Forest ecosystem, personal and group 1.3

Comment Document #1

agendas and personal biases. We as a forest industry and long time foresters are very concerned that good forestry be practiced on the National Forest land base.

Thank you for the opportunity to comment on the Eddy Gulch Late-Successional Reserve Fuels / Habitat Protection Project DEIS and please keep us informed of any issues, appeals, or litigation that may arise from your decision.

Sincerely,

/s/***Richard J. Svilich***

Richard J. Svilich
AFRC, Northern California Representative
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Yreka, CA 96097
Home Phone: 530-842-3345
Cell Phone: 530-905-0181
E-mail: ricknroll50@yahoo.com

Comment Document #2

August 7, 2009

To: Eddy Gulch LSR Project
c/o RED, Inc. Communications
298 First Street
Idaho Falls, ID 83401

John W. Menke

From: Dr. John W. Menke
10935 Quartz Valley Road
Fort Jones, CA 96032

RE: Eddy Gulch LSR Project

I reviewed with interest and joy this potentially outstanding project to reintroduce fire effects on 2.1
a nearby forest ecosystem of a significant size. The quantity of knowledge presently available to assess potential benefits, positive and negative effects is remarkable. I fully support the project as a local demonstration of the role of fire in forests with the hope that it will serve as a stimulus for additional projects of this kind.

In 1973 I began my career in natural resources teaching and research as an Assistant Professor, Department of Forestry and Conservation, University of California, Berkeley filling a position following the retirement of Dr. Harold H. Biswell. Two of my first students had been mentored by Dr. Biswell in prescribed burning of forests, so one of my first projects with them was to study the effects of reintroduction of fire in Calaveras Big Trees State Park. The south grove of big trees like much of California had been protected from fire since about 1890 and therefore the fuel build-up was incredibly high—e.g., 24-inches depth of litter and duff requiring raking from the boles of giant sequoias to assure no damage to these majestic trees that were as large as 22 feet in dbh. The state park foresters thought we were crazy, but with the experience of Dr. Biswell (also known by his students as Harry the torch!) they quickly got the hang of it and developed the patience to do the prescribed burning job efficiently. Soon thereafter similar work was carried on by student projects in Yosemite National Park. If late-successional reserve protection/enhancement can serve as a vehicle justifying reintroduction of fire effects in our forests, so be it.

In reviewing the draft EIS the only missing analysis I noted was no water yield assessment. 2.2
With the expected temporal reduction in competitive effects among plants, this implies some increased watershed output albeit probably small. Given the importance of even a small stream flow enhancement, I feel some assessment of water flow is called for.

Thanks for the opportunity to review the Eddy Gulch Late-Successional Reserve Fuels/Habitat 2.3
Protection Project. The document was very professionally prepared and clear in is presentation and findings.

Comment Document #3

September 3, 2009

Patricia Grantham
Forest Supervisor
Klamath National Forest
1312 Fairlane Road
Yreka, CA 96097

eddylsr@redinc.com

RE: Eddy Gulch Draft Environmental Impact Statement

Dear Patty Grantham and Eddy Gulch ID Team,

Thank you for accepting these comments regarding the Eddy Gulch Project on behalf of the Klamath Siskiyou Wildlands Center, the Klamath Forest Alliance and the Environmental Protection Information Center. Contact information for our organizations may be found at the conclusion of this document.

The Eddy Gulch Project would authorize approximately 25,969 acres of thinning and prescribed burning across project area. Specifically, the project proposes 60 miles roadside fuels treatment, 8,291 acres of commercial thinning, 17,524 acres of underburning, 1.0 mile of "temporary" road, and 3,184 acres of mastication.

Please note that our organizations support the vast majority of the proposed actions in this project. We are encouraged and supportive of the agency's efforts to conduct small-diameter thinning and prescribed fire activities in this fire-suppressed project area. *Thank you for your work on this important project.* And thank you for reducing the amount of proposed road construction that was contemplated in the scoping notice. 3.1

Our largest remaining concern involves the logging of "M units" down to 32%-50% canopy. This represents a very small portion of the proposed project and hence we believe that the purpose and need for the project can be fully met while retaining canopy levels necessary the dispersal needs of late-successional associated species within this LSR. We are particularly concerned with the proposed M unit that would remove many of the large trees and snags of an old-growth Shasta Red Fir stand (see the DEIS page 25). We believe that HFRA is designed to retain large trees, and old-growth stands, such as this proposed logging unit. 3.2 . . . 3.2

We are also very concerned with the intention to meet snag and coarse woody debris requirements on the "landscape level" within this LSR, rather than on the unit level. The standards and guidelines of both the Northwest Forest Plan and the Klamath National 3.3 . . .

1

Comment Document #3

Forest LRMP apply to retention of these features at the unit level, rather than the landscape level.

We are concerned that the 3,184 acres of proposed machine mastication may inhibit attainment of the purpose and need for this project. Our comments will detail how studies indicate that mastication may contribute to fuel loading and fire hazard. 3.4

The last "bright line" issue for our organizations is the agency's refusal to implement sub-part (a) of the travel rule at either the Forest or the Watershed scale. During the travel management planning process we have repeatedly been told by the Supervisor's Office that the Klamath National Forest will identify the "minimum road system" and propose needed road decommissioning to bring its road system in line with its maintenance budget during watershed level projects. Yet here, where we have a watershed level project in an LSR planning area that has been severely degraded by roads, the Forest Service states that road management is "outside the purpose and need for the project." The agency cannot continue to ignore the requirements of the travel rule and the findings and recommendations of your LSRA, watershed analysis and forest-wide roads analysis. 3.5

Late Successional Character.

> "The objective of Late-Successional Reserves is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl."
> -Northwest Forest Plan Standards and Guidelines C-9.

The DEIS indicates that some large trees may need to be felled for hazard abatement, and within temporary roads, landings, skid trail and logging corridors, which would likely be removed as commercial timber. The project would remove large diameter snags within many commercial thinning units. The impacts of removing large trees across the LSR (within the harvest units and along 60 miles of roads) has not been adequately analyzed. 3.6 . . .
Instead it is simply concluded that the loss of these large trees is not expected to impact the overall vegetation. In fact, loss of numerous snags and large trees could have a significant impact on the overall environment, including canopy, shade, and wildlife. 3.6
The late successional characteristic components in the LSR must be retained. Loss of these old growth features may result in a significant harm of an array of species.

We are also extremely concerned by the contention that snag and coarse woody debris (CWD) standards will be met on the "landscape level" rather than in actual logging units within the LSR. This is not the intention of either the Klamath LRMP or the Northwest Forest Plan. Page 4-25 of the KNF Forest-wide Standards and Guidelines clearly directs the agency to "maintain 5 to 20 pieces of CWD *per acre* in various states of decay." C-42 of the Northwest Forest Plan requires that "snags are to be retained *within the harvest units* at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels." Further, the soil mitigation measures identified in the DEIS (page 2-27) call for retaining CWD at the level identified in the KNF LRMP on a "per acre" basis. 3.3

2

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The importance of snags, down logs, and other coarse woody debris is also recognized in the agency's FEMAT (1993) scientific analysis. For example:

> "Because of the important role of dead wood in late-successional and old-growth forest ecosystems, and because there is much to learn about the role of dead wood in the development of forests, only limited salvage is appropriate in Late-Successional Reserves . . . The Final Draft Recovery Plan [for the NSO] would allow removal of small-diameter snags and logs, but would also require retention of snags and logs likely to persist until the new stand begins to contribute significant quantities of coarse woody debris."
> -FEMAT 1993, p. IV-37

> "Snags provide a variety of habitat benefits for a variety of wildlife species associated with late-successional forests. Accordingly, following stand-replacing disturbances, management should focus on retaining snags that are likely to persist until late-successional conditions have developed and the new stand is again producing large snags."
> -FEMAT 1993, p. III-37

Please note that the contribution of very large logs (> 20 inches in diameter) to fire severity and intensity is negligible, as they are the fuels least available for combustion. When these large logs do burn, it is because the smaller fuels needed to ignite them and sustain combustion are present. Logs also burn mainly by smoldering combustion, which is not considered in the calculation of fire intensity. This is the reason why relatively high fuel loads comprised primarily of large-diameter woody material can be present without eliciting high intensity fire effects.

The Klamath LRMP Forest-wide Standards and Guidelines 4-39 states:

> "Maintain snag densities through the full timber rotation by providing green replacement trees to become snags of adequate signs. The size of snags and green trees to be retained within a given managed stand should be greater that the average diameter of the stand. Retain snags in clumps when possible…Retain snags with the largest DBH as they tend to last longer and make the best wildlife habitat."

Late Successional Reserves

While our organizations support the vast majority of the proposed project, we steadfastly opposed logging the canopy down to as low as 32% canopy in M Units. Clearly the purpose and need for this landscape level project can be met while also retaining canopy in the LSR that allows for dispersal of late-successional associated species.

While we recognize that M units are generally located on ridge tops, please note that page 1-2 of the DEIS acknowledges that mature forest cover has always been an element of some ridge tip stand conditions.

The NWFP establishes clear standards for silviculture in the LSR.

3

Comment Document #3

For Klamath Province LSRs, the Northwest Forest Plan directs, "Silvicultural activities aimed at reducing risk shall focus on younger stands in [LSRs]. The objective will be to accelerate development of late-successional conditions while making the future stand less susceptible to natural disturbances" (NWFP ROD p. C-13). Where the risk of major disturbance is very high, management activities should *still* focus on young stands, but activities are permitted in late-successional habitat if they: (1) would clearly result in greater assurance of long-term maintenance of habitat, (2) would clearly reduce risks of major disturbance, and (3) would not prevent the LSR from meeting its intended purpose. Therefore, any action in late-successional habitat must be justified with *demonstrated benefits* to such habitat in order to comply with the NFP. These benefits must be "clear" from either the local analysis or from relevant scientific literature. Professional opinion that benefits *may* result is an inadequate justification for mechanical intervention in existing late-successional forest habitat. 3.7

Please note that page 3-70 of the DEIS acknowledges that "the Klamath LRMP specifies that LSRs are to be managed to maximize the amount of late-successional forest to a reasonably sustainable level…"

Please further note that page 3-82 indicates that "thinning in M units could reduce three features that are used to define suitable nesting, roosting or foraging habitat: canopy cover, basal area and the number of large diameter trees."

Mastication

We have concerns about the increasing use of the Slashbuster masticator. While this machine can be cost effective and may produce desired results in some instances, there is very little information available to the public or the decision maker regarding the impacts it has on the forest environment, particularly on the herbaceous understory. Broadly, we are concerned that there has been little monitoring of the affects of the Slashbuster. Several concerns have been raised by prominent scientists that study chaparral, soils, Neotropical birds, fire behavior, and other implications of the widespread use of the Slashbuster. 3.8 . . . 3.8

Slashbuster Science

Attached to these comments are several peer-reviewed studies regarding the effects of Mastication on forest resources. 3.9 . . .

Attachment number one is an article entitled "In Plantations or Natural Stands: Ponderosa is Programmed to Partner with Fire" that appeared in the July 2009 issue of Fire Science Brief. This study concludes that:

Ponderosa pine plantation forests cover nearly 400,000 acres of California's National Forests. Fire hazard is extreme both within and adjacent to many of these areas which 3.9 . . .

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has led to extensive fuel reduction plans for plantations and other forests on federal public lands. Although fuels treatments have been implemented on a limited basis in California's plantations, the effectiveness of varying methods has only recently received scientific attention. This project analyzed the effectiveness of individual and combination treatments to provide science-based guidance for fire hazard reduction in these areas. Prescribed understory fire, both alone and combined with pre-burn mastication, was most effective for reducing surface fuels and potential fire behavior. Likelihood of active crown fire was reduced in masticated stands because bulk density was decreased. Predicted torching, tree mortality and flame length were higher in masticated units than in prescribed burn units and controls.

Given these findings our organizations suggest the use of prescribed fire rather than mastication for the reduction of fire hazard in plantations. 3.9 . . .

Attachment number two is a study entitled "Lethal Soil Heating During Burning of Masticated Fuels: Effects of Soil Moisture and Texture." In this study Forest Service Researchers from the Pacific Southwest Research Station conclude that: 3.10 . . .

> The potential for soil damage during burning of masticated fuels is substantial. Recent evidence suggests that temperatures between 100 and 300 C in the upper soil horizon may result if masticated fuel beds are ignited (Busse et al. 2005). Of immediate concern is the survival of roots and soil organisms. The lethal threshold for roots is approximately 60 C while that of many soil organisms is between 50 and 200 C (Neary et al. 1999). 3.10

The third attachment is a study entitled "Bird Composition After Mechanical Mastication Fuel Treatments In Southwest Oregon Oak Woodland and Chaparral." 3.11 . . .

The abstract for this paper states:

> To evaluate ecological effects of vegetation management in southwest Oregon oakwoodlands and chaparral, we compared bird abundance and vegetation structure at four untreated stands and four stands where shrub cover had been reduced by using mechanical mastication thinning. Treated stands had less shrub cover than untreated stands. Three bird species were consistently more abundant on untreated stands. Species that were more abundant on untreated stands were associated with shrub cover, while those that tended to be more abundant on treated stands were associated with open areas, providing further evidence that the treatments were responsible for the observed differences in bird community composition. These results demonstrate a stronger response of shrub-associated species than was documented in an earlier study of smaller-scale shrub removal treatments. This difference suggests that managers can design treatment prescriptions that benefit particular species by altering the size and shape of project areas as well as the tools that are used to reduce shrub cover (e.g., mechanical vs. manual treatments). 3.11

Soils and Hydrology

The widespread use of the Slashbuster may in fact alter soil nutrient cycling. How important nutrient cycles such are influenced by the use of the Slashbuster at the site level could be critical to the long-term site conditions. Soil biota is another important 3.12 . . . 3.12

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element of site level conditions that could be impaired by the Slashbuster. Lastly, the Slashbuster could harm mychorizal communities that are known to be important symbiots of many species. This concern is heightened by the proposal to conduct 69.5 acres of mastication within riparian reserves (DEIS page 2-17).

Understory Flora (and Herbaceous Understory)

We have a number of concerns about the potential impacts that widespread use of the Slashbuster on forest and chaparral understory vegetation. Native plants could be harmed or extirpated, and it is unclear if buffering plant sites has been effective in previous Slashbuster treatments. It is also unclear if the Forest Service will be conducted survey and manage protocols prior to slashbusting. How the understory responds to mastication is unclear, and with the amount of masticated material left on the site years after a treatment it is likely that some native understory will be lost. 3.13 . . . 3.13

The rampant spread of noxious weeds is a growing problem for the forests of Northwestern California. The widespread use of the Slashbuster could facilitate the spread of noxious weeds. Seeds of invasive plant species could be spread on the machinery itself, or the treatment units could be prime sites for many "pioneer" invasive and noxious weeds. 3.14 . . .

Has the vegetative response to Slashbuster treatment been studied? How does the Forest Service anticipate the response of species such as manzanita and ceanothus to slashbuser treatment? 3.14

Vegetation Dynamics

The dynamics of vegetation over time with the scale and rate of Slashbuster use on the landscape level is also a concern. The scale and rate of use will determine the cumulative level of impact to many species. Is there currently a way for the public or the decision maker to anticipate the amount of treatment that is likely to take place across the landscape? 3.15 . . .

Prioritization of Sites

We are curious how the Forest Service chooses the sites on which to implement the Slashbuster treatment. Is there currently a prioritization of vegetation density, proximity to the community protection zone, vegetation type, or any other parameters or vectors? It appears that the sites are chosen based on non-commercial lands where the slope is gentle enough for the Slashbuster to operate. Some level of prioritization for fuels treatments based on Urban Interface and ecological need is appropriate. What criteria are currently being used to determine the location of proposed slashbuster treatments? 3.15 . . . 3.15

Fire Behavior

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Our organizations are very interested in learning about the impacts of slashbuster treatment on such "fire variables" as residence time, short-term fuel loading, long-term vegetative response, and microclimatic conditions on the site. This information is relevant to whether an EA, or EIS, should be prepared for this project. 3.16

Neotropical Birds

Refugia for many species could be impaired by the widespread and ubiquitous use of the Slashbuster. Please disclose all literature or scientific studies relied upon in the analysis of impacts on Neotropical birds in the EIS. 3.17

Road Decommissioning

> "It is desirable to minimize the negative effects of roading within the LSRs, including a reduction in the amount of road related sediment within the watershed."
> Late Successional Reserve Assessment (LSRA) at 1-7.
>
> "Road densities within the LSRs should be assessed on the seventh field watershed scale. Generally, road densities below two miles per square mile are considered acceptable levels of risk. Two miles per square mile is a target to reduce toward, and does not imply increased road construction is acceptable in areas currently below that density."
> -LSRA at 1-8.
>
> "Reducing road densities on unstable lands within LSRs is likely to provide the greatest benefit to aquatic resources and is the highest priority."
> -LSRA at 1-22
>
> "The potential for adverse cumulative watershed effects (CWE) exists in some watersheds due to existing road densities."
> -Eddy Gulch DEIS at 3-166.

It is reasonable to develop and consider an alternative that would *reduce* the road density in the planning area. 3.18 . . .

Please note that page 3-116 of the DEIS states that "Mathews Creek, Shadow Creek, and Whites Creek are all rated as 'at risk' for road density, and Eddy Gulch is rated as 'not properly functioning for road density (road density is 4.44 miles/mile). 3.19 . . .

It is extremely troubling that all of the proposed "temporary" road construction is located in drainages that currently exceed 2.0 miles of road per square mile of forest. (DEIS page 3-133). 3.19 . . .

It is important to note that the Klamath National Forest's ongoing Travel Management Planning process states that needed road decommissioning will be addressed during site specific planning. The Eddy Gulch project is just such a site-specific opportunity. 3.20 . . .

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Current TMP process says the agency will implement Sub-part (a) of the travel rule (identify minimum sustainable transportation system) via site-specific projects rather than through the TMP EIS. Given the grand scale of the project area this is the watershed level time to do that.

The Forest Service cannot simultaneously refuse to implement Sub-part (a) of the travel rule at both the Forest and the Watershed scale. 3.20

As repeatedly acknowledged in the statements from the WA, road construction, road density and a lack of road maintenance are severely impacting the aquatic health of watersheds in the planning area. As stated in our scoping comments, rather than decrease road density as recommended in the WA and the LSRA, the DEIS calls for increasing the equivalent roaded area (ERA) through road and landing construction. 3.19 . . .

Hence the purpose and need (and the proposed action) arbitrarily limited the action alternatives so as to include road and landing construction while precluding needed road density reductions. 3.19 . . .

Please note that it appears that all temporary road construction would traverse through mature or late-successional forest stands in the LSR (DEIS page 2-11).

Please also note that implementation of an alternative that does not require new road construction would still allow for treatment of 24,894 of the 25,815 acres in the project. 3.18

Finally, we were very concerned to read that the project may authorize “alternate” road construction locations post-NEPA and post-decision. DEIS page 2-28. NEPA does not allow this. 3.21

Etna Summit Fuel Break

The Etna Summit fuel break is not a good idea. This unit is mostly a Northwest facing slope down to the creek. It does not meet the intent to target southerly slopes with prescribed fire that has been expressed by the Forest Service. It also has three NSO home territories. This area should be dropped as a FRZ. The Sawyers Bar Road should have the road-side, escape route prescription. 3.22

Roadside Hazard Trees

Please note that the entire project is located within the LSR land-use allocations, and is within designated NSO critical habitat. Large down wood is a habitat characteristic of late-successional forests. Please retain all large (>20” dbh) hazard trees that you fell as hazard trees. 3.23

Shasta Red Fir Stands

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Patch-scale tree mortality observed in the analysis area is consistent with historical stand development patterns recorded in other *Abies magnifica* forests unaffected by fire suppression or other silvicultural management. Stand development in red fir forest occurs both through episodic and continuous seedling recruitment, which is a function of periodic disturbance and the ability of red fir to colonize small gaps in the forest (Taylor and Halpern 1991). Red fir can establish in the partial shade of small canopy gaps or in the more severe microclimates of larger gaps (Selter et al. 1986). According to Agee (1993), the most important small-scale disturbances that promote red fir regeneration or the release of understory saplings include Indian paint fungus (*Echinodontium tinctorium*) or fir engraver beetle (*Scolytus ventralis*). Old-growth stands at Castle Point near Crater Lake featured red firs of various ages up to 525 years with a pronounced 30-to-60-year-old cohort that probably established in a group release after canopy gap creation by one or more such disturbance agents (Agee 1993). Thus, disease and beetle kill are intrinsic to the adapted gap dynamics of red fir forests.

The FEIS/ROD should address the findings contained in Chappell and Agee, 1996, Fire Severity and Tree Seedling Establishments in Abies Magniffica Forests, Southern Cascades, Oregon. Ecological Applications, Vol. 6, No. 2 (May, 1996), 628. **A copy of this study accompanies these DEIS comments.** 3.24

Chappel and Agee conclude that:

-The role of disturbance in the development and dynamics of red fir forests has been perplexing, in part, because of a seeming contradiction: red fir is both (1) shade-tolerant and self perpetuating, and (2) regenerates abundantly after some major disturbances, including fire and wind (Taylor and Halpern 1991).

-Regeneration in clearcuts is highly variable and often inadequate from a silvicultural perspective (Gratkowski 1958, Gordon 1970.)

-Red fir seedling establishment and growth is strongly related to periodic disturbance. The existence of episodic regeneration after disturbance does not preclude however, the simultaneous occurrence of a more continuous, slower mode of regeneration that allows red fir to perpetuate itself indefinitely (Taylor and Halpern 1991).

-Retention of a partial canopy after disturbance favors red fir seedling establishment. The resultant shade ameliorates drought stress, a key mortality agent for red fir seedlings (Gordon 1970, Ustin et al. 1984, Selter et al 1986).

-As Picher (1987) noted in the southern Sierra Nevada, fire suppression in red fir forests probably has not altered fuel loads or stand structure to a point outside the natural range of variability within a stand, as it has in lower elevation mixed conifer stands.

Our organizations believe these are important findings given that the Eddy Gulch project is proposing to log old-growth red fir stands with the LSR and CHU down to 32%

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canopy. (DEIS page 2-13). Please note that such logging would reduce the basal area of this stand to "approximately 20 to 30 percent below the late-successional habitat guideline" found in the LSRA.

Please further note that the Scott and Salmon Mountains NSO Critical Habitat Unit 25 is designed to "maintain habitat that provides the Primary Constituent Elements (PCEs)" of NSO habitat. Snags, CWD and large trees are elements of the CHU PCEs. Removing large tree canopy will result in degradation of the habitat functions of the CHU and the LSR. 3.25

Please note that §102 (e)(2) of HFRA directs the agency:

> "In carrying out a covered project, the Secretary shall fully maintain, or contribute toward the restoration of, the structure and composition of old growth stands according to the pre-fire suppression old growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health, and retaining the large trees contributing to old growth structure."

Hence our organizations believe that the intent of HFRA is to authorize and expedite projects that retain, rather than remove, big trees and old-growth forests such as those found in "decadent" red fir stands.

The proposed large-tree and canopy removal is all located within a Late-Successional Reserve. The purpose of the LSR is to provide the very habitat character (closed canopy, decadence, snags, CWD) that the red fir M unit logging would remove.

Riparian Reserves

Our organizations are very concerned by the proposal to conduct 69.5 acres of mechanical slashbusting mastication within riparian reserves (see DEIS 2-17). Why not manually treat these acres? 3.26 . . .

We are also perplexed by the statement on page 2-26 of the DEIS indicating that some trees greater than 20" dbh may be felled in "perennial stream channels or inner gorges." 3.26 . . .

We believe that slashbusting, and large tree felling, within designated riparian reserves violates both the intent and the letter of the Aquatic Conservation Strategy. 3.26

Cumulative Impacts

Future, present and the past management actions were not fully disclosed and analyzed in a comprehensive cumulative effects analysis. As acknowledged in the WA and LSRA, portions of the project area has been heavily impacted by past management activities as evidenced by the hundreds of acres of hazardous fiber plantations in the project area and the numerous roads located within riparian reserves that occur in the project area. 3.27

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Soils

"M units 21 and 24 (tractor) both currently exceed the 15% disturbance threshold." -Eddy Gulch DEIS, page 3-149. 3.28 . . .

"Presently M units 19, 21, 24, 35 and 36 fall well below the 70% desired ground cover standard and would likely see further reductions." -Eddy Gulch DEIS, page 3-153. 3.28 . . .

The Forest Service may only yard timber if the activity will be "carried out in a manner consistent with the protection of soil." 16 USC §1604(g)(3)(F)(v); 36 CFR §219.27(c)(6). Management plans and projects must "insure that timber will be harvested from National Forest System lands only where-"soil, slope, or other watershed conditions will not be irreversibly damaged." 16 USC § 1604(g)(3)(E)(i). By enacting this section, Congress intended that the Forest Service "provide empirical guarantees that timber harvesting will not damage soils, water conditions, and fish habitats."[1] 3.28 . . .

Further, the NFMA regulations require the "conservation of soil and water." 36 CFR §219.27. Section 219.27(a)(1) provides that "[a]ll management prescriptions shall-[c]onserve soil and water resources and not allow significant or permanent impairment of the productivity of the land." Section 219.27(b)(5) provides that "[m]anagement prescriptions that involve vegetative manipulation of tree cover for any purpose shall-[a]void permanent impairment of site productivity and ensure conservation of soil and water resources." Further, [c]onservation of soil and water resources involves the analysis, protection, enhancement, treatment, and evaluation of soil and water resources and their responses under management and shall be guided by instructions in official technical handbooks." 36 C.F.R. §219.27(f). 3.28

The DEIS at page 26 indicates that some skid trails may be located on slopes greater than 35%. Clearly this type of fudging does not allow the public or the decision maker to assess the cumulative impacts of the project. 3.29

Endangered, Threatened and Sensitive Species

"Project areas should be surveyed for the presence of Sensitive species before project implementation. If surveys cannot be conducted, project areas should be assessed for the presence and condition of Sensitive species habitat."
LRMP at 4-23.

"Management activities shall be compatible with the recovery of Endangered, Threatened (E&T) plants and animals."
LRMP at 4-36.

[1] Charles F. Wilkinson and Michael Anderson, Land and Resource Planning in the National Forests 161 (1987).

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"Collect information on Sensitive Species to assess population distribution and habitat associations…Inventory a portion of the suitable habitat each year. Assess conditions at occupied sites. Based on the assessment, use appropriate management techniques to maintain or enhance habitat suitability."
LRMP at 4-38.

The KNF must "seek to conserve E&T species and shall utilize its authorities in furtherance of the Endangered Species Act.
FSM 2670.11 ·

Northern Spotted Owls

As acknowledged in the DEIS, roadside thinning of hazard trees is known to degrade NSO habitat. 3.30

We are extremely concerned that units M-19 and M-69 are located in NSO cores within the LSR and CHU. Please note these units will substantially reduce forest canopy within the core areas. 3.31

Pacific Fishers

It is essential that surveys be conducted for Pacific Fishers and that the Forest Service disclose the impacts of the proposed project on Fisher *populations* and habitat. 3.32

On April 8, 2004, the U.S. Fish and Wildlife Service ("FWS") issued a decision finding that the listing of the Pacific fisher is warranted under the Endangered Species Act due to its imperiled status, but deferring action due to workload constraints (a "warranted but precluded" decision). FWS concluded in 2004 that the West Coast population of the fisher (the "distinct population segment" or "DPS") warrants listing under the Endangered Species Act. 69 Fed. Reg. 18769 (April 8, 2004). According to the FWS, "preliminary analyses indicate West Coast fisher populations ... may be at significant risk of extinction." Id. at 18789.

The FWS cites logging as one of the primary causes of fisher decline across the U.S. Id. at 18778. The FWS ultimately concluded that: "Federal, State, and private land management activities may affect key elements of fisher habitat; reduction of any of these key habitat elements could pose a risk to the fisher. Current regulations provide insufficient certainty that conservation efforts will be implemented or that they will be effective in reducing the level of threat to the fisher. We, therefore, believe that the existing regulatory mechanisms are not sufficient to protect the DPS as a whole from habitat pressures." Id. at 18792. 3.33

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The USFWS warranted but precluded findings contain a detailed review on the conservation status of the fisher, including a comprehensive analysis of threats to the continued existence of the species. 69 Fed. Reg. 18770, 18770 (April 8, 2004). For example, FWS noted that "habitat loss and fragmentation appear to be significant threats to the fisher. Forested habitat in the Pacific coast region decreased by about 8.5 million acres between 1953 and 1997." Id. at 18780. "Forest cover in the Pacific coast is projected to continue to decrease through 2050, with timberland area projected to be about 6 percent smaller in 2050 than in 1997." Id. "Thus fisher habitat is projected to decline in Washington, Oregon, and California in the foreseeable future." Id.

The FWS status review also discloses that "[v]egetation management activities such as timber harvest and fuels reduction treatments . . . can destroy, alter, or fragment forest habitat suitable for fishers." Id. at 18778. "A number of studies have shown that the fisher avoids areas with little forest cover or significant human disturbance and conversely prefers large areas of contiguous interior forest." Id. at 18773. "The fisher's need for overhead cover is very well documented. Many researchers report that fishers select stands with continuous canopy cover to provide security cover from predators." Id. "Fishers probably avoid open areas because in winter open areas have deeper, less supportive snow which inhibits travel, and because they are more vulnerable to potential predators without forest cover." Id. "Furthermore, preferred prey species may be more abundant or vulnerable in areas with higher canopy closure." Id.

In the annual Candidate Notice of Review, issued by the FWS each year, the FWS reiterated the concerns highlighted in the fisher's warranted but precluded determination, noting that "extant fisher populations are small and isolated from one another" and that "[m]ajor threats that fragment or remove key elements of fisher habitat include various forest vegetation management practices such as timber harvests…." 71 Fed. Reg. 53777 (Sept. 12, 2006).

Survey and Manage Species

Please be advised that should this project rely on the Bush Administration's illegal 2007 ROD eliminating the survey and mange program that it is highly likely that implementation of your project will be enjoined by a federal court. We would prefer that the agency take the necessary survey and manage steps to ensure that this project is not halted by the foreseeable injunction of the Bush Administration's 2007 ROD. 3.34

We note that your Land Resource Management Plan, the Northwest Forest Plan, the WAs and the Forest-Wide LSRA *all* rely on the assumption that the survey and manage program will be faithfully implemented.

Dwarf Mistletoe

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The DEIS "acknowledges that dwarf mistletoe, as a natural disturbance agent, plays a role in influencing both the structure and function of Forest ecosystems." Yet disclosure of the impacts of the proposed logging of large diameter trees to address mistletoe infection is completely lacking. Indeed the DEIS downplays the structure and function provided by dwarf mistletoe. This can be contrasted with the analysis provided by your colleagues in the Rogue River National Forest who initially proposed sanitation logging in the Big Butte Springs DEIS and decided to drop that ill-conceived proposal because their analysis concluded that: 3.35 . . .

> "Dwarf mistletoe provides a source of vertical and horizontal diversity through gap creation, and production of snags, brooms and down woody material. Many species of mammals, birds, and anthropods can take advantage of the favorable structure mistletoe infection provides, while other species use dwarf mistletoe plants or host tissues associated with infection for food."
> Rogue River National Forest, Big Butte Springs DEIS II-46.

As acknowledged above, Dwarf mistletoe provides a source of vertical and horizontal diversity through gap creation and production of snags, brooms and down woody material. Many species of mammals, birds, and anthropods can take advantage of the favorable structure mistletoe infection provides, while other species use dwarf mistletoe plants or host tissues associated with infection for food. These habitat benefits provided by mistletoe-infected trees, increase, rather than decrease, the value of residual old-growth trees and mature second growth trees. The DEIS does not analyze or disclose these habitat benefits. 3.35 . . .

Large snags are in severe deficit in this planning area. Please allow for snag recruitment by maintaining large mistletoe infected trees in the project area. 3.35

We Offer the Following Mistletoe Science to the Administrative Record of This Project:

Pollock, Michael M., Ph.D. Kieran Suckling. 1995. *An Ecologically Integrated Approach to Management of Dwarf Mistletoe (Arceuthobium) in Southwestern Forests.* Southwest Forest Alliance May 5, 1995.
http://www.sw-center.org/swcbd/Programs/science/mistltoe.html

Conklin, David A., *Dwarf Mistletoe Management and Forest Health in the Southwest* USDA Forest Service, Southwest Region.
http://www.forestpests.org/diseases/pdfs/dwarfmistletoe.pdf

Pennings, Steven C., and Ragan M. Callaway. 2002. *Parasitic plants: parallels and contrasts with herbivores.* Oecologia.

Geils, Brian W.; Cibrián Tovar, Jose; Moody, Benjamin, tech. coords. 2002. *Mistletoes of North American Conifers.* Gen. Tech. Rep. RMRSˆGTRˆ98. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 123 p.

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http://extension.usu.edu/forestry/Reading/Assets/PDFDocs/RMRS_GTR_098.pdf

Bennetts, Robert E., Gary C. White, Frank G. Hawksworth, and Scott E. Severs. 1996. *Dwarf Mistletoes: Biology, Pathology, and Systematics The Influence of Dwarf Mistletoe on Bird Communities in Colorado Ponderosa Pine Forests.* Agriculture Handbook 709. USDA Forest Service, Washington, DC. Mar 1996.

Maloney, P.E.; Rizzo, D.M. 2002. *Dwarf mistletoe-host interactions in mixed-conifer forest in the Sierra Nevada.* Phytopathology. 92(6):597-602.

Hawksworth, F. G. 1985. *Insect-Dwarf Mistletoe Associations.* P. 49-50, In, Proceedings Of The 36th Annual Western Forest Insect Work Conference, Boulder, Colorado. March 4-7, 1985. Northern Forestry Centre, Canadian For. Service, Edmonton, 54p.

Johnson, D. W.; Yarger, L. C.; Minnemeyer, C. D.; Pace, V. E. 1976. *Dwarf Mistletoe As A Predisposing Factor For Mountain Pine Beetle Attack Of Ponderosa Pine In The Colorado Front Range.* U.S. For. Serv., Rocky Mountain Region, Forest Insect And Disease Manage. Tech. Rept. R2-4, 7 P.

Conclusion

We believe that the intent of the Northwest Forest Plan, the Klamath LRMP, and the Healthy Forest Restoration Act, is to maintain and increase the amount of late-successional forest habitat located within Late Successional Reserves and NSO Critical Habitat. Hence we are concerned by proposals to log large diameter overstory trees within the LSR and CHU. 3.36

The purpose and need for this project could be met via a combination of prescribed burning, understory thinning, and road decommissioning. 3.9

We urge the Forest Service to follow the findings and recommendations contained in the WAs and the LSRA by avoiding new road construction and seeking to actively *reduce* road density in lands designated as LSRs and CHUs. Please begin to implement sub section (a) of the travel rule by identifying roads for decommissioning in this planning area. 3.19

Despite the concerns noted above, we think that on balance this project is headed in the right direction. We want to see the effects of Forest Service fire suppression on tree density and seral conditions addressed. We generally support small-diameter thinning projects and the use of prescribed fire. 3.37

We sincerely hope that the Forest Service will incorporate and address our reasonable concerns regarding portions of the proposed project.

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Thank you for considering these comments.

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Attachment 1 Comment Document #3

Joint Fire Science Program
Fire Science Brief
RESEARCH SUPPORTING SOUND DECISIONS

In the Groveland Ranger District of California's Stanislaus National Forest, a prescribed burn makes its way through the Granite Plantation that was planted after the 1973 Granite Fire (osprey pictured flying above the fire). Credit: L. Kobziar.

In Plantations or Natural Stands: Ponderosa is Programmed to Partner with Fire

Summary

Ponderosa pine plantation forests cover nearly 400,000 acres of California's National Forests. Fire hazard is extreme both within and adjacent to many of these areas which has led to extensive fuel reduction plans for plantations and other forests on federal public lands. Although fuels treatments have been implemented on a limited basis in California's plantations, the effectiveness of varying methods has only recently received scientific attention. This project analyzed the effectiveness of individual and combination treatments to provide science-based guidance for fire hazard reduction in these areas. Prescribed understory fire, both alone and combined with pre-burn mastication, was most effective for reducing surface fuels and potential fire behavior. Likelihood of active crown fire was reduced in masticated stands because bulk density was decreased. Predicted torching, tree mortality and flame length were higher in masticated units than in prescribed burn units and controls.

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Key Findings

- Prescribed understory fire was most effective at reducing surface fuel loads and decreasing modeled predictions of potential wildfire behavior and severity.
- Within one year of treatment, models predicted that some, but not all, components of wildfire behavior would be highest in masticated, unburned stands when compared to both burned and control units, and that they would likely remain high pending additional treatments or natural reduction of fuel loads from decomposition.
- Predictions of tree mortality were most severe for all tree size classes in masticated units under weather conducive to wildfire.
- Tree mortality following understory burning in masticated units is likely to be higher because deeper fuel beds cause trees to be subjected to greater direct and radiant heat for extended periods.

Will plantations reach their golden years?

In some regions and forest types, plantations are considered the most effective means of restoration after fire and are often planted in areas where fire is historically frequent. Plantations are structurally different than naturally occurring forest stands in that planted trees are evenly spaced and of similar age. In natural stands, trees of varying age are unevenly distributed.

But ponderosa in both arrangements share the same physical characteristics and potential lifespan and are subjected to similar environmental conditions—including the potential for ignitions and wildfire.

In California, hundreds of thousands of acres of plantation forests cover portions of the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Inyo, Toiyabe, Sierra and Sequoia National Forests. Fire hazard is extreme in and around many of these plantations—a result of high planting success rates, dense undergrowth, low summer fuel moisture, mountainous terrain, and frequent ignitions from lightning and recreational activity.

And the plantations, interspersed with fire-prone, second growth forests and flammable shrublands, are burning. Nearly 70 percent of the Groveland Ranger District (GRD) of the Stanislaus National Forest has been impacted by large, high severity wildfires since the 1970s. After the 1973 stand-replacing Granite Fire, the burned area was almost completely salvage logged and re-forested as a ponderosa and Jeffrey pine plantation. Today nearly 15,000 acres of the district are covered with dense, relatively young plantation stands, with the entire area in need of fuels reduction attention.

"We wanted to find out what we could learn in the process of giving it that attention," says John Swanson, Principal Investigator and former District Ranger for the GRD. He was more than ready for definitive solutions given the increasing frequency and extent of severe fire occurring under his jurisdiction, which makes up a quarter of the Stanislaus. Fuels treatments had been done in plantations, but they hadn't been scientifically studied. In addition to the lack of science there was a lack of time and resources to support treatment efforts. During the years following the Granite Fire, thinning took a back seat to more pressing demands and constraints. The GRD continued to get large, stand-replacing fires virtually every six years. Two thirds of the district was consumed by stand-replacing fires between 1973 and 2003. Staff was literally too busy putting out fires to get around to taking action that would reduce their negative impacts.

"Just when we'd be ready to turn our attention back to these plantations we'd get another big fire, and once again we had to focus not only on putting it out, but on salvage," Swanson laments. "It was very difficult to get back around to thinning. Plus, it required money. If you thin trees that are only 5 or 10 years old they have no commercial value to help defray operational expense. So we just had to have blind faith that the plantations wouldn't burn up before we could get to them."

"If you thin trees that are only 5 or 10 years old they have no commercial value to help defray operational expense. So we just had to have blind faith that the plantations wouldn't burn up before we could get to them."

Co-Principal Investigator and Assistant Professor of Fire Science at the University of Florida, Dr. Leda Kobziar, who along with Dr. Scott Stephens of the University of California, Berkeley, was responsible for all the on-the- ground work during the study, emphasizes the magnitude of the overgrowth. "There is at least a thirty-year accumulation of ground, surface, and aerial fuels, which is well outside of the historical range of variability for natural stands in that forest type. One of the sites I looked at had been burned and pruned in1990, but that was it. They had to do what they could with what they had over the last few decades. There had been no pre-commercial thin in the area and average tree diameter was 11 inches, so the plantations were very dense—about 350 trees for every two and a half acres."

Thirty years of surface fuel accumulation prior to treatment in the study area. Credit: L. Kobziar.

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The study was designed to help figure out which treatment methods were affordable and effective at making young plantations more fire-resilient, so that the trees can grow large enough to meet the need for wood and all the other values that forests provide.

"More fires are wiping out more vegetation and we're doing more and more replanting," continues Swanson. "As a result, managers in the West have to manage more and more young stands of trees, particularly ponderosa pine. We wanted to determine the point at which we can reintroduce fire and see what we have to do mechanically to make young plantations more fire resilient in a way that's environmentally acceptable, so these trees can grow to be 100 or 200 years old," Swanson says.

"In addition, we're constantly being challenged socially, professionally and in the courts to make sure that the work we propose to do is scientifically based," he continues. "This study provides some scientifically sound, documented, citable information that can be used in environmental analyses and decision making that will hold up under challenge."

No variability in the vulnerability

Natural stands of ponderosa pine owe their inherent fire resilience to variable tree age and stand structure. Young ponderosa pines—whether in natural or planted stands—have relatively thin stems and bark. The crowns are close to the ground, and grass and brush grow around them at the same height. For the first couple of decades, the crowns are well within reach of a flaming front and very vulnerable. As trees mature their trunks and bark thicken, providing some fire-resistant girth and insulation. In a natural ponderosa system, staggered tree spacing and age creates a patchy, irregular mosaic of old and young trees. Over time, a clumpy pattern emerges with both dense areas and open spaces within the stand. The combination of uneven spacing and a broad range of tree ages help to insure the survival and persistence of the stand in the face of periodic fire.

In plantations, trees are all the same age and size, and evenly spaced. Thus, they lack the structural variability that provides fire resilience in natural forest stands. Credit: L. Kobziar.

Once trees have managed to reach the age where they have some fire-resistant qualities many of them will survive wildfire and continue growing taller, stronger and more fire-resistant. Fire will kill most thin-stemmed, thin-barked young trees. But the resulting space and sunlight paves the way for another generation to give life a try, naturally seeded by their surviving, more mature predecessors.

But plantations are crops. Trees are all the same age and size. If fire comes through when they're young they all go up in smoke. Increasingly this is happening when they are less than a quarter of the way through their life span. And once again, managers have to reforest from scratch.

Prescribed fire finishes first

The study took place between 2001 and 2006 in the 25–30 year old ponderosa/Jeffrey pine plantations that were established after the 1973 Granite Fire. All of the study stands were similar in aspect, slope, and soil type and were between 12 and 200 acres in size. Treatments included mastication alone (of understory vegetation and all trees less than 9 inches in diameter), mastication followed by understory prescribed fire, understory burning without prior mastication, and untreated control. Mastication took place in 2003 and early 2004 to decrease density and remove suppressed, diseased, or otherwise weakened trees. Understory shrubs and trees were also masticated, and residual slash was left on site. All burns took place in late June, 2005. Post-treatment data was collected within five months of mastication, and within three months of prescribed burning. Treatment effectiveness was evaluated using the fire modeling program—Fuels Management Analyst. It provides not only fire behavior predictions, but assessments of tree-level fire severity.

Prescribed fire proved to be the most effective fuels reduction technique in both masticated and un-masticated plantation stands. Understory burning alone or following mastication was most effective at decreasing predicted wildfire behavior and increasing fire-resilience, when compared to controls. Prescribed burned units had the lowest predicted tree mortality in all tree size classes. In addition, actual tree mortality was lower in burn only units than in units which had been masticated prior to prescribed burning. In both cases, prescribed fire-related tree mortality was within prescribed limits.

To assess the accuracy of modeled predictions, actual fuels and weather characteristics for the prescribed burns were used to predict fire behavior and effects. Model predictions of fire behavior were similar to actual fire behavior, while tree mortality was within 8 percent and 15 percent for masticated and burn only stands, respectively.

Mastication problematic for short-term

No other treatment proved to be less effective at reducing fuel loads than the use of mastication alone. For this treatment the researchers modeled tree mortality from hypothetical subsequent fire under moderate, high and extreme wildfire weather conditions. The model predicted loss of nearly all trees less than 12 inches in diameter, with overall losses averaging almost half of the stands. Mastication resulted in a higher potential for torching than controls, even with the decreased crown bulk density. Rate of fire spread was lower in masticated stands than in controls, but longer flame lengths contributed to a higher degree of predicted torching, and burned units had even lower rates of spread. Mastication opened up space between larger trees reducing predicted active crown fire, but neither this nor the increase in height to crown base offset the contribution of slash and its influence on wildfire behavior and high predicted tree mortality.

Conditions in masticated area prior to burning. Credit: L. Kobziar.

Kobziar explains that in the short-term, mastication increases surface and ground fuel loads. This makes both torching and internal damage to trees more likely if wildfire were to occur because the fire takes longer to consume the extra fuel and gives off more heat.

"Generally speaking, the faster a fire moves the shorter the residence time, or the duration of time that combustion is taking place in a given location. The increase in available fuels from mastication contributes to a longer residence time for fire. When this increased amount of fuel burns it exposes trees to a lot of heat which can injure or kill younger trees that lack sufficient bark thickness to protect them."

A prescribed underburn works its way through masticated fuels. Credit: L. Kobziar.

Swanson emphasizes however, that the mastication results should be viewed within the context of the short-term nature of the study. The resulting surface fuels were burned relatively soon—just over a year following mastication. Natural decomposition and compaction from snow during heavy winters would likely decrease potential fire behavior in these areas over several years.

Kobziar points out the possibility too, that the benefits of increased spacing created by mastication may eventually outweigh the negative effects of increased surface fuels, but no one knows how long that might take. "That's one of the missing pieces of information. How long will it take for those increased surface fuels to compact and decompose to the point where potential fire behavior is no longer increased in relation to pre-treatment conditions? We still need to know what that long term tipping point is." Until then the fuel bed will have lots of surface area and air flow conducive to ignition.

Pushing the envelope to save the farm

"Where we used prescribed fire, whether in previously masticated stands or areas that weren't thinned beforehand, we got the best results in terms of cleaning up the ground litter and fuels," Swanson says.

But in this forest type, when you add prescribed fire to the treatment mix you're likely to kill more trees. "Maybe even a bunch," Swanson continues. "But you're going to have a more thorough reduction in fuels. Then, when a wildfire comes through under bad conditions you'll lose a lot less in a stand that was treated with prescribed fire. Where you've thinned and under-burned you'll have better results in terms of the forest being there after the smoke has cleared."

"Where you've thinned and under-burned you'll have better results in terms of the forest being there after the smoke has cleared."

"When we burned we were pushing the edge of the envelope to find out where the edge of the envelope was," says Swanson. "We burned under some hotter conditions than we would normally specify in an operational context. We clearly stated in our burn plan that we would accept a higher level of tree mortality than we would on an operational basis. If we had only burned when it was nice and cool and gentle and damp we wouldn't have learned much."

What they learned was that operationally, it may be time to consider looking beyond low tree mortality as a measure of success for prescribed fire. Swanson points out that in a natural, Sierra ponderosa pine fire regime it would not be unusual to see 20 percent tree mortality in a wildfire, in relatively big patches in some cases.

Prescribed fire moving through a portion of the study area that was not pretreated.

"Today from the perspective of a National Forest manager, if you completely torch half an acre of ponderosa pine during a prescribed fire—it takes your breath away. Traditionally we'd say, 'My God we've really done something wrong here.' But if we apply a historical, long-term perspective it's really quite ecologically acceptable. That kind of effect is well within the historical range of variability in natural ponderosa pine forests. There are important ecological benefits to having holes punched in the canopy like that." Those benefits include recreating components of the natural, historical relationship between fire and ponderosa pine, and the diverse, fire-resilient forest structure it brings.

Attachment 1 **Comment Document #3**

Relatively large areas of scorched and dead trees are well within the historical range of variability in natural ponderosa pine forests, and so may be an acceptable outcome of prescribed fire. Credit: L. Kobziar.

So there may be much to learn about the possible benefits of effects that have traditionally been viewed from the management perspective as error, or something to avoid. It all depends on management objectives—which are becoming increasingly diverse.

Management Implications

- Across all size classes, prescribed burning resulted in 4 and 13 percent tree mortality in the masticated and burn only units, respectively. Following prescribed burning alone and after mastication, wildfire-induced mortality predicted by the model averaged 15 percent.
- In contrast, predictions of wildfire-induced mortality in pre-treatment and control stands exceeded 60 percent on average.
- Given prescribed fire tree losses, the burn treatment still results in stands which are twice as resistant to wildfire-induced tree mortality.
- Results can be immediately incorporated into adaptive management strategies to help managers reach fire hazard reduction goals.

Expense and trade-offs

In the study, personnel costs for prescribed burning were relatively high because of the perceived risks and the small size of the burn units. Cost per acre for burning would go down significantly for larger scale, operational burns under more moderate conditions. The overarching question remains: Is effective fuels treatment less expensive than the fire that could result from doing nothing, or doing something unproven, in an overgrown plantation?

"That's really hasn't been answered yet," Kobziar says. "With the complexities involved in trying to predict whether wildfire is going to occur in a given place at a given time—it's really hard to conduct that cost/benefit evaluation for fuel treatments. This is something that we fire scientists really need to work together on, to provide the missing pieces to better inform management practices for effective wildfire mitigation."

Follow-up inquiry is needed in several areas including potential for post-treatment insect infestation, disease, and the potential contribution of scorched crowns and dead snags to future fire behavior. In terms of reducing potential fire behavior, mastication (including small trees) has positive effects on stand structure because density is reduced, but fuel loads and continuity are increased, particularly for the first several years. The relative ecological impacts of different manipulations must be taken in to account too.

"I hope that others will build on this because there is a lot more to be learned," adds Swanson. "We need more knowledge so we can continue to make good sound, defensible decisions."

Manage fire-adapted species with fire

The project was a successful collaborative effort, and included a monitoring team comprised of representatives from local environmental, industry, and Native American groups. Fifteen permanent plantation forest research sites were established, and are now demonstration areas for technology transfer to professionals and for the education of students and the public.

"The salient point for me is that we need to manage fire-adapted species with fire, regardless of whether the structure is natural or artificial," concludes Swanson. "We can pretend to substitute for it by thinning mechanically but ultimately until we get fire back into fire-adapted ecosystems we're not doing the full professional job. The Joint Fire Science Program allowed us to examine and quantify the return of fire, as well as the efficacy of pre-prescribed burning treatments in a way that hadn't been done before. That's the real value of the study."

Further Information: Publications and Web Resources

Final report: http://www.firescience.gov/projects/00-2-30/00-2-30_final_report.pdf

Fuels Management Analyst Plus (Don Carlton): http://www.fireps.com/software/ug_fma.pdf

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Scientist Profiles

John R. Swanson retired after 35 years with the USDA Forest Service, He is now Assistant Fire Chief for the East Bay Regional Park District in Oakland, California. During his years with the Forest Service he worked primarily in forest fire and timber management in the West. He served on several regional and national incident management teams and provided technical fire management assistance to numerous countries in Latin America, Europe as well as in Australia.

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Attachment 2 Comment Document #3

LETHAL SOIL HEATING DURING BURNING OF MASTICATED FUELS: EFFECTS OF SOIL MOISTURE AND TEXTURE

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INTRODUCTION

The potential for soil damage during burning of masticated fuels is substantial. Recent evidence suggests that temperatures between 100 and 300 ^{o}C in the upper soil horizon may result if masticated fuel beds are ignited (Busse et al. 2005). Of immediate concern is the survival of roots and soil organisms. The lethal threshold for roots is approximately 60 ^{o}C while that of many soil organisms is between 50 and 200 ^{o}C (Neary et al. 1999).

Whether soil temperatures will unavoidably exceed these thresholds when masticated fuels are burned is not clear. Heat transfer in soils is a complex process regulated by numerous soil physical properties (moisture, texture, porosity, pore continuity) and fuel characterisitics (mass, size class, moisture, surface area, structural arrangement). Our previous study examined only a limited set of these conditions, leaving doubt as to the true potential for soil heat transfer during burning (Busse et al. 2005). Here we expand the previous findings by assessing soil moisture and soil texture as regulators of heat transfer. Our overall objective was to provide managers with a comprehensive predictive model of soil heating that encompasses most soil and fuel conditions. Results are presented from a replicated experiment testing the effects of soil moisture (from maximum water availability to dry summer conditions) and texture on temperatures in the upper soil profile during burning of masticated fuels. In addition, validation results from several field burns of masticated fuel beds are summarized.

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METHODS

Forty-eight controlled burns were conducted on the grounds of the Redding Silviculture Laboratory in Redding, CA. Factorial treatments included three soil textures (pumice sand, loam, clay) in full combination with four soil moisture contents (approximately 10, 20, 30, and 40% on a volumetric basis). The moisture contents were equivalent to water potentials of -3.0; -0.3; -0.1; and -0.01 MPa, respectively. Four replications of each treatment combination were included.

Soil temperatures were measured at 0, 1, 2, 4, and 6 inch depths in undisturbed soil using thermocouples (K type) connected to temperature data loggers. Large intact soil cores (12 inch diameter, 6 inches high) were collected from field sites representative of the three soil textures. Upon return to the Redding Lab, the cores were saturated with water and allowed to dry slowly to the desired moisture contents. When ready, each core was placed in the center of a 10.8 ft^2 plot and packed with loose soil, filling the entire plot except for a narrow opening to allow access for installing the thermocouples horizontally into the center of each core. Soil was then gently filled in the small opening with minimal disturbance to the thermocouple wires. Masticated residues (60 tons/acre) were added to the soil surface at a bulk density matching the conditions found at our field sites (8.42 lbs/ft^3) immediately before igniting the downwind side of the fuel bed.

Air temperature, relative humidity, wind speed, wind direction, flame length, and rate of spread were recorded during each burn. Soil temperatures were measured for 24 hours following ignition, providing sufficient time for the soils to recover to ambient temperature. Data from all burns were used in multiple regression analysis to predict maximum soil temperature as a function of soil moisture, soil texture, soil depth, and heat load (degree hours above the ambient temperature at 1 inch soil depth).

Soil temperatures were also measured during field burning of masticated residues to validate the results of our controlled burns. Four experimental units (~ 1 acre each) were burned in spring 2005 at the Challenge Experimental Forest and an additional four units were burned in spring 2006 near Whitmore, CA. The units had been masticated for control of understory shrubs and trees 2 to 3 years prior to burning. Thermocouples were placed at 0, 1, 2, and 4 inches in the soil profile at multiple locations within each unit prior to prescription burning. Fuel load, fuel moisture, and soil moisture in the vicinity of each thermocouple station were recorded prior to burning.

RESULTS AND DISCUSSION

Maximum temperatures on the soil surface ranged from 350 to 1080 ^oC during burning. As expected, an incremental drop in temperature was found with increasing soil depth. Temperatures ranged from 43 to 370 ^oC at 1 inch; from 35 to 308 ^oC at 2 inches; from 29 to 74 ^oC at 4 inches; and from 27 to 51 ^oC at 6 inches.

Soil temperatures were strongly affected by soil moisture but not by soil texture. An example of the influence of soil moisture on heating is presented in Figure 1. Regression analysis identified soil moisture ($p < 0.0001$), soil depth ($p < 0.0001$), and surface heat load ($p < 0.0001$) as significant independent variables. In contrast, soil texture was not signficant ($p = 0.872$). The

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final model in stepwise regression analysis provided a good prediction of soil temperature (r^2 = 0.77) and was applicable for all soil textures: ln (temperature) = 4.689 – (0.196*soil depth) – (1.06*soil moisture) + (0.00038*heat load), where heat load is the degree hours above ambient temperature at a depth of 1 inch in the soil profile. This dampening of heat transfer by soil moisture supports previous studies of natural fuels that emphasize the importance of burning when soils are moist in order to avoid excessive temperatures (Frandsen and Ryan 1986; Valette et al. 1994).

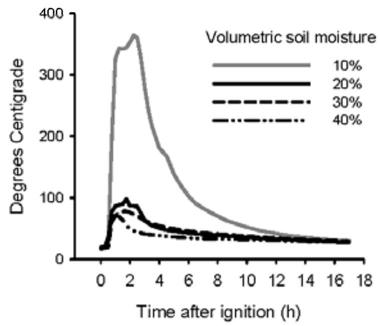

Figure 1. Effect of soil moisture on maximum soil temperature. Response curves are for the pumice soil at a soil depth of 1 inch and a masticated fuel load of 60 tons/acre.

Results from our experiment were limited to a single fuel load of 60 tons/acre, and are thus fairly confined in their practicality. To address this limitation, we combined the experimental results with previous findings of soil heating (Busse et al. 2005) to develop soil temperature response curves for a broad range of fuel loads (Figure 2). These data confirm that lethal temperatures (> 60°C) are mostly superficial when soils are moist. Temperatures exceeded the lethal threshold only to a depth of 1-2 inches in moist soil regardless of fuel load, yet surpassed this threshold to a depth of 4-6 inches in dry soil. In addition, the temperatures in dry soil were highly responsive to increasing fuel loads, whereas moist soils only showed a slight response. We are currently testing a range of fuel moistures and fuel materials in order to expand our predictive model.

From a practical standpoint, these results suggest that most roots and soil organisms will be unaffected by burning of masticated fuels in all but the driest of soils. Burning when soils are moist (> 20% volumetric moisture) should inhibit damaging temperatures below 1 to 2 inches in the mineral soil. On the other hand, wildfires or prescribed fires may produce considerable soil heating when soil moisture is low. Results from our field burns support this concept. Eight spring burns were conducted when soils were moist, ranging from 18 to 45% volumetric soil moisture content. Corresponding soil temperatures in nearly all cases were well under the lethal threshold, averaging 36 °C at 1 inch and 28 °C at 2 inches in the mineral layer.

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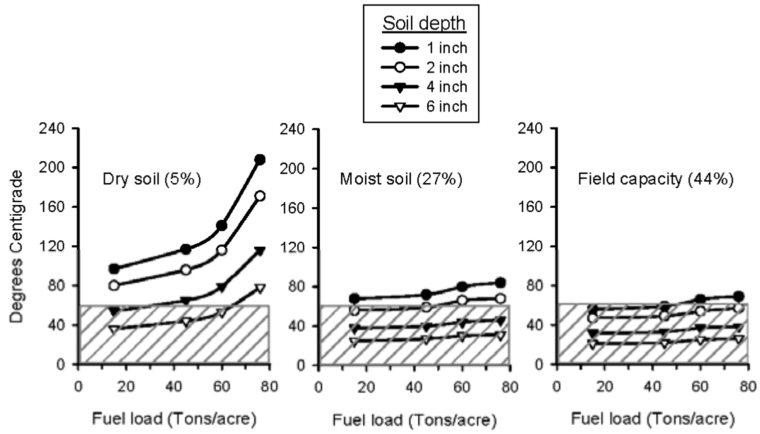

Figure 2. Predicted maximum soil temperatures during burning of masticated fuels as a function of soil moisture, soil depth, and fuel load. The gray-shaded area in each graph represents sub-lethal temperatures for roots. Volumetric soil moisture content is shown in parentheses in the graph titles. Field capacity is equivalent to the maximum available water content found within 24 hours of a saturating rainfall.

SUMMARY AND CONCLUSIONS

We developed a predictive model of soil temperature maxima during burning of masticated fuels. The model was well explained by three factors: soil moisture, soil depth, and fuel heat load. Soil texture, in contrast, was unrelated to the temperature profiles, suggesting a single model is applicable for all tested soils (pumice sand, loam, clay). Soil moisture as low as 20% by volume was sufficient to quench soil heating and inhibit the progression of lethal soil temperatures below the surface inch. Thus, burning of masticated fuels when soils are moist is recommended to avoid damaging roots and soil organisms.

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Bird community composition after mechanical mastication fuel treatments in southwest Oregon oak woodland and chaparral

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ABSTRACT

To evaluate ecological effects of vegetation management in southwest Oregon oak woodlands and chaparral, we compared bird abundance and vegetation structure at four untreated stands and four stands where shrub cover had been reduced by using mechanical mastication thinning. Treated stands had less shrub cover than untreated stands. Three bird species were consistently more abundant on untreated stands. Species that were more abundant on untreated stands were associated with shrub cover, while those that tended to be more abundant on treated stands were associated with open areas, providing further evidence that the treatments were responsible for the observed differences in bird community composition. These results demonstrate a stronger response of shrub-associated species than was documented in an earlier study of smaller-scale shrub removal treatments. This difference suggests that managers can design treatment prescriptions that benefit particular species by altering the size and shape of project areas as well as the tools that are used to reduce shrub cover (e.g., mechanical vs. manual treatments).

1. Introduction

Biodiversity and ecosystem function may be closely linked to historical fire regimes. These regimes have been altered by fire suppression policies implemented in the 20th century (Agee, 1993). In an attempt to restore fuel conditions created by historical fire regimes, management agencies are using prescribed fire, mechanical fuels treatments, and forest thinning to mimic the effects of natural fire (Stephens, 1998). The ability of these management activities to mimic the effects of natural fire on habitat structure and animal populations is not well understood (Tiedemann et al., 2000; Huff et al., 2005). In some cases, these treatments appear to have the desired effect of increasing the abundance of bird species that are associated with post-fire habitat conditions (Siegel and DeSante, 2003; Alexander et al., 2007). However, in other cases such treatments may fail to create the range of habitat conditions used by birds after naturally occurring wildfires (Smucker et al., 2005; Seavy and Alexander, 2006).

In oak woodlands and chaparral of southwest Oregon and northern California, fires are believed to have been common and to have played an important role in the maintenance of these communities (Agee, 1993). Because fires in these habitats may damage homes, property, and natural resources, fires have been effectively suppressed over the last 50 years. As a result of fire suppression, these habitats are believed to be changing or disappearing (Huff et al., 2005). In an attempt to reduce the risk of severe fire, while maintaining oak woodland and chaparral communities, managers are increasingly using mechanical fuels reduction in these habitats. By reducing canopy cover of shrubs and creating open areas without vegetation, these treatments are primarily designed to slow the rate at which fires spread, reduce the intensity with which they burn, and increase firefighter safety. The degree to which these treatments can help restore desired ecological conditions remains uncertain (Purcell and Stephens, 2005; Perchemlides et al., 2008).

In a previous study (Alexander et al., 2007), we compared bird abundance in areas where shrub cover had been reduced by hand on relatively small plots (7–42 ha) and untreated areas. In this study, six bird species were more abundant on the treated plots. These species were mostly those associated with open conditions or forest edges. Surprisingly, there was little evidence that species associated with shrubs were less abundant in the treated areas. We hypothesized that their ability to persist in the treated areas was

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facilitated by the small size of the treatment areas and the maintenance of untreated areas within treatment stands (0.4–1.2 ha). Since this study was conducted, larger-scale shrub removal treatments using heavy equipment have been implemented. We hypothesized that because these treatments are larger and leave a smaller proportion of the area untreated, the effects on shrub-associated birds would be greater. To test this hypothesis, we compared vegetation structure and bird abundance over a 2-year period in treated and untreated stands. The objectives of this project were to (1) describe the differences in vegetation structure and bird community composition and (2) compare these differences with those that were described in the previous study of smaller-scale treatments in the same habitat.

2. Study area and methods

2.1. Study site and fuels treatments

The Bureau of Land Management Medford District is responsible for over 14,000 ha of oak woodlands, shrublands, and grasslands on public lands in the Applegate Valley of southwestern Oregon. Collectively, we refer to these vegetation types as "oak woodland and chaparral", a term that encompasses hardwood-dominated vegetation at more mesic sites and shrub or grass-dominated vegetation at more xeric sites. Common tree species include oaks (mostly *Quercus garryana* and *Q. kelogii*), *Arbutus menziesii*, and conifers, predominantly *Pinus ponderosa* and some *Pseudotsuga menziesii*. Major components of the shrub layer are *Ceanothus cuneatus*, *Cercocarpus betuloides*, *Arctostaphylos viscida*, and *Toxicodendron diversiloba*. Mesic oak woodlands may show greater canopy closure of *Q. kelogii* or *P. menziesii*, while drier non-clay dominated sites show increased domination by the shrub component. In formerly open areas, fire suppression is believed to have shifted the vegetation towards closed canopies, dense shrubs, and a poorly developed herbaceous community and raised a concern that high fuel-loads of these conditions will lead to intense fires causing ecological and economical damage. A detailed account of the vegetation community, fire-history, and restoration activities in the study area is provided by Hosten et al. (2006).

The BLM has identified desired future conditions that incorporate a reduction of fuel-loads and the creation of a range of vegetation conditions across the landscape. To achieve these conditions, the BLM is developing prescriptions that reduce fuels using mechanical mastication. We studied four untreated stands (52–412 ha, average = 158 ha) and four treated stands (95–173 ha, average = 121 ha) where shrub cover had been reduced. Although treatment prescriptions varied with stand condition and management objectives, in all stands trees and shrubs were fragmented to ground-level with a mechanical masticator, also referred to as a slashbuster. These masticators were modified track mounted (ca. 3.0 m wide from edge to edge) excavators with a rapidly spinning toothed "masticating head" that can grind shrubs and small trees. The soil surface at treated stands showed more than a 16% increase woody debris (>1 cm in diameter) cover compared to paired untreated stands (Perchemlides et al., 2008). The mean stem density of shrubs and trees taller than 1 m was reduced from 40 to 3.3 stems per 100 m^2 of treated area. Ten to fifteen percent of the project areas were left untreated to preserve wildlife habitat and create structural heterogeneity. Untreated patches usually coincided with areas that were inaccessible to the mechanical masticator or met specific wildlife habitat needs. Mechanical mastication treatments were conducted by contractors hired by the BLM. The woody material that was removed was not merchantable in traditional markets, and no effort was made to find alternative markets.

Table 1
Characteristics and sample sizes for treated and untreated oak woodland and chaparral units located in the Applegate Valley, Oregon

	Treatment type	Year treatment completed	Area (ha)	No. of stations
Treated units				
T1	Mechanical mastication	2001	173	16
T3	Mechanical mastication	2002	103	16
T5	Mechanical mastication	2003	114	20
T9	Mechanical mastication	2000	95	16
Untreated patches				
C4			412	25
C6			97	9
C7			71	9
C8			52	12

2.2. Sampling design

Our objective was to compare bird abundance between treated and untreated areas with a design that included heterogeneity in treatment size, timing, and intensity. Treated stands were selected for mastication by the BLM based on treatment priorities and logistical constraints. Treatment of these study stands was completed between 2000 and 2003 (Table 1). Because we were unable to collect pre-treatment data that could be used in a before-after-control-impact study design (Osenberg et al., 1994), we compared the bird abundance at stands 1–5 years after treatment to untreated stands that were chosen because they were similar to the pre-treatment conditions of the treated stands. We selected untreated stands with vegetation characteristics similar to the pre-treatment characteristics of treated stands using BLM maps of ortho-photo derived plant community designations. Four untreated stands ranged from 52 to 412 ha, averaging 158 ha per stand (Table 1). Using a randomly placed grid overlay, we mapped out locations of point count stations in stands. Stations were spaced >150 m apart and were located more than 75 m from stand boundaries or habitat edges. Sixty-eight stations were placed in treated stands (16–20 stations per stand) and 55 in untreated stands (9–25 stations per patch; Table 1). We used Arcview GIS (Version 3.2a) to identify point count station locations with UTM coordinates. In the field, we used GPS units (Garmin GPS 12 XL) to locate point count stations. Field data were collected between 9 and 17 June in 2004 and between 8 and 24 June in 2005.

2.3. Measuring habitat structure

Vegetation composition and structure were measured at all point count stations, in 2004. We used a relevé method to collect vegetation data at each station on 50 m radius plots (Ralph et al., 1993). Within these plots, we recognized three vegetation layers: a tree layer (generally >5 m), shrub layer (generally >0.5 m and < 5 m), and herb layer (<0.5 m). For each layer, we visually estimated total cover of all vegetation and recorded the estimate as the center point of one of six cover classes (0, 0–5, 5–25, 25–50, 50–75, and 75–100%). Additionally, we estimated species-specific cover values (using the same cover categories) for dominant plant taxa in each of the three strata. As an index of shrub cover for each plot, we summed the shrub-strata cover values for four common shrub taxa: *Ceanothus* spp., *Cercocarpus betuloides*, *Arctostaphylos viscida*, and *Toxicodendron diversiloba*.

2.4. Measuring bird abundance

Point counts were conducted at all stations, once in both 2004 and 2005. Bird abundance was evaluated using standardized point count methodologies (Ralph et al., 1993). 5-Minute bird counts were conducted between sunrise and 1000 PDT on each station, and all landbird species seen and heard within 50 m of the observer were recorded. Flyover detections were excluded from the analysis. Counts were conducted only on days when the wind was <20 kph and it was not raining. All observers were experienced and had been trained for distance estimation and species identification.

2.5. Statistical analyses

All statistical tests were conducted in SAS (Version 6.12) and results were considered significant when $P < 0.05$. To compare vegetation characteristics between treatment and control stands, we averaged across stations within stands and considered stands as independent samples. We compared cover scores of treated and untreated stands using a Wilcoxon's rank-sum test (Zar, 1999). Tests of tree cover were two-tailed, as there was no a priori prediction for the difference in scores. In contrast, one-tailed tests were used for herb cover (greater cover predicted in treated areas) and shrub cover (less cover predicted in treated areas) because the treatment prescriptions were clear about the desired conditions after treatment.

We limited our comparison to species that had an average abundance >0.1 individuals per station in at least one treatment by year combination. We used generalized linear models (hereafter GLM) (Crawley, 1997; Seavy et al., 2005), with Poisson distributions and log links, to evaluate if bird abundance varied between treatments or years. We fit models with year, treatment, and treatment × year interaction parameters. Because points within stands were pseudoreplicated measurements of the same habitat conditions, we used generalized estimating equations (PROC GENMOD) (Hardin and Hilbe, 2003) that included stands as clusters with repeated measurements (stations) to generate parameter estimates with accurate confidence intervals. We fit these models using independent correlation structures, which are recommended for experimental designs with fewer than 30 clusters (Hardin and Hilbe, 2003). Type III Wald tests were used to evaluate whether or not treatment, year, or year × treatment interaction contributed significantly to the model. Studies with small sample sizes may suffer from relatively low statistical power and a high probability of committing Type II errors (concluding no difference when in fact one exists) (Walshe et al., 2007). To ameliorate the potential of Type II errors, we focus on species with treatment effects with $P < 0.05$, but we also discuss species with treatment effects with $P < 0.15$ and without evidence of year × treatment interactions. However, we caution that these differences should be treated as highly uncertain. Because GLMs cannot estimate parameters when one category has zero detections, we were unable to use this method to make inferences for species with no occurrences in one of the treatments during one of the years. Because we did not correct for detectability, our point count results represent an index of abundance rather than true density. We assume that the ability of an observer to detect birds within 50 m was equivalent in treated and control areas (Schieck, 1997; Siegel and DeSante, 2003).

3. Results

3.1. Vegetation structure

There was no evidence that treated and untreated stands differed in total tree (Wilcoxon's $Z = -0.45$, $P = 0.653$) or herb cover (one-tailed Wilcoxon's $Z = 1.08$, $P = 0.139$; Fig. 1). As expected, untreated stands had greater total shrub cover (one-tailed Wilcoxon's $Z = 1.93$, $P = 0.026$) and shrub cover index (one-tailed Wilcoxon's $Z = 1.90$, $P = 0.029$) than treated stands (Fig. 1).

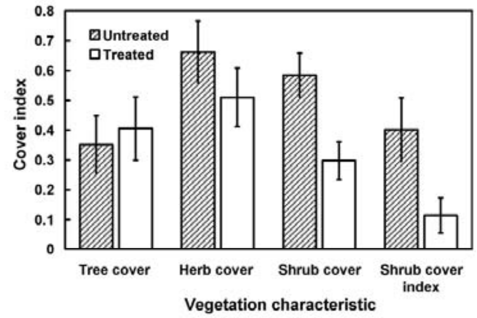

Fig. 1. Characteristics (mean, ±S.E.) of vegetation structure of treated ($N = 4$) and untreated ($N = 4$) units in oak woodland and chaparral habitat of the Applegate Valley, Oregon measured in 2004. Tree, shrub, and herb cover were measured at each station using categorical cover values. Shrub cover index was generated for each station by summing cover scores of six shrub taxa on each plot (see text for species). Unit scores were calculated as the mean of the station scores within each unit (see Table 1 for number of stations per unit). Shrub cover and shrub cover index were significantly ($P < 0.05$) greater at untreated stations.

3.2. Bird abundance

We detected 22 bird species with sufficient frequency for analysis (Table 2). Bewick's wren (*Thryomanes bewickii*) and wrentit (*Chamaea fasciata*) were consistently less abundant at treated stations in both years of the study (Table 2). Black-headed grosbeak (*Pheucticus melanocephalus*), lazuli bunting (*Passerina amoena*), and western scrub-jay (*Aphelocoma californica*) had significant year × treatment interactions, indicating that differences between treated and untreated stand varied between years. Black-headed grosbeak was more abundant at treated stations in 2004, but there was little difference in abundance in 2005. The lazuli bunting was equally abundant in treated and untreated stands during 2004, but more abundant at treated stands in 2005. Western scrub-jay was more abundant at the untreated sites in both 2004 and 2005, but the magnitude of the difference was much greater in 2004 (Table 2). Because the sample size was relatively small, species with treatment effects approaching statistical significance ($P < 0.15$) and without evidence of year × treatment interactions also merit mention: California towhee (*Pipilo maculatus*) was less abundant at treated stands in both years, and dark-eyed junco (*Junco hyemalis*) and western tanager (*Piranga ludoviciana*) were consistently less abundant on untreated stands in both years.

4. Discussion

4.1. Vegetation structure

Differences and similarities in vegetation structure of treated and untreated plots were consistent with the desired effects of the fuels reduction prescriptions on vegetation; treated stands had less shrub cover but similar tree cover relative to untreated stands (Fig. 1). These results are generally consistent with a more detailed comparison of the vegetation at these sites (Perchemlides et al., 2008). However, in their comparison, Perchemlides et al. (2008) documented greater herbaceous cover on the treated sites. These authors also documented greater wood debris cover, more burn scar cover, and more regeneration of *A. viscida* and *C. cuneatus*, and

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Table 2
Mean abundance (individuals per station) of bird species detected in treated (62 stations clustered in 4 stands) and untreated (53 stations clustered in 4 stands) oak woodland and chaparral of the Applegate Valley, Oregon

Species	Abundance				χ^2/d.f.	*P*-values		
	Treated 2004	Untreated 2004	Treated 2005	Untreated 2005		Treatment	Year	Treatment × Year
Acorn Woodpecker, *Melanerpes formicivorus*	0.01	0.04	0.00	0.11	NA			
American robin, *Turdus migratorius*	0.12	0.09	0.16	0.13	1.65	0.78	0.27	0.95
Ash-throated flycatcher, *Myiarchus cinerascens*	0.09	0.13	0.15	0.07	1.06	0.77	0.95	0.16
Bewick's wren, *Thryomanes bewickii*	0.07	0.24	0.09	0.53	0.99	0.03	0.03	0.18
Blue-gray gnatcatcher, *Polioptila caerulea*	0.25	0.33	0.24	0.40	1.25	0.45	0.71	0.48
Black-headed grosbeak, *Pheucticus melanocephalus*	0.25	0.09	0.24	0.20	1.03	0.28	0.05	0.02
Black-throated gray warbler, *Dendroica nigrescens*	0.16	0.00	0.24	0.07	NA			
Bushtit, *Psaltriparus minimus*	0.29	0.28	0.19	0.18	3.40	0.95	0.33	0.99
California towhee, *Pipilo crissalis*	0.10	0.35	0.28	0.53	1.12	0.13	<0.01	0.25
Chestnut-backed chickadee, *Poecile rufescens*	0.09	0.05	0.18	0.09	1.71	0.51	0.46	0.91
Chipping sparrow, *Spizella passerina*	0.04	0.00	0.10	0.00	NA			
Dark-eyed junco, *Junco hyemalis*	0.13	0.02	0.18	0.05	1.18	0.15	0.01	0.15
Hutton's vireo, *Vireo huttoni*	0.03	0.04	0.10	0.09	1.18	0.96	0.12	0.81
Lazuli bunting, *Passerina amoena*	0.24	0.29	0.50	0.24	1.14	0.37	0.02	<0.01
Lesser goldfinch, *Carduelis psaltria*	0.40	0.25	0.35	0.27	1.93	0.58	0.95	0.79
Nashville warbler, *Vermivora ruficapilla*	0.12	0.13	0.18	0.20	0.99	0.80	0.45	0.97
Oak titmouse, *Baeolophus inornatus*	0.13	0.36	0.21	0.27	1.67	0.29	0.80	0.22
Spotted towhee, *Pipilo maculatus*	0.35	0.67	0.51	0.93	0.97	0.16	0.04	0.87
Western scrub-jay, *Aphelocoma californica*	0.09	0.40	0.24	0.36	1.12	<0.01	0.09	0.04
Western tanager, *Piranga ludoviciana*	0.15	0.09	0.18	0.04	1.19	0.10	0.29	0.11
Wrentit, *Chamaea fasciata*	0.07	0.25	0.07	0.49	1.13	0.02	0.49	0.49
Yellow-rumped warbler, *Dendroica coronata*	0.00	0.02	0.12	0.02	NA			

Model diagonistics, from independent generalized linear models, are given by Pearson χ^2 statistic divided by the degrees of freedom. *P*-values are from Type III Wald tests of parameters. "Treatment" compared treated and untreated stands, "year" compared 2004 and 2005, and "year × treatment" evaluated the interaction of main effects.

greater cover of exotic annual grasses in the treated units (Perchemlides et al., 2008).

4.2. Bird abundance

Differences in bird abundance were consistent with the differences in vegetation structure. Three species, Bewick's wren, wrentit, and western scrub-jay were significantly less abundant in treated stands. Furthermore, the California towhee showed a consistent, though non-significant ($P = 0.15$) trend in the same direction. Bewick's wren, wrentit, California towhee and western scrub-jay are all species that have been described as associated with shrub cover (Altman, 2000; Purcell and Stephens, 2005; Alexander et al., 2007). These results corroborate the sensitivity of these species to reduced shrub cover characteristic of post-fire habitat conditions that was hypothesized by Purcell and Stephens (2005) based on habitat associations.

Very few species were consistently more abundant at the treated stations. Black-headed grosbeak and lazuli bunting were both more abundant at treated sites, but only in one of the 2 years. Two other species, dark-eyed junco and western tanager were marginally ($P < 0.15$) more abundant at treated areas. Of these species, the most easily explained pattern is that of the dark-eyed junco. This species is often associated with more open areas, and often increases after disturbances such as logging (Franzreb, 1983) or fire (Apfelbaum and Haney, 1981; Seavy, 2006). We propose that this species increases in treated areas where the shrub layer is reduced and the grass and herb layer is released (Perchemlides et al., 2008). It is interesting to note that the chipping sparrow (*Spizella passerina*), a species that is also associated with open areas with grasses and herbaceous vegetation (Altman, 2000), was recorded only on treated stands (Table 2).

4.3. Comparison of treatment alternatives

In an earlier paper (Alexander et al., 2007), we used similar methodologies to compare bird abundance at untreated stands and stands where shrub cover had been reduced by hand on plots that were 7–42 ha in area. Both of these studies provide information about the short-term (2–5 year) response of bird communities to fuels treatments that differ in the patch-size of the treated units. The differences between these studies suggest three major ways in which the effects of smaller-scale hand-pile treatments and the larger-scale mastication treatments on bird abundance may differ.

First, shrub-associated species appear to be more impacted by large-scale mastication treatments in this study than they were by smaller-scale hand-pile treatments. In our comparison of untreated and hand-pile stands, we did not observe any shrub-associated species that were dramatically less abundant on the treated stands. In contrast, in this study we found three shrub-associated species (Bewick's wren, wrentit, and western scrub-jay) that were significantly ($P < 0.05$) less abundant on treated stands during both years of this study, and one (California towhee) that was marginally ($P < 0.15$) less abundant.

Second, edge-associated species were more abundant in the smaller-scale hand-pile treatments, but not in the mastication treatments in this study. In our first study (Alexander et al., 2007), six species were more abundant than in the control stands. These species (olive-sided flycatcher [*Contopus cooperi*], western wood-pewee [*Contopus sordidulus*], white-breasted nuthatch [*Sitta carolensis*], purple finch [*Carpodacus purpureus*], mourning dove [*Zenaida macroura*], and Cassin's vireo [*Vireo casinnii*]) are all associated with edge habitat to some degree. None of these species were more abundant at the masticated stands in this study (Table 2). Although we do not know the mechanism responsible for this pattern, we hypothesize that these edge-associated species may prefer smaller patches because the ratio of edge to treated area is greater. Alternatively, the smaller-scale hand-pile treatments may have created greater heterogeneity in vegetation structure than the more uniform mechanical mastication treatments.

Third, species that use grassy open areas appear to be more abundant in the mastication treatments. In the current study, there was a statistically suggestive ($P < 0.15$) trend for the dark-eyed junco to be more abundant at treated stands, and chipping sparrow was only detected in treated stands. In contrast, neither of these species showed a consistent pattern in our study of smaller-scale hand-pile treatments (Alexander et al., 2007).

We caution that metrics other than bird abundance should be considered when evaluating the ecological effects of fuels treatments, in part because bird abundance may not always be correlated with habitat quality (Bock and Jones, 2005). Nest searching and demographic monitoring may provide more insights into the dynamics of population responses to habitat conditions created by fire management. Furthermore, we recognize that desired change, or lack of undesired change, in bird populations does not necessarily imply lack of undesired change in other ecosystem components. Even if they were to benefit bird species of concern, mechanical treatments may fail to facilitate important ecosystem processes of fire, such as stimulating germination or sprouting of native shrubs and forbs (Perchemlides et al., 2008). Furthermore, mechanical treatments may introduce unwanted noxious weeds to a site (Perchemlides et al., 2008). When designing mechanical fuels treatments, an ecosystem approach will be critical.

4.4. Management implications

The results of this study, in combination with our previous study (Alexander et al., 2007), provide information that can be used by managers when designing treatment prescriptions in oak woodland and chaparral vegetation types of southern Oregon. First, small scale treatments are likely to have less impact on shrub-associated species, such as Bewick's wren, wrentit, and possibly the California towhee. Using the upper limit of the treatment stands in our initial study, and the lower limit of treatment stands in this study, we propose that small treatments, designed to maintain shrub-associated species should be <50 ha, and large treatments, designed to benefit open-habitat species, should be >100 ha. We emphasize, however, that this distinction is preliminary, and should be used with caution and continued monitoring. Second, enhancing habitat for edge-associated species may be more efficiently accomplished with small-scale treatments than with large-scale treatments. This is probably not because the edge effects of small- and large-scale treatments are different, but simply because small-scale treatments will have a more edge for a given treatment area.

Oak woodland and chaparral vegetation types in southern Oregon were historically a very diverse habitat type, both structurally and compositionally (Franklin and Dyrness, 1988; Hosten et al., 2006). Thus, management plans designed to capture this condition should emphasize the maintenance of structural and compositional diversity. This approach has been incorporated into the partners in flight oak woodland habitat conservation objectives designed to benefit shrub-associated (e.g., Bewick's wren and wrentit), open-habitat (e.g., chipping sparrow), and edge-associated conservation focal species (Altman, 2000). Successful bird conservation in these habitats will require management plans that maintain the range of historical conditions and employ a variety of management tools (e.g., small-scale hand pile and burn, large-scale mechanical, and broadcast underburn treatment). Considering comparative effects of different treatment types on birds can inform land management planning and the design of treatment alternatives at a landscape scale that balance multiple objective that include cost-effective fire hazard reduction, restoration of fire adapted ecosystems, and implementation if bird conservation objectives.

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Attachment 4 Comment Document #3

Promoting the Science of Ecology

Fire Severity and Tree Seedling Establishment in Abies Magnifica Forests, Southern Cascades, Oregon
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FIRE SEVERITY AND TREE SEEDLING ESTABLISHMENT IN *ABIES MAGNIFICA* FORESTS, SOUTHERN CASCADES, OREGON[1]

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Abstract. To determine the relationship between fire severity and tree seedling establishment, we investigated landscape pattern and composition, fire history, and tree seedling establishment on recent natural burns in Shasta red fir (*Abies magnifica* var. *shastensis*) forests of Crater Lake National Park in the southern Oregon Cascade Range.

Fire severity classes, defined by basal area mortality, were mapped on three burned sites (29–197 ha). Variation in fire severity contributed to a landscape mosaic of patches with varying size, shape, forest stand structure, and tree species' composition. Post-fire tree regeneration was numerically dominated by red fir in all fire severity classes, but seedling establishment and growth varied among severity classes. Density of red fir seedlings was highest in low- and moderate-severity patches, and lower in high-severity patches and unburned areas. Height growth of red fir seedlings increases with fire severity.

Variations in fire severity in red fir forests appear to be a major influence on post-fire stand structure and species composition, successional pathways, and resulting landscape patterns. Our results suggest that drought may be an important mortality agent controlling red fir regeneration on these burned sites. Red fir seedling establishment occurs in pulses, usually 3–4 yr after fire.

Key words: Abies magnifica; *disturbance; fire history and severity; landscape ecology;* Pinus contorta; Pinus monticola; *seedling survival; stand dynamics; succession;* Tsuga mertensiana.

INTRODUCTION

Forest ecosystems that experience fires with moderate frequency (mean fire return interval 25–100 yr) and high variation in severity (Agee 1993) are largely unstudied compared to ecosystems with infrequent high-severity fires (e.g., Heinselman 1981) and those with frequent low-severity fires (e.g., Kilgore 1981). Spatial variability in fire severity, a potentially major influence on ecological processes and states, has been largely ignored (Hobbs and Atkins 1988). However, substantial spatial and temporal variability in fire severity has been noted in forest ecosystems dominated by western larch (*Larix occidentalis*)–Douglas-fir (*Pseudotsuga menziesii*) (Arno 1976); white pine (*Pinus strobus*) and red pine (*Pinus resinosa*) (Heinselman 1973); lodgepole pine (*Pinus contorta*) (Brown 1975); Douglas-fir (Morrison and Swanson 1990); and red fir (*Abies magnifica*) (Pitcher 1987, Taylor and Halpern 1991).

Red fir forest is an upper montane forest type that occurs between the lower montane and subalpine forest zones from the Cascade and Siskiyou Mountains of central Oregon south to the southern Sierra Nevada and North Coast Range of California (Franklin and Dyrness 1973, Barbour and Woodward 1985). Repeatedly, red fir has been referred to as a zonal climax dominant (Oosting and Billings 1943, Franklin and Dyrness 1973, Barbour and Woodward 1985). Common associates with Shasta red fir in southern Oregon are mountain hemlock (*Tsuga mertensiana*), western white pine (*Pinus monticola*), lodgepole pine, and white fir (*Abies concolor*) (Franklin and Dyrness 1973). Size and age structure of trees in these forests vary among stands (Oosting and Billings 1943, Barbour and Woodward 1985, Parker 1986, Pitcher 1987, Taylor and Halpern 1991).

The role of disturbance in the development and dynamics of red fir forests has been perplexing, in part, because of a seeming contradiction: red fir is both (1) shade-tolerant and self-perpetuating, and (2) regenerates abundantly after some major disturbances, including fire and wind (Taylor and Halpern 1991). Regeneration of red fir has been studied for decades, but the combination of conditions conducive to natural regeneration is still unclear (Laacke 1988). Regeneration in clearcuts is highly variable and often inadequate from a silvicultural perspective (Gratkowski 1958, Gordon 1970). Patchiness of its regeneration in natural stands has often been observed and assumed to be related to canopy openings (e.g., Oosting and Billings 1943). Alternatively, others associate spatial patterning with the beneficial effects of shade on seedling establishment (Ustin et al. 1984, Selter et al. 1986). Taylor (1993) suggests that clumping of regeneration is related in part to small, patchy, low-severity fires. Only Pitcher (1987), Taylor and Halpern (1991), and Taylor (1993) present definitive evidence for the role of fire and wind

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disturbance in these forests, based on relatively small plots in mature and old-growth stands.

We examined seedling establishment after recent lightning-ignited fires in Crater Lake National Park. We focused on the role of fire severity as an influence on seedling establishment and landscape pattern and composition in the red fir forest ecosystem. For our purposes, landscape pattern and composition are defined by differences in gross vegetative physiognomy, forest stand age classes, and tree species dominance within landscapes up to 1000 ha in size. Our primary hypothesis is that post-fire tree seedling density and height are related to fire severity. We predicted, based upon a synthesis of earlier reports (especially Gordon 1970, Ustin et al. 1984, Selter et al. 1986, Pitcher 1987) and our preliminary observations, that red fir seedling density would be greater on burned areas than on unburned areas and that red fir seedling density within burned areas would be lower on high-severity patches. Secondary objectives were to: (1) examine stand, site, microenvironmental, and landscape factors that may be of importance to seedling establishment in red fir forests; (2) document yearly variations in red fir seedling establishment after recent fires; (3) describe fire history in red fir forests at Crater Lake; and (4) describe the landscape patch composition with respect to fire severity and dominant vegetation on recent burned sites.

Study Area

Crater Lake National Park (CLNP) is in the southern Cascade Range of south-central Oregon, mostly between 42° and 43° N latitude and west of 120° W longitude. The study sites are located on recent (1978–1988) burned sites within the *Abies magnifica* zone at elevations of 1740–2257 m. The zone overlaps the higher elevation *Tsuga mertensiana* zone within much of CLNP. Most of the extensive lodgepole pine forests are seral to red fir and mountain hemlock (Zeigler 1978). Forests dominated by red fir were the primary subject of this study. Red fir in the study area belong to the taxon Shasta red fir (*Abies magnifica* var. *shastensis* Lemmon) (Zavarin et al. 1978).

A total of five burned sites were sampled: Crater Peak (1978 fire), Desert Cone (1982), Sphagnum Bog (1986), Castle Point (1986), and Prophecy (1988). Most field work was carried out on the Crater Peak and Desert Cone sites, where substantial post-fire tree regeneration had occurred by the time of sampling. The more recently burned sites had little tree regeneration prior to 1990 and were therefore unsuitable for intensive examination of tree seedling establishment. The fires were all ignited by lightning during July or August and were allowed to burn as prescribed natural fires for periods of 3–11 wk. The smallest of the fires was at Desert Cone (29 ha) and the largest was the Prophecy fire (approximately 760 ha).

The study sites all occur on parent materials of volcanic origin including lavas, glowing avalanche deposits, and aeolian deposits (Williams 1942). Forests dominated by red fir are common on lavas and relatively uncommon on the glowing avalanche deposits. The two primary study sites, Crater Peak and Desert Cone, occur on the slopes (5°–35° slope) of different cinder cones and a few nearly level adjacent areas. Aspect ranges from 90° to 300° azimuth (east to northwest).

The climate of CLNP is characterized by mild, dry summers and moderately cold winters, with deep snow accumulations. Mean annual precipitation at Park headquarters (1990 m elevation) within the *T. mertensiana* zone, is 167 cm, 70% of which is snow (National Oceanic and Atmospheric Administration 1982). Precipitation in the *A. magnifica* zone in CLNP is probably comparable to the 100–160 cm reported as typical for the *A. magnifica* zone in northern California (Barbour and Woodward 1985). The height at which foliose lichens appear on tree trunks, a good indicator of winter snow depth, was 1.8–3.5 m during 1990 in the *A. magnifica* zone at CLNP (C. B. Chappell and J. K. Agee, *personal observation*). Snow may persist until June. The dry summers (June–August precipitation of ≈10 cm total) are marked by occasional thunderstorms.

Methods

Fire severity classes, as well as pre-fire cover types, were mapped on the Crater Peak and Desert Cone sites in 1990 and on the Castle Point site in 1989. Fire severity was defined in four classes as the percentage of tree basal area mortality after fire: unburned: no fire; low severity: 0–20% basal area mortality; moderate severity: 20–80% basal area mortality; and high severity: 80–100% basal area mortality. These classes, although unbalanced in the percentage of canopy removed, are better balanced in terms of the environments they provide for seedling establishment. The moderate severity class was split in two for some statistical analyses: moderate/low = 20–50% basal area mortality, and moderate/high = 50–80% basal area mortality. Pre-fire cover type was defined by two elements: (1) forest stand age class and (2) tree species composition. Stand age classes were nonforest (no or scattered trees, tree canopy absent or <25% cover); young (mostly 50–100 yr old trees dominating a forest canopy with minimum 25% tree cover); and mature/old-growth (>150-yr-old trees at least co-dominating a forest canopy). Trees were cored when necessary to determine age classes. Mapping was accomplished on the ground with a 2.5-factor metric prism, topographic maps, compass, clinometer, measuring tape, and altimeter.

The patches of varying fire severity were sampled with a series of 500-m^2 plots. Minimum patch size mapped was 0.1 ha. Plot sampling was restricted to forests that were or had been dominated by mature or old-growth (>150-yr-old) red fir, with <10% of the total pre-fire basal area composed of whitebark pine

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TABLE 1. Distribution of plots by study site and fire severity class, Crater Lake National Park, Oregon.

Fire severity class	Crater Peak	Desert Cone
Unburned	8	4
Low	8	4
Moderate/low (20–50% mortality)	8	4
Moderate/high (50–80% mortality)	8	4
High (small patch)*	8 (5)†	4
High (large patch)	8 (3)†	0

* Small patches are defined as <2.0 ha.
† Numbers in parentheses represent only those plots used for ANOVA (see *Methods*).

(*Pinus albicaulis*), a subalpine indicator, or white fir (*Abies concolor*), an indicator of the ecotone with the lower *Abies concolor* zone. Sixty-eight plots distributed by fire severity class and study site were sampled (Table 1). Large high-severity patches were defined as those >2.0 ha and were sampled separately because they appeared to present a different environment for seedling establishment than small high-severity patches. One of the large high-severity patches was much larger than all other patches and was divided into six subunits of approximately equal size, which were each sampled. Only one of these subunits was chosen for analysis of variance (see next paragraph). All plot sampling occurred during July–September 1990.

The study design for statistical tests consisted of 60 plots in a balanced design (Table 1). Sampled patches were chosen randomly, without replacement, and each plot was randomly located within the chosen patch. One of the six plots on the largest high-severity patch was chosen randomly for statistical tests. High-severity patches removed from the original sample of 68 (to balance the design) were chosen randomly. Unburned plots were randomly located outside fire boundaries in adjacent unburned forest that met the sampling criteria for species composition and stand age.

Each 500-m^2 circular plot contained five 10-m^2 circular subplots, located in a random fashion. On each subplot, all tree seedlings >1 yr old, but established since the last fire, were counted, identified to species, and classed as > or <15 cm in height. Seedling density on a plot was calculated as the mean of the densities on the five subplots. The height of the tallest red fir seedling on each subplot was also recorded.

Independent variables recorded or calculated for each plot were: elevation; slope in degrees; aspect; a topographic index incorporating aspect and slope (similar to that of Stage [1976], where low values of the index represent steep, southwest aspects, while higher values show less steep slopes and/or aspects farther from the southwest); micro-topographic configuration (convex, concave, straight, undulating); topographic position (e.g., ridgetop, mid-slope); a slope position index incorporating topographic position and microtopographic configuration (modified from Parker [1982]); percentage of surface soil composed of fragments (>0.5 cm diameter) of pumice, scoria, and solid volcanic rock; distance to nearest edge (different patch); patch size; patch width (smaller dimension); a perimeter influence index incorporating proportion of a patch's perimeter in tree survival categories paralleling the fire severity classes (higher values of index indicate more canopy surviving in perimeter patches); percent canopy cover; scorch height; live and dead basal area of each tree species (measured both with a prism and from tree diameters on the plot); and proportion of saplings >1.4 m height that are dead. Trees that died within the last 2 yr (including blowdowns), identified by retained bark and needles or fine branches, were included in the live condition category because they were still alive in the first few years after the fire. Therefore, their recent mortality would have minimal influence on >1 yr old seedling densities. Trees dead before the fire were not recorded. Parent material was classed as old dacite lava flow, scoria or solid lava ejecta, or pumice. All shrub, herb, and tree species on each plot were identified and placed in percentage cover classes: <1%, 1–5%, 6–25%, 26–50%, 51–75%, 76–100%.

Independent variables recorded on each subplot were percentage cover of logs, shrubs, herbs, rocks >10 cm diameter, and rock fragments 1–10 cm diameter; percentage of ground surface unburned (including litter-covered); number of live and dead saplings within 2.5 m of subplot center; and a point mortality index consisting of the percentage post-fire mortality of a point index to tree competition (sum of the ratios of diameter breast height [in centimetres] over distance from subplot center [in metres] for trees within 5 m of subplot center; adapted from Lorimer 1983).

Analyses of variance (ANOVA) were carried out with seedling densities of each tree species as the dependent variables, fire severity as the main independent factor, and study site/fire year as a blocking factor. Dependent variables were normalized with natural log transformations. These transformations also helped stabilize variances, which in some cases were not homogeneous across cells. Sample sizes were equal across severity classes. Orthogonal contrasts were used to detect differences among severity classes in red fir seedling density (Bock 1975).

Relationships between seedling densities and independent variables were explored using Spearman's nonparametric correlation coefficient. Unburned areas were not included in the correlation analyses. Plot variables were considered significant if $P < 0.05$ for red fir and western white pine, or if $P < 0.10$ for mountain hemlock and lodgepole pine (because analysis was limited to Desert Cone for the latter species and n was therefore small). Subplot variables were considered significant only at $P < 0.01$, because n was high and subplots were not independent, being located in clumps of five on the plots.

Survival of red fir seedlings germinated during 1990 was tracked on the Sphagnum Bog burn site (1986 fire). On 15 July 1990, five plots were established in areas where 1990 seedlings were numerous. A total of 274 seedlings were marked. The plots were revisited on 6 August, and 1 and 25 September, at which time germinants live and dead were counted and apparent cause of death was noted.

Red fir seedlings were collected from Desert Cone and Crater Peak plots to assess the temporal pattern of seedling establishment among different years. One plot was chosen from each combination of study site and severity class and one additional moderate severity plot for each site were sampled for a total of 211 seedlings at Crater Peak and 174 seedlings at Desert Cone. Bud scale scars and annual growth rings were used to age seedlings. Cursory field observations at the Sphagnum Bog, Castle Point, and Prophecy sites gave an indication of the degree of post-fire seedling establishment on the other sites, in order to complement the age data from Desert Cone and Crater Peak. For the same reason, 10 50 × 4 m transects were used to quantify pre-1990 (>1 yr old) red fir seedling density at Sphagnum Bog.

Fire history information was collected at two sites. Fire scars and tree establishment were dated on recently cut stumps on the Prophecy burn site in Winema National Forest land adjacent to CLNP. The Prophecy site was used because of the availability of a recent post-fire clearcut harvest unit on the site. At Crater Peak, park fire records, one wedge from a scarred red fir, and cores from live young trees provided a second fire history data set.

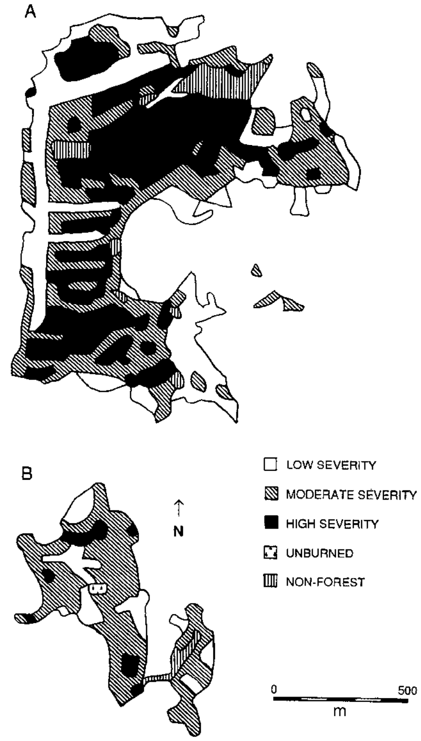

FIG. 1. Landscape maps of fire severity on the 1978 Crater Peak (A) and 1982 Desert Cone (B) burn sites, Crater Lake National Park, Oregon.

RESULTS

Landscape pattern and composition

The maps of fire severity for the Crater Peak and Desert Cone burn sites demonstrate substantial spatial variability in fire severity (Fig. 1). The burned landscape is divided rather evenly between low-, moderate-, and high-severity classes at Crater Peak, is strongly dominated by moderate severity at Desert Cone, and is dominated primarily by low severity and secondarily by moderate severity at Castle Point (Table 2). The high-severity class occupies 33.9% of the Crater Peak burn, but only 6.7% of the Desert Cone burn and 6.5% of the Castle Point burn. Proportional distribution of severity classes appears to vary considerably from fire to fire.

Old stands appear less susceptible to high-severity fire. At the Castle Point site, 68% of the area covered by old stands (300–500 yr) burned at low severity, 27% at moderate severity, and 5% at high severity. Conversely, young stands (50–80 yr) had 24% of their area burned by high-severity fire, 35% by moderate-severity fire, and 41% by low-severity fire.

Fire history

Field ring counts of 11 fire-scarred stumps on a 0.5-ha plot at the Prophecy site produced mean fire-return intervals of 45 yr for the period 1628–1988 (range 15–157 yr, s = 49.2) and 39 yr for the pre-fire-suppression period 1628–1902 (range 15–71 yr, s = 21.9). The 1988 fire killed all trees on the plot. There have been at least four fires on the Crater Peak site in the last 100 yr, at least two of which were extensive (as indicated by fire scars, cores of live trees, wedge count, and park records), fitting the pattern of moderately frequent fires previously noted. External fire scars have been observed on many trees at Crater Peak, Sphagnum Bog, and elsewhere in the *A. magnifica* zone of CLNP.

Fire severity and seedling establishment

The pattern of variation in red fir seedling density with respect to severity class is similar on the two primary study sites (Fig. 2). Seedling density is significantly greater on burned areas than unburned areas, and high-severity patches have significantly fewer seedlings than moderate- and low-severity patches (Table 3). No significant differences were detected in contrasts among the low- and moderate-severity classes.

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TABLE 2. Landscape patch type composition of three recent burns in *Abies magnifica* forest, Crater Lake National Park, Oregon.

Patch type	Crater Peak Area (ha)	Crater Peak % area	Desert Cone Area (ha)	Desert Cone % area	Castle Point Area (ha)	Castle Point % area
Pre-fire cover type						
Mature/old-growth						
Abies magnifica	89.6	77.7	23.8	83.8	170.4	86.5
A. magnifica–Abies concolor	16.3	14.1				
Pinus albicaulis–A. magnifica	1.9	1.6				
Young						
Tsuga mertensiana			0.5	1.8		
A. magnifica	1.6	1.4	1.1	3.9	16.4	8.3
Pinus contorta			2.0	7.0	10.2	5.2
Nonforest	5.9	5.1	1.0	3.5		
Fire severity						
Low	33.0	28.6	5.8	20.4	129.0	65.5
Moderate	37.3	32.4	19.7	69.4	55.0	27.9
High	39.1	33.9	1.9	6.7	13.0	6.5
Nonforest	5.9	5.1	1.0	3.5		
Total fire size	115.3		28.4		197.0	

The Desert Cone site had significantly greater seedling density than the Crater Peak site, but there was no significant interaction between site and severity in the ANOVA or between site and any of the contrasts.

Western white pine seedling density varies significantly with respect to fire severity (Table 3). The species, present in relatively small numbers on both sites (mean ± 1 SE = 330 ± 83.0 trees/ha), is most numerous on moderate-severity patches and least numerous on unburned areas. Significant differences in white pine seedling density were found between unburned and burned areas, and between low and moderate severity patches. The site factor and interactions between site and other factors or contrasts were not significant in the ANOVA with white pine seedling density (Table 3).

Seedlings of other species showed less significant trends (Fig. 3). Lodgepole pine seedling density shows a significant trend with respect to fire severity if both sites are included (Table 3). However, there is a significant interaction effect between severity and site that complicates the interpretation of this ANOVA. The very few lodgepole pine seedlings at Crater Peak all occurred on high-severity patches. If we include only Desert Cone data (where the species was numerous) in the ANOVA for lodgepole pine, the trend is not significant. Mountain hemlock seedling density (present only at Desert Cone) showed no significant trends (Table 3).

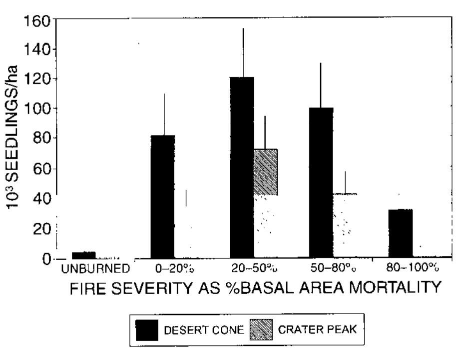

FIG. 2. Mean *Abies magnifica* seedling density by fire severity class on the Desert Cone and Crater Peak burns. Error bars are +1 SE.

Seedling height

The proportion of seedlings that are >15 cm tall increases with increasing fire severity on both study sites (Fig. 4). Red fir appears to be shorter at this early stage of post-fire regeneration than the other tree species. Lodgepole pine seedlings are the tallest tree species at Desert Cone, where all four tree species are frequent. Maximum red fir seedling height also increases with increasing fire severity (one-way ANOVA, df = 3, $F = 7.7$, $P < 0.0005$).

Moderate-severity plots show considerable variation in red fir seedling height that appears to be due to differences in growth rates rather than differences in age. Larger seedlings are more likely to be near fire-killed trees: the point mortality index (percent mortality of the tree competition index, see *Methods*) is positively correlated with maximum height of red fir seedlings (Spearman's $r_s = 0.49$, $P < 0.001$, $n = 211$). Maximum height of red fir seedlings is also positively correlated with percent cover herbs ($r_s = 0.41$, $P < 0.01$), percent cover logs ($r_s = 0.35$, $P < 0.001$), and percent cover shrubs ($r_s = 0.28$, $P < 0.001$), and negatively correlated with percent surface unburned ($r_s = -0.23$, $P < 0.001$).

Site, stand, and landscape factors influencing seedling establishment

The site factor most useful in explaining variation in red fir seedling density is a topographic index com-

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TABLE 3. Results of ANOVA and contrasts testing the relationship between seedling density and fire severity class.*

	SS	df	*F*	*P*
Abies magnifica				
Fire severity	72.43	4, 50	21.45	<.0005
Site (fire year)	19.13	1, 50	22.67	<.0005
Severity × site	1.81	4, 50	0.54	.710
Contrasts: fire severity†				
Unburned vs. burned	51.28	1, 50	60.76	<.0005
High vs. low + moderate‡	24.92	1, 50	29.52	<.0005
Low vs. moderate‡	2.71	1, 50	3.21	.079
Moderate/low vs. moderate/high‡	0.96	1, 50	1.14	.290
Pinus monticola				
Fire severity	1.30	4, 50	3.20	.020
Site (fire year)	0.03	1, 50	0.27	.608
Severity × site	0.47	4, 50	1.15	.342
Contrasts: fire severity				
Unburned vs. burned	0.58	1, 50	5.76	.020
High vs. low + moderate‡	0.00	1, 50	0.02	.886
Low vs. moderate‡	0.63	1, 50	6.24	.016
Moderate/low vs. moderate/high‡	0.35	1, 50	3.49	.068
Pinus contorta				
Fire severity	2.54	4, 50	4.18	.005
Site (fire year)	4.54	1, 50	29.88	<.0005
Severity × site	2.39	4, 50	3.94	.007
Pinus contorta (Desert Cone only)				
Fire severity	3.69	4, 15	1.83	.175
Tsuga mertensiana (Desert Cone only)				
Fire severity	10.64	4, 15	1.61	.224

* Dependent variable is seedling density of species listed, followed by factors for each ANOVA.
† Low = 0–20% basal area mortality, moderate = 20–80%, moderate/low = 20–50%, moderate/high = 50–80%, high = 80–100%.
‡ See *Methods* for definitions.

bining slope and aspect (Table 4). Slope steepness is significantly negatively correlated with red fir and lodgepole pine seedling density. Red fir seedling density generally increases with increasing values of the topographic index, from low values on the steepest slopes on xeric southwest aspects to high values on gentle slopes or flats on increasingly mesic aspects toward the northwest and southeast. Aspect is significantly correlated with mountain hemlock seedling density, with more seedlings on northwest aspects. Elevation is negatively correlated with red fir and western white pine seedling densities (Table 4). The slope position index is negatively correlated with lodgepole pine seedling density, indicating greater densities on convex and/or upper slopes.

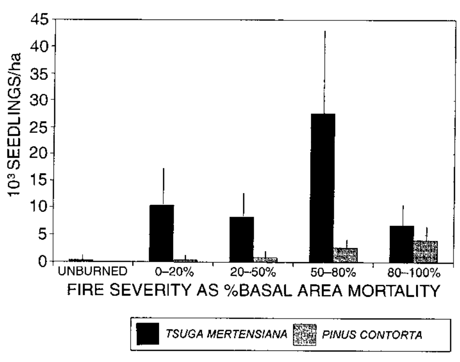

FIG. 3. Mean seedling density of *Pinus contorta* and *Tsuga mertensiana* by fire severity class on the Desert Cone burn. Error bars are +1 SE.

Seedling density showed significant relationships with a few soil characteristics (Table 4). Red fir seedling density was negatively correlated with the percentage of surface soil composed of solid lava fragments. Western white pine seedling density was negatively correlated with the percent surface soil composed of scoria fragments. Both red fir and western white pine seedling density were negatively correlated with percent cover of rock fragments >1 cm in diameter. Western white pine seedling density was significantly greater on old dacite lava parent materials than on other parent materials (Kruskal-Wallis test, k = 3 groups, P = 0.0008). Other significant variables for white pine seedling density did not correlate with parent material.

Red fir seedling density was negatively correlated with patch size and distance to nearest edge (Table 4). Lodgepole pine seedling density was also negatively correlated with distance to nearest edge. The influence of multiple samples (the six subunits) from the largest

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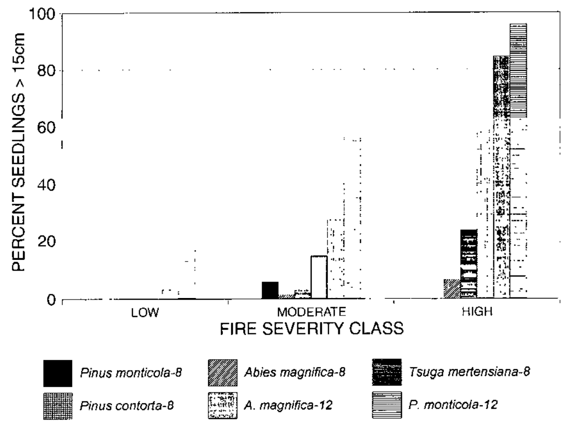

FIG. 4. Relative seedling height in 1990 of four tree species on Crater Peak (1978 fire) and Desert Cone (1982 fire) sites grouped by fire severity class. Relative seedling height is represented by the percentage of seedlings that are >15 cm height. The number following each species name is number of years since fire (maximum seedling age).

TABLE 4. Spearman's rank correlation coefficients between tree seedling densities and site, stand, and landscape variables on sampled burns.†

	Species‡			
	ABMA	PIMO	PICO	TSME
Plot variables				
Elevation	−.29**	−.40***	.26	.01
Slope	−.57***	−.16	−.47*	−.06
Aspect	−.19	−.04	−.24	.52**
Topographic index	.68***	.12	.07	−.07
Slope position index	.00	−.25	−.76***	.11
% pumice fargments	.13	−.01	...	...
% scoria fragments	−.16	−.35***	.15	−.20
% solid lava fragments	−.52***	−.07	.22	.39
Distance to nearest other patch	−.27**	−.33**	−.39	−.37
Patch width	−.26	−.25	−.34	−.08
Patch size	−.35***	−.08	.02	.18
Perimeter influence index	.29**	.03	−.25	.33
Scorch height	−.47***	.19	.44*	.07
% canopy cover	.49***	−.16	−.42	−.10
ABMA pre-fire basal area	.13	−.20	−.44*	−.01
% basal area mortality ABMA	−.56***	.17	.37	.04
TSME pre-fire basal area	.38***	−.05	−.21	.45*
PICO pre-fire basal area	.37***	.24	−.16	−.40
PIMO pre-fire basal area	.11	.19	.18	.16
Live residual basal area	.56***	−.19	−.48*	−.10
Total pre-fire basal area	.25	−.15	−.49*	.02
% basal area mortality total	−.53***	.19	.35	.04
% sapling mortality	−.33**	.20	−.11	−.28
Subplot variables				
Point mortality index	−.25***	.21***	.38***	.07
% cover logs	−.12	.09	−.02	−.07
% cover rock fragments	−.31***	−.21***	−.02	−.03
% cover rock >10 cm	−.03	.13	−.35***	.05
% cover shrubs	−.56***	.10	−.06	−.06
% cover herbs	−.37***	−.08	.12	−.01
% surface unburned	−.02	−.09	−.39***	−.22
No. live saplings	−.12	−.12	−.14	−.06
No. dead saplings	.12	−.01	.10	−.07

† * $0.10 > P > 0.05$, ** $0.05 > P > 0.01$, *** $P < 0.01$. Plot variables: $n = 56$ for ABMA and PIMO, $n = 16$ for PICO and TSME. Subplot variables: $n = 280$ for ABMA and PIMO, $n = 80$ for PICO and TSME.
‡ ABMA = *Abies magnifica*, PIMO = *Pinus monticola*, PICO = *P. contorta*, TSME = *Tsuga mertensiana*.

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TABLE 5. Spearman's rank correlations between red fir seedling density and patch size analyzed by fire severity class.*

Fire severity class†	r_s	P	n
All combined	−.20	.163	48
High	−.71	.001	12
Moderate/high	−.37	.241	12
Moderate	.12	.584	24
Low	−.25	.440	12
High + moderate/high	−.55	.005	24
Low + moderate	−.02	.924	36

* Sample was 48 burned plots, 12 per severity class, with no patch replication.
† High = 80–100% basal area mortality, moderate/high = 50–80%, moderate = 20–80%, low = 0–20%.

patch on the correlation between patch size and red fir seedling density was inordinate: the correlation is not significant when only one plot from each patch is included ($r_s = -0.20$, $P = 0.16$, $n = 48$). Examining patch size correlations by fire severity class (with no patch replication and equal sample sizes) reveals that red fir seedling density is significantly negatively correlated with patch size on high-severity patches and on the combination of high-severity and moderate-/high-severity patches (Table 5). Other combinations of fire severity classes do not show significant correlations between seedling density and patch size. Patch size did not differ significantly with fire severity class (one-way ANOVA, df = 3, $F = 1.22$, $P = 0.313$, $n = 48$).

Seedling density was compared on large (>2 ha) and small high-severity patches at Crater Peak. Seedling density of red fir was significantly greater on small high-severity patches than on large high-severity patches (one-tailed Mann-Whitney U test, $P = 0.050$, $U' = 19$, $n_1 = 7$ $n_2 = 3$). Western white pine seedling density did not differ significantly between small and large high-severity patches ($P = 0.714$). There were almost as many western white pine seedlings as red fir seedlings on large high-severity patches, despite the much greater abundance of red fir in both pre- and post-fire stands.

Red fir seedling density was positively correlated with the perimeter influence index (Table 4). This result indicates that the more living canopy around a patch perimeter, the greater the density of red fir seedlings.

Post-fire stand structure varies among fire severity classes (Fig. 5). Small-diameter live trees are most numerous on patches that burned with low severity. Moderate-severity patches generally have fewer live stems than low-severity patches and the diameter distribution is more heavily weighted in the middle than other classes. Patches that burned with high severity have few remaining stems, all of which are relatively large.

The most important of the stand-level variables for red fir seedling establishment was red fir basal area mortality, which displays a negative relationship with red fir seedling density (Table 4). Other stand-level variables related to basal area mortality, including percent canopy cover and live residual basal area, also show correlations with red fir seedling density. Mountain hemlock seedling density is positively correlated with pre-fire mountain hemlock basal area. Lodgepole pine seedling density is negatively correlated with live residual basal area and total pre-fire basal area. Scorch height is negatively correlated with red fir seedling density and positively correlated with lodgepole pine seedling density. Red fir seedling density is negatively correlated with percent saplings killed by fire.

Red fir seedling density is strongly negatively cor-

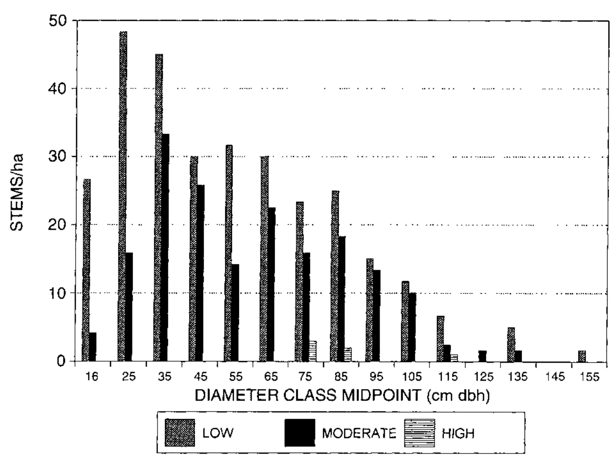

FIG. 5. Mean post-fire diameter class distribution of live *Abies magnifica* on the Crater Peak and Desert Cone burns, grouped by fire severity class. Data pooled from $n = 56$ plots.

Attachment 4

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TABLE 6. Mean percentage cover of shrubs and herbs by fire severity class.*

Fire severity class	Shrub cover (%) Mean	Shrub cover (%) 1 SE	Herb cover (%) Mean	Herb cover (%) 1 SE
Unburned	0.7[a]	0.4	11.3[ab]	3.9
Low	1.4[a]	0.8	5.0[a]	2.0
Moderate/low (20–50% mortality)	0.9[a]	0.3	10.7[ab]	3.2
Moderate/high (50–80% mortality)	5.2[a]	2.5	10.0[ab]	2.7
High	22.7[b]	7.1	20.5[b]	5.4

* Means within a column followed by the same superscript letter do not differ significantly at $P = 0.05$ by the Tukey test after one-way ANOVAs. Dependent variables (shrub and herb cover) were ln-transformed for ANOVAs. $n = 60$ plots (40 Crater Peak, 20 Desert Cone).

related with percent cover of shrubs, and less so with percent cover of herbs (Table 4). The point mortality index, which is intended to measure release from tree competition due to fire-related tree death, is negatively correlated with red fir seedling density and positively correlated with western white pine and lodgepole pine seedling density (Table 4). Lodgepole pine seedling density was negatively correlated with percentage of surface unburned.

Seasonal mortality of 1st-yr red fir seedlings at the Sphagnum Bog burn from 15 July through September 1990 was at least 25% ($n = 274$). Desiccation was the apparent cause of 87% of this late-season mortality and was identified by shrunken, brittle leaves and the absence of stem lesions. These samples were all from areas with a relatively high initial density of germinants (8 seedlings/m^2 on the transect) and many residual red fir trees.

Dominant vegetation and fire severity

Shrub cover and herb cover differ significantly among fire severity classes (Table 6). Shrub cover is significantly greater on high-severity patches than in other severity classes. The only significant difference among severity classes for herb cover was between high severity and low severity.

Species of shrubs that dominate or co-dominate the understory on a frequent basis at the Crater Peak and Desert Cone sites, in relative order of importance, are snowbrush (*Ceanothus velutinus*), trailing gooseberry (*Ribes binominatum*) (Crater Peak only), sticky currant (*Ribes viscosissimum*), pinemat manzanita (*Arctostaphylos nevadensis*) (primarily Desert Cone), and waxy currant (*Ribes cereum*). Creeping snowberry (*Symphoricarpos mollis*) or green-leaf manzanita (*Arctostaphylos patula*) are occasionally co-dominant at Crater Peak. The dominant herbaceous species is long-stolon sedge (*Carex inops*). Graminoids and forbs of secondary importance that may be co-dominant in some instances include bottlebrush squirreltail (*Elymus elymoides*), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), dwarf chamaesaracha (*Chamaesaracha nana*) (Crater Peak only), and sickle-keeled lupine (*Lupinus albicaulis*). Many other shrub and herb species had low percent cover.

Red fir is the major dominant species on unburned and low- and moderate-severity patches. At Desert Cone, mountain hemlock or lodgepole pine are of secondary importance in some areas, occupying 10–30% canopy cover. Herbs often occupy >10% cover on unburned and moderate-severity patches, but are of secondary importance to the trees.

High-severity patches are dominated by red fir, by shrubs and herbs, or by a combination of red fir and shrubs/herbs. Lodgepole pine is of secondary importance in high-severity patches at Desert Cone. Large high-severity patches are dominated primarily by shrubs and secondarily by herbs.

Temporal pattern of seedling establishment

Establishment of red fir seedlings at Crater Peak (1978 fire) showed distinct peaks in 1981 and 1986; establishment of seedlings at Desert Cone was prominent in 1986 and 1987 (Fig. 6). On both sites, there was a lag of 3–4 yr between the year of the fire and a year with substantial seedling recruitment. There was no apparent correlation between snowpack, precipitation, or summer temperatures (NOAA National Climatic Center Annual Climatological Summary at CLNP headquarters) and years of abundant red fir establishment on our study sites.

Establishment on 2–4 yr old burns in the red fir zone at CLNP was minimal by 1990. Density of established (>1 yr old) red fir seedlings at the 1986 Sphagnum Bog site was only 245 seedlings/ha, compared to 32 967 seedlings/ha at the Crater Peak site and 82 875 seedlings/ha at the Desert Cone site. First-year seedlings were numerous in 1990 at Sphagnum Bog and Castle Point (1986 burns), but completely absent at the Desert Cone and Crater Peak burn sites. The Prophecy site (1988 fire) had almost no seedlings in 1990.

DISCUSSION

Identification of fire return intervals for red fir forests depends on the scale at which they are applied. Mean fire-return intervals for small plots (<1 ha) and single trees range from 40 to 65 yr (McNeil and Zobel 1980, Pitcher 1987, Taylor and Halpern 1991, Taylor 1993, this study), although low-severity fires may go undetected (Agee 1993). Much shorter reported mean fire-return intervals in northeastern California (Taylor 1993) occur at larger scales (16–19 yr on 3.0-ha plots and 13 yr on a 400-ha study area). Single trees in the same study area showed a mean fire return interval of 47 yr.

Red fir seedling establishment and growth is strongly related to periodic disturbance. The existence of episodic regeneration after disturbance does not preclude,

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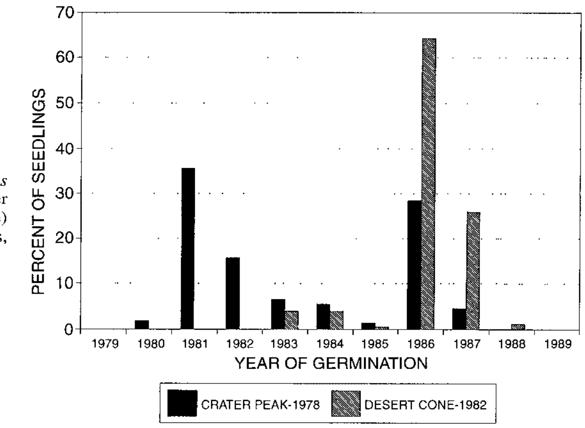

FIG. 6. Seedling establishment of *Abies magnifica* by year of germination on the Crater Peak (1978 fire) and Desert Cone (1982 fire) sites. Sample sizes were 211 and 174 seedlings, respectively.

however, the simultaneous occurrence of a more continuous, slower mode of regeneration that allows red fir to perpetuate itself indefinitely (Taylor and Halpern 1991). The much greater success of red fir seedling establishment on burned surfaces than on unburned may be due to exposure of mineral soil (Gordon 1970, Parker 1986, Laacke 1990), reduction of detrimental fungal populations (Parmeter 1977), or reduction of competition for belowground resources (Volland 1976, Oliver 1981). Removal of organic layers may also provide better access for seedlings to beneficial mycorrhizal fungi (Laacke 1990).

Retention of a partial canopy after disturbance favors red fir seedling establishment. The resultant shade ameliorates drought stress, a key mortality agent for red fir seedlings (Gordon 1970, Ustin et al. 1984, Selter et al. 1986). However, our results only suggest the importance of drought to seedling mortality, they do not directly test the importance of drought as a causal agent. The greater abundance of red fir seedlings on more mesic environments (as determined by aspect, slope, topographic position) within the *A. magnifica* zone (Parker 1986, Barbour et al. 1990, this study), suggests the importance of drought in seedling establishment. Our seedling survival data from the middle to late summer period indicate the prominence of drought as a mortality agent on 1st-yr seedlings. Similar results were obtained by Gordon (1970) and Selter et al. (1986). The negative correlation between red fir seedling density and percent of surface soil composed of solid lava fragments may also be related to drought. The positive correlations of red fir seedling density with pre-fire mountain hemlock and lodgepole pine are probably not biologically meaningful: these species were common only at Desert Cone, where significantly greater seedling density was probably related to the more recent fire year.

The scarcity of red fir seedlings on larger high-severity patches may be due to an accentuation of the microclimatic extremes (especially high surface temperatures) on these surfaces (Geiger 1950, Gordon 1970, Phillips and Shure 1990), and a decrease in seed dispersal with increasing distance from the patch edges (Gratkowski 1958, Gordon 1970, Franklin and Smith 1974). Although seed dispersal is considered adequate to regenerate an isodiametric 16-ha opening given modest germination and survival, the fewer seeds that reach the interior of large openings (Franklin and Smith 1974) experience higher mortality than the more numerous seeds in small openings. The negative correlation between red fir seedling density and shrub cover may be coincidental: shrubs (especially *Ceanothus velutinus*) are most abundant on high-severity patches where red fir seedlings could be less numerous for other reasons. The beneficial effects of shade from the shrubs probably balance or outweigh the detrimental effects of their competition for water (Zavitkovski and Newton 1968).

Pulses of red fir seedling establishment appear to be related more to cone crops than to weather during the seedling's 1st yr. The apparent 3–4 yr delay in red fir regeneration after fire may be related to high seedling mortality rates in the initial years after fire, or to an effect of fire on cone crop timing.

The prominence of mountain hemlock seedlings on more northerly aspects is consistent with its drought sensitivity (Fowells 1965) and previous data from areas where red fir and mountain hemlock overlap (Taylor 1990).

The rarity of western white pine seedlings on unburned areas is consistent with its reported preference for bare mineral soil and burned substrates (Fowells 1965). The peak of western white pine seedling density on moderate-severity patches may indicate a balance between avoiding interspecific competition on low-severity patches and injury or drought due to high surface

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temperatures on high-severity patches (Fowells 1965). White pine seedling establishment may be more sensitive to nutrient differences than the other species examined, as indicated by its significant association with soil parent material differences (dacite vs. pumice or scoria).

Fire appears to be primarily responsible for the complex landscape mosaic of patches with differing stand structure in red fir forests at CLNP. Fire suppression during the period 1902–1977 altered the distribution of fire in the red fir ecosystem. As Pitcher (1987) noted in the southern Sierra Nevada, fire suppression in red fir forests probably has not altered fuel loads or stand structure to a point outside the natural range of variation within a stand, as it has in lower elevation mixed-conifer stands. This lack of major structural change due to fire suppression is related to the fact that the mean fire-return interval is not much shorter than the period of suppression (40–75 yr), and the period of suppression is actually shorter than many natural fire-free intervals. We conclude that fire suppression has not had a large effect at the *stand* level. However, stand structure and fuel loads probably have been altered on a landscape scale by fire suppression. Fire suppression would have resulted over time in more and more stands (patches) developing greater fuel loads and more late-successional-type structures. The cumulative impact would be to create a more homogeneous landscape, with respect to forest structure, where a large percentage of the landscape was in a state toward the high end of the variability in natural fire return interval.

The pattern of relative abundance and height growth of tree seedlings on these recent burns sets a template for future succession and landscape composition. Red fir dominates low- and moderate-severity patches. High-severity patches are dominated by red fir and/or by shrubs and herbs. Based solely on its autecological characteristics, lodgepole pine would be expected to dominate or co-dominate regeneration on high-severity patches. However, lodgepole pine is infrequent in the overstory at Crater Peak and therefore very little seed was available to regenerate the high-severity openings. Where lodgepole pine is an overstory co-dominant, such as at Desert Cone, it plays a more prominent role in regeneration dynamics. The lodgepole pine regeneration on Desert Cone high-severity patches is considerably taller than other species, indicating that it will likely suppress red fir and mountain hemlock later in stand development (Zeigler 1978). The distribution of regeneration by species on these two burns shows that post-fire species composition depends to some extent on the species present before and after a disturbance.

Our results suggest several post-fire successional seres for red fir forests that are related to the forest development models of Zeigler (1978) and Pitcher (1981). Succession in a patch apparently depends upon: (1) fire severity, (2) patch size, and (3) the presence or absence of lodgepole pine as a prominent pre-fire stand component. Other variables that we did not track, e.g., fire frequency, are probably also important in determining the successional pathway.

In large part because red fir is considerably more fire resistant than its associates (Chappell 1991), it dominates post-fire overstories on low- and moderate-severity patches. Low- and moderate-severity patches will have abundant red fir regeneration and will continue to be dominated by red fir, with varying amounts of other tree species being subordinate. Post-fire stand structure is considerably altered from the pre-fire state in moderate-severity patches, but not in low-severity patches. Small high-severity patches in areas without lodgepole pine are likely to follow a similar successional path as low- and moderate-severity patches, with the replacement of the pre-fire red fir stand with a new post-fire red fir stand. A relatively short period of shrub dominance may precede red fir dominance on small high-severity patches.

Lodgepole pine may be present in the pre-fire stand if a high-, or less commonly, moderate-, severity fire has occurred in the last century or two. If no such fires have occurred, the nonserotinous lodgepole pine will become decadent and be attacked by mountain pine beetles (*Dendroctonus ponderosae*), eliminating lodgepole pine from the stand.

If a small high-severity patch has a lodgepole pine seed source, it is likely to soon become dominated by lodgepole pine, but will have abundant red fir, and sometimes mountain hemlock, saplings in the understory or subcanopy (Zeigler 1978). These patches are likely to succeed, in the absence of fire, to dominance by red fir (with mountain hemlock where present) as the lodgepole pine dies later in stand development.

Large high-severity patches in areas with little or no lodgepole pine will follow a different path, and are most likely to become dominated by shrubs (and to a lesser degree, herbs). These openings may persist for an indefinite period or may slowly succeed to red fir forest, with an intermediate stage consisting of scattered trees over shrubs (Pitcher 1981, Laacke 1990). We did not encounter the situation of large high-severity patches with a lodgepole pine seed source.

Many authors (e.g., Heinselman 1973, Romme 1982), have emphasized the importance of fire-dependent landscape mosaics, yet very few have explored such mosaics in the context of variable fire severity. Most analyses assume that the landscape is composed of patches in various stages of succession from a post-disturbance state of uniform severity. This viewpoint is appropriate for a high-severity fire regime, but fails to recognize the inherent variability of disturbance effects (Pickett and White 1985) and is clearly inadequate when applied to a moderate-severity fire regime, such as that of red fir forests. The complex landscape mosaics created by variation in disturbance severity documented here and by Morrison and Swanson (1990), and suggested by others (e.g., Pitcher 1987, Anderson

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and Romme 1991, Frelich and Lorimer 1991), indicate that spatial heterogeneity in the severity of fire and other disturbances is an important determinant of landscape pattern and composition in many ecosystems.

ACKNOWLEDGMENTS

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From George Sextion et al.
See full article at http://www.jstor.org/pss/2269397

Abstract from http://www.jstor.org/pss/2269397

To determine the relationship between fire severity and tree seedling establishment, we investigated landscape pattern and composition, fire history, and tree seedling establishment on recent natural burns in Shasta red fire (Abies magnifica var. shastensis) forests of Crater Lake National Park in the southern Oregon Cascade Range. Fire severity classes, defined by basal area mortality, were mapped on three burned sites (29-197 ha). Variation in fire severity contributed to a landscape mosaic of patches with varying size, shape, forest stand structure, and tree species' composition. Post-fire tree regeneration was numerically dominated by red fir in all fire severity classes, but seedling establishment and growth varied among severity classes. Density of red fir seedlings was highest in low- and moderate-severity patches, and lower in high-severity patches and unburned areas. Height growth of red fir seedling increases with fire severity. Variations in fire severity in red fir forests appear to be a major influence on post-fire stand structure and species composition, successional pathways, and resulting landscape patterns. Our results suggest that drought may be an important mortality agent controlling red fir regeneration on these burned sites. Red fir seedling establishment occurs in pulses, usually 3-4 yr after fire.

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August 3, 2009

Patricia Grantham
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RE: Eddy Gulch Draft Environmental Impact Statement

Dear Patty Grantham and Eddy Gulch ID Team,

Please accept these DEIS Eddy Gulch LSR Project comments on behalf of the Klamath Forest Alliance and EPIC- the Environmental Protection Information Center in addendum to those previously submitted with the Klamath Siskiyou Wildlands Center.

Northern Spotted Owl

According to the BE/BA at least 23 NSO activity centers occur in the Eddys Gulch LSR, with at least 20 of these activity centers in the assessment area. While the proposed action has the potential to possible prevent a high intensity fire, it also has the potential to affect a large proportion of this region's NSO population. The DEIS models predict that a total of 7200 acres will burn in the assessment area in the next 20 years, with 720 acres of active crown fire—potentially destroying NSO habitat. However the project proposes to treat 8,291 acres of Fuel Reduction Zones, thinning forest to 32-50% canopy cover and degrading NSO habitat. This project will also cause disturbance in the form of noise from logging trucks, collision with associated project vehicles, increased human presence, over 17,000 acres of prescription fire, etc. Both outcomes have the potential to substantially affect NSO, but considering another alternative that more seriously weighs disturbance to the owls may protect these owls in one of their last refuges.

4.1 . . .

4.1 . . .

As the BE/BA states, NSO have clear requirements for high canopy closure—from 60 to 90%--in nesting and roosting habitat (pg. 16). As part of the thinning in M units, the project proposes to downgrade 36.4 acres of nesting/roosting habitat in NSO home ranges. · Inside NSO home territories (.5 miles) ALL overstory canopy (dominants and sub-dominants) should be retailed. Considering that core areas in the NSO home range are admittedly deficient in nesting/roosting habitat, the Forest should not downgrade *any* nesting/roosting habitat. The project also proposes to modify—that is to reduce canopy cover, basal area and trees per acre-- ~200 acres of foraging habitat. Again, considering the undisputed importance of the Eddys Gulch LSR as a refuge for NSO, every effort should be made to maintain the highest possible quality of habitat in

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the NSO home ranges.

We have several concerns with the adequacy of the Resource Protection Measures discussed on pages 10 and 11 of the BE/BA. 4.2 . . .

1) The first measure prohibits activity occuring from February 1st to September 15 within an active NSO 70-acre nest core. Have all the nest cores been located for all the active activity centers? The Forest should expand this first measure to prohibit activities within the NSO core area in addition to the nest area for these dates in order to protect any unknown nesting locations. 4.2
2) As previously discussed, no NSO habitat should be removed or downgraded at anytime. 4.3
3) There should be no exceptions to full protocol surveys. These surveys were designed with the best available science showing the highest probability of accurately detecting NSO and their nesting status. Less than adequate surveys will not give any conclusive evidence to the status of the owls, and any of the projects activities that would be allowed with these inadequate surveys could disturb nesting owls and cause the nest to fail.
4) As discussed below, there should be no new roads constructed in the LSR. 4.4

Studies have shown significantly higher stress levels were found in male NSO's centered on logging roads as compared to owls beyond 0.41km from a logging road[1]. The costs to the owls of disturbance such as this include energetic demands of avoidance flight and time lost that would be allocated to other activities, as well as increased heat production and heat-related stress due to avoidance flight. If an owl flushes the site due to disturbance, it may also be exposed to predation of diurnal predators[2]. Roads affect not just owls, but dozens of other wildlife species in many different ways, including habitat fragmentation, collision with vehicles, increased human disturbance, etc.[3] The costs of building the 1.03 miles of new temporary roads far outweigh the meager benefits to treat a relatively small amount of area for fire prevention. 4.5

Finally, we fully support re-introducing fire back into the landscape, and support the effort to burn in a mosaic like pattern as discussed in the BA/BE (pg 27). We agree a heterogenous landscape will provide cover for various wildlife species as well as food for NSO prey species. The prescription burning units should explicitly describe how this mosaic pattern will be created, and what the finally outcome should resemble. 4.6

Prescription burning will consume many existing snags that are key nesting and habitat features for NSO. We disagree that the prescription burning will create many new snags 4.7

[1] Wasser, S. K., K. Bevis, G. King, and E. Hanson. 1997. Noninvasive physiological measures of disturbance in the northern spotted owl. Conservation Biology 11:1019-1022.
[2] Swarthout, E. C., and R. J. Steidl. 2001. Flush responses of Mexican spotted owls to recreationists. Journal of Wildlife Management 65(2): 312-317.

[3] Trombulak, S.C. and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1): 18-30.

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suitable for NSO use (BA/BE pg.27). Most prescription burning is cool enough to kill only small understory trees and NSO utilize large diameter snags. We believe it is feasible that the Forest add an additional mitigation measure to design fire treatments to maintain as many large (greater than 21 dbh) snags as possible. This could be accomplished by directing fire in a way to avoid these snags, or by raking flammable fuels away from the base of them.

Please note that the Healthy Forest Restoration Act:

> "Requires HFRA projects on NFS land maximize retention of larger trees in areas other than old-growth stands, consistent with the objective of restoring fire-resilient stands and protecting at-risk communities and federal lands."
>
> "In carrying out a covered project, the Secretary shall fully maintain, or contribute toward the restoration of, the structure and composition of old growth stands according to the pre-fire suppression old growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health, and retaining the large trees contributing to old growth structure."
> -HFRA§ 102(e)(2)

In areas outside of delineated old growth stands (which have to meet the requirements in § 102(e)(2), HR 1904 also provides requirements for the keeping of large trees in project areas. § 102(f) mandates that projects be carried out so that they (1) focus largely on small diameter trees, thinning, strategic fuel breaks, and prescribed fire to modify fire behavior and (2) maximize the retention of large trees, as appropriate for the forest type, to the extent that the trees promote fire-resilient stands.

Canopy and Slope

Our organizations believe that the Klamath National Forest Land Managers should follow the Salmon River CWPP that calls for 70-100% canopy. Decreasing canopy as is proposed may cause an increased fuels risk and eliminate habitat for fishers. 4.8

The Etna Summit fuel break is mostly all Northwest facing. It does not meet the intent to target southerly slopes with prescribed fire. It also has three NSO home territories. In our opinion: this area should be dropped as a FRZ. The Sawyers Bar Rd should have the road side, escape route prescription. 4.9

Basin Plan

There are three units, which the geologists have identified as having "indications of elevated landslide potential." These are M23, M61 and M73. Increasing landslide potential violates the Basin Plan. Since the Lower Klamath is listed for sediment and there is no TMDL Action Plan all sediment delivery must be off-set. We would suggest looking at these units on the ground and likely get them to reconfigure away from unstable features. 4.10 . . . 4.10

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Roads and Landings

In addition to the temporary roads, we are concerned about all the roads they are re-opening and all the landings. How many of these landings exist now and how many are new? How does creating new landings in LSRs maintain or restore old growth characteristics? What is the risk of the roads they propose to reopen? If the proposed roads and landings cross/are located on earthflow terrain they should not be constructed or reopened because of the landslide/sediment delivery risk. 4.11

During the travel management planning process we have repeatedly been told by the Supervisor's Office that the Forest Service will identify the "minimum road system" and propose needed road decommissioning to bring its road system in line with its maintenance budget during watershed level projects. Yet here, we have a watershed level project in a Key Watershed that has been severely degraded by roads. The agency cannot continue to ignore the requirements of the travel rule and the findings and recommendations of your watershed analysis regarding road decommissioning in key watersheds. 4.12

Monitoring

We would like to express our interest in collaborating with the District and other interested parties in effectiveness monitoring and restoration for the Eddy LSR project. 4.13

We would like to request hardcopies of the FEIS to both addresses below. Thank you.

Sincerely,

/s/ Kimberly Baker
Forest and Wildlife Protection Coordinator
Klamath Forest Alliance
PO Box 21
Orleans, CA 95556

Scott Greacen
Executive Director
Environmental Protection Information Center
122
600 F. St., Suite 3
Arcata, CA 95521

4

Comment Document 5

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Pacific Southwest Region
1111 Jackson Street, Suite 520
Oakland, California 94607

IN REPLY REFER TO:
ER 09/787

Electronically Filed

8 September 2009

US Forest Service
c/o RED, Inc. Communications
P.O. Box 3067
Idaho Falls, ID 83403

Subject: Review of the Draft Environmental Impact Statement (EIS) for the Eddy Gulch Late-Successional Reserve Fuels/Habitat Protection Project, Salmon River and Scott River Ranger Districts, Klamath National Forest, Siskiyou County, California

The Department of the Interior has received and reviewed the subject document and has no comments to offer. 5.1

Thank you for the opportunity to review this project.

Sincerely,

Patricia Sanderson Port

Patricia Sanderson Port
Regional Environmental Officer

cc:
Director, OEPC

Comment Document #6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

SEP 0 8 2009

Patricia A. Grantham
Forest Supervisor
Klamath National Forest
1312 Fairlane
Yreka, CA 96097-9549

Subject: Draft Environmental Impact Statement (DEIS) for the Eddy Gulch Late-Successional Reserve Fuels/Habitat Protection Project, Siskiyou County, CA (CEQ# 20090246)

Dear Ms. Grantham:

The U.S. Environmental Protection Agency (EPA) has reviewed the Draft Environmental Impact Statement (DEIS) for the above-referenced project. Our review and comments are pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), and our NEPA review authority under Section 309 of the Clean Air Act.

The Salmon River and Scott River Ranger Districts of the Klamath National Forest are proposing vegetation management for the purpose of protecting existing and future late-successional habitat and to reduce threat from wildfires to local communities and watersheds that may occur inside and/or outside the Eddy Gulch Late-Successional Reserve. The Proposed Action (Alternative B) would involve 25,969 acres of landscape-level treatments located in the Klamath National Forest.

EPA acknowledges the importance of project goals to improve forest health, reduce fuel loading, and protect communities and watersheds from wildfire threats. We support the best management practices described in the DEIS, such as minimizing new road construction and decommissioning roads after project activities have taken place to help reduce adverse environmental effects. 6.1

We have rated the DEIS as Environmental Concerns – Insufficient Information (EC-2) (see enclosed "*Summary of Rating Definitions*"). We recommend that the Final Environmental Impact Statement (FEIS) provide additional information concerning a smoke management plan, worker exposure to naturally occurring asbestos, the wildland-urban interface (WUI), and noxious weeds. Please see the enclosed Detailed Comments for a description of these concerns and our recommendations. 6.2

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Comment Document #6

We appreciate the opportunity to review this DEIS. When the FEIS is released for public review, please send one hard copy and one CD ROM to the address above (mail code: CED-2). In the meantime, we are available to discuss our comments. If you have any questions, please contact Jennifer Gagnon, the lead reviewer for this project, at (415) 947-4121 or Gagnon.Jennifer@epa.gov, or me at (415) 972-3521.

Sincerely,

Kathleen M. Goforth, Manager
Environmental Review Office

Enclosures:
Summary of EPA Rating Definitions
Detailed Comments

cc: Eddy Gulch LSR Project, c/o RED, Inc. Communication

2

Comment Document #6

SUMMARY OF EPA RATING DEFINITIONS*

This rating system was developed as a means to summarize the U.S. Environmental Protection Agency's (EPA) level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the Environmental Impact Statement (EIS).

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

ADEQUACY OF THE IMPACT STATEMENT

"Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, Policy and Procedures for the Review of Federal Actions Impacting the Environment.

Comment Document #6

EPA DETAILED DEIS COMMENTS FOR THE EDDY GULCH LATE-SUCCESSIONAL RESERVE FUELS/HABITAT PROTECTION PROJECT, SISKIYOU COUNTY, CA., SEPTEMBER 08, 2009

Air Quality

Provide a detailed smoke management plan describing the Siskiyou County Air Pollution Control District (SCAPCD) Smoke Management Program. The U.S. Environmental Protection Agency (EPA) acknowledges the need to reduce fuel, which may lead to a reduction of emissions from wildfires. Emissions from wildfires can be a major contributor of PM_{10}, $PM_{2.5}$, and CO (page 3-54, lines 5-6). The DEIS states that the Forest Service would coordinate with the appropriate air quality regulatory agencies during the planning and implementation of its resource management activities that affect air quality (page 1-21, lines 7-16). 6.3

Recommendation:

The FEIS should include a detailed smoke management plan describing the SCAPCD's regulations for pile burning and smoke management, an implementation schedule, the responsible parties, and monitoring and reporting requirements.

Naturally Occurring Asbestos

Limit exposure to Naturally Occurring Asbestos. The DEIS states that asbestos can be introduced into the air by activities that include road construction, reconstruction, or maintenance on roads underlain by ultramafic rock (3-159, lines 5-6). The DEIS also states that ultramafic rock is concentrated in the southwest corner of the Assessment Area, and acknowledges the presence of serpentine geology in the project area (page 3-159, lines 7-9). Although serpentine soils may be limited, it is important to protect human health by limiting the exposure of workers to serpentine soils that may introduce airborne asbestos during vegetation management activities. Very low levels of asbestos in soil can generate airborne asbestos at hazardous levels. We are concerned about the potential exposure of workers to naturally occurring asbestos. 6.4

Recommendations:

EPA recommends that the Forest Service determine whether or not naturally occurring asbestos is present in treatment units or along project access routes. If naturally occurring asbestos is found to be present, the FEIS should provide information on exposure mechanisms and assess the potential for exposure to elevated levels of airborne asbestos from proposed activities.

EPA recommends that the Forest Service review the asbestos occurrence information on the California Geological Survey website: http://www.consrv.ca.gov/cgs/minerals/hazardous_minerals/asbestos/index.htm and the California Air Resources Board (CARB) regulations and guidance at: http://www.arb.ca.gov/toxics/asbestos/asbestos.htm. The CARB website addresses California's Asbestos Airborne Toxic Control Measures for Surfacing Applications, which apply to unpaved roads.

EPA also recommends that the Forest Service review the recommendations presented in the Department of Toxic Substances Control report, "Study of Airborne Asbestos from a Serpentine Road in Garden Valley, California" at:

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Comment Document #6

http://www.dtsc.ca.gov/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=33546.

The FEIS should identify and include commitments for measures that can be implemented to protect human health from naturally occurring asbestos, if appropriate, and include this discussion in the FEIS.

Wildland-Urban Interface 6.5

Describe how the Community Wildfire Protection Plan relates to the proposed project.
A main component of the purpose and need for this project is to provide fire protection for the wildland-urban interface (WUI) (page 1-11, lines 18-19). The Healthy Forest Restoration Act (HFRA) encourages the development of Community Wildfire Protection Plans (CWPPs) under which communities designate their WUIs and the locations where fuel reduction projects may take place. A summary of the Salmon River CWPP is provided in the DEIS (page 2-4, line 31 through page 2-5, line 10).

Recommendations:
The FEIS should further describe actions that will be taken by the Forest Service and the communities to ensure fire protection efforts are consistent, complementary, and fully integrated with the preferred alternative. For instance, describe whether local building and fire safety ordinances are consistent with the effort to reduce and minimize excessive fuels.

Noxious Weeds

The DEIS states that a total of 24 high-priority weeds are found on the Klamath National Forest Noxious Weed List (page 3-205, lines 7-8). A Weed Risk Assessment identified this project as having a moderate to high risk of introducing or spreading noxious weeds (3-209, lines 36-37). The DEIS states that the Forest Service will implement prevention, control, and monitoring activities to prevent noxious weeds from infesting areas in the Project Area (page 2-30, lines 1-27). The Forest Service identifies several noxious weed resource protection measures (RPMs) for each treatment activity. For example, if noxious weeds were found in the area during prescribed burn treatments, there would be an omission of prescribed burn treatments and fireline construction within weed populations, cleaning of all equipment before entering treatment units, post-treatment surveys, site-specific surveys, and monitoring of noxious weed sites to ensure that natural vegetation has recovered from the disturbance (page 3-211, lines 29-33). While these measures are commendable, the DEIS does not specifically state what measures the Forest Service would take to manage or eradicate noxious weeds if they were found at the project sites. 6.6

Recommendation:
The Forest Service should indicate precisely what treatment methods would be used if noxious weeds were found, and any potential impacts they could cause. We also suggest that the Forest Service consider incorporating noxious weed management or eradication treatments as part of the project design.

2

Attachment 7 to Comment Document

Comment Document #7

California Regional Water Quality Control Board
North Coast Region
Bob Anderson, Chairman

Alan C. Lloyd, Ph.D.
Agency Secretary

www.waterboards.ca.gov/northcoast
5550 Skylane Boulevard, Suite A, Santa Rosa, California 95403
Phone: (877) 721-9203 (toll free) • Office: (707) 576-2220 • FAX: (707) 523-0135

Arnold Schwarzenegger
Governor

September 2, 2009

Eddy Gulch LSR Project
c/o RED, Inc. Communications
298 First Street
Idaho Falls, Idaho 83401

Subject: Eddy Gulch LSR Project DEIS
File: USDA-USFS- Klamath National Forest

North Coast Regional Water Quality Control Board (RWB) staff have reviewed the Draft Environmental Impact Statement (DEIS) for the Eddy Gulch Late-Successional Reserve (LSR) Project. The Eddy Gulch LSR is on the Salmon River and Scott River Ranger Districts, Klamath National Forest, Siskiyou County, California. The LSR is located mostly west of Etna Summit, south of North Russian Creek and the town of Sawyers Bar, east of Forks of Salmon, and north of Cecilville. The LSR is about 61,900 acres in size, making it one of the largest LSRs on the Klamath National Forest. The LSR encompasses much of the area between the North and South Forks of the Salmon River, as well as the headwaters of Etna Creek. Elevations range from 1,100 feet to about 8,000 feet. The terrain is generally steep and dissected by sharp ridges and streams. There are a few private inholdings in the LSR and along the main Salmon River and other stream corridors adjacent to the LSR. Field inspections of the project area were conducted by RWB and USFS staff in July 2009. RWB staff appreciates the opportunity to have been involved in the planning process for this project.

The proposed action for this project proposes 25,969 acres of landscape-level treatments to protect late-successional habitat and communities. Within those acres, Fuel Reduction Zones (FRZs), totaling 8,291 acres, would be constructed to increase resistance to the spread of wildfires to adjacent watersheds. The 8,291 acres include 931 acres in 42 thinning units and 7,383 acres in fuel reduction areas (outside the thinning units) to reduce ground and ladder fuels. The proposal includes 17,524 acres of Prescribed Burn Units located outside the FRZs to increase resiliency to wildfires and protect habitat for the Northern Spotted Owl and other wildlife species that are dependent on late-successional forests. There would also be 154 acres of roadside treatments along 22 emergency access routes. The proposed action includes 1.03 miles of new temporary road construction.

California Environmental Protection Agency

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Attachment 7 to Comment Document Comment Document #7

Eddy Gulch LSR Project DEIS -2- September 2, 2009
c/o RED, Inc. Communications

As background, State law assigns responsibility for protection of water quality within North Coast watersheds to the RWB. The RWB implements and enforces the Porter-Cologne Water Quality Control Act (Porter-Cologne Act, California Water Code §13000 et seq.) and the Water Quality Control Plan for the North Coast (Basin Plan). All forest projects must comply with all substantive and procedural requirements of the Porter-Cologne Act and the Basin Plan. Additionally, the Project must comply with the RWB's *Categorical Waiver For Discharges Related to Timber Harvest Activities On Federal Lands Managed by the United States Department of Agriculture, Forest Service in the North Coast Region, Order No.R1-2004-0015* (Waiver). The Eddy Gulch LSR Project will be required to comply with the RWB's Waiver for discharges related to USFS timber operations. The full text of Order R1-2004-0015, a guidance document, and pertinent forms may be accessed at the following web address: 7.1
http://www.swrcb.ca.gov/northcoast/publications_and_forms/available_documents/timber_waiver/

RWB Order No. R1-2004-0015 Item C.3 specifies, "The USFS shall submit and comply with a monitoring program prior to commencement of timber harvest activities when: (1) the USFS's cumulative water effects analysis indicates that the project may cause any water watershed or sub-watershed to exceed a threshold of concern as determined by various models (i.e. Equivalent Roaded Acres (ERA), Surface Erosion (USLE), Mass Wasting (GEO), etc.); or (2) the cumulative watershed effects analysis indicates that the Project may increase risk values, as determined by various models (i.e. Equivalent Roaded Acres (ERA), Surface Erosion (USLE), Mass Wasting (GEO), etc.), in any watershed or subwatershed that already exceeds a threshold of concern prior to project implementation. The Executive Officer retains the discretion to waive this requirement, or to impose monitoring."

The Eddy Gulch LSR is within the Salmon River basin on the Klamath National Forest. The LSR lies primarily within tributary watersheds (7th-field hydrologic units) between the North Fork (5th-field hydrologic unit) and South Fork (5th-field hydrologic unit) Salmon River. A small portion of the LSR (6,771 acres) overlaps into the headwaters of Etna and Mill creeks (6th-field hydrologic units), tributary to the South Fork Scott River (5th-field hydrologic unit).

The Cumulative Watershed Effects (CWE) modeling done for this Project and detailed in the Hydrologist's Report indicates that Eddy Gulch, Kanaka-Olsen and Indian 7th Field Watershed are over the threshold of concern (TOC) of 1.0. The Eddy Gulch 7th Field Watershed had a value of 1.05 for the USLE model. The Kanaka-Olsen 7th Field Watershed had a value of 1.53 for the GEO model. The Indian 7th Field Watershed had a value of 1.04 for the ERA model. In accordance with RWB Order No. R1-2004-0015, a water quality monitoring program is required to be approved for this project by the RWB prior to commencement of timber harvest activities. 7.2

A Salmon River temperature total maximum daily load (TMDL) and action plan was adopted by the Regional Water Board on June 22, 2005, through Resolution No. R1-2005-0058. The temperature TMDL concluded in Section 4.3 that, "The recovery of riparian vegetation height and extent from past disturbances is expected to be the most important factor at a landscape scale in lowering stream temperatures toward natural levels where they would meet Basin Plan objectives."

California Environmental Protection Agency

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Attachment 7 to Comment Document Comment Document #7

Eddy Gulch LSR Project DEIS -3- September 2, 2009
c/o RED, Inc. Communications

A portion of the Project area is within the Scott River watershed. The Action Plan for the Scott River Sediment and Temperature Total Maximum Daily Loads (TMDLs) was approved by the U.S. Environmental Protection Agency on September 8, 2006. The Scott River TMDL Action Plan specifies the following:

- Basin Plan, Page 4-61.00, "The Regional Water Board encourages parties responsible for roads and sediment waste discharge sites to take actions necessary to prevent, minimize, and control road-caused sediment waste discharge. Such actions may include the inventory, prioritization, control, monitoring, and adaptive management of sediment waste discharge sites and proper road inspection and maintenance."
- Basin Plan, Page 4-62.00, "The Regional Water Board encourages parties responsible for vegetation that provides shade to a water body in the Scott River watershed to preserve and restore such vegetation. This may include planting riparian trees, minimizing the removal of vegetation that provides shade to a water body, and minimizing activities that might suppress the growth of new or existing vegetation." To ensure compliance with the Basin Plan temperature objective and the temperature TMDL, the Project should be implemented in a manner that does not reduce shading of any streams. 7.3

The potential impact on stream temperature was judged to be very small in the DEIS because the mechanical thinning units and the proposed temporary roads are not within Riparian Reserves and are located on or near ridgetops. The proposed temporary roads would not cross any streams or other Riparian Reserves and are dispersed in a number of short segments across several watershed areas. The temporary roads would be closed, ripped, and re-contoured after use. The greatest potential for adverse stream temperature effects would be related to flare-ups associated with prescribed fire within Riparian Reserves. Flareups could remove canopy and create openings adjacent to streams. Such events are expected to be few in number and limited in size by the fact that burn plans will consider retention of cover in these areas in conformance with Klamath LRMP guidance. Please describe in the Final EIS how the sediment objectives for the Scott River TMDL described above will be achieved for this Project. 7.4 7.5

RWB Order R1-2004-0015 requires that, prior to commencement of timber harvest activities, the USFS shall, in writing, file with the RWB a Notice of Intent (NOI), in which the USFS certifies they understand and intend to comply with all criteria and conditions of this Order and applicable water quality regulations. The NOI shall be signed by the Forest Supervisor or their duly authorized USFS representative. The Waiver can be revoked at if the RWB's Executive Officer determines that the criteria and conditions set forth in the Order are not met.

California Environmental Protection Agency

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Attachment 7 to Comment Document Comment Document #7

Thank you for the opportunity to comment on the Eddy Gulch LSR Project DEIS. Please contact me to discuss monitoring required by Order R1-2004-0015 for watersheds over the TOC. If you have any questions regarding these comments or other information in this letter, please contact me at (707) 576-2030 or Fred Blatt at (707) 576-2800.

Sincerely,

for Thomas R. Williams, Engineering Geologist
Northern Timber Unit

090209_FJB_KNF Eddy Gulch LSR Project DEIS

California Environmental Protection Agency

Recycled Paper

Appendix C
Klamath National Forest
Klamath National Forest Hazard Tree Policy
Safety Provisions On National Forest System Roads

FOREST SERVICE MANUAL
KLAMATH NATIONAL FOREST
YREKA, CA

FSM 7700 – TRANSPORTATION SYSTEM

CHAPTER 7730 – OPERATION AND MAINTENANCE

Supplement No.: 7700-2005-1

Effective Date: May 23, 2005

Duration: This supplement is effective until superseded or removed.

/s/Margaret J. Boland

Approved: MARGARET J. BOLAND
Forest Supervisor

Date Approved: 05/23/2005

Posting Instructions: Supplements are numbered consecutively by title and calendar year. Post by document; remove the entire document and replace it with this supplement. Retain this transmittal as the first page(s) of this document. The last supplement to this title was
Supplement 11 to 7730

New Document	7733.03	11 Pages
Superseded Document(s) by Issuance Number and Effective Date	None	0 Pages

Digest:

This supplement establishes the Klamath National Forest Hazard Tree Policy.

7733 – SAFETY PROVISIONS ON NATIONAL FOREST SYSTEM ROADS

7733.03 - Policy

This hazard tree guidance is intended to assist Districts in addressing hazard trees that pose an immediate threat to the public. This guidance is developed only for hazard trees and not general salvage. Hazard tree removal is considered a road maintenance activity and not a salvage activity. This guidance is not intended to discourage the use of general salvage sales to address hazard trees where appropriate.

This guidance is divided into 4 sections: Exhibit 1 assists in identifying appropriate Klamath LRMP objectives and requirements, Exhibit 2 addresses NEPA and ESA considerations, Exhibit 3 lists processes that identify hazard trees, and Exhibit 4 contains the short term mortality definitions that are discussed in the hazard tree matrix in Exhibit 3.

The hazard tree identification process in Exhibit 3 is for trees along road systems, within campgrounds, administrative sites, and other high use recreation areas. The line officer will identify the appropriate level of risk based upon the type of public use.

All trees meeting the hazard criteria in Exhibit 3 should be considered a high priority for treatment. There may be some trees deemed to be a hazard that do not meet the enclosed criteria. These trees will need to be addressed on a case-by-case basis.

EXHIBIT 1
KLAMATH HAZARD TREE GUIDANCE

PURPOSE: This document is intended to aid forest personnel and decision makers in identifying: 1) Hazard trees, 2) Options available for hazard tree disposition (i.e., retain on site, salvage with or without replacement), and 3) Requirements defined by the Klamath National Forest Land and Resource Management Plan (Klamath LRMP).

Hazard Tree Identification and Policy: It is Regional policy to abate public hazards and protect public safety. How we choose to treat hazard tree abatement and disposition (i.e., felling with or without replacement or topping, and /or sale) is within the line officer's decision space. Once the hazard tree(s) have been identified, a decision must be made on the appropriate treatment for the tree. Hazard trees within various land allocations should be abated and disposed of differently.

Watershed analysis and LSR Assessments are not required in order to abate public safety hazards. Each activity will need to meet the appropriate NEPA direction, survey and manage requirements, and ESA evaluation/consultation requirements prior to undertaking the management activities.

The following offers some guidance for hazard tree abatement and disposition for several of the key land allocation areas found on the Forest.

LSR's:

A completed LSR Assessment is not required to abate a public safety hazard. As stated in the Klamath LRMP; "Removal of snags and logs may be necessary to reduce hazards to humans along road and trails and in or adjacent to campgrounds. Where materials must be removed from the site, as in a campground or on a road, a salvage sale is appropriate. In other areas, such as along roads, leaving material on site should be considered. Also, material will be left where available CWD is inadequate."

The following contains the CWD guidance for LSR's that is found in the Klamath National Forest Late-Successional Reserve Assessment (pages 3-3 – 3-5): The desired amounts of down logs are within the ranges described in the Klamath LRMP. The recommended amounts shown here have been adapted for three vegetation types and reflect Forest data obtained from the 1992 old growth inventory. Down logs are to be in a variety of decay classes; logs 15" in diameter and 10 feet in length count towards meeting the guideline for late-successional stands, but larger down logs (i.e.>20") are preferable. The desired figure shown in the following chart represents a minimum average for the landscape or treatment area (i.e., 100 acres). Numbers of down logs can vary on any particular acre. It is desired to exceed this minimum figure, but not at a point that will create the likelihood of a stand replacing event.

Vegetation Type	Aspect	CWD/acre
Douglas-fir	North and East	12
Douglas-fir	South and West	8
Mixed Conifer	North and East	10
Mixed Conifer	South and West	7
True Fir	All	15

An assessment of current CWD densities should be done in order to determine appropriateness of disposing the hazard by removal. Methods to consider where CWD densities are not adequate should include topping or felling and leaving on site. Any felled tree should be left in a position where it will not be a potential hazard to the road/site from rolling. REO review is not needed for hazard tree abatement.

NSO Critical Habitat:

If the hazard tree abatement project is within designated critical habitat, emphasis shall be given to maintaining the primary constituent elements (canopy closure, snags, and coarse woody debris) while mitigating the hazard. Depending on the scope and scale of the project, the USFWS may need to be contacted. Sale of trees is appropriate if all Klamath LRMP standards and guides are met for CWD. Methods to consider where CWD densities are not adequate should include topping or felling and leaving on site. Any felled tree should be left in a position where it will not be a potential hazard to the road/site from rolling.

SONCC (Coho) Critical Habitat: Follow guidelines for Riparian Reserves

Riparian Reserves:

Consideration for riparian CWD requirements is key in the Riparian Reserve land allocation. Most trees felled will be left on site to help meet CWD requirements for riparian areas. Pertinent S&Gs are:

MA10-56 Maintain 20 pieces of large wood (40 cubic feet or larger) per 1,000 lineal feet within 3rd to 5th order channels, or as identified in the ecosystem management process at the watershed level.

MA10-53 Fall roadside safety hazard trees. Allow the removal of these trees where woody debris requirements have been met."

Page 3-69 of KLRMP EIS describes the amount of large woods per 1,000 for a number of streams on the Forest. None of the streams listed in the KLRMP EIS meet the S&G for large wood. The greatest number of wood estimated for streams listed is Rock Creek at 1.11 pieces per thousand feet. Therefore, it is unlikely that hazard trees would be removed based on sufficient large wood levels. Priority must be given to meeting the Klamath LRMP standards and guides for CWD, unless public safety and integrity of the road drainage system dictates otherwise. **Methods to consider where CWD densities are not adequate should include topping or felling and leaving on site.** Any felled tree should be left in a position where it will not be a potential hazard to the road/site from rolling.

The removal of hazard trees in Riparian Reserves is considered a road management activity, not a timber management-salvage activity. Therefore S&G MA10-54 (Salvage trees only when watershed analysis determines that present and future CWD needs are met and other Aquatic Conservation Strategy objectives are not adversely affected) does not apply to hazard tree removal.

For other Forest-wide standards and guides refer to 6-16 (page 4-25), Coarse Woody Debris, in the Klamath LRMP.

Administrative Sites (Campgrounds, Special Use Permits, Day Use Areas, Trailheads, etc.):

For these types of areas it is recommended that the sites receive a Forest Pest Management evaluation. This should be followed up with the development of a site-specific vegetation management plan. Recommendations from the Forest Pest evaluation and subsequent vegetation management plan should be used to develop abatement and disposition strategies for administrative sites. Options to consider for disposition in administrative sites can include fell and remove the hazard, remove the defective part of the hazard, fell and leave on site, and/or remove the potential target.

Matrix:

This land allocation offers the most flexibility for felling and removal. Klamath LRMP standards and guides for CWD should be considered during analysis of hazard tree safety abatement and disposition. Several factors should be considered during the analysis including the potential for future CWD recruitment (within the general area and not limited to just the roadside) and the likelihood of any felled tree remaining on site due to potential firewood use.

AMA:

Hazard tree disposition within the AMA should consider the land allocation that has been identified within the AMA designation and treated appropriately using above guidance.

Appropriate NEPA and ESA requirements must be met for hazard tree abatement and disposition for all the above land allocations. Follow the standards and guides within the Klamath LRMP for each land allocation (Riparian Reserves, LSR's, Matrix, and AMA).

EXHIBIT 2
NEPA AND ESA CONSIDERATIONS:

1. Determine the Klamath LRMP land allocation(s) in which the project is located. If the project will occur in an area where the maintenance of snags is extremely important, consider topping the trees to maintain the snag component of the stand. These types of allocations may include Research Natural Areas, spotted owl habitat, LSR's, Riparian Reserve areas, Goshawk areas, and Bald Eagle roost areas.

When hazard tree removal is proposed within an RNA, NSO critical spotted critical owl habitat, Managed wildlife area, LSR, riparian area, Goshawk area, or Bald Eagle roost area, it is important that the hazard removal activity be consistent with the intent of that land designation.

2. An analysis to determine the level of coarse woody material on the site, consistent with the scope of the proposed project should be used to determine if there is adequate coarse woody material to meet the Klamath LRMP standards and guidelines. If the guidelines are not met, the material should be left on site if it is not a safety hazard.

3. The project may have to be reviewed by a Level 1 consultation team if the project is within 45 miles of the coast and within ¼ mile of suitable MAMU habitat, is within a bald eagle roost or nest area, or within a known spotted owl activity center; or is within ¼ mile of unsurveyed suitable spotted owl habitat.

4. NMFS has provided guidelines for the definition of hazard trees. The NMFS definition for hazard trees identification is consistent with the KNF definition. NMFS concluded informal consultation for hazard tree removal in the July 17, 1997 BO/LOC for the "Road and Trail Maintenance, Watershed Restoration, and January 1997 Flood Response Actions on the KNF". NMFS has also provided Project Design Standards and concluded programmatic consultation of the removal of hazard trees if the Project Design Standards below are met (See August 1, 1997 NMFS letter for more information):

Removal of hazard trees that have fallen or are felled within interim RRs will generally be left on site, as these trees may be needed to maintain and restore coarse woody debris levels and function within these areas.

a. Fallen or felled hazard trees may be removed from interim RRs if

    i. Trees must be removed to provide safe road passage or campground access and function; OR

Those trees would pose a substantial risk to the forest road drainage system integrity; AND
A fisheries biologist determines through site inspection and written document that removal of individual hazard trees within interim RRs is consistent with the Aquatic Conservation Strategy Objectives.

5. Use a categorical exclusion (Decision Memo) when the hazard trees pose a significant threat to public safety. Use categories 31.1b.3 ("Repair and maintenance of administrative sites"), 31.1b.4 ("Repair and maintenance of roads, trails, and landline boundaries"), or 31.1b.5 ("Repair and maintenance of recreation sites and facilities") for trimming, felling, or removing individual hazardous trees and other vegetation from around administrative sites,

recreation sites, roads, and trails, where the material could be sold. To correctly apply these CE's, the primary reason for the actions must be the hazard, and that the hazard must clearly pose an immediate public danger or threat in campgrounds, recreation facilities or other high use areas; or public danger or threat along open roads. Refer to the February 9, 2000 memo concerning "Clarifying order and Categorical Exclusions for Hazard Trees."

6. Where the removal of trees includes more than hazard trees the use of categorical exclusions is not warranted. An environmental assessment with supporting decision notice needs to be completed.

EXHIBIT 3
HAZARD TREE DEFINITION

A tree is considered a hazard if all or a portion of the tree has a high potential to fall or roll onto a roadway or facility and cause personal injury or property damage. Distance to trees on the uphill side may exceed one tree height if they are likely to roll or slide onto the roadway, site, or facility (i.e., there are insufficient barriers to prevent trees from reaching the roadway, trail or facility).

R.O. Direction – Top priority will be given to the felling and/or the removal of trees that are dead or have visible defects and are <u>sufficiently tall to fall on</u> roads or high use areas and cause personal injury, death, or significant property damage.

Areas of Consideration:
Roads: Level 3, 4, and 5 system roads (required in Federal Highway Safety Act) and level 2 roads where closure is not an option. The Federal Highway Safety Act includes signed snowmobile trails.

Campgrounds, Administrative Sites, etc.: Developed and undeveloped recreation sites, special use areas, Forest Service administrative sites, day use areas, river access areas, trailheads, and other areas of high recreation and visitor use.

Hazard Tree Criteria:
It must be remembered that these are guidelines for determining definite hazard tree situations. These guidelines are based on physical location (target potential) and physical characteristics (tree defects) that either present a definite hazard or have high potential for tree failure and the potential to reach an area of concern (road, campground, administrative site, etc.). There may be other trees and situations that may not specifically fall into these categories but may still be determined to be a hazard based on local conditions, further site evaluation and the judgment of the inspector. All hazard tree evaluations should be documented in writing. A hazard tree inspection form is included for use where appropriate, particularly in the recreation or administrative sites listed above.

To be considered a hazard tree, it must meet one or more of the following criteria:

1. **Forest pest management experts (entomologist and/or pathologist) have reviewed the trees/snags and have indicated that they are a hazard.**

   If Forest Pest Management specialists have not reviewed the proposed project area, the following should be used to determine if a tree/snag is a hazard. The following is a guideline rating systems to be used for judging hazard trees by tree defect and target potential.

Rating: Tree/snag needs any combination of 3 points or greater to qualify as Hazard Tree (more than one category can be used to get a total of 3 or greater).

2. Tree Defect and Target Potential

Tree Defect and/or Target Potential	Points
Tree is dead (no live crown)	2
Snags or spike top trees above road that are within the height of the snag/spike top tree and are straight or lean toward road	2
Snags or spike top trees below road that are within the height of the snag/spike top tree and lean toward road	2
Snags or spike top trees with potential to reach site/facility	2
Unnatural lean exceeds 20 degrees from vertical toward area of concern	2
Green trees above or below road sufficiently tall to reach road (unnatural lean only) exceeding 16" DBH and 20 feet tall	1
Green trees with potential to reach a site/facility (unnatural lean only).	2
Soil shows evidence of recent movement (within the last 5 years)	2
Spike top tree where the dead portion of the tree has the potential to reach the area of concern	1
Trees showing signs of advanced symptoms of root diseases (trees infected with annosus root disease, black stain, Armillaria root disease, etc.) and have the potential to reach the area of concern	3
Trees expected to die within the next 6 months (see Exhibit 4, Klamath "Short-term Mortality Indicators") and have the potential to reach the area of concern	3
Mechanical and bole defects (including fire damage). Bole damage (cambium) exceeds one-third of the circumference for all species except sugar pine and has the potential to reach the area of concern. Bole damage (cambium) on sugar pines exceeds 50% of the circumference and has the potential to reach the area of concern	3
Exposed root wad of tree sufficiently tall to reach the road	3
Trees showing symptoms of advanced branch, bole or basal decay due to root disease or heart rot. Total solid rind thickness is less than one-third of the diameter at the point of decay and the tree has the potential to reach the area of concern.	3

EXHIBIT 4
SHORT TERM MORTALITY INDICATORS

The following conditions indicate that the affected trees have a fatal, non-reversible condition and are very likely to be dead within 6 months. Some trees under severe drought-stress may show no external sign of being attacked by beetles. Any tree, which has life stages or galleries of any species of beetle, except red turpentine beetle, visible when bark is removed with an axe, should be expected to die within 6 months. Trees infested with only red turpentine beetle must be physically girdled around at least 40 % of the tree circumference to be expected to die within 6 months.

A. Pines. (Ponderosa, Jeffrey, sugar and western white pines).

(1) Top one third of crown faded down to a stem diameter of at least 6 inches. (Crown fading will follow a rapid progression of colors from pea-green to straw-yellow to orange to brick-red to brown. The size limitation indicates infestation by a species of Dendroctonus bark beetle).

(2) Fresh, sticky pitch tubes located on the bole between 2 and 20 feet above the ground. Pitch tubes must be reddish in color (pink, rosy, red, purplish-red, reddish-brown). Number of fresh pitch tubes must be at least equal or greater than half of the DBH in inches (i.e. a 12 inch DBH pine must have at least 6 fresh, reddish pitch tubes). Crown may be any color.

(3) Fine, dry red frass (boring dust) accumulated in bark crevices, or cobwebs, or on ground around base of pine tree. (This does not include the coarse, crumbly frass produced by red turpentine beetle, which is often resinous.) Amount of frass per tree must total at least one tablespoon to be considered significant. Crown may be any color.

(4) Conspicuous removal of bark by woodpeckers. Outer bark of ponderosa pines usually removed in patches of several square inches to reveal reddish inner bark. Woodpecker work on Jeffrey, sugar and western white pines usually a vertical series of 3/8 inch diameter holes at about 1 inch spacing on bark plates. Bark flakes usually accumulate on ground or snow under tree. Crown may be any color.

(5) Blowdown.

B. White fir.

(1) Crown currently faded down to a stem diameter of 4 inches or greater. Crown color will rapidly change from pea-green to yellow to orange to brick-red to brown. Size limitation indicates the fir engraver, Scolytus ventralis is infesting the main stem.

(2) White frass (boring dust) accumulated in bark crevices, cobwebs or around base of fir tree. Amount of frass per tree must total one tablespoon to be significant. Crown may be any color. (White frass indicates either no pitch flow in response to fir engraver attack, or successful infestation by ambrosia beetles. Either

condition indicates a dying fir tree.)

(3) Ground or snow below white fir tree covered with "green" needles. This does not include normal fall shedding of older yellow needles.

(4) Blowdown.

C. Red fir.

(1) No limbs with normal-color green foliage left in crown.

(2) White frass (boring dust) accumulated in bark crevices, cobwebs or around base of fir tree. Amount of frass per tree must total one tablespoon to be significant. Crown may be any color. (White frass indicates either no pitch flow in response to fir engraver attack, or successful infestation by ambrosia beetles. Either condition indicates a dying fir tree.)

(3) Blowdown.

D. Douglas-fir.

(1) At least one accumulation of rusty-orange frass (boring dust) per foot of circumference. The piles of frass will be approximately ¾ inch in diameter and will be located in bark crevices in the lower 3 feet of the bole. (This indicates successful attack by the Douglas-fir beetle.)

(2) Trees have not broken bud while all adjacent trees have broken bud.

Buds are drying and are not firm.

(3) Woodpeckers have removed at least several square inches of bark from the bole portion which has bark less than 1.5 inches in thickness. Crown may be any color, including green. Ignore single, deep woodpecker holes near the base of old, thick-barked trees (the woodpeckers at the base are usually seeking ants in the bark, which are not a threat to the tree).

(4) No limbs with completely normal-color foliage remaining on tree.

(5) Blowdown.

E. Incense-cedar.

(1) No limbs with completely normal-color foliage remaining on tree.

(2) Blowdown.

The Eddy Gulch LSR Project

Pathway to a healthy future