United States Department of Agriculture

Forest Service

April 22, 2013

Environmental Assessment

Boulder Creek Fuels Restoration Project

Hume Lake Ranger District,
Giant Sequoia National Monument, Sequoia National Forest
Fresno County, California

Township 13 South, Range 29 East, Mount Diablo Base and Meridian

For Information Contact: Marianne Emmendorfer
35860 Kings Canyon Rd. Dunlap, CA 93621
559-338-2251 x 313
www.fs.usda.gov/projects/sequoia/landmanagement/projects

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Summary

The Sequoia National Forest proposes to use prescribed burning to begin restoring the ecological conditions in the Boulder Creek Drainage. The project area is located in the lower portion of the Boulder Creek Drainage, in Township 13 South, Range 29 East, Mount Diablo Base and Meridian, within the Hume Lake Ranger District, Giant Sequoia National Monument, Sequoia National Forest, California. This action is needed because fire, which has been suppressed for about 100 years, plays a key role in sustaining the natural ecological processes.

The proposed action, Alternative 2, would reduce fuels across 6,000 to 9,000 acres through prescribed burning during the spring and fall in compliance with the local air quality control board designated burn days. The burning fuels would produce smoke for up to two weeks at a time, and alter the vegetation which forms the surface and ladder fuels. Alternative 2 would also reduce fuels around the old-growth sequoias, old forest wildlife habitat and a number of cultural resources. Alternative 2 proposes use of aerial and hand ignition tactics that would have been used during the 2010 Sheep Fire, if that wildfire had been allowed to continue west into Boulder Creek. The timing of the proposed burning would minimize exposure of firefighters to dangerous fire behavior, and when prospects of weather events would minimize long-term smoke impacts.

In addition to the proposed action, the Forest Service also evaluated the following alternatives:

- Alternative 1, the No Action Alternative, would not allow prescribed burning in the area at this time.

- Another alternative was considered and eliminated from detailed study that would not use aerial ignition in the Monarch Wilderness and Agnew Inventoried Roadless Area (IRA). Instead it would mimic a natural fire as nearly as possible in the Wilderness and IRA, as if the Sheep Fire had been allowed to continue burning beyond the line where the Sheep Fire was suppressed. The timing of such a burn should as nearly approximate the time of year when the Sheep Fire began or was suppressed, given weather constraints and those placed on the project by the air resources control board.
  This alternative was eliminated from detailed study because of firefighter safety concerns. The majority of the Boulder Creek project area is comprised of steep inaccessible terrain. Hand firing in the steep slopes and dense fuels, where the 2010 Sheep Fire was kept from proceeding west into Boulder Creek Drainage, would expose firefighters to extreme risk of injury and could not be safely accomplished without air support. During the Sheep Fire aerial ignition was successfully used within the Monarch Wilderness and the Giant Sequoia National Monument. This ignition tactic, coupled with strategic hand ignition, successfully minimized most of the upslope stand-replacing fire effects and helped to reduce long-term smoke impacts.

All of the alternatives support the public suggestion referencing “natural fire”, as does the management direction provided by the 2012 Giant Sequoia National Monument Management Plan (Monument Plan) (USDA 2012) for the project area: “Managed wildfire is considered available if a naturally-ignited wildfire is burning at the desired time to initiate a project, or during project planning or implementation. If managed wildfire is available, the risks and effectiveness of using it will be weighed using the Wildland Fire Decision Support System (WFDSS), or subsequent systems developed for this purpose”(Monument Plan, page 80, 2012). See Appendix C of this document for the Management Tool Determination and Tree Felling Criteria for the Boulder Project, which documents the assessment of risk, effectiveness and feasibility required by the Monument Plan (Monument Plan Decision Tree pages 79-82, 2012).

Based upon the effects of the alternatives, the responsible official will decide which alternative best meets the long-term management direction for ecological restoration of the fuels and fire regime across the landscape, specifically within the sequoia groves and Monarch Wilderness.

Chapter 1: Purpose and Need for Action

Introduction

This Environmental Assessment documents the analysis performed by an interdisciplinary team on the Boulder Fuels Restoration (Boulder Fuels) Project area on the Hume Lake Ranger District within the Giant Sequoia National Monument and Sequoia National Forest. The Boulder Fuels project area is approximately 9,000 acres on National Forest System lands, located in Townships 13 South and Ranges 29-30 East, Mount Diablo Base and Meridian. It is in Fresno County, approximately 70 air miles east of Fresno, California (See Figure 1).

The Boulder Fuels Restoration project area boundaries are the Sheep Fire edge and Deer Meadow Trail (Forest Trail (FT) 30E05) on the east, portions of Big Meadows and Burton Pass roads (Forest Road (FR) 14S11 and 14S02 respectively) on the south, a portion of FR 13S26 on the west, and State Highway 180 and the Kings River on the north.

The project area includes portions of Monarch Wilderness, Agnew Roadless Area, the Wild and Scenic South Fork of the Kings River, giant sequoia groves (Agnew, Deer Meadow and Evans Complex), and the Windy Gulch Geologic Area as shown in the 2012 Giant Sequoia National Monument Environmental Impact Statement and Management Plan (Monument Plan) (USDA 2012).

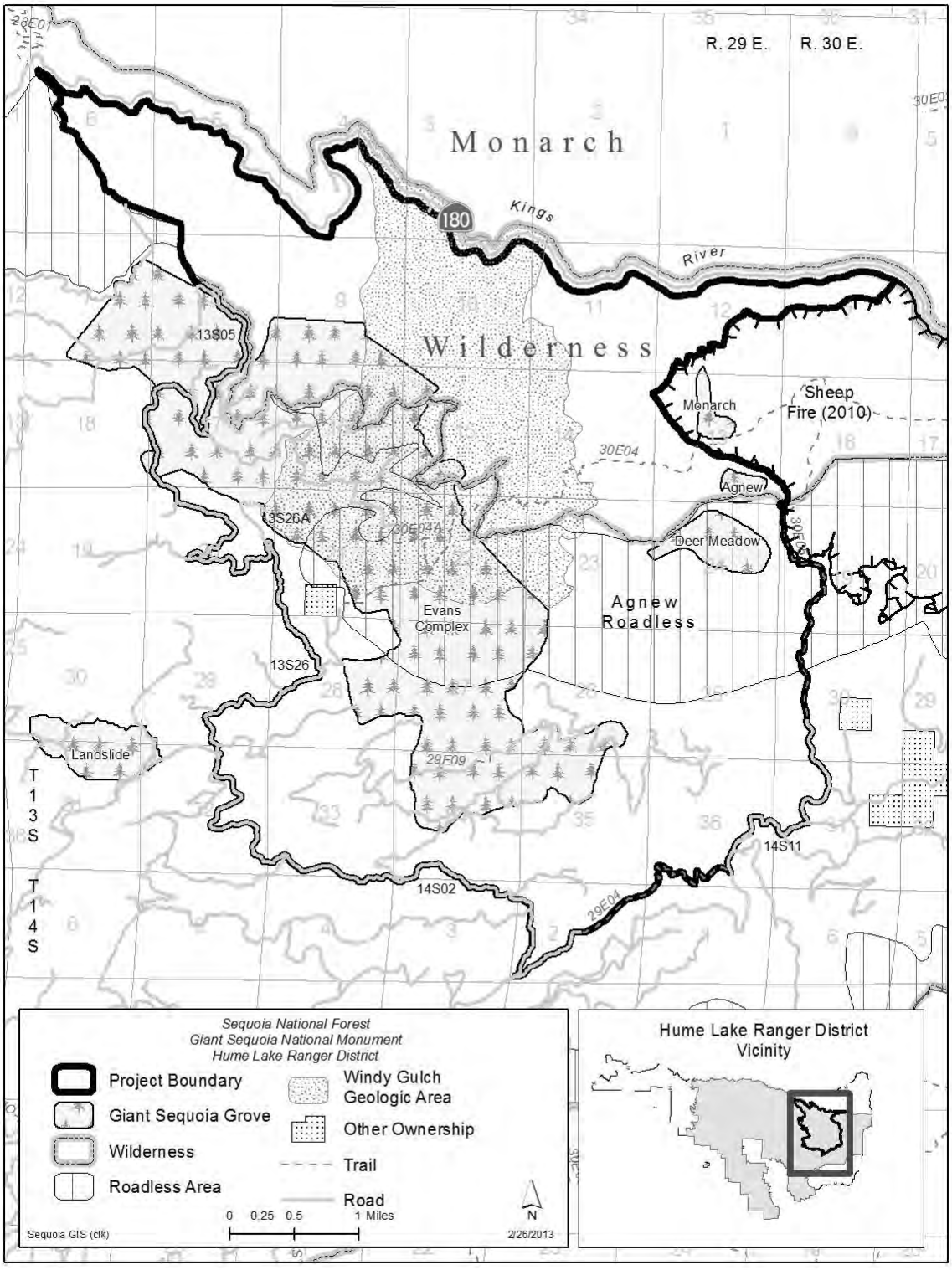
Background

Fire has played an important role in the ecology of the Sierra Nevada for thousands of years. Before the area was settled by Euro-Americans, fires were generally frequent throughout much of the range. The frequency and severity of these fires varied based upon climate, elevation, topography, vegetation, soil conditions, and Native American occupation. Fires affected the dynamics of biomass accumulation and nutrient cycling, and generated vegetation mosaics on a variety of spatial scales.

Management strategies in the past century have reduced the influence of fires in the ecosystem and contributed to the forest conditions that encourage high-severity fires. Live and dead fuels have increased along with the development of denser brush and mixed conifer forests. Higher stand densities are concentrated mainly in small and medium size classes of shade-tolerant, fire-sensitive species. The result has been an increase in the amount and continuity of live and dead forest fuels providing a link between surface and canopy fuels.

The majority of the Boulder Creek Drainage has missed the last five fire return intervals (100+ years of fire exclusion). It is in steep inaccessible terrain with a moderate to heavy fuel layer, contained mostly in the Agnew Inventoried Roadless Area and Monarch Wilderness.

Figure 1: Project Area Resource Concerns



Vegetation in the project area is comprised mainly of mixed conifer, ponderosa pine, and live oak overstory, with an understory mainly of bear clover, green-leaf manzanita, and whitethorn. Trees, including areas of giant sequoia and pinyon pine, are competing with each other for water, nutrients, and growing space. There is also a heavy dead and down woody fuels component in the project area. The vertical and horizontal continuity of the fuels provides a ladder for fire to transition from low intensity surface fire to an active crown fire.

In the summer of 2010, the Sequoia National Forest and Sequoia and Kings Canyon National Parks jointly managed the 9,000 acre Sheep Fire, which burned into Monarch Wilderness. Within the wilderness area, the fire was allowed to burn into Monarch Sequoia Grove, located to the north of Agnew and Deer Meadow Sequoia Groves and east of Evans Complex Sequoia Grove.

Current Management Direction

Legislative authorities for administration of the National Forest System wilderness, and vegetation and fuels management programs are listed in Forest Service Manuals (FSM) 2320, 2020 and 5150, respectively (USDA 2007a, USDA 2011a and USDA 1991a). Objectives, policies, and responsibilities for wilderness management, ecological restoration and fuels management are in FSM 2320, FSM 2020 and FSM 5150, respectively:

- Fire management in wilderness is to "reduce, to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness." (FSM 2320)
- The objective is to "reestablish and retain ecological resilience of National Forest System lands and associated resources to achieve sustainable management and provide a broad range of ecosystem services." (FSM 2020)
- The objective is "to identify, develop, and maintain fuel profiles that contribute to the most cost-efficient fire protection and use program in support of land and resource management direction in the forest plan." (FSM 5150.2)

The proclamation that established the Giant Sequoia National Monument identified a need for forest restoration in the sequoia groves and the surrounding forest to counteract the effects of a century of fire suppression and logging. The Boulder Creek Fuels Restoration project area lies in the northern portion of the Monument, and portions of the project are in Monarch Wilderness or Agnew Inventoried Roadless Area.

The proclamation states (Clinton 2000) (Proclamation 7295, Federal Register 65(80): 24095-24100):

- *These giant sequoia groves and the surrounding forest provide an excellent opportunity to understand the consequences of different approaches to forest restoration. These forests need restoration to counteract the effects of a century of fire suppression and logging. Fire suppression has caused forests to become denser in many areas, with increased dominance of shade-tolerant species. Woody debris has accumulated, causing an unprecedented buildup of surface fuels. One of the most immediate consequences of these changes is an increased hazard of wildfires of a severity that was rarely encountered in pre-Euroamerican times. Outstanding opportunities exist for studying the consequences of different approaches to mitigating these conditions and restoring natural forest resilience.*
- *Nothing in this proclamation shall be deemed to revoke any existing withdrawal, reservation, or appropriation [i.e. wilderness designation]; however, the national monument shall be the dominant reservation.*

The Monument Plan (USDA 2012) [1] provides management direction in the form of desired conditions, strategies, objectives, and standards and guidelines to address these conditions. The applicable management direction for this project is:

Desired Conditions:

Vegetation, including Giant Sequoias, is (Monument Plan p. 22):

- Forested stands in the Mediterranean climate of the Monument are subject to frequent weather cycles. Years of cooler, wetter weather are often followed by years of hotter, drier weather. The desired condition of a forested stand subject to these extremes is diversity in composition (species, size, age class, distribution) and spatial distribution that are expected to be more resilient to climate changes over time.

Fire and Fuels is (Monument Plan p. 24):

- Fire occurs in its characteristic pattern and resumes its ecological role. Frequent fire maintains lower, manageable levels of flammable materials in most areas, especially in the surface and understory layers. There is a vegetation mosaic of age classes, tree sizes, and species composition, and a low risk for uncharacteristic large, catastrophic fires. The objects of interest are protected; sustainable environmental, social, and economic benefits (such as those associated with tourism) are maintained; and the carbon sequestered in large trees is stabilized.

Air Quality is (Monument Plan p. 24):

- Emissions generated by the Monument are limited and managed, and clean air is provided for the Monument and surrounding communities.

Wildlife Habitat is (Monument Plan p. 24):

- Lands in the Monument continue to provide a diverse range of habitats that support viable populations of associated vertebrate species, with special emphasis on riparian areas, montane meadows, and late successional forest….Old forest habitat is in suitable quality, quantity, and distribution to support viable populations of late successional dependent species, including Pacific fishers, American martens, California spotted owls, northern goshawks, and great gray owls. The configuration of habitat in the Monument provides connectivity and heterogeneity

Strategies and Objectives:

Strategies for Climate Change/Carbon Sequestration (Monument Plan p. 45):

- Improve the potential for forest ecosystems to return to desired conditions following natural disturbances, such as through the use of prescribed fire, managed wildfire, or mechanical treatments to reduce ladder fuels or tree densities (Strategy 6).

[1] Note that the Monument Management Plan replaced, in its entirety, all previous direction for the Monument, including the 1988 Sequoia National Forest Land and Resource Management Plan(Forest Plan), the 1990 Sequoia National Forest Land Management Plan Mediated Settlement Agreement (MSA) (USDA 1990a), 2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA) (USDA 2001), 2004 Sierra Nevada Forest Plan Amendment (2004 SNFPA) (USDA 2004a) and 2007 Sierra Nevada Forests Management Indicator Species Forest Plan Amendment (2007 SNF MIS) (USDA 2007a).

Strategies for Ecological Restoration (Monument Plan p. 45):

- Accomplish ecological restoration, in part, through the reduction of fuels by decreasing down woody material, ladder fuels, and brush (Strategy 9).
- Promote resiliency in Monument ecosystems by using the following tools, in order of priority: prescribed fire, mechanical treatment, managed wildfire (when available) (Strategy 13).

Strategies for Fuels Reduction (Monument Plan p. 48):

- Locate fuel treatments and manage wildfires (when available) across broad landscapes so that the spread and intensity of wildfire is reduced (Strategy 11).
- Use the following tools for fuels reduction, in order of priority: prescribed fire, mechanical treatment, managed wildfire (when available) (Strategy 13).

Standards and Guidelines:

Fire and Fuels (Monument Plan p. 82)

- Use the most recent inventories of fuel load to develop a fuel load reduction plan for each giant sequoia grove (within its administrative boundaries) (Standard 1).
- Use lightning-caused fires to reduce fuel loads or to provide other resource benefits, such as conserving populations of fire-dependent species (Standard 4).
- For prescribed fire treatments, use multiple entries, as needed, to achieve fuels management objectives, up to two burns per decade and four burns over 20 years (Standard 5).

Wilderness (Monument Plan p. 85):

- In wilderness, use naturally ignited wildfires to meet management strategies when fuel loading and natural barriers will limit the final fire perimeter to a planned boundary under the most severe weather conditions (Standard 14).

Fuel Load Reduction Plan

The 2012 Monument Plan requires that a fuel load reduction plan be prepared for each giant sequoia grove in the Monument, using the most recent inventories of fuel load to evaluate the need for treatment. The Fuel Load Reduction Plan for the Agnew, Deer Meadow and Evans Complex Giant Sequoia Groves (Grove Fuel Plan) was written (Forbes 2012). This Grove Fuel Plan describes the fire history and existing condition, as well as the fuel treatment goals for the groves that lie within the Boulder Creek Fuels Restoration project area (see Appendix B). Fuel treatment goals for these groves are:

- Maintain lower, manageable levels of surface and ladder fuels to reduce the risk of uncharacteristic stand-replacing fires.
- Restore fuel conditions such that an average live crown base tree height of 20 feet and average flame lengths of six feet or less can be maintained should a wildfire occur under 90th percentile fire weather conditions.
- During fuel load reduction activities, emphasize the protection of large giant sequoia trees and large trees of other species including pines.

Purpose of and Need for Action

In accordance with FSM 2020, and Pacific Southwest Regional policy (USDA 2011b), long-term management direction in the southern sierra forests is for ecological restoration of the fuel and fire regime across the landscape. In the Giant Sequoia National Monument ecological restoration is focused on the sequoia groves and their surrounding ecosystems.

The purpose of the Boulder Creek Fuels Restoration (Boulder) Project is to protect, restore, and maintain the giant sequoia groves, the surrounding forest, and the other Monument objects of interest in the Boulder Creek area, and allow for safe and efficient fire suppression activities on fires burning out of the Monarch Wilderness and Agnew Inventoried Roadless Area.

This project is needed to:

- Reduce excessive fuel loads across the landscape, particularly within Monarch Wilderness;
- Re-establish fire to this fire-adapted ecosystem, particularly within Agnew, Deer Meadow, and Evans Complex Sequoia Groves;
- Reduce the risk of loss of old-growth forest habitat to large scale, stand-replacing wildfires;
- Reduce the risk of loss of cultural resources to wildfires; and
- Establish conditions that allow for a highly diverse vegetation mosaic of age classes, tree sizes, and species composition.

Timing is critical for the Boulder Creek Fuels Restoration (Boulder) Project. In 2010, the Sheep Fire was ignited by lightning and burned through a portion of the Monarch Wilderness and Agnew Inventoried Roadless Area. The Sheep Fire was a managed wildfire to reintroduce fire and lower hazardous fuel loading. It was stopped on the eastern edge of the Boulder Creek Drainage, which created a temporary natural fuel break. To take advantage of the natural fuel break the Sheep Fire created, implementation of the Boulder Project would need to start as soon as possible before fuels accumulate in the Sheep Fire area.

Proposed Action

The Forest Service proposes to use prescribed fire to reintroduce fire into the lower portion of the Boulder Creek drainage. The project area encompasses approximately 14,385 acres of the watershed, of which 6,000 to 9,000 acres would be proposed for underburning (see Figure 1). The range in number of treatment acres is due to large areas of rock outcrops and other features that would need other treatments prior to, or instead of, prescribed fire as described in more detail under Alternative 2.

This action responds to the strategies and objectives outlined in the Monument Plan, and helps move the project area towards the desired conditions for the Monument. See Appendix C of this document for the Management Tool Determination and Tree Felling Criteria for the Boulder Project, which documents the assessment of risk, effectiveness and feasibility required by the Monument Plan (Monument Plan Decision Tree pages 79-82, 2012). Reintroducing fire at this scale would increase the pace of restoration treatments in compliance with regional direction.

Decision Framework

Given the purpose and need, the deciding official will review the proposed action and the other alternatives in order to make the following decision:

> Which alternative best meets the long-term management direction for ecological restoration of the fuels and fire regime in the project area and across the landscape, specifically within the sequoia groves and Monarch Wilderness?

Public Involvement

The proposed action was listed in the Schedule of Proposed Actions starting in February 2012. On March 29, 2012 a scoping letter was sent out to 136 individuals or organizations. A public field trip was held on June 14, 2012, and was attended representatives of Sierra Club, Sierra Nevada Conservancy, Sequoia

ForestKeepers and the California Department of Fish and Game. The group hiked into the project area from the Kennedy Meadow trailhead into the Evans Grove Complex. Several stops were made overlooking the Boulder Creek Drainage and while in the sequoia grove to discuss the various concerns and issues.

The scoping period resulted in six respondents, of which five raised several of the same concerns. As a result of the public field trip, a number of the concerns were alleviated. All of the public responses are in the project record on file at the Hume Lake Ranger Station.

Issues

Forest Service Handbook direction provides guidance on identifying and considering issues in environmental assessments: "Issues (cause-effect relationships) serve to highlight effects or unintended consequences that may occur from the proposed action, providing opportunities during the analysis to explore alternative ways to meet the purpose and need for the proposal while reducing adverse effects" (FSM 1909.15, Section 12.4) (USDA 2007c). Public scoping brought forth a number of ideas, suggestions, and important information used in developing this project. Referencing the comments received during scoping, the interdisciplinary team identified the following issues that were analyzed fully within this EA to assess their effects in order for the Decision Maker to make an informed decision:

Issues:

1. *Issue Statement*: The Proposed Action, which includes aerial ignition, does not mimic closely enough a natural fire such as the Sheep Fire.

   The EA should include detailed analysis of an Alternative that does not use aerial ignition in the Monarch Wilderness and Agnew Inventoried Roadless Area (IRA). The Forest Service should fully analyze an alternative that mimics a natural fire as nearly as possible in the Wilderness and IRA, as if the Sheep Fire had been allowed to continue burning beyond the line where the Sheep Fire was suppressed. Instead the alternative should mimic a natural fire as nearly as possible in the Wilderness and IRA, as if the Sheep Fire had been allowed to continue burning beyond the line where the Sheep Fire was suppressed. Moreover, the timing of such a burn should as nearly approximate the time when the Sheep Fire began or was suppressed, given weather constraints and those placed on the project by the air resources control board. Ignitions should be done manually along the old Sheep Fire line in the same locations and only at points where the Sheep Fire was suppressed, which means that ignitions should not take place in patches that the fire did not reach due to the natural patchiness of the fire.

   How Addressed: An alternative that would not use aerial ignition was considered and eliminated from detailed study, because the steep slopes and dense fuels would expose firefighters to extreme risk of injury and could not be safely accomplished (See page 12 of this document). It is important to note that during the Sheep Fire aerial ignition was successfully used within the Monarch Wilderness and the Giant Sequoia National Monument. This ignition tactic coupled with strategic hand ignition successfully minimized most of the upslope stand-replacing fire effects and helped to reduce long-term smoke impacts. Appendix C of this document includes the assessment of risk, effectiveness and feasibility required by the Monument Plan (Monument Plan Decision Tree pages 79-82, 2012).

   Note that Forest Service Manual 2320 does not address the use of aerial ignition within wilderness. A Minimum Requirements Analysis was conducted using the Minimum Requirements Decision Guide, for use of plastic spherical incendiary devices within the wilderness area (This document is in the project record on file at the Hume Lake Ranger Station, and is available upon request).

2. *Issue Statement*: A lack of detail in the scoping document regarding protective measures in Grove areas will result in damage to grove features.

   Grove areas within the project need more detailed and protective steps during planning and implementation of project burns than much of the non-grove areas. This special concern is about part of Area 2 which is in the Evans Grove, and Area 3A which includes part of the Evans Grove and all of Kennedy Grove. The grove features requiring protection from damage during management fires include 1) the living and dead old growth sequoia features (i.e. logs, snags, large stumps), 2) the cultural resources in the grove (i.e., in Evans Grove below Forest Road 13S05, and sequoia early logging era relics) and any Native American use relics, and 3) any other special grove resource values identified in site specific planning as needing special protection during Project burning. The Ishi Giant is the second largest sequoia on National Forest land. The basal exposed wood pans of live old growth sequoias (typically large basal fire scars) and of old growth sequoia logs and snags are vulnerable to ignition by management fire, which could severely damage or destroy the old growth features. Therefore, fire-vulnerable old growth sequoia features (live and dead) should be protected from burn damage by the pre-fire techniques of removing fuels and small trees from the exposed sequoia basal fire scars, and, if necessary for protection, removing ladder fuels that would cause a crown fire in live old growth sequoias.

   How Addressed: Several design features and/or mitigations have been added to ensure the natural and cultural features susceptible to damage from fire are protected adequately in accordance with the Monument Plan (See pages 14-23 of this document). Due to cultural resource protection and confidentiality needs, their specific locations are not presented in this document.

3. *Issue Statement*: The project doesn't take advantage of existing natural fire lines resulting in visual impacts or impacts to the trail system.

   We suggest that the Forest Service try to use the fire line where the Sheep Fire was suppressed, or a ridge top where a fire might naturally cool and stop, or any other natural fuel breaks where clearing would have minimal visual impact or impact on the trail system. We ask that you analyze the project area for the most appropriate fire breaks based on predicted fire behavior, and make the most use out of natural firebreaks like rock outcroppings within the project area.

   How Addressed: The proposed action was clarified to better describe that the project was designed to use the fireline where the Sheep Fire was suppressed, which is a portion of the Deer Meadow Trail. The other unit boundaries also follow natural and management features that slow or stop fires (rock outcrops, ridglines, roads, etc.). Some fireline may be constructed in areas 2 (non-wilderness), 3A, 3B and 3C to protect resources and create smaller unit sizes due to the lack of some natural boundaries. Fireline construction would use minimum impact suppression (MIST) tactics where applicable for containment and would be rehabilitated after the burning is completed. Note that fuel reduction projects in overstocked forests or forests with excessive fuel loads can improve scenic quality when they create more open forest conditions, improve diversity, and minimize scorching from fire.

4. *Issue Statement*: The use of wilderness trails as firebreaks will result in disturbance to the trails, visual impacts, and damaging wilderness qualities of this trail system.

   We have a concern about using the existing trails in the wilderness, including Deer Meadow Trail, as the fire perimeter. In the Golden Trout Wilderness, all snags, no matter how small or deteriorated, and brush were cleared, ten to twenty feet out from the trail, and trees along the trail were pruned up to ten feet and higher. Deer Meadow Trail is where most visitors see and experience the Wilderness, and the visual impacts from creating a fire break should be minimized to the greatest extent possible. The Forest Service should take extraordinary measures to assure that their pre- and post-fire human

management is consistent with the values the Wilderness Act protects, and the qualities that made this area qualify for the wilderness system in the first place.

[During the field trip] we were assured that trails used as fire breaks and any new fire breaks would be "minimally disturbed." Trails used as fire breaks would be minimally treated, sometimes amounting to nothing more than raking or pushing aside needles or debris on the trail down to the existing trail tread or minimal brush cutting along the trail. We urge the Forest Service to provide more detail about this, including a detailed description of how much clearing and what type will be done to the historic trails in the area and where, how wide, and what will be entailed in the construction of new fire breaks. Will fire breaks be cut or dug around the subareas? [See concern 3 above]

How Addressed: Maintenance activities that would allow the trails in the project area to be used as fire lines, if needed, follow the Trail Management Objectives (TMOs) in accordance with FSM 2320. Maintenance would also follow the mitigations clarifying the allowable treatments including only light maintenance on historic trails (See detailed description on pages 14, 21 and 46 of this document).

5. *Issue Statement*: The Proposed Action will result in only 6,000 acres being treated, rather than the preferred 9,000 acres.

   I urge you to implement the 9,000-acre burn option, rather than 6,000 acres (the scoping notice mentions a range of 6,000 to 9,000).

   How Addressed: The range of treatment acres is due to large areas of rock outcrops and other features that would need other treatments prior to, or instead of, prescribed fire. Since some of the rock outcrops are intermixed with vegetation there is a possibility that not all of the vegetation would ignite.

Concerns:

In addition to the five issues identified above, the Forest Service received a number of questions and concerns about the Proposed Action. Although they were not determined to be key factors for developing the environmental effects analysis, in an effort to answer questions and alleviate concerns, we are including responses here:

1. We learned from the recent Southern Sierra Nevada Prescribed Fire and Smoke Symposium in Clovis, CA, that many burns are being continuously shut down by nuisance complaints. The Boulder Creek Fuels Restoration Project is a unique opportunity to start a "one message, many voices" campaign to increase the awareness of the need for fire in the forest and the need for tolerance by the public of "good smoke". Sierra Forest Legacy would like to engage with the planners and implementers of the Boulder Creek Fuel Restoration Projects to develop a strong, interagency outreach campaign to support ecological burning.

   Response: The forest is working with several stakeholders, including Sierra Forest Legacy, to better educate the public about smoke, while also proposing to time the prescribed burns to have the least impact on air quality and the human environment. Several methods of public outreach are already proposed for use during project implementation including public notices in print media, on the internet and in person at various locations on and off the Forest.

2. We urge the Forest Service to provide additional detail about the timing of planned ignitions and provide a breakdown of these ignitions more precisely on the maps provided with the draft EA. They indicated that smaller blocks would be burned on a periodic basis and that each of these smaller blocks would be 500 acres or less. The map could show breakdowns of sub-area, such as 1a, 1b, 1c, etc. based on the Forest Service's estimate of periodic burn areas in the already designated areas.
   Response: Alternative 2 has additional detail about timing and location of the proposed ignitions in Area 1 to provide clarity (See pages 14-20 of this document, and Figure 4).

3. Before moving on to each subsequent phase of the project, and because fire behaves in unpredictable ways, the Forest Service should monitor and evaluate the implementation of each burn phase, especially after the first phase, to learn what it can from its successes and/or setbacks. It should analyze whether it should make adjustments to the project before implementing the next phase of the project. To do this type of monitoring and evaluation, a five-year implementation schedule may be overly optimistic, and the Forest Service should build in sufficient time to adequately evaluate the results from monitoring. The design of the project should also build in adaptive management protocols that allows for adjustments in the scope and manner of project implementation based on the monitoring results and evaluations.
   Response: Monitoring and evaluation would be conducted as necessary during each phase of the project. Several Best Management Practices are identified for Alternative 2 which requires monitoring both during and after project implementation. In addition, smoke emissions and air quality would be closely monitored during project implementation, in part, to evaluate and adjust the phase in progress and the following phases (See pages 20-21 of this document for specific criteria).

4. The EA should explain how the Forest Service's management approach compares to the Park Service's approach to prescribed fire management in and around giant sequoia groves. It is unlikely that the National Park Service would burn all the area in such a short period of time. While there have been natural ignitions in the area, most fires in the area have been suppressed for 100 years. We request that the Forest Service consult with fire managers at Sequoia and Kings Canyon National Parks to get input on how they would design the proposed Boulder Burn.
   Response: Forest Service personnel have been working closely with Park Service personnel for several years regarding fire management, including joint burns across our shared boundaries and this project. The Park Service has conducted a number of burns similar in size and scope to the Boulder Fuels Restoration Project. The most recent comparable burns are in Redwood Mountain Sequoia Grove, which is also a newly designated wilderness area.

5. The "Boulder Burn" should use hand tool "mechanical treatments" to an appropriate extent. Pre-burn cutting of small trees near fire scars in old growth sequoias may be necessary to protect them from destruction by managed fire. I am puzzled by the scoping notice statement that "no mechanical treatments" would be used during the project, if that is meant to preclude appropriate use of hand power tools to do pre-burn manipulations of fuels that are intended to be killed in the burn. Sensible mechanical treatments which serve a restoration and preservation purpose, without conflict to the Monument purposes and resource values, or applicable law concerning wilderness area, should not [be] precluded.
   Response: Wilderness management standards require that "minimum tools" (i.e. crosscut saws, loppers, etc.) be used in wilderness areas whenever possible to achieve management objectives (See Figure 3 portions of areas 1 and 2). This level of tool use is sufficient for the treatments proposed in the Monarch Wilderness portion of the Boulder project area to protect the objects of interest. The effects analysis has shown that prescribed burning with minimal hand tool work, including chainsaws to manipulate fuels around objects of interest (i.e. cultural resources), would be sufficient for pretreatment and implementation in Agnew Roadless Area (Portions of areas 1, 2 and 3A); and the remaining portions outside of the wilderness and roadless area (Portions of areas 3A, 3B, 3C, and 4B (if necessary to stop fire burning out of Area 1)).

6. Some of the plantations in the burn perimeter will be burned and others will not. Please provide specific information about these plantations, their ages, locations, acreages, and whether or not fire will be used as a treatment in each plantation. The description of each plantation should include information about the brush and fine fuels and should apply some sort of criteria for when a fire treatment is appropriate and when it is not. Also, if some of the plantation will not be burned, please provide an estimate for when these unburned plantations may be treated with fire in the future. Can the FS provide a map with stand ages of areas that have more recently been logged (in the last 50 years) in this area? Are any mechanical treatments or removal planned in these plantations prior to introducing fire? What is the ecological restoration protocol proposed in these plantation areas, and will it be informed by the new Giant Sequoia National Monument Plan?
   Response: The analysis of effects on vegetation (see pages 49-53), and Appendix D of this document provide more detail about the plantations which responds to these questions.

7. Burning in Wilderness must be consistent with the purposes of the Wilderness Act. Wilderness means that the Forest Service should use minimal tools in order to accomplish management of Wilderness resources and protect Wilderness values. This generally means that mechanical equipment, chainsaws, and aerial ignition should not be used in the Monarch Wilderness. The Forest Service must take extraordinary measures to assure that their pre- and post-fire management is consistent with the values the Wilderness Act protects and the qualities that made the Monarch Wilderness qualify as the wilderness in the first place. The same should apply to the adjacent Agnew IRA.
   Response: FS Policy allows the use of prescribed fire within wilderness and roadless areas if meeting FSM 2320. This project meets all of the requirements listed in the FSM, specifically objectives to reduce, to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness, and minimal tool analysis. See the responses to concern 5, and issue 1 and 4.

8. A portion of a managed fire burned through the Golden Trout Wilderness Area and damaged some of the habitat for a federally-listed trout species. Identification of listed, candidate, and sensitive species habitat and coordination with the U.S. Fish and Wildlife Service will be important to mitigate any negative consequences that may result in the alteration or loss of key habitat.
   Response: The *Biological Assessment and Biological Evaluation for the Boulder Creek Fuels Restoration Project* (Wildlife BABE) (Cordes 2012a) and *Management Indicator Species Report for the Boulder Creek Fuels Restoration Project* (MIS Report) (Cordes 2012b) evaluated potential effect of this project. Pages 58 to 69 of this document summarize the analysis and page 20 displays the required mitigations.

9. Ignition of fire in a manner that closely mimics a natural fire as much as possible, similar to the continuation of the Sheep Fire, is likely to be tolerated better by species of concern than one that is ignited aerially. The EA must analyze the potential effects from burning on species of concern, including Pacific fishers, California spotted owls, and northern goshawks. All of the species of concern in this area have evolved with, are adapted to, and have survived after natural fires. But they may not be as adaptable to the type of aerial ignitions that the Forest Service has detailed in its proposed action. In fact, if present, aerial ignitions throughout the area might result in an indirect take of some of these animals, especially Pacific fishers, who may have difficulty finding a way out of the fire area and to a place of safe retreat. The analysis must accurately describe the existing habitat conditions for species of concern, and describe both the adverse and beneficial direct and indirect effects from the proposed action and any alternatives.
   Response: The Wildlife BABE and MIS Report evaluated potential effect of this project. Pages 58 to 69 of this document summarize the analysis and page 20 displays the required mitigations. In addition, hand and aerial ignition tactics were used successfully during the Sheep Fire to minimize most of the upslope stand-replacing fire effects and helped to reduce long-term smoke impacts.

10. The EA must clarify what is meant by “other features” and “other treatments” proposed prior to or instead of prescribed fire. What are these other features? What are these other treatments? Why should these be done prior to or instead of prescribed burning? Why is prescribed fire not appropriate in these areas?
    Response: The analysis of effects discloses the “other features” including cultural resources, recreation facilities, wildlife habitat, and cave resources to protect from fire effects. Alternative 2 includes mitigations that prescribe “other treatments” to protect the resources mentioned above from being damaged or destroyed by fire (see pages 20-23 of this document).

11. The vegetation "mosaic" concept is properly applied only at the landscape scale. It should not be misinterpreted or misapplied to unnaturally create large fire clearings in the limited areas within the project boundary which are dominated by old growth conifers, such as the east part of Evans Grove and Kennedy Grove. Current localized domination by old growth forest is part of the natural mosaic of mixed conifer zone conditions, which should be protected in this project. On the landscape scale, the Project area already has abundant younger age class sequoia growth.
    Response: The proposed action is to burn using generally a low to moderate intensity fire. This burn prescription is not anticipated to result in large openings in the forest canopy that would require reforestation (see page 52 of this document).

Chapter 2: Alternatives, including the Proposed Action

This chapter describes and compares the alternatives considered for the Boulder Creek Fuel Restoration Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social and economic effects of implementing each alternative.

Alternative Eliminated from Detailed Study

Three alternatives were proposed, one of which was considered and eliminated from detailed study. An alternative was suggested that would not use aerial ignition in the Monarch Wilderness and Agnew Inventoried Roadless Area (IRA). Instead the alternative should mimic a natural fire as nearly as possible in the Wilderness and IRA, as if the Sheep Fire had been allowed to continue burning beyond the line where the Sheep Fire was suppressed. Moreover, the timing of such a burn should as nearly approximate the time when the Sheep Fire began or was suppressed, given weather constraints and those placed on the project by the Air Resources Control Board. Ignitions should be done manually along the old Sheep Fire line in the same locations and only at points where the Sheep Fire was suppressed, which means that ignitions should not take place in patches that the fire did not reach due to the natural patchiness of the fire.

This alternative was eliminated because of firefighter safety concerns. The majority of the Boulder Creek project area is comprised of steep inaccessible terrain. Hand firing in the steep slopes and dense fuels where the 2010 Sheep Fire was stopped, would expose firefighters to extreme risk of injury and could not be safely accomplished without air support.

It is important to note that, during the Sheep Fire, aerial ignition was successfully used within Monarch Wilderness and the Giant Sequoia National Monument. This ignition tactic, coupled with strategic hand ignition, successfully minimized most of the upslope stand-replacing fire effects and helped to reduce long-term smoke impacts.

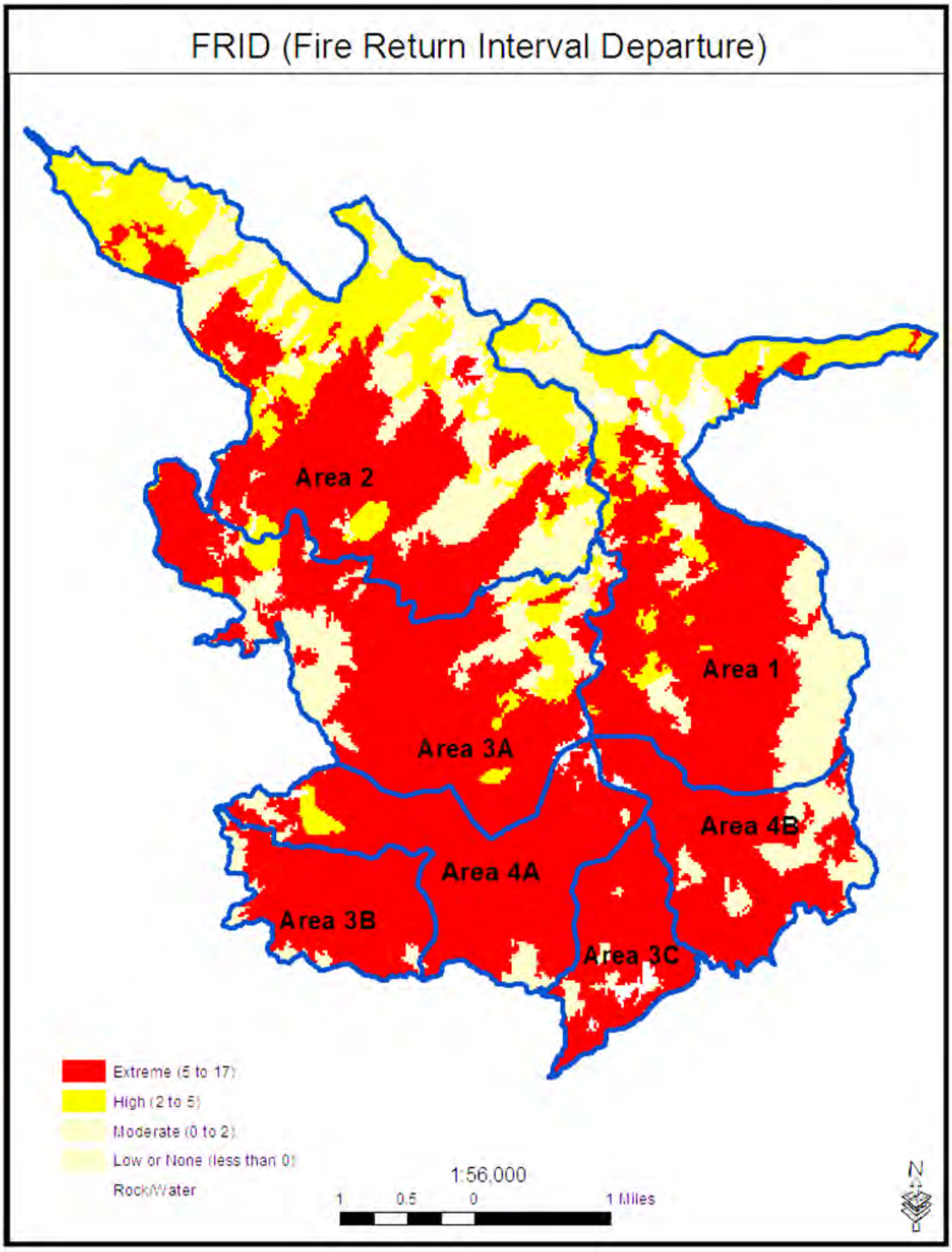
Alternatives Considered in Detail

Alternative 1-No Action

Under the No Action Alternative, no prescribed burning would be implemented to accomplish project goals. In the short term fire would not be reestablished into this fire-adapted ecosystem, specifically within Agnew, Deer Meadow, and Evans Complex Sequoia Groves.

Fire return interval describes how often fires occurred historically (pre-European settlement) in a particular location and vegetation type. Fire Return Interval Departure (FRID) is a temporal attribute of the fire regime that is measured by determining when fire occurred last on each of the acres in the area and comparing this with the fire return interval for the locale and vegetation type. Fire Return Interval Departure (FRID) is an indicator of how close the area is to the historic fire regime. As shown in Figure 2, the Fire Return Interval Departure (FRID) levels would continue to be moderate to high across the project area. Therefore the fuel loads, particularly in Monarch Wilderness, would continue to exceed levels that would allow personnel to safely suppress a fire burning from the wilderness onto adjacent Monument lands causing damage to public and private facilities. In the event of a wildfire, there is a potential to lose old-growth forest habitat to large scale, stand-replacing wildfires. In addition, there are a number of cultural resources that are susceptible to a fire of any magnitude. These objects of interest would remain at a high risk of loss in the event of a wildfire.

Figure 2: Current Departure from Fire Return Interval



Alternative 2- Proposed Action

Alternative 2 proposes prescribed burning to reintroduce fire into the lower portion of the Boulder Creek drainage. The project area encompasses approximately 14,385 acres of the watershed, of which 6,000 to 9,000 acres is proposed for underburning (see Figure 1). Two factors reduce the number of acres that can be treated through prescribed burning. The first factor is large areas of rock outcrops or sheer cliff faces, especially near the Kings River. The second factor is the other features that would need treatments prior to, or instead of, prescribed fire. The features that need to be protected from fire are discussed in more detail under the following area descriptions; and include cultural resources, plantations and wildlife habitat. See Appendix C of this document for the Management Tool Determination and Tree Felling Criteria for the Boulder Project, which documents the assessment of risk, effectiveness and feasibility required by the Monument Plan (Monument Plan Decision Tree pages 79-82, 2012).

Smoke management is a critical issue in the San Joaquin Airshed. Alternative 2 is designed to limit the impact smoke would have on the airshed. Prescribed fires would be ignited in the fall and in the spring, one or two weeks prior to a predicted rain or snow event, and in compliance with burn day status. This would allow the prescribed fire to burn long enough to achieve resource goals before wetting rains or snow extinguish the active burning in the project area. The duration of active burning and smoke impact on the airshed is expected to be up to two weeks after the ignition.

The project area would be burned in sections over approximately 5 years (see Figure 3). The burn treatments would begin on the east side of Boulder Creek in the first year and generally move in a counter-clockwise direction over the years. The following paragraphs provide detailed descriptions of each area. The intent is to use the previous year's activities as a buffer and fuel break for the next treatment area where feasible.

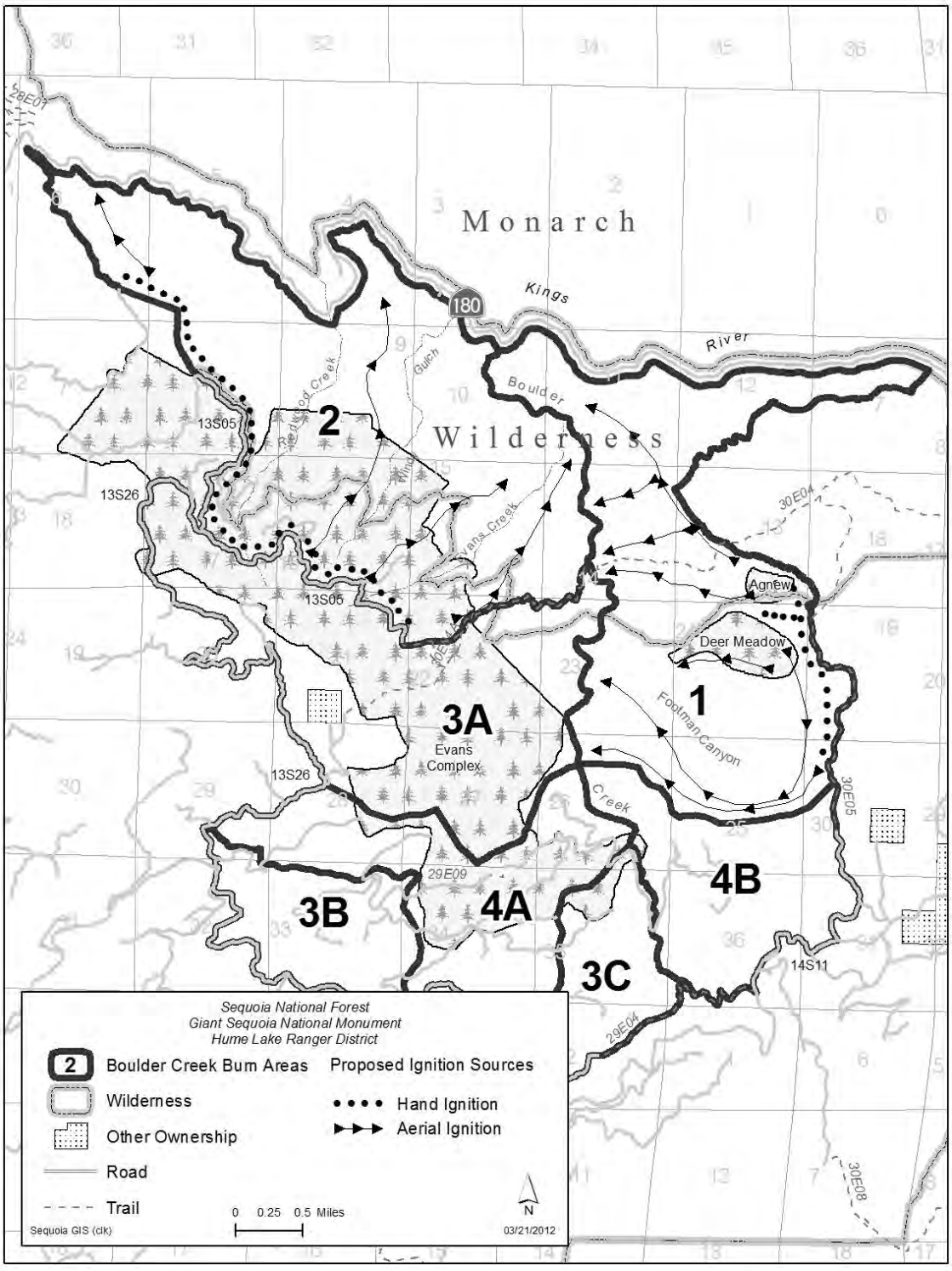
The treatments are designed to reintroduce fire and produce a mosaic of age classes, tree size and species composition across the landscape. No mechanical treatments or removal of logs or other forest products are proposed under Alternative 2. However, hand treatments, including chainsaw use outside of the Wilderness, to cut brush or fell trees, will likely be needed during project implementation to protect firefighters, and protect some of the objects of interest (see mitigations on pages 20-23).

After the prescribed burn treatments, hand crews would repair trail tread if the burning activities damage the trail (i.e., Kanawyer or Deer Meadow Trail). Tread work may include reestablishing waterbars or other drainage features along the trail. These activities would be designed to reduce the potential for erosion or sedimentation as a result of the fuels reduction activities, and manage that portion of trail to standard (see discussion of trail management standards on page 46 of this document). Incidental tree felling may occur if a tree is identified as a safety hazard to the workers.

Area 1: Fall (2013)

As shown on Figure 3, Area 1 is on the east side of Boulder Creek. Area 1 would burn vegetation between Boulder Creek on the west and Deer Meadow Trail (FT 30E05) and the Sheep Fire on the east. Treatment would start along the Deer Meadow Trail, and extend north to Kings River and south to the ridge forming Footman Canyon. The following paragraphs describe the proposed ignition pattern, in part as an example of prescribed burn procedures.

Figure 3: Proposed Treatment Units



Fire would be ignited in three stages. For example, as shown in Figure 4, the first stage would be hand ignition (such as drip torch) beginning on the Deer Meadow Trail above the Deer Meadow and Agnew Giant Sequoia Groves, displayed as Subarea 1a. In this section of Deer Meadow Trail, prescribed fire would be lit along the trail edge and allowed to back off the ridge line and into the groves. In the groves hand ignitions would continue to maintain an even backing fire front and prevent high intensity fire burning upslope in pockets of unburned fuel. This order of operations and techniques would keep the flame lengths and rates of spread in the grove area at a moderate level (1- to 3-foot flame lengths, 1 to 15 chains per hour rate of spread) to avoid unwanted loss of sequoias (Subarea 1b).

The second stage of ignition would be two-pronged, and begin once burning operations in the groves are two thirds complete. Hand lighting would be used north from the groves along the ridge toward the Kanawyer Trail (FT 30E04). Where the Kanawyer Trail extends about ¼ mile into Monarch Wilderness, the fire would be allowed to back downslope off of the ridgeline (Subarea 1c).

Simultaneously, the second prong of Stage Two, would hand light along the section of Deer Meadow Trail from the sequoia groves south to the southern boundary of Area 1, which is the top of Footman Canyon (Subarea 1d). At the ridge south of Footman Canyon (Subarea 1f), fire would be allowed to extend in a westerly direction until it meets Boulder Creek (the western boundary). A control line would not be constructed on this ridge; instead fire would be allowed to back over the ridge to the south into Area 4B (see Figure 3). Fire would only be allowed to creep in Area 4B for up to one to two weeks after ignition (i.e., until the predicted rain or snow event occurs).

Though trail maintenance is an on-going activity, as part of this project Deer Meadow Trail would be maintained through trail tread work and brushing along the trail prior to prescribed burning. This maintenance work would allow the trail to serve as a barrier during the burn, mitigating the potential for fire to cross at locations south of where the Sheep Fire burned (see Figures 1 and 3).

Stage Three would begin once the hand ignition is completed on the ridge and the sequoia grove area (Stage Two). Stage Three would light fire from an aircraft (aerial ignition) such as a plastic spherical incendiary device (SID) from a helicopter, as shown in Subareas 1e and 1f (See Figure 4). The aerial ignition would focus on helping the fire to back down the ridge and down slope towards the creek in a uniform manner.[2] Fire would also be ignited using aerial ignitions, where necessary, on the east-west ridges within Subarea 1g (see Figure 4).

Area 2: Years 2 – 5[3]

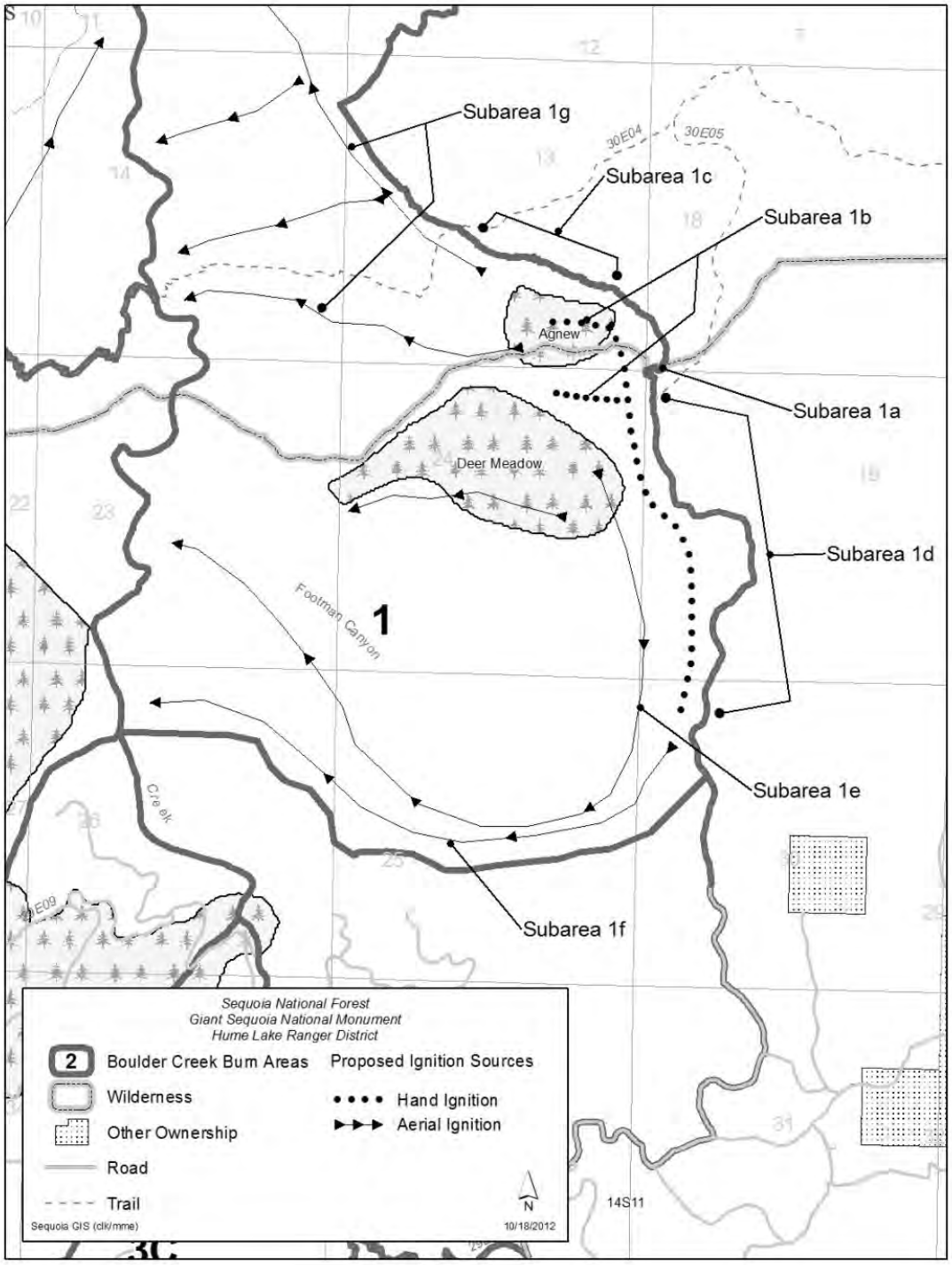
Area 2 is located northwest of Area 1 and bounded by Boulder Creek on the east, Forest Road (FR) 13S05 (Camp 7 Road) on the south, the Kings River on the north, and a combination of Forest Service roads and hand line on the west side (see Figure 3).

Due to the locations of cultural resources and recreation activities in the vicinity of Evans Grove Complex, fire would be ignited only in portions of this area. The portion of the unit between FR 13S05 and the Wilderness boundary would be divided into subareas which could be ignited by hand, allowing for both firefighter safety and the protection of cultural resources. Control lines and hand fuels reduction, using handtools and chainsaws, would be used in this area to protect at-risk historic properties and features.

[2] Since fire can burn faster in different fuels, there is the potential for a section of the flame front to reach the bottom of the ridge faster than other sections. This scenario can result in a large scale upslope run of high intensity fire that cannot be controlled. The aerial ignition would help keep an even flame front and prevent a large scale upslope run.

[3] Though the intent is to treat an area each year, weather and other factors may delay or accelerate treatments of individual areas.

Figure 4: Potential Firing Pattern in Area 1



The smaller burn units and shorter burn durations would allow fire managers to reintroduce fire to the landscape under controlled conditions, and without unwanted ignitions encroaching onto sensitive cultural resource sites. This is slower and more costly, but gives the burn boss more control over timetables and fire intensities.

Continuing to the north, in the Wilderness portion of Area 2, prescribed fire operations would be a combination of aerial and hand ignitions. The terrain becomes steeper from the Wilderness boundary north toward the South Fork of the Kings River. Aerial ignition would occur along the ridges in this portion of Area 2, and fire would be allowed to back down the slopes naturally toward the Kings River, similar to the multi-step process described for Area 1 until the predicted rain or snow event arrives.

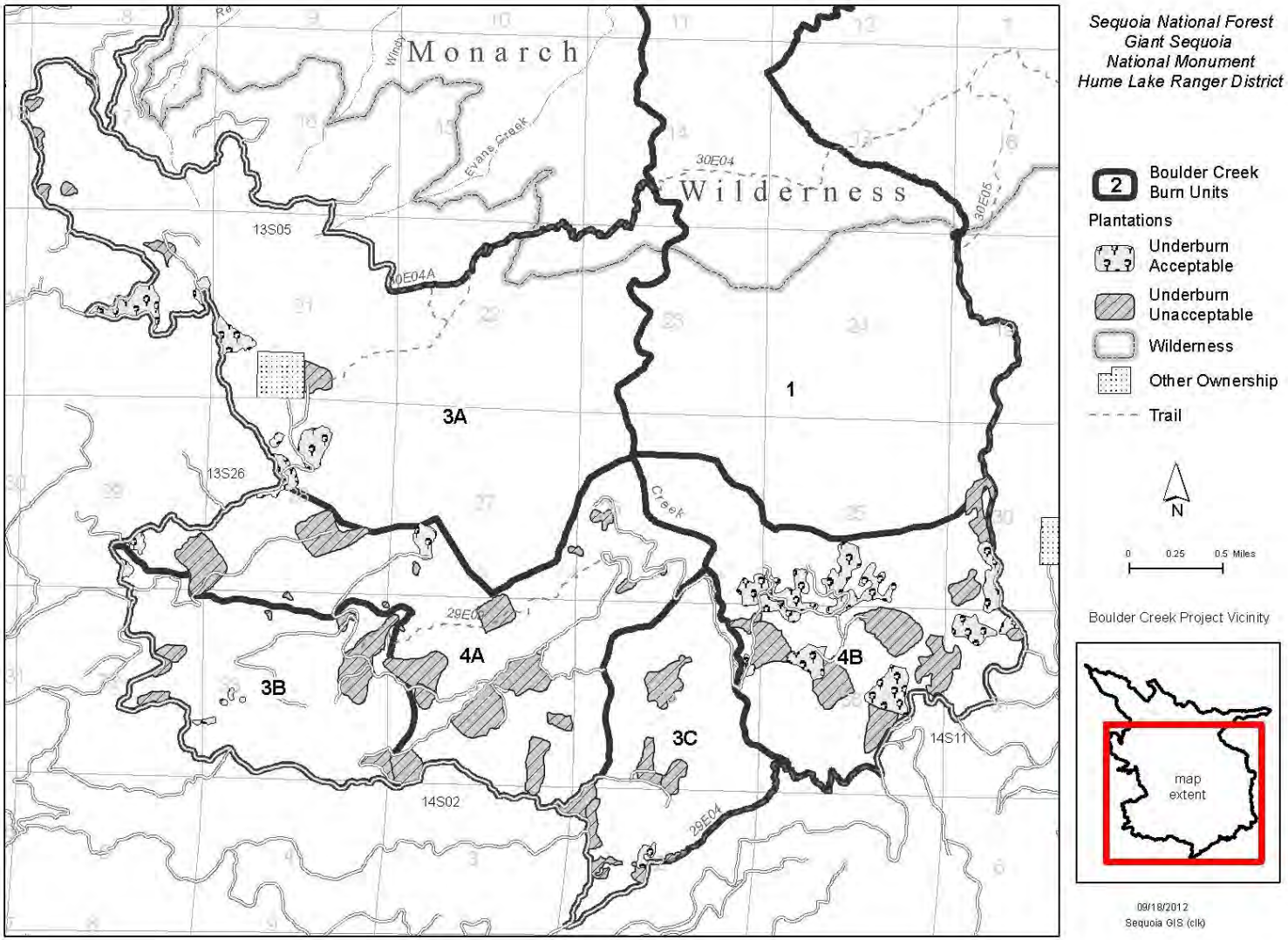
Area 3: Years 1 - 5

Area 3 is divided into three subareas: A, B, and C which are interspersed among areas where no ignition treatments (Area 4) are proposed. Area 3 subareas A, B, and C would have similar hand treatment guidelines as described above for Areas 1 and 2. This is the only area that includes spring burning, and is located in the southern portion of the project area (see Figure 3). In addition, based on the effects analysis documented herein, portions of Area 3 could be burned prior to Areas 1 or 2 because it is not dependent on the reduced fuels in the other areas to provide barriers.

This area includes the numerous conifer plantations in the southern portion of the project area. Identified burn areas would be divided into small units of 40 to 100 acres, and would be burned over one or two days per unit (see Figure 5). Due to the timing of the burning, wildlife surveys would need to be conducted. If active California spotted owl or northern goshawk nests are found, handline may need to be constructed, or the burn unit boundary modified, to ensure nesting areas are not negatively affected by the prescribed burning (see the mitigations on page 20 for further details).

In portions of Area 3, specifically 3A within the Evans Grove Complex, there are known cultural resources and recreation facilities that may need protection during or after burn treatments. To protect cultural resources, fuel reduction using hand tools (including chainsaws) may take place, or fire would be lit under a prescription for low intensity to reduce fuels while avoiding damage to at-risk resources (i.e., wooden structures) (see the mitigations on pages 22-23 for further details). Also, fire control lines may be constructed by hand crews to protect plantations susceptible to fire damage. The smaller burn units and shorter burn durations would allow fire managers to reintroduce fire under controlled conditions, without unwanted fire encroaching into plantations or sensitive cultural resource sites. The specific areas would be identified as specialists confirm specific sites that can be burned without negatively affecting other resources or objects of interest (i.e., nesting northern goshawks or California spotted owls).

Figure 5: Plantations where Underburning is or is not Currently Acceptable



Area 4

Area 4 is divided into two subareas: A and B, of which both are where no ignition treatments are proposed (see Figure 3). Several existing plantations are located in Area 4 and the vegetation is currently a mix of trees and brush that form a contiguous pocket of ladder fuels. Prescribed burning in these plantations, especially Subarea 4A, would likely result in a fire that would burn up most of the trees and the reforestation investment they represent.

However, Subarea 4B contains more wild native stands intermixed with plantations, so fire would not be excluded if it enters the general area from the treatments proposed in Area 1. Instead, fire would only be allowed to creep in Subarea 4B for up to one to two weeks (i.e., until the predicted rain or snow event occurs), and would be closely monitored and managed to minimize damage to the planted trees and the reforestation investment they represent. In the event that fire threatens these plantations south of Footman Canyon, minimally invasive suppression actions (i.e., hose lays, existing road systems, or narrow hand-constructed fire control line) would be used to protect resources.

Mitigations to Alternative 2

Mitigation measures were developed using current standards and guidelines to reduce the potential impacts of Alternative 2:

- For spring burning, active northern goshawk and spotted owl nest sites would be avoided. This would require surveys prior to burning and either putting in handline around the nest stand or modifying the boundary of the burn unit to exclude the area. Portions of two designated northern goshawk PACs fall within the project area. A limited operating period of February 15 through September 15 for activities within one-quarter mile of the nest site may be required if disturbance to nesting activities is possible.
- For prescribed fire treatments, use firing patterns, fire lines around snags and large logs, and other techniques, if necessary, to minimize effects on snags and large logs.
- A smoke management plan must be submitted and approved by the San Joaquin Valley Air Pollution Control District (SJVAPC District) prior to the project. As part of the plan, the Forest Service must provide a detailed meteorological prescription that must be met prior to igniting any of the burning operations. At a minimum, the prescription must include acceptable wind direction. Other considerations include wind speed, temperature profile, winds aloft, humidity, temperature, actual and predicted inversions, burn day status and forecast, precipitation forecast, and any other meteorological conditions which may affect smoke dispersion and/or fire behavior. The plan must also contain contingency measures in the event smoke impacts smoke sensitive areas. Smoke sensitive areas must be delineated in the plan.
- The Sequoia National Forest operates a comprehensive air quality and smoke monitoring program. The program emphasizes instrumentation that provides near real-time data for fine particles, ozone and meteorology. Instrumentation would be placed at smoke sensitive areas and would be used to coordinate with the SJVAPC District and the Great Basin Unified Air Pollution Control District. Information would be coordinated to assist in mitigating public exposure. In addition, an Air Quality Specialist would be assigned to provide smoke forecasts utilizing the monitoring data and predictive models.
- Protect known cave entrances from all activities, including prescribed fire, hand treatments, and recreation. Cave entrances would need to be protected from fire by preventing direct ignition of plastic spherical incendiary devices (PSD) in cave entrances. PSD should not be dropped within 500 feet above cave entrances and should not be dropped within 200 feet below or on either side of cave entrances. Locations of cave entrances would be given to the project implementation team in order to protect the entrances.

- Monitor soil in the Boulder Project area to determine the degree of soil burn severity and soil cover, especially in the first entry of Area 1. If the impacts to ground cover and burn severity are not as expected in Area 1, the prescribed fire prescription should be adjusted to achieve desired results.
- Monitor conditions in Boyden Cave and Church Cave to evaluate sediment deposition in cave passages. If sediment is deposited in cave passages from this project, removal of the sediment to allow access through the cave should be considered.
- Avoid any known noxious weed infestations during project implementation and staging of fire crews.
- Require equipment and personnel (boots/tools) to be free from noxious weeds and soil before working in the project area (i.e. power wash prior to accessing work area).
- Adhere to the applicable Best Management Practices (BMPs) to protect water quality:
    - 2.3 Erosion Control Plan,
    - 6.1 Fire and Fuels Management Activities,
    - 6.2 Consideration of Water Quality in Formulating Fire Prescription, and
    - 6.3 Protection of Water Quality from Prescribed Burning Effects.

- Monitor post project for effects to several previously disturbed sites (disturbance type is in the parenthesis):
    - Forest Road 13S05C in Redwood Creek (mass wasting and hillslope failure),
    - Forest Road 13S06 in Lockwood Creek (erosion associated with road),
    - Headwaters of Little Boulder Creek (compaction and erosion),
    - Old logging road in tributary to Little Boulder Creek (erosion associated with road),
    - Little Boulder Creek (grazing), and
    - Decommissioned/converted roads: 13S23D, 13S23E, 13S23F, 13S28 and 13S53A.

In addition to the design features regarding trail management, there are several mitigations to reduce effects to other trail infrastructure, wilderness, hunters and other recreationists:

- Notify the public through notices on trailheads, recreation information boards, and press releases prior to implementing each phase of project. This includes residents of the nearby private property owner, local communities and potentially affected air districts (including the San Joaquin Valley and Great Basin-Owen's Valley),
- Repair signs that are damaged during project implementation, and
- Remove any partially-burned or unburned plastic spherical incendiary devices that may be found in the project area near the trail system after implementation.

Prescribed fire ignited in the vicinity of established plantations has the potential to creep into those planted areas. If trees are small or the surface fire burns hot enough, unacceptable damage to the planted trees can occur. Plantations susceptible to fire damage are identified in Table 11. The following mitigation measures would be taken to protect young trees (less than or equal to five inches diameter), where necessary:

- Burn under a cooler prescription (i.e. low intensity fire);
- Construct fire control lines by hand to exclude fire from reaching the young trees; and
- Break up and scatter fuel concentrations, or employ hose lays to reduce fire intensity near small trees.

Protect large, old-growth sequoias, if necessary, by:

- Pulling surface and ladder fuels away from the stems and exposed basal fire scars of live and dead old-growth sequoia; and
- If necessary for protection, remove ladder fuels by hand that would cause a crown fire in live old-growth sequoias.

Procedures to mitigate potential effects to cultural resources in compliance with the Regional Programmatic Agreement (PA), specifically Appendix H: Region 5 Hazardous Fuels Protocol for Non-Intensive Inventory Strategies for Hazardous Fuels and Vegetation Reduction Projects (USDA 2013) are:

- Site location information is confidential and protected under the Freedom of Information Act (FOIA). Information where and how site boundaries are delineated would be communicated to the appropriate personnel prior to work occurring in the vicinity of the sites.
- **At-Risk Properties**
- The Zone Archaeologist is to conduct pre-field research to identify at-risk historic properties that may be affected by low intensity prescribed fire in the undertaking's Area of Potential Effect (APE). An "At Risk Historic Property" is defined as a property that the Forest Heritage Program Manager (HRM) identifies as susceptible to being adversely affected by specific undertaking activities. An at-risk historic property is identified based on property characteristics (e.g., flammability or fragility) and undertaking parameters (e.g., fuel load or fire temperature, or equipment weight or type). Examples are wooden structures susceptible to fire from prescribed burning or rock alignments that can be crushed by tracked vehicles. At-Risk Historic Properties for Boulder Creek Project were determined to be sites containing a high potential for wooden features or structures, and rock art sites. Of the 38 sites in the APE, 21 sites were identified as At-Risk.
- The Zone Archaeologist, in conjunction with the fuels, vegetation management, or fire specialists as necessary, shall develop treatment measures for at-risk historic properties designed to eliminate or reduce potential adverse effects to the extent practicable by utilizing methods that minimize surface disturbance, and/or by planning project activities in previously disturbed areas or areas lacking cultural features.
- Sites that are determined to need protection may receive any of the appropriate protection measures:
    a) Fire crews may monitor sites to provide protection as needed.
    b) Fire lines or breaks may be constructed off sites to protect at-risk historic properties.
    c) Vegetation may be removed and fire lines or breaks may be constructed within sites using hand tools, so long as ground disturbance is minimized, and features are avoided, as specified by the Zone or Forest archaeologist.
    d) Fire shelter fabric or other protective materials or equipment (e.g., sprinkler systems) may be utilized to protect at-risk historic properties.
    e) Fire retardant foam and other wetting agents may be utilized to protect at-risk historic properties and in the construction and use of fire lines.
    f) Surface fuels (e.g., stumps or partially buried logs) on at-risk historic properties may be covered with dirt, fire shelter fabric, foam or other wetting agents, or other protective materials to prevent fire from burning into subsurface components and to reduce the duration of heating underneath or near heavy fuels.
    g) Trees which may impact at-risk historic properties should they fall on site features and smolder can be directionally felled away from and left in the vicinity of properties prior to ignition, or prevented from burning by wrapping in fire shelter fabric or treating with fire retardant or wetting agents.
    h) Vegetation to be burned shall not be piled within the boundaries of historic properties unless the location (e.g., a previously disturbed area) has been specifically approved by the Zone or Forest Archaeologist.
- The Zone or Forest archaeologist shall determine whether prescribed fire treatments within site boundaries shall be monitored, and how such monitoring shall occur.
- If the standard protection measures cannot provide appropriate protection, the undertaking shall be subject to the provisions of 36 CFR 800.

- **Post-burn ATV use and casual collection**
  - Protect exposed, sensitive cultural resources from looters or vandalism to sites by placing barriers to block off illegal travel routes and maintenance level 1 roads (13S05C and 13S44).
  - Forest Service law enforcement, and patrol personnel would temporarily be increased. Patrols are expected to be effective as a Forest Service presence in the burned area and reduce the opportunity for potential vandals and looters. Patrols should continue until public interest decreases, and re-growth has served to obscure previously exposed artifacts and features.
  - Archaeological site stewards, certified through the California Archaeological Site Steward Program and part of the Sequoia National Forest Site Steward Program, would be assigned to monitor selected sites.
  - All law enforcement officers, Forest Service personnel and site stewards assigned to the project would receive annual Archaeological Resources Protection Act (ARPA) and cultural resource protection training conducted by the Zone Archaeologist and a law enforcement officer.
- **Trail maintenance work**
  On all historic trails, work would be limited to routine trail maintenance limited to brushing and light maintenance of existing tread with hand tools.
- **When Avoidance Is Not Possible:** If a procedure described above cannot be implemented to protect cultural resources, the Zone or Forest Archaeologist shall immediately consult with State Historic Preservation Office (SHPO). If the SHPO and Forest Service agree that the activity would not diminish or destroy those qualities that may make the property eligible or potentially eligible (including potential visual impacts if National Register of Historic Places (NRHP) criteria A or C may be relevant) then the permitted use may continue without further mitigation.
- **Unanticipated Discoveries:** There is always the possibility that surface and sub-surface cultural resources may be located during project operations. Should any additional project cultural resources be located, the find must be protected from operations and reported immediately to the Cultural Resource staff. All operations in the vicinity of the find would be suspended until the sites are visited and appropriate recordation and evaluation is made by the Zone or Forest Archaeologist.

Comparison of Alternatives

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

Table 1: Comparison of Alternatives

Resource	Alternative 1	Alternative 2
Surface Fire Intensity (percent of burnable area)	51	92
Crown Fire Intensity (percent of burnable area)	49	8
Flame Length less than 4 feet (percent)	54	95
Rate of Spread less than 5 chains per hour (percent)	66	96
Plantations burned (acres)	0	Up to 273
Snags/canopy cover (over 15 inches diameter)	No measurable change	No measurable change

As shown in the table above, the alternatives differ in the anticipated fire behavior. Under Alternative 1, there is a fairly even split in the amount of surface and crown fire. In contrast, Alternative 2 would result in a shift of the majority of fire intensity from crown to surface fire. These intensity levels are supported by the flame lengths and rates of spread for the two alternatives. In the event of a wildfire, under Alternative 1 a greater percentage of the area would have flame lengths greater than 4 feet high, and a rate of spread faster than 5 chains per hour, both of which prevent direct attack by firefighters. In the event of a wildfire occurring after implementing Alternative 2, the majority of the project area (95 percent or greater) would

have low to moderate flame lengths and rates of spread, which allow firefighters to more safely guide or control fire through direct attack techniques.

Alternative 1 does not propose igniting fire in and around plantations and, as a result, several hundred acres could be burned in a wildfire event. Alternative 2 would reintroduce fire around an estimated 273 acres of plantations, which would improve their resiliency in a wildfire event.

Neither Alternative 1 nor 2 is expected to alter the large tree component in the project area. Alternative 1 would not affect the number or types of snags or the canopy cover in any of the stands, unless there was a wildfire. Similarly the low to moderate intensity prescribed burning proposed in Alternative 2 should result in little change to the number or character of the large trees or snags. Instead, the prescribed burning in Alternative 2 would reduce the number of shrubs and smaller trees (less than 11 inches diameter breast height).

Chapter 3: Environmental Consequences

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives presented in the chart above. Note that climate change is discussed in the context of potential effects to specific resources: wildlife and vegetation.

Context and Intensity Factors

1. Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.

In terms of context and intensity, the Boulder Creek Fuels Restoration Project has minimal effects on the various resources. The Boulder Creek Fuels Restoration Project is a site-specific project and was analyzed within the context of a portion of the South Fork Kings River, and Boulder Creek watershed. Based on the specialist reports summarized in the following discussion all the impacts from this project would be minimal. None of them would be significantly beneficial or adverse as discussed under the cumulative effects analysis summarized under factor 7 of this Chapter. A number of existing impacts have occurred in the project area over the past several decades including grazing, wildfires, timber sales, recreation use, establishing and maintaining conifer plantations, road maintenance and drought. The magnitude of beneficial effects disclosed herein have not been significantly offset or reduced by the adverse effects of the proposed activities under the action alternative in the Boulder Creek Fuels Restoration Project.

2. The degree to which the proposed action affects public health or safety.

The proposed action has the potential to affect firefighter safety in the short term, so mitigation measures are in place to reduce the hazard from falling trees or limbs during project implementation. Otherwise, very few people use the project area for any length of time so there is little potential to impact public health or safety under the proposed action, specifically regarding water quality of a municipal watershed. There is likely to be no measurable difference in impacts on public health and safety in the project area under either alternative due to the limited impacts that the prescribed burning would have on the watershed (See cumulative watershed effects on pages 53 to 58).

In terms of air quality, the smoke can have a negative effect so the timing and duration of this project has been designed to limit the potential to negatively affect public health. The fall burning would be scheduled for October to early November, between the high ozone and high particulate matter (PM_{10}) periods. The spring or fall burning is also proposed to occur in a time frame of two weeks or less. The burn windows would be set in compliance with the San Joaquin Air Quality Control Board allowable burn days (See pages 30 to 37 for further discussion on air quality).

3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

The Boulder Creek Fuels Restoration Project is not near park lands, prime farmlands, wetlands or known ecologically critical areas. However, a portion of the project is within the Kings Wild and Scenic River corridor, and the recently established Windy Gulch Geologic Area. The project area also includes known cultural resources, which along with the caves are objects of interest under the Giant Sequoia National Monument designation (Clinton 2000). The known cultural resources are discussed in the *Boulder Creek Fuels Restoration Project Cultural Resources Specialist Report* (Further discussion can be found under factors 7 and 8). The activities proposed in the Boulder Creek Fuels Restoration Project would help protect the

cultural resources during project implementation. As a result, the Boulder Creek Fuels Restoration Project would have no adverse effect on the cultural resources and minimal cumulative effect on cave resources.

4. The degree to which the effects on the quality of the human environment are likely to be highly controversial.

Scoping surfaced no scientific controversy regarding the magnitude or nature of effects of the action alternative. However, during scoping, respondents raised the concerns that the prescribed burning could damage trails, the wilderness character, wildlife habitat, cultural resources, caves and sequoias in the project area. Alternative 2 addresses these concerns through design features and mitigations. The effects analysis discussed in this document display that there are few minor differences between the alternatives in terms of effects to these resources unless there is a stand-replacing wildfire event under Alternative 1. The magnitude and nature of potential to affect climate change is negligible under either alternative.

5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

The Boulder Creek Fuels Restoration Project proposes resource management activities under circumstances similar to numerous other projects that have been successfully implemented for many years. The nature and magnitude of the effects to the human environment from implementing the action alternative of the Boulder Creek Fuels Restoration Project are well understood and do not pose highly uncertain, unique or unknown risks (See discussion of cumulative effects under factor 7).

6. The degree to which the action may establish a precedent for future actions with significant effects, or represents a decision in principle about a future consideration.

All of the proposed management practices under the Boulder Creek Fuels Restoration Project have been conducted both separately and in various combinations within similar landscapes and vegetation types. These management practices, as well as the project objectives, are envisioned by the Monument Plan and are consistent with applicable standards and guidelines. Therefore, the activities proposed in Alternative 2 are already well established, and would not represent a decision in principle about future considerations or set a new precedent.

Regarding the potential for significant effects, the Sequoia National Forest has implemented such practices for many years (e.g. 1999 Tornado Forest Health Project Decision Notice, and 2010 McKenzie Ranch Fuels Reduction Project Decision Notice) (USDA 2010a). In addition, the neighboring Sequoia and Kings Canyon National Parks have conducted prescribed burns in the Redwood Mountain Grove and other areas for the past several years. In each case this has been accomplished without producing significant effects by designing projects with protection measures to prevent such effects from occurring. Based upon the analysis of the action alternative, as documented herein and further discussed under factor 7, none of the proposed activities should result in significant effects.

7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.

A number of impacts have occurred in the project area over the past several decades including grazing, wildfires, timber sales, recreation use, establishing and maintaining conifer plantations, road maintenance and drought. Present activities continuing in the project area are plantation and road maintenance, and recreation use. Ongoing recreation uses within the project area include hunting, dispersed camping, and use of roads and trails. These uses have not resulted in significant habitat loss or resource damage.

Past activities in the vicinity of the Boulder project area that modified fuels are the Boulder Timber Sale (Decision Notice and Sale Contract, 1997), and Tornado Forest Health Project (1999 Decision Notice, and 2000 Tornado Thinning Timber Sale Contract) which both included piling and burning, and underburning; the Roadside Hazard Tree Salvage (2007 Decision Memo, and 2008 Hume Roadside Hazard Timber Sale Contract) (USDA 2007) which felled and removed trees posing a safety hazard to the public or Forest Service employees; and the 2010 Sheep Fire which forms the eastern boundary of the Boulder Creek Project.

On-going and reasonably foreseeable activities in the vicinity of the Boulder project area are grazing, vegetation management, wildfires and recreation. Portions of the Buck Rock, Hoist and Horse Corral cattle grazing allotments are near or within the Boulder Creek drainage. The grazing use level and associated impacts are not expected to change or contribute measurable impacts to the Boulder Creek Fuels Restoration Project. The analysis area is used regularly by campers, hunters and off-highway vehicle (OHV) users. There are approximately 215 miles of roads in the analysis area, with Burton Pass Road (Forest Road 14S02) and State Highway 180 providing primary vehicular access. Road and trail maintenance activities are on-going activities. Two areas currently slated for maintenance in the next year are the Deer Meadow Trail and Forest Road 13S05, since they are both likely to be used to access the Boulder Creek Fuels Restoration Project in the next few years.

There are only two projects currently in the planning process that may overlap the southern portion of the Boulder Creek Fuels Restoration Project:

- The Kirkland Plantation Thin proposes to masticate small trees (less than 10 inches diameter breast height) and brush causing overstocked conditions in plantations near Kirkland Meadow. The Kirkland project would underburn, or pile and burn fuel concentrations leaving 80-120 trees per acre and pockets of untreated shrubs for wildlife. Approximately one half of a Kirkland unit, plantation number 108-0007, extends into Area 3A of the Boulder Creek project area. This plantation is 40 acres in size.
- The Hume Roadside Hazard Tree Removal Project proposes to fell dead or damaged trees along district roads (35 miles of these roads are in the Boulder Creek Project analysis area) that pose a safety hazard to public or Forest Service personnel using these routes. Some trees may be removed after down woody debris requirements are met, and a determination is made that the action would be clearly needed for ecological and maintenance or public safety.

If additional actions are proposed in the vicinity or within the Boulder Creek Fuels Restoration Project area prior to a decision on this project, they would be discussed in the decision document.

Cultural Resources

Cultural resources are an object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties (FSM2360.5). These resources are not mutually exclusive and can oftentimes overlap either in time and space (e.g., an historic building on a prehistoric archaeological site). In the Boulder Project area there are prehistoric sites such as lithic scatters, food-processing sites, rock shelters, village sites, petroglyphs, and pictographs; and historic sites such as historic logging, remains of homestead properties, Forest Service administrative sites, and mining sites. Both prehistoric and historic sites are considered “objects of interest” under the Clinton Proclamation.

According to the *Cultural Resources Report for the Boulder Creek Fuels Restoration Project* (Gassaway 2013) the project area is located within the traditional territory of the *Wobonuch* (Gayton 1948). The *Wobonuch* are represented by what is today the Dunlap Band of Mono Indians, comprised of the amalgamated tribes of

the *Entimbitch* and *Woponuch* (also known as *Wobonuch)*. "Their traditional territory extended east/west along the South Fork of the Kings River and to the north, encompassing Rodgers Ridge and beyond. Post contact historic processes in the late 19th century forced the *Woponuch* out of their remote and secluded home and into the lower elevation Dunlap area, where they took up permanent residence among the *Entimbitch* by about 1910…" (McCarthy 2000).

In 1878, the Timber and Stone Act was passed which allowed people to purchase public domain land that was "unfit for farming," but good for "timber and stone" purposes (logging and mining), in 160-acre blocks for his own use. However, the act was often used by speculators to increase their land holdings at minimal expense and this is exactly what happened in the formation of the Kings River Lumber Company. The Kings River Lumber Company was incorporated on April 24, 1888, and over time was replaced with the Sanger Lumber Company. In 1905 the Sanger Lumber Company was sold to the Hume-Bennett Lumber Company.

In 1911, two railroad lines were in use; one line, known as the "switchback line," headed to the north then east across Tornado Creek towards the redwoods to the Camp 4 area into the Horseshoe Bend Grove portion of Evans Grove Complex. Camp Four (just west of the Boulder project area) and Camp Six were established in 1914. Camp Seven, which was above Windy Gulch Grove and Evans Creek near the end of the main railroad line, was established in 1916 (Brown and Elling 1981). The United States entered World War One and 40 percent of the workforce joined the armed forces. In November 1917, a fire consumed the Hume Lake Mill, and the Hume-Bennett operations were reorganized as the Sanger Lumber Company, which continued at a decreased output until 1923.

On April 8, 1935, over 20,782 acres of land, including 11 sequoia groves, owned by Sanger Lumber Company was sold to the U.S. Forest Service (Johnston 1974). In the late 1930s, the Forest Service began cleaning up obsolete lumber camps, hauling away tons of rusting scrap metal, and dismantling and removing collapsing structures. In 1950-51, the Forest Service split nearly 1,000,000 board feet of redwood, which was sold for fence posts, that had been left near Camp Seven (Johnston 1974).

Of the project area, 5,825 acres have been surveyed by 22 archaeological projects, with the most recent survey in 2012. Protocols for surveys include intensive, general, and cursory coverage. In total, there are 43 known sites, 20 historic sites, 21 known prehistoric sites, and 2 multicomponent sites within the area of potential effect (APE) for the Boulder Project.

Determination as to whether the sites qualify for listing on the National Register of Historic Places (NRHP) has not yet been made. Pursuant to Regional PA and 36 CFR 800.4 (c)(1)), all sites would be treated as eligible for the National Register of Historic Places. Under the stipulations of the Hazardous Fuels PA the Zone Archaeologist would conduct pre-field research to identify at-risk historic properties that may be affected by low intensity prescribed fire in the undertaking's APE.

Any fire can potentially affect cultural resources. The effects of fire on cultural resources are often divided into and described as direct fire, operational, and post-fire effects. Direct effects are those caused by the fire itself. These are caused by either direct contact with flames or being in close proximity to heat produced by combustion or smoke. Operational effects are the result of management operations like line construction or staging. Post-fire effects are most often those caused by the change in soil stability and vegetation following a fire.

The differences in effects on cultural resources from fire come with the differences in the intensity of a fire, the ability to identify cultural resources and initiate protective measures, the type of management actions taken to control the fire, and the post-fire effects. The potential effect on cultural resources from direct fire depends on the material components of the cultural resource and the magnitude of the heating and

combustion generated by a fire. Specifically, fire and its byproducts can alter such resources through total consumption, melting, breakage, spalling, charring, and discoloration. Different materials are vulnerable based on the peak and duration of the exposure to heat and combustion. Artifacts and features above the ground surface (i.e., structures, arboglyphs, rock art, etc.) are susceptible to preheating, convection heat transfer, and smoke impacts. Thus, surface and shallow cultural resources consisting of flammable organic components (i.e., wooden structures, botanical remains) are at greatest risk from direct flame impingement, especially high intensity fire.

High-intensity fire in general has a greater potential to negatively affect cultural resources than low-intensity fire. Fires with cool combustion temperatures, generated by sparse understories and light fuels, have a lower potential to affect diagnostic artifact characteristics. Fires designed for cool combustion temperatures, such as controlled burns, can avoid major impacts on archaeological sites and artifacts. Thus, prescribed burns can be effectively used to control vegetation on archaeological sites without damage to cultural resources (U.S. Army Corps of Engineers 1989). Low-intensity fire and planned vegetation reduction has a beneficial effect of protecting cultural resources from catastrophic, high-intensity fire and large-scale post-fire erosion.

Operational effects are usually from ground-disturbing activities, but can also be from backfires and burnouts, and the use of fire retardants. They are not limited to wildfires, but can also occur during prescribed burns. Operational effects can be mitigated, if planned in advance, to avoid and protect cultural resources.

Any type of vegetation removal reduces protective vegetative cover and increases the visibility of cultural resources, which can result in unlawful collecting and excavation. The lack of vegetation can also contribute to an increase in erosion that can damage or destroy the site matrix. Fire on any level can result in the loss of ethnographic resources and the disturbance and degradation of traditional plant gathering areas, cultural sites, and sacred or spiritual places. Looting (including casual collection) and vandalism is known to occur within the logging remains of the Evans Grove. The lack of cover vegetation would make the cultural resources sites more visible and as a result they are more susceptible to damage from vandalism and looting.

Post-fire effects include increased erosion of soils that can remove or bury archaeological resources, increased tree mortality resulting in impacts from trees falling or uprooting, increased rodent and insect populations that can alter subsurface soil structure, intentional and inadvertent looting, increased microbial activity which can lead to increased feeding on organic matter within archaeological soils, and the addition of “new” carbon, which can be move through the soil column of archaeological sites by a variety of agents. These potential effects can be mitigated during prescribed burns through the use of fire prescriptions that limit the intensity of the fire.

Direct and Indirect Effects

Alternative 1 does not propose any actions and would have no direct effect to cultural resources. Lack of fuels management could lead to an indirect adverse effect to at-risk cultural resources.

Alternative 2 would have the least potential to negatively affect cultural resources because it relies on prescribed fire. The use of prescribed fire allows the greatest ability to implement protective measures for cultural resources. This would greatly increase the protection during project implementation and minimize the potential for uncontrollable wildfire that could negatively affect cultural resources. The increased ability to protect cultural resources would also allow us to increase our knowledge of the cultural resources.

The reduction of fuels on and surrounding cultural resources within the Boulder Creek Fuels Restoration APE will increase the visibility of artifacts and features. The existing use of ATVs within the APE can be expected to increase following fuels reduction especially on the railroad grades. The increased use and visibility could lead to an increase in looting and vandalism to cultural resource sites. The increase in ATV use on railroad grades and potential looting can be decreased through the use of barrier placement on railroad entry ways post burn and increased patrols.

Direct, indirect, and operational fire impacts from Alternative 2 can be mitigated pursuant to the Regional PA through use of standard protection measures.

Cumulative Effects

Cultural resources in the project area have been potentially subject to impacts from land use such as cattle grazing, timber sales and other prescribed burning, hiking, hunting, and dispersed camping.

Alternative 1 does not propose any actions and would have no direct effect to cultural resources. Lack of fuels management could lead to an indirect adverse effect to at-risk cultural resources. Therefore, the potential for a cumulative effect is minimal if there is no stand-replacing fire event.

For Alternative 2 of the Boulder Creek Fuels Restoration Project, all surveys and site protection measures have and would follow survey and site protection standards defined in the Regional PA, particularly Appendix H. By following these standards, increased post burn patrols, and monitoring as described in the Mitigation section of this document, the determination is that Alternative 2 would have **no adverse effect** to historic properties under NHPA through use of management measures; and no indirect, direct effects, or cumulative effects in combination with the on-going and reasonably foreseeable actions.

Air Quality

According to the *Air Quality Specialist Report for the Boulder Creek Fuels Restoration Project (*Procter 2012) the federal government sets air quality standards, oversees state and local actions, and implements programs for toxic air pollutants, heavy duty trucks, locomotives, ships, aircraft, off-road diesel equipment, and some types of industrial equipment. The role of federal, state, and local governments is defined in the Clean Air Act and its amendments of 1977 and 1990. Several agencies are responsible for regulating air quality and ensuring compliance with law, regulation and policy:

- Federal-Environmental Protection Agency (EPA)
- State-California Air Resources Board (CARB)
- Local- San Joaquin Valley Air Pollution Control District (District)

One of the principal components related to the Clean Air Act that may directly or indirectly affect planning in the project area is the National Ambient Air Quality Standards (NAAQS) – These are standards for pollutants considered harmful to public health and the environment. The EPA has set NAAQS for six principal pollutants, which are called “criteria pollutants” and are shown in Table 2. Smoke contributes to PM10, PM2.5, and to a lesser degree NO2, CO, and O3.

Table 2: National Ambient Air Quality Standards

Pollutant	Averaging Time	Federal Standard
Ozone (O_3)	8 hour	0.075 parts per million (ppm)
Respirable Particulate Matter (PM_{10})	24 hour	150 µg/m^3
Nitrogen Dioxide (NO_3)	Annual Arithmetic Mean	0.053 ppm
Fine Particulate Matter ($PM_{2.5}$)	24 hour	35 µg/m^3
	Annual Arithmetic Mean	15 µg/m^3
Carbon Monoxide (CO)	8 hour	9 ppm
	1 hour	35 ppm
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.030 ppm
	24 hour	0.14 ppm
Lead	Rolling Three Month average	0.15 µg/m^3
Lead	Quarterly Average	1.5 µg/m^3

Source: EPA. Accessed online 9/28/2012 at http://www.epa.gov/air/criteria.html.

State governments are responsible for developing State Implementation Plans (SIP). These describe how each state would achieve the requirements of the Clean Air Act. In California, the California Air Resources Board (CARB) which has set more stringent standards (see Table 3), oversees state and local actions, and implements programs for toxic air pollutants, heavy-duty trucks, locomotives, ships, aircraft, off-road diesel equipment, and some types of industrial equipment.

Table 3: California Air Quality Standards

Pollutant	Averaging Time	Federal Standard
Ozone	1 hour	0.09 parts per million (ppm)
	8 hour	0.07 ppm
Respirable Particulate Matter (PM_{10})	24 hour	50 µg/m^3
	Annual Arithmetic Mean	20 µg/m^3
Nitrogen Dioxide (NO_3)	Annual Arithmetic Mean	0.030 ppm
	1 hour	0.18 ppm
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3
Carbon Monoxide (CO)	8 hour	9 ppm
	1 hour	20 ppm
Sulfur Dioxide (SO_2)	24 hour	0.04 ppm
	1 hour	0.25 ppm
Lead	30 Day Average	1.5 µg/m^3

The Smoke Management Guidelines for Agricultural and Prescribed Burning (Title 17) are the regulatory basis for California's Smoke Management Program. Local air pollution control districts use these guidelines in local rule development.

Local air pollution control districts in California develop plans and implement control measures in their areas of jurisdiction. These collectively make up California's SIP. The San Joaquin Valley Air Pollution Control District (District) is comprised of eight counties that share a common air district: Fresno, Kern, Kings, Madera, Merced,

San Joaquin, Stanislaus, and Tulare Counties. The following District regulations may directly or indirectly affect the Boulder Creek Fuels Restoration Project:

- Public Nuisance (Rule 4102) – Prohibits air discharge of material that causes nuisance or annoyance to any considerable number of people
- Prescribed Burning and Hazard Reduction (Rule 4106) – This rule was adopted June 21, 2001, in response to California's Title 17, and is designed to permit, regulate, and coordinate the use of prescribed burning and hazard reduction burning while minimizing smoke impacts on the public

The Boulder project area lies in the eastern portion of the District and adjacent to the Great Basin Air Pollution Control District (GBAPCD) to the east. The San Joaquin Valley has a northwest to southeast orientation, approximately 100 miles wide by 300 miles long. Major urban centers including Bakersfield, Fresno, Modesto, and Stockton and large agricultural areas are adjacent to the project area.

Air pollution is typically generated in urban and agricultural areas west of the Boulder project area and moved toward it by prevailing west-to-east winds. There are several factors used to measure air quality including particulate matter, smoke sensitive areas, deposition, ozone and visibility. In addition to primary pollutants that impact human health, forest fires also generate Black carbon (BC) and Greenhouse Gases (GHGs) like Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O) that impact climate.

Air circulation and the movement of smoke and other pollutants in the San Joaquin Valley are restricted in both vertical and horizontal directions by radiation and subsidence inversions. Air quality in the Boulder project area is typically better when the inversion base is 1,000 to 1,500 feet above the ground surface. Localized night-time radiation inversions in mountain valleys are also common and are normally the main drivers of smoke impacts on public health. During winter months, wind flows in the valley are from the south, with stagnant conditions prevailing except during passage of winter storm systems. The Boulder Project is located in the east-west oriented canyon formed by the South Fork of the Kings River. It is generally above the inversion layer in fall, winter, and spring months while summer months provide enough heating of the airshed to transport pollutants into higher elevations.

As shown in Table 4 the regulatory status and trends of air pollutants are generally measured against the National and California Ambient Air Quality Standards. A Federal non-attainment status for a specific pollutant indicates that the air regulatory jurisdiction is NOT meeting the standard. That status results in required submittals of plans with proposed control strategies that are modeled to bring an area into compliance/attainment by specific time frames.

Table 4: Ambient Air Quality in the San Joaquin and Great Basin Air Districts

Pollutant	Designation/Classification by Air Pollution Control District			
	Federal Standards		State Standards	
	San Joaquin APCD	Great Basin APCD	San Joaquin APCD	Great Basin APCD
Ozone - One hour	No Federal Standard		Non-attainment/ Severe	Non-attainment (Inyo and Mono Counties) Unclassified (Alpine County)
Ozone - Eight hour	Non-attainment/ Extreme	Attainment/ Unclassified	Non-attainment	
PM_{10}	Attainment	Non-attainment (Owens Lake and Mono Basin)	Non-attainment	Non-attainment
$PM_{2.5}$	Non-attainment	Attainment/ Unclassified	Non-attainment	
Carbon Monoxide	Attainment/ Unclassified	Attainment/ Unclassified	Attainment/Unclassified	
Nitrogen Dioxide	Attainment/ Unclassified	Attainment/ Unclassified	Attainment	
Sulfur Dioxide	Attainment/ Unclassified	Attainment/ Unclassified	Attainment	
Lead (Particulate)	No Designation/ Classification	Attainment/ Unclassified	Attainment	
Hydrogen Sulfide	No Federal Standard		Unclassified	
Sulfates	No Federal Standard		Attainment	
Visibility Reducing Particles	No Federal Standard		Unclassified	
Vinyl Chloride	No Federal Standard		Attainment	

Particulate Matter: Particulate matter in ambient air is composed of complex mixtures of inorganic and organic species. The mixture is made up of liquid or solid particles suspended in the air. These particles vary in origin, size, and composition. Major components of $PM_{2.5}$ include nitrate, sulfate, ammonium, organic carbon, and elemental carbon (Chow et al. 1994). Short term exposure to Particulate Matter has been associated with negative effects to human health. Long term exposure to Particulate Matter is believed to have a much greater impact on human health, but is less certain because less is known about it (Koelemeijer et al. 2006). There is strong evidence to suggest that $PM_{2.5}$ is more hazardous to human health than PM_{10} in terms of cardio pulmonary disease, and mortality (WHO 2003). Thus epidemiological studies in the last decade have emphasized the negative health effects are mainly related to the increase in levels of fine particulate matter in the atmosphere of sizes of less than 2.5 mm (Querol et al. 2007).

Smoke Sensitive Areas: Smoke sensitive areas include campgrounds, residences, camps, and visitor centers in the areas of Hwy 180, Cedar Grove, Hume Lake, Big Meadows, and Grant Grove. Farther from the project, other potential areas of concern might include lower elevations within the Kings River drainage and northeast to east in the Great Basin from around Mammoth to Bishop and Lone Pine. Federal Land Managers have a responsibility to protect visibility in Class I areas which are designated under the Clean Air Act. Class I areas in the vicinity of the project include Kings Canyon National Park, Sequoia National Park, John Muir Wilderness, Dinky Lakes Wilderness, and Kaiser Wilderness. Although smoke management objectives are intended to minimize smoke intensity and duration in Class I areas, smoke is recognized by federal land managers and EPA policy to have a role in natural systems. California's Regional Haze State Implementation Plan was developed to identify causes of visibility impairment in Class I areas, and acknowledges that the primary contribution to poor visibility in Sierra Nevada Class I areas is organics from wildfire smoke events.

Deposition: Atmospheric deposition includes nutrients in several forms, with two of the most important being sulfur and nitrogen. The primary gases involved with nitrogen (N) deposition include ammonia (NH3), nitrogen oxides (NOx), and nitric acid (HNO3), while the primary particles are nitrate (NO3-), and ammonium (NH4+). NOx and HNO3 are emitted as a result of high temperature combustion (e.g. power plants, cars, industrial facilities), while ammonia (NH3), nitrate (NO3-), and ammonium (NH4+) are most often from agricultural sources. Sulfur dioxide (SO2) is the dominant sulfurous pollutant emitted by anthropogenic sources, including fossil fuel combustion and industrial processes. Sulfur is transferred to ecosystems through wet deposition of sulfate (S04), as well as dry deposition of sulfate particles and gaseous SO2.

Ozone: Ozone occurs in the troposphere as the result of chemical reactions involving the photochemical precursors volatile organic compounds (VOCs), nitrogen oxides (NOx), and solar radiation. Conditions favoring high ozone concentrations include inversion layers and low wind speeds, which limit pollutant dispersion and hot, sunny weather which provides energy for the chemical reactions to occur. These conditions occur in California predominantly during the summer months, resulting in peak ozone concentrations from May through September.

Visibility: In the Sierra Nevada, organic carbon makes the greatest contribution to visibility impairment on the worst visibility days. Sulfates and nitrates are also critical components of haze in the region. Visibility impairment is driven primarily by organic carbon from wildfire smoke, followed in importance by sulfates and nitrates (CARB)**.** Visibility is worst during the summer months, due to smoke from California wildfires and biogenic emissions.

In addition, the 2006 Global Warming Solutions Act set the 2020 greenhouse gas emissions reduction goal into law, and directed the California Air Resources Board to begin developing discrete early actions to reduce greenhouse gases while also preparing a scoping plan to identify how best to reach the 2020 limit.

Direct and Indirect Effects

Current management plans under the No Action Alternative would continue to guide management of the project area. No prescribed fire activities would be implemented to accomplish project goals. Therefore special mitigations would not be necessary under this alternative. However, fire severity and intensity would continue to increase as fuel loading naturally increases. The absence of burning Alternative 1 would likely ensure low emissions in the short term but with the continued accumulation of fuels, in a wildfire scenario, would risk the production of high emissions and high risk of public exposure. Wildfires in this area tend to occur in late summer months when background fine particles and ozone are high, compounding public exposure risk.

Alternative 2 is designed to meet Title 17 and subsequent District rules which constitute California's approved Smoke Management Program. Compliance with the state Smoke Management Program also satisfies the conformity requirements under the Clean Air Act. In addition, the Giant Sequoia National Monument Management Plan (USDA 2012) contains several standards and guidelines to maintain or improve air quality, of which the following are applicable to the Boulder Project:

- Minimize resource and air quality effects from air pollutants generated by management activities through use of the following control measures:
  - Follow dust abatement procedures.
  - Conduct an air quality analysis for all projects that may impair air quality to determine effects, mitigations, and/or controls.
  - Conduct prescribed burning activities in accordance with air pollution control district regulations and with proper prescriptions to assure good smoke management.
  - Notify the public before burning.
- Minimize smoke emissions by following best available control measures (BACMs). Avoid burning on high visitor days. Notify the public before burning.
- Coordinate and cooperate with other agencies and the public to manage air quality. Conduct prescribed burns when conditions for smoke dispersal are favorable, especially away from sensitive or class I areas. Use smoke modeling tools to predict smoke dispersion.

Since smoke management is a critical issue in the San Joaquin Airshed, Alterntive 2 is designed to limit the impact smoke would have on the airshed by proposing prescribed burns in the fall, with some limited ignitions in the spring, prior to predicted rain/snow events. This would allow the prescribed fire to burn long enough to achieve resource goals before wetting rains or snow extinguish the active burning in the project area. The duration of active burning and smoke impacts on the airshed is expected to be two weeks. The timing of the prescribed burns would also be coordinated with the California Air Resources Board and the San Joaquin Valley Air Pollution Control District in compliance with Title 17, the Smoke Management Program and the Monument Plan. These requirements and the two additional mitigation measures would reduce the potential direct and indirect impacts to air quality from smoke and particulates entering the airshed (See page 20 of this document).

Boulder Creek drainage is considered an area requiring restoration indicating the fuel loading is outside the range of natural variability and, as such, a portion of the emissions generated would also be outside the range of natural variability. Although the emissions generated (Table 5) are not indicative of public exposure or effects they do provide a relative understanding of the total release to the atmosphere.

Table 5: Annual Emissions under Alternative 2 (tons)

Year	$PM_{2.5a}$	PM_{10b}	CO_c	CO_{2d}	CH_{4e}	$NMHC_f$	NOX_g	N_2O_h	$GHGs_i$
1	346	377	3699	58249	236	180	110	6	65022
2	869	947	9291	146297	592	453	277	15	163307
3	263	287	2812	44276	179	137	84	4	49424
4	395	431	4223	66499	269	206	126	7	74231
5	263	287	2812	44276	179	137	84	4	49424
EF (lbs/ton)	**18.8**	**20.5**	**201**	**3165**	**12.8**	**9.8**	**6**	**0.32**	
Emission Factors(EF) are from Conformity handbook tables 6 and 7									
GHGs (metric tons in CO2 eq)= ((CO2*1)+(CH4*21)+(N2O*310))*0.907									
0.907 factor is conversion from US tons to metric tons									

a-$PM_{2.5}$ = particulate matter less than 2.5 microns
b-PM_{10} = particulate matter less than 10 microns
c-CO = carbon monoxide
d-*CO2 = carbon dioxide
e-CH4 = methane
f-NMHC= non methane hydrocarbons
g-NOx = nitrogen oxides
h-N2O = nitrous oxides
i-GHGs = greenhouse gases

The management approach under Alternative 2 is directed at mitigating or reducing the potential for those emissions to affect public exposure, local economies and impair visibility. Effects would potentially be seen in the Boulder project area, as well as the Kings River Canyon west towards lower elevation communities and east towards Cedar Grove. Previous events (i.e. Sheep Fire) suggest that smoke, when dispersal is good, can extend effects towards Mammoth and Bishop in the Great Basin/Owens Valley. As required by the Monument Plan and the mitigations, the local communities and potential visiting public would be made aware of the potential for smoke and particulates in the vicinity during project implementation. Communication tools may include road signs, articles in local papers or community bulletin boards, and personnel on site or at public venues.

There may be opportunities for the scientists involved with air quality to run their models or conduct research as well because the short-term effects of fire and the emissions associated with fire are important for managing air quality. These effects need to be viewed over the long term to better account for the effects of fire on carbon stocks (Hurteau 2011). If the successional pathway that resulted in the pre-fire forest remains unchanged, the recovering forest would transition from a carbon source to a carbon sink, and with sufficient time, the forest would re-sequester all of the carbon lost from both direct and indirect sources.

Cumulative Effects

The cumulative effect area for air quality could potentially reach beyond the planning area for this project and bordering lands within the Giant Sequoia National Monument and surrounding National Parks. Under the No Action Alternative, fuel loading conditions would continue to deteriorate with current and future wildfires expected to exceed capabilities of ground fire suppression. The highest likelihood of wildfire would be in late summer when the smoke emissions would have a higher chance of combining with additional urban generated pollutants which are often transported into higher elevations of the Sierra on hot summer days. A wildfire in the planning area or one extending beyond the planning area would generate higher emissions and join with other sources to increase public exposure for a longer duration. These effects would be seen in the Boulder project area, as well as the Kings River Canyon west towards lower elevation communities and east towards Cedar Grove. Previous events also suggest that smoke, when dispersal is

good, can extend effects towards Mammoth and Bishop in the Great Basin/Owens Valley, and therefore result in a higher potential for cumulative effects.

Unlike a wildfire scenario, the prescribed burning under Alternative 2 would take place on days designated as burn days with adequate dispersion by the San Joaquin Valley Air District. Approval is contingent on background air pollution, allocation of burn requests in the air basin, and conditions in adjacent air basins. These regulatory approval factors that reduce the potential for direct and indirect effects would also minimize cumulative effects.

Fuels

As described in the background section of this document, and as reflected in the purpose and need for the project, the majority of the area has missed the last five fire return intervals (100+ years of fire exclusion). It is in steep inaccessible terrain with a moderate to heavy fuels layer. The arrangement of fuels is such that the vertical and horizontal continuity provide ladder fuels would enable low intensity surface fires to move into the canopies and become crown fires. The combination of topography, vegetation, and fuel loading are such that a wildfire could not be safely suppressed under extreme conditions. Such a fire would not only be a threat to giant sequoia trees, but also to life, property, and other resources in the area, such as wildlife habitat, cultural sites, plantations, and recreation improvements.

The Agnew Grove was inventoried in 2009. This grove is unique in that it is both in Agnew Inventoried Roadless Area and since 1984 has been part of the Monarch Wilderness. Available forest management records date back to 1955 and fire history information is available back to 1910. In Agnew Grove there are no records of past management activities and no fire history, natural or human caused, for fires ten acres or larger. Surface fuel loading conditions during the inventory year of 2009 including duff and litter, are approximately 24 tons of fuel per acre. Grove density and tree stocking included approximately 238 trees per acre, with the majority of the trees in the less than 20 inch diameter class. At the time of the inventory white fir made up more than 86 percent of the trees per acre and almost 70 percent of the basal area. All other species combined, including hardwoods, made up slightly more than 30 percent of the total basal area, with 22 percent of that being sequoia trees. The increased number of shade tolerant trees, particularly in the 10-16 inch diameter size class, can be attributed to lack of fire throughout the grove (Wood 2010).

The Deer Meadow Grove was inventoried in 2009. Forest management records show no recorded management activities or fire history, for fires ten acres or larger in the grove. Surface fuel loading conditions during the inventory year of 2009 including duff and litter, are approximately 17 tons of fuel per acre. Grove density and tree stocking included approximately 484 trees per acre, with a mean diameter of 9.3 inches.

The Evans Giant Sequoia Grove Complex was inventoried in 2009. Some management activities, including harvest, tree planting, and prescribed fire have occurred within the grove complex. These areas are shown on the grove disturbance map below. Fire history records show 501 acres of fires ten acres and larger have burned in the grove since 1916. Surface fuel loading conditions including duff and litter, are approximately 43 tons of fuel per acre. Grove density and tree stocking included approximately 505 trees per acre, with a mean diameter of 7.7 inches.

Giant sequoias should account for approximately 55 to 75 percent of total basal area and greater than 10 percent of the total trees. The mixed conifer component should contain 25 to 45 percent of the total basal area with white fir being the dominant species. Incense cedar, sugar pine, and black oak are also important

components of most groves, but even in combination should occupy less than 20 percent of the total basal area (Piirto 1999).

The Boulder Creek project area and adjacent lands generally have a north/ south drainage alignment and consist of steep rugged terrain (Figure 1) with many ephemeral and intermittent streams flowing into perennial drainages that feed the South Fork of the Kings River. Aspects vary depending on the drainage but the general orientation is northerly. Fires in the Boulder Creek geographic area tend to be wind and slope driven. The Kings River on the northern boundary of the project area, along with steep rocky terrain provides an effective barrier to fire spread into the Boulder Creek Drainage.

The fire history for the Boulder Creek Drainage dates back to the early 1900s, during which time 11 fires have burned in or onto the Boulder Creek project area (see Figure 6). The 11 fires, both natural and human caused, total approximately 448.2 acres. Six fires were initiated in Boulder Creek Drainage, and five fires began outside the drainage and spread into the project area. Two fires in the drainage were less than 10 acres and one fire was greater than 100 acres. Fires in the Boulder Creek Drainage were treated as suppression fires and actions were taken to limit their growth and extinguish them. The 2010 Sheep Fire is the exception. This fire was treated as a managed wildfire and only one half acre crossed into the Boulder Creek drainage.

Direct and Indirect Effects

According to the *Fuels Specialist Report for the Boulder Creek Fuel Restoration Project* (Leusch 2012), the fuel models within the Boulder Creek drainage were determined utilizing standard fire behavior fuel models found in Sequoia National Forest and Giant Sequoia National Monument fuels data and Wildland Fire Decision Support System (WFDSS) California Landscape 2010 fuels data. The description of these models can be found in Scott and Burgan 2005, *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model*. This set of fuel models was developed to improve the accuracy of fire behavior predictions outside of the severe period of the fire season, such as prescribed fire and fire use applications. For each alternative, the fuels analysis modeled a fire occurring during late summer, when a wildfire is most likely to occur. In the case of Alternative 2, the model was run as a wildfire after the Boulder Creek Project was implemented.

The existing fuel conditions and their associated fire risks are likely to be maintained and continue to increase with time under the No Action Alternative. Under Alternative 1, the Fire Return Interval Departure (FRID) for the project area would potentially continue to remain outside of historic fire return intervals (See Figure 2). An increase in surface fuels would occur over time as existing snags, needle cast, and woody debris continue to accumulate. Snag densities are anticipated to increase with naturally occurring tree mortality. Ladder fuels are also anticipated to increase as regeneration continues and, in turn, decreases the average canopy base height within the project area.

Alternative 2 proposes to reintroduce fire into the lower portion of the Boulder Creek drainage. This proposed action utilizes prescribed fire to restore ecological processes within areas of extreme FRID. As shown in Table 6, the proposed action is projected to change crown fire activity to surface fire in all the treatment areas. The change from generally passive crown fire to surface burns would reduce surface and ladder fuels, which would move the project area toward fire and fuels management desired conditions. This would also break up the vertical and horizontal fuel continuity which provides a ladder for fire to go from the ground to the crowns of the trees. As shown in the table below, the change from crown fire to surface fire would be greatest in Areas 1 and 3.

Figure 6: Fire History in the Vicinity of Boulder Creek Project

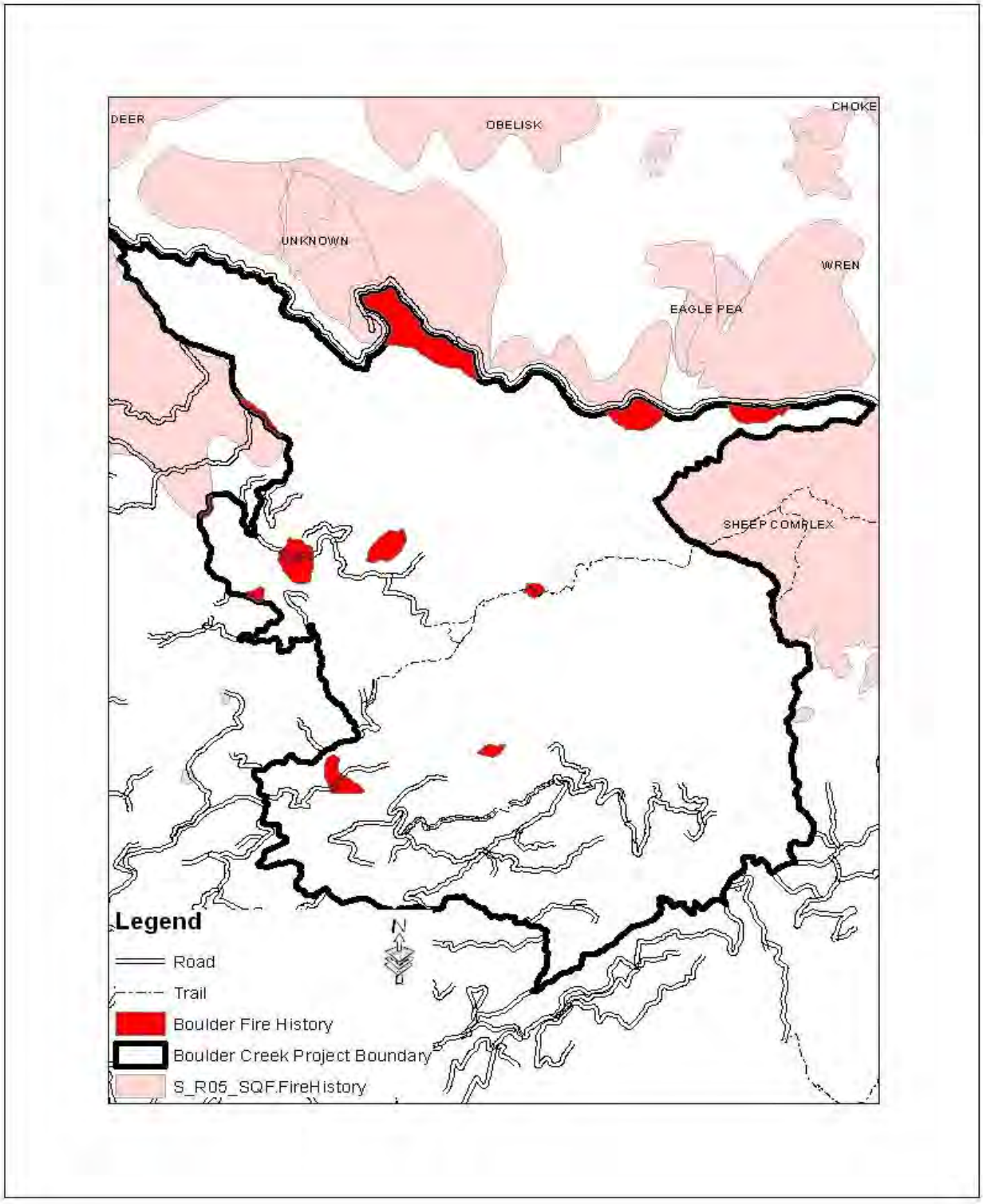


Table 6: Projected Surface and Crown Fire Activity by Alternative

Alternative	Area	Surface (percent of Burnable Area)	Passive (percent of Burnable Area)	Active (percent of Burnable Area)
1	1	36	63	1
	2	46	53	1
	3	71	29	0
2	1	92	8	0
	2	86	14	0
	3	98	2	0

Actions proposed in Alternative 2 would protect the sequoia groves in the project area from future uncharacteristically severe wildfire, by reintroducing fire to restore and conserve grove ecosystems. Re-establishment of fire in fire excluded giant sequoia groves helps to restore these ecosystems and promote resilience.

A four-foot flame length is considered the maximum height that can be safely attacked by hand crews to create fire lines near the fire. As shown in Table 7, under Alternative 1 flame lengths would be over 4 feet high between 24 and 62 percent of the burnable portions of the project area. Under Alternative 2 flame lengths would be reduced to 4 feet or less in over 90 percent of the burnable area.

Table 7: Projected Flame Length by Alternative

Alternative	Area	0 to 4 feet (percent of Burnable Area)	4 to 8 feet (percent of Burnable Area)	8 to 12 feet (percent of Burnable Area)	Over 11 feet (percent of Burnable Area)
1	1	39	10	13	39
	2	48	11	8	34
	3	76	12	4	8
2	1	94	5	0	0
	2	93	6	0	0
	3	99	1	0	0

Under Alternative 1 fire severity and intensity would continue to increase as fuel loading naturally increases. Flame lengths and rates of spread would continue to support passive and active crown fire. As shown in Table 8 for Alternative 1, the rate of spread in Areas 1 and 2 is 5 chains or greater in almost half of the burnable area. In the event of a wildfire, safe firefighter access would continue to decline with no treatment of fuels within the project area as fuel accumulates within travel corridors.

Under Alternative 2 fireline intensity is reduced as the rate of spread is lowered from as high as 40-80 chains per hour to less than 5 chains per hour in most of the project area (Table 8). The combination of lower flame lengths, less crown fire and slower rate of spread describe conditions for future wildfire behavior which resemble historic wildfire; slow moving, low intensity fire with very limited potential for passive or active crown fire. It also describes conditions allowing for subsequent low risk, maintenance prescribed fire or managed wildfire in the future.

Table 8: Projected Rate of Spread by Alternative

Alternative	Area	0 to 5 (chains per hour)	5 to 10 (chains per hour)	10 to 20 (chains per hour)	20 to 40 (chains per hour)	40 to 80 (chains per hour)
1	1	52	27	9	5	6
	2	57	12	10	11	7
	3	88	6	3	3	1
2	1	93	6	1	0	0
	2	95	5	0	0	0
	3	99	1	0	0	0

Prescribed fires would be ignited in the fall and in the spring, one or two weeks prior to a predicted rain or snow event. This would allow the prescribed fire to burn long enough to achieve resource goals before wetting rains or snow extinguish the active burning in the project area. The duration of active burning and smoke impact on the San Joaquin airshed is expected to be two weeks from ignition.

Cumulative Effects

Past, present and future activities within and near the project area include prescribed fire activities and managed wildfire. Most recently, in the summer of 2010, the Sequoia National Forest jointly managed the Sheep Fire with Sequoia and Kings Canyon National Parks for over 9,000 acres adjacent to the project area. This fire successfully lowered hazardous fuel loading on 52 acres within the Monarch Sequoia Grove.

Under No Action, Alternative 1, current fuel loading conditions would continue to degrade in the long term. The shade-tolerant tree species would continue to increase, providing the ladder to move fire into the crowns of the larger trees. Surface fuels would continue to exist and be expected to increase with no action taken to reduce fuel loadings. In these conditions, current and future wildfires are expected to exceed capabilities of ground fire fighters to control the spread of the fire. The safety risk for fire fighters and the public is high in areas of heavy fuel loadings. The risk level would continue to grow in the future as fuel loading continues to increase with no treatment action.

Short term smoke emissions would be low because no burning would occur in the No Action Alternative, until the occurrence of a wildfire. Over the long term a wildfire is likely, and a large increase of emissions from smoke during a wildfire would be expected. With no treatment, the ability to manage wildfires and prescribed fires to achieve fuel management and resource objectives would be difficult due to the current fuel loading and forest stand characteristics that result in the potential for extreme fire behavior.

Fuel management actions in Alternative 2 would result in a positive long-term benefit in contributing to the reduction of potential fire behavior and moving towards the fire and fuels management desired conditions. Over the long term smoke emissions from future wildfires would be reduced. This reduction is because cumulative smoke produced by prescribed burning and low intensity fires resulting from fuel reductions is less than smoke produced by high intensity wildfires that occur where no fuel reductions have taken place.

The combination of this project and the 2010 Sheep Fire provides an area of strategically reduced fuel loading and continuity, slowing the rate of spread and decreasing flame lengths of future high intensity wildfires burning in the area. The recent Sheep Fire, located to the east of the project area, currently provides a window of opportunity allowing more flexibility to accomplish what would otherwise be a higher risk burn.

Geology and Soils

According to the *Geological Specialist Report for the Boulder Creek Fuels Restoration Project* (Gallegos 2012) the Windy Gulch Geologic Area (WGGA) has at least nineteen inventoried caves, and nine of them meet the criteria for significant caves (see Gallegos, 2005). Boyden Cave, Church Cave, and Beauty Cave have been inventoried for cave fauna and found to have bats, spiders, ants, and several other organisms living in them (SID, 2012). Reviews of Church Cave in the early spring have found flowing water, high water lines and evidence of minor sedimentation in portions of the cave passages. It is unknown how these caves may be affected by prescribed fire in the area. Natural fire has occurred in the past, based on evidence of fire scars on sequoias in the upper Windy Gulch subwatershed.

There is potential that other unknown caves exist in the Windy Gulch Geological area. The location of caves in the Windy Gulch Geologic Area is sensitive information under the authority of the Federal Cave Resources Protection Act of 1988.

There are two sets of caves in the Boulder project area and only the caves in Windy Gulch could be affected from sediment indirectly caused by a wildfire or prescribed fire in this area. The proximity of burnable material, soil and overall topography near cave entrances would determine whether sediment could flow into the caves after a wildfire event.

Direct and Indirect Effects

The proposed project has the potential to adversely affect cave resources by:

1. Deposition of sediment in cave floors; this is mostly a concern in the caves located in Windy Gulch.
2. By igniting fires in caves from dropping plastic spherical incendiary devices (PSD) into cave entrances. This is a concern in all caves in the WGGA.
3. By smoke circulating in caves. This is a concern in all caves in the WGGA.

The effects analysis for potential impacts to cave resources from sedimentation was conducted by considering the results of the prescribed fire in terms of soil cover, erosion potential, channel geometry and the location of cave openings. The effects analysis for potential impacts to cave resources from fire was conducted by considering the location of cave openings and where SID would be restricted from dropping or landing. The effects analysis of smoke circulating in caves was conducted by personal communication from people who have been present at Boyden Cave over the years, when fires have occurred.

Alternative 1, No Action, serves as a baseline from which to compare Alternative 2, the Proposed Action. The no action alternative assumes that a wildfire could burn in the Boulder project area and the effects of a wildfire would be similar to the Sheep Fire. Wildfire is a recurring event in the Windy Gulch drainage and the Boulder project area has similar terrain and vegetation as the Sheep Fire area. Under Alternative 2, the Windy Gulch Geological Area is located in Areas 2 and 3A, which are proposed to be burned in years 2 and 3 (See Figures 1 and 3).

Under either alternative, the direct and indirect effects of fire on caves in the Windy Gulch Geologic Area include potential burning of vegetation near the cave openings, ash and sediment entering cave openings and depositing in cave passages, and smoke entering the caves. Burning vegetation near cave entrances has the potential to supply ash and smoke into the caves. It also has the indirect effect of increasing erosion and sedimentation if all the vegetation is burned up so there is nothing left to hold the soil in place. Alternative 2 includes a mitigation to avoid dropping the plastic spherical incendiary devices directly into caves or near the cave entrances to minimize the amount of vegetation burned in this vicinity.

The amount of ash and sediment is directly related to how severely a fire burns. As shown in the table below, the Sheep Fire burned at various severities across the landscape. It resulted in approximately five percent high burn severity, 21 percent moderate burn severity, and 25 percent low burn severity.

Approximately, 49 percent of the Sheep Fire area was unburned. The Sheep Fire Burned Area Emergency Response Assessment estimated that 1,700 cubic yards per square mile of soil could be transported into stream channels in the Sheep Fire area (USDA, 2010b). Applying the sedimentation rate of the Sheep fire to a wildfire in the proposed Boulder project area would result in similar amounts of sediment under Alternative 1.

Under either alternative, the Windy Gulch sub-drainage has the most susceptible cave resources to fire effects. The Windy Gulch sub-drainage is approximately 837 acres. The lower 1/3 of the Windy Gulch drainage (up to 4,800 feet elevation) is underlain with shallow soils and rock outcrop. The middle 1/3 of the Windy Gulch drainage (between 4,800 and 6,600 feet elevation) is underlain with moderately deep to shallow soils, and the upper 1/3 of the Windy Gulch drainage is underlain with moderately deep soils and rock outcrop (USDA, 1996). Approximately 25 percent of the Windy Gulch drainage is rock outcrop.

The portions of the project area with potential for high burn severity would have exposed soils with less than 20 percent ground cover and these areas would be susceptible to erosion and subsequent deposition of sediment into the Windy Gulch sub-drainage.

Under Alternative 1, using the Sheep Fire data (1,700 cubic yards per square mile) across the approximately 837 acre Windy Gulch sub-drainage, there would be approximately 2,223 cubic yards of sediment movement. A small portion, 10 percent, or 220 cubic yards of this sediment could move into Church Cave or Boyden Cave in the bottom of Windy Gulch; which has a low potential to affect cave resources. The chance of this occurring is greater under Alternative 1 than Alternative 2 simply because a wildfire burning under high temperatures and very dry conditions is more likely to produce more severe burning and subsequent sediment than a prescribed burn under a specific range of temperatures and humidity.

Table 9: Comparison of Estimated Burn Severity across Burnable Area[1]

Burn Severity	Sheep Fire (acres)	Boulder Project (acres)	Windy Gulch sub-drainage (acres)
High	451.0	719.25	42
Moderate	1894.2	3020.85	176
Low	2255.0	3596.25	209
Unburned	4419.8	7048.65	410
Total Acres	9020	14,385	837

1. Estimates are based on erosion modeling using the WEPP based ERMit Model (See Gallegos 2012).

Alternative 2 includes mitigations to avoid dropping the plastic spherical incendiary devices directly into caves or near the cave entrances, to monitor burn severity and sediment deposition in the caves, and modify treatments to reduce potential for further sedimentation into the caves. Under Alternative 2 the estimated amount of sediment depositing into Windy Gulch from high burn severity areas is approximately 40 tons per acre. With approximately 42 acres of estimated high burn severity, that would be approximately 1600 tons of sediment generated in the Windy Gulch sub-drainage. Approximately 10 percent of this sediment, or 160 tons, could enter the cave openings in the Windy Gulch sub-drainage; which has a low potential to affect cave resources and limited direct and indirect effects.

Assuming a wildfire occurrence under Alternative 1 or implementing Alternative 2 and a rainfall event after the fire, the indirect effects to caves in the Windy Gulch Geological Area would be from ash and sediment entering the caves. Most of the ash and sediment mobilized after a fire would occur within the first few major storms in fall and early winter. Ash would initially be mobilized, in solution with the flowing water moving down Windy Gulch channel. It is possible that sediment could be mobilized in storm events up to two years after the natural or prescribed fire in the Windy Gulch Geological Area. Sedimentation after a fire

is a function of exposed soil, rainfall, and proximity to a steam channel. Some of the water and ash would enter the cave openings in Windy Gulch and be transported into Church Cave and Boyden Cave. Steven Fairchild, Sr., permittee operating Boyden Cavern tours, attested that in a wildfire about 15 years ago, ash was deposited into Boyden Cave and left a ring in the cave channels (personal communication with S. Fairchild, 2012).

Very little research has been conducted on the effects of smoke from prescribed fire on cave processes. Prescribed burning has been implemented in Sequoia-Kings Canyon National Park near Lilburn Cave and Crystal Cave. Smoke in caves was considered a natural effect of fires burning in the park and monitoring was not conducted. Review of the published literature did not find any documentation on the effects of smoke in caves.

Smoke could leave a residue on cave speleothems and formations and slightly discolor the cave formations. Cave mineralization results in different colors of speoleothems and formations and rings are often seen in some of these features. Some of this discoloration and rings could be from smoke generated from wildfires of the past. Boyden Cave formations show discoloration and rings from past fire events, which have not been dated. Wildfire has been occurring in this landscape for millennium and caves have developed with fire as part of the natural processes.

Cumulative Effects

Management activities in the analysis area include grazing, fire suppression, sivicultural planting/release, mining, and recreational use, including public tours of Boyden and Church caves. These cumulative impacts have had minor alterations to the soil and geology of the project area, particularly the Windy Gulch sub-watershed.

Since most of the project area has been designated wilderness or inventoried roadless area since the early 1980s, most of the cumulative effects are located in the higher more accessible southern portion of the project area. The exception is the Boyden and Church caves area. Boyden has been a commercial public tour operation for over a century. Church cave is also open on a more limited basis for cave tours. Current regulations require a number of protection measures for management of these caves. The direct and indirect effects of a wildfire or cooler fall burn on cave resources, as described previously, would be minimal and of short duration. Under either alternative the sediment, ash and smoke that may reach the caves would be expected to remain within the natural variation in the long term. As a result, the reasonably foreseeable activities in combination with the limited direct and indirect effects of the Boulder Creek Fuels Restoration Project should result in minimal cumulative effects to geologic resources, especially those in the Windy Gulch sub-drainage.

Recreation

According to the *Boulder Creek Fuels Restoration Project Recreation Specialist Report* (Recreation Report) (Hallacy 2012) the project area is in steep inaccessible terrain with a moderate to heavy fuel layer, contained mostly in the Agnew Roadless Area and Monarch Wilderness. The Boulder Trail (Forest Trail (FT) 29E04) is located just below Big Meadow Road (Forest Road 14S11) and would act as part of the southern boundary, and the Deer Meadow Trail (FT 30E05) serves as the eastern boundary. The Kanawyer Trail (FT 30E04), Evans Grove Loop Trail (FT 30E04A), and Little Boulder Grove Trail (FT 29E09) are all within the project boundary.

Recreational use of the project area is low to moderate, with the Little Boulder Grove Trail and the Evans Grove Loop Trail being the more popular among hikers and those seeking an experience of solitude. The

Deer Meadow and Kanawyer Trail are remote and can be difficult to hike except possibly for those with more experience.

The South Fork Kings Wild and Scenic River runs directly parallel to State Highway 180 and is just outside the project boundary. The river segments include South Fork, on the eastern project boundary, which is managed as "recreational" and a small section of Converse, on the western project boundary, which is managed as "wild" (*Kings River Special Management Area (KRSMA) Implementation Plan*, Boundaries Wild and Scenic Rivers Map, Sheet 8 of 8) (USDA 1991b). "The basis for classification is the degree of naturalness. The most natural rivers are eligible for "wild"; those with less natural features are eligible for "scenic" and those least natural "recreational" (KRSMA Implementation Plan p. 67 Appendix B).

Scenic Integrity is a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes which have little or no deviation from the character valued by constituents for its aesthetic appeal. The existing Scenic Integrity for the Agnew Roadless Area is High, the Monarch Wilderness is Very High, the southern project area outside of the Evans Complex is moderate with a few small areas of low, and in the northwest project area there are a few small areas of low (See Existing Scenic Integrity Map in the Recreation Report). The existing scenic integrity values were generated through the scenery inventory and analysis which was conducted during the recent Giant Sequoia National Monument planning process (USDA 2012, Monument FEIS Volume 1, Map 23). Fuel reduction projects in overstocked forests or forests with excessive fuel loads can improve scenic quality when they create more open forest conditions, improve diversity, and minimize scorching from fire.

Direct and Indirect Effects

Alternative 1, the No Action Alternative, would have no direct or indirect effect on recreation, wilderness, trail management, or recreationists.

Under Alternative 2, trails in the project area may be closed to the public during or directly after implementation and trail infrastructure such as signage and wooden water drainages may be damaged by fire. As described in Alternative 2, after the prescribed burn treatments, hand crews would repair trail tread if the burning activities damaged the trail. The tread work may include reestablishing waterbars or other drainage features along the trail. These activities would be designed to reduce the potential for erosion or sedimentation as a result of the fuels reduction activities, and manage that portion of trail to standard. Also, mitigations have been added to repair signs damaged during project implementation. As a result of the design features and mitigations, there would be minimal impact to trail infrastructure.

Aerial ignitions, using plastic spherical incendiary devices, may leave man-made debris in the Monarch Wilderness and Agnew Inventoried Roadless Area. As a result, one of the mitigations required under Alternative 2 is that any partially-burned or unburned spheres be removed where they land near trails. This would most likely happen while any necessary repairs are being made after the prescribed burning. A Minimum Requirements Analysis is being conducted using the Minimum Requirements Decision Guide, for use of plastic spherical incendiary devices within the wilderness area. (This document is the project record on file at the Hume Lake Ranger Station and is available upon request)

Direct effects of this project include a change to visible scenery, with visitors seeing burned vegetation, including brush and trees and the smoke during and right after project implementation. An indirect effect of implementing Alternative 2 is that it may improve the scenic integrity and the scenic stability by preventing and minimizing the risks of severe fire in visually sensitive areas. These would be the areas viewed from travelways and recreation areas. The Scenic Integrity Objective (SIO) is the value that the Forest strives to attain (see SIO Map in Appendix B of the Recreation Report). The SIOs used in this report were generated

through the scenery inventory and analysis which was conducted during the recent Giant Sequoia National Monument planning process. The SIO for this project is to retain the existing SIO or achieve a higher value where possible. Therefore, implementing Alternative 2 may result in a beneficial change to scenery, adding more open forest area and vistas.

Hunters may have limited access to the area if the project is implemented during hunting season. A mitigation measure has been developed to provide information about the burn and any area closures to the public as early as possible to avoid conflicts with hunters. In the long term, adding more open forest areas may be beneficial to hunting. According to the California Department of Fish and Game, deer populations in this area generally respond favorably to vegetation disturbances that enhance brush species (wildfire and timber harvesting). Recently burned areas that have re-sprouted with brush are good areas to hunt. Typically, lower densities of deer are observed in the more densely forested areas or in older, more decadent brushlands (California Department of Fish and Game D8 Zone Information 2012).

Cumulative Effects

Trail maintenance, including removing downed logs, cleaning drainages, brushing, and tread maintenance has been completed on the eastern portion of the Kanawyer Trail and on the Deer Meadow Trail over the past 5 years. Some trail maintenance occurs on the Little Boulder Grove Trail and the Evans Grove Loop Trail annually, or on an as-needed basis. The regular trail maintenance activities would allow the trails in the project area to be used as fire lines. This maintenance follows the Trail Management Objectives (TMOs) in accordance with FSM 2320. TMOs are fundamental building blocks for trail management and tier from and reflect forest plan, travel management, and/or trail specific management direction. All trails use the national standards, unless specific site management requires deviation from these (USFS Recreation, Heritage, and Wilderness Resources Integrated Business Systems website). As shown in Table 10, all of the trails in the Boulder Fuels Restoration project area are managed using the national standards and are designated as Trail Class 2 – Moderately Developed.

Table 10: Trail Maintenance Objectives

Trail Name/Number	Managed Use	Tread Width (inches)	Clearing Width (inches)	Clearing Height (feet)
Kanawyer 30E04	Pack and Saddle	18	72	8
Little Boulder Grove 29E09	Hiker/Pedestrian	12	36	6
Evans Grove Loop 30E04A	Pack and Saddle	18	72	8
Deer Meadow 30E05	Pack and Saddle	18	72	8
Boulder 29E04	Pack and Saddle	18	72	8

The cumulative effects of this project include minor beneficial effects on trails because of the mitigations in place. In addition, the trail system may receive additional maintenance that is beyond the normal maintenance schedule. Overall, the prescribed burning would be beneficial in the long term for recreationists, including hunters, hikers, campers, sightseers, and other recreations that could use the project area. This project is designed to fully comply with all laws, rules and regulations regarding recreation and wilderness management.

Sensitive Plants

According to the *Biological Assessment for Federally Listed Threatened or Endangered Plant Species and Biological Evaluation for Forest Service Sensitive Plant Species for Boulder Creek Fuel Restoration Project* (Linton 2012) the project area has no potential habitat for any federally proposed or listed plant species that

occur or have potential to occur on the Giant Sequoia National Monument. In contrast, the analysis area has known populations of the following Pacific Southwest Region sensitive plant species:

- Hall's Daisy, (*Erigeron aequifolius*)
- Sequoia False Goldenaster, (*Heterotheca monarchensis*)
- Marble Rockmat, (*Petrophyton caespitosum* ssp*. acuminatum*)

The analysis area also has potential habitat for the following Pacific Southwest Region sensitive plant species:

- Short-Leaved Hulsea, (*Hulsea brevifolia*)
- Congdon's Bitterroot, (*Lewisia congdonii*)
- Tehipite Valley Jewel-Flower, (*Streptanthus fenestratus*)

The Boulder Creek Fuel Restoration Project analysis area was not surveyed formally. Because the proposed action does not include any mechanical disturbance of soils, Forest Service Manual 2600 does not require comprehensive sensitive plant surveys. However, those species with potential to be found in the project area but which were not found in the treatment units are also included in the analysis.

Hall's Daisy is found only in steep, rocky, granitic crevices with little or no competition from other species. It is generally found on dry ridges, approximately 5200 to 8000 feet in elevation in mixed conifer forests. Populations are relatively stable due to the steep, rugged nature of the habitat, making them inaccessible for timber harvest, grazing, and most recreation.

Sequoia False Goldenaster is locally common on limestone formations northeast of Horseshoe Bend along the South Fork of the Kings River near Boyden Cave. However, to date, it is known only from this portion of the Monarch Wilderness which experiences little to no human impacts. It is generally scattered on south-facing slopes of limestone in cracks, ledges and flats, with higher densities of plants seen in the coarse sandy flats at the base of cliffs, from 3650 to 6000 feet elevation.

Marble Rockmat is found in Fresno, Inyo, and Tulare Counties. Locally it is found along the South Fork of the Kings River near Boyden Cave. It grows in the lower and upper montane coniferous forest, on carbonate or granitic, rocky substrates from 3900 to 7545 feet elevation.

There are 4 known occurrences of Short-Leaved Hulsea on the Sequoia National Forest. However, the known locations of these plants are all near Dorst Creek along the General's Highway, which is in Sequoia National Park and approximately 10 miles south of the Boulder project area. This species is found in red fir or mixed conifer forest, from 5000 to 9000 feet elevation.

Congdon's Bitterroot has 8 known occurrences in a disjunct distribution between the Kings River Canyon and the Merced River Canyon 50 miles to the north. All but one population are in the Merced River drainage. The only occurrence on Sequoia National Forest is directly next to Highway 180. Plants are found on rock faces, cracks and ledges in rocky areas, on talus and scree, and on spoil piles of an abandoned barium mine. Estimates of population size range from less than 100 plants to over 10,000. The Kings River population grows on granitic rock in the chaparral to coniferous forest, from 2000 to 7000 feet elevation.

Tehipite Valley Jewel-Flower is known from less than 10 occurrences, all within the South and Middle Forks of the Kings River drainage. Most occurrences are in Kings Canyon National Park. However, two populations are on the Sequoia National Forest, one on Monarch Divide and the other near Boyden Cave. Large metapopulations are found on carbonate soils, but populations are also found in granitic soils from 4000 to 7500 feet elevation, consisting of hundreds to many thousands of plants.

Direct and Indirect Effects

No direct effects to sensitive plant species are expected under Alternative 1. Very limited direct effects to sensitive plants are expected under Alternative 2. The three known species (Hall's Daisy, Sequoia False Goldenaster, and Marble Rockmat) and the other two potential species (Congdon's Bitterroot and Tehipite Valley Jewel-Flower) are lithophiles (they grow on rock outcrops) and would not be affected by the prescribed fire. Direct effects to undiscovered populations of Short-Leaved Hulsea by the treatments (prescribed fire) are possible, but would be short and transient to this perennial plant.

Under Alternative 1 indirect effects to sensitive plant habitat and species (where present) may occur because of the risk of severe wildfire followed by shortened fire return intervals. This scenario could introduce and perpetuate early seral vegetation conditions that could degrade habitat for the sensitive plant species dependent on older forest ecosystems, such as an unknown population of Short-Leaved Hulsea. In addition, though wildfires occurring could likely be more intense and widespread, the other species would not be indirectly affected since they are lithophiles.

Under Alternative 2 the proposed prescribed fire that consumes leaf litter could result in soil movement for a short period (i.e. less than five years). Movement of soil into an unknown population of Short-Leaved Hulsea could affect them indirectly by changing their habitat. However, soil movement would not be a likely indirect effect to the other species since they grow on rock outcrops with little leaf litter to burn. In the mid and long-term, treatment of the fuels in the Boulder area would meet the overall goals of reducing the risk of catastrophic wildfire and possibly greater soil movement/plant habitat effects.

In Alternative 2, short-term increases in risk from the introduction and spread of noxious weeds from equipment/personnel used during implementation of the project, as well as reductions of soil cover, can be expected. A reduction of soil cover increases the risk of introduced weeds becoming established. Noxious weed infestations are a threat to sensitive plants and their habitats. Mitigations to prevent the introduction and spread of noxious weeds into the proposed treatment areas have been added to the proposed action (see page 21 of this document). These practices would eliminate the risk of negative indirect effects from noxious weeds on sensitive plants.

Cumulative Effects

Management activities that have cumulatively impacted sensitive plant occurrences within the analysis area include grazing, fire suppression, sivicultural planting/release, mining, and recreational use. These cumulative impacts have altered the present landscape to various degrees. As a result, cumulative impacts may vary from species to species especially where past and current activities on National Forest System lands have altered potential habitat for the sensitive plant species found in or have the potential to be in the Boulder project area.

Since most of the project area has been designated wilderness or roadless area since the early 1980s, most of the cumulative effects are located in the higher more accessible southern portion of the project area. Short-Leaved Hulsea has the potential to occur in this part of the project and may be the most affected by past, present, and future activities. The direct/indirect effects of a cooler fall burn on an unknown population of Short-Leaved Hulsea are minimal so the cumulative effects of the Boulder Project are minimal as well. Therefore, the determination is that the Boulder Creek Fuel Restoration Project **may affect** undiscovered individuals but is not likely to result in a trend toward federal listing or loss of viability for Short-Leaved Hulsea.

The rest of the Boulder project area is located in the steep inaccessible Kings River gorge, and most of the sensitive plants that have habitat in the project area grow on rock outcrops. Minimal adverse cumulative

effects are expected for any of these species under Alternative 2. Therefore, the determination is that the Boulder Creek Fuel Restoration Project would have **no effect** on Sequoia False Goldenaster, Marble Rockmat, Congdon's Bitterroot or Tehipite Valley Jewel-Flower. The *Biological Assessment for Federally Listed Threatened or Endangered Plant Species and Biological Evaluation for Forest Service Sensitive Plant Species for Boulder Creek Fuel Restoration Project* is hereby incorporated by reference.

Vegetation

According to the *Silviculture Report for the Boulder Creek Fuels Restoration Project* (Silviculture Report) (Burd 2012) the project area ranges from about 4,000 feet elevation at the Kings River, to slightly over 8,000 feet and the native vegetation varies accordingly. The Sequoia National Forest geographic information system (GIS) vegetation records were used with vegetation series and sizes classified using CALVEG (USDA 1980) standards. Acres of vegetation types were determined from Landsat (satellite) imagery. Table 11 summarizes the vegetation types found in the project area.

Table 11: Existing Vegetation Types in Boulder Project Area

Vegetation Classification	Acres
Grass/Rock/Barren	304
Chaparral	1,965
Hardwoods	1,884
Giant Sequoia	2,931
Mixed Conifer, crown diameters ≤ 24’	3,262
Mixed Conifer, crown diameters > 24’	1,809
Ponderosa Pine, crown diameters ≤ 24’	593
Ponderosa Pine, crown diameters >24’	106
Red Fir, crown diameters ≤ 24’	458
Red Fir, crown diameters > 24’	458
Conifer Plantations	576
Private property at Kennedy Meadow	39
Total	14,385

All three giant sequoia groves within the project area were inventoried in 2009 (Wood 2010, 2012a. 2012b). Information on live trees, dead trees, and fuels was collected. At that time, no information was gathered for the non-grove portions of the project. For these areas, Boulder Project relies on field observations and Sequoia Forest-wide data collected for a periodic forest vegetation inventory conducted in 2008. These data are not as site specific or detailed as the individual sequoia grove inventories, but are adequate for conducting burning projects like Boulder Creek Fuels Restoration. Detailed data for timber vegetation types is summarized in Appendix B of the Silviculture Report as well.

Vegetation and Climate Change

Research continues to provide new information on climate change. The potential effects of climate change on Sierran vegetation are largely speculative at this time (North et al. 2009). Two recent publications that consolidate research pertinent to the conifer forests of the Sierra Nevada Mountains are Meyer and Stafford (2011a) and North et al. Research suggests an upward trend in temperatures, both world-wide and locally, primarily indicated by significantly higher nighttime low temperatures (Meyer et al. 2009, Easterling et al. 1997). Results of this trend include a longer frost-free growing season, and an earlier spring melt of mountain snowpacks (North et al. 2009). Westerling et al. (2006) showed that the frequency of large wildfires in the western U.S. since the 1980s was correlated to increasing temperatures and earlier spring snowmelt.

Trends in precipitation are variable. For instance, most higher-elevation locations on the Sequoia National Forest have experienced increases in precipitation over the past century, while most lower-elevation locations have seen yearly precipitation amounts drop (Meyer and Stafford 2011a). A study by van Mantgem et al. (2007) documented increased tree mortality in old growth western forests, with the highest mortality in the Sierra Nevada at middle elevations (3300-6700 feet). The authors attribute the increase in mortality rate to regional climate warming and associated drought stress. North et al. conclude that climate models "agree the climate will become more extreme, suggesting oscillations between wet and drought conditions will be more common."

North et al. reports that "a modeling comparison of different stand structures grown over 100 years…found a low-density forest dominated by large pines was most resilient to wildfire, sequestered the most carbon, and had the lowest carbon dioxide (CO_2) emissions and thus contributed less to global warming. An analysis of carbon emissions and storage from different fuel treatments, found understory thinning followed by prescribed fire produced the greatest reduction in potential wildfire severity without severely reducing carbon stocks."

Area 1 encompasses the full range of vegetation types from the Kings River up to and including the red fir stands along the Deer Meadow Trail. Area 2 includes the remaining low elevation brush and hardwood stands, as well as part of the Evans Complex of giant sequoia groves. Neither Area 1 nor Area 2 contains any conifer plantations.

Area 3 vegetation is predominantly mixed conifer and pine stands, and includes a portion of the Evans Grove Complex. All lighting would be by hand to protect cultural resources in the Evans Grove Complex, and the numerous conifer plantations scattered through Area 3. Table 12 and Figure 5 show the acres of plantation by burn area that could most likely be underburned with acceptable results, and conversely, the plantation areas that would require mitigation to protect them from unacceptable prescribed fire mortality.

Table 12: Plantation Potential for Underburning

Burn Area	Plantation Acres OK to Burn	Plantation Acres Requiring Protection or Fire Exclusion
1	No plantations	No plantations
2	No plantations	No plantations
3A	69	42
3B	12	59
3C	5	76
4A	20[a]	228
4B	187	155
Total	293	560

a-No burning is planned in Area 4A under this project.

The Area 4 vegetation is mostly mixed conifer stands and a portion of the Evans Grove Complex, and the majority of the young plantations that could be damaged by under burning treatments. In order to protect plantations, no ignition is planned for Area 4 (See Table 12 and Figure 5). Though 20 acres of plantations could withstand underburning, no fire would be allowed in Area 4A. However, if fire should back into Area 4B from Area 1, the surface fire would be allowed to creep within Area 4B for up to one or two weeks (until the predicted rain or snow event happens). Creeping fire would be monitored and suppressed if necessary to minimize damage to plantations and the reforestation investment they represent.

Direct and Indirect Effects

Under Alternative 1 fuels reduction and the associated vegetation management would be postponed indefinitely. The existing high fuel loadings would maintain the risk of losing old forest vegetation and habitat, including giant sequoia groves, to wildfires burning in hot, dry summer conditions. Established plantations would not face the risk of damage from controlled burns flaring up in places and killing the planted trees. However, this would be a short term benefit, and the long term threat of stand replacing wildfires would not be mitigated.

Under Alternative 1 stands, especially in the ponderosa pine and mixed conifer types, would continue to grow under dense stocking conditions. Brush and smaller trees (generally less than five inches diameter breast high) would remain to create fuel ladders into the crowns of larger trees. As tree densities increase, stands would become more susceptible to losses from bark beetles and tree diseases (Oliver 1995, Oliver et al 1996). Understory regeneration would continue to consist almost entirely of shade-tolerant trees like incense cedars and white firs, while sun loving species like pines, oaks and giant sequoias would be underrepresented (North et al 2009).

This effects analysis uses a summary of the vegetation types that would be impacted by prescribed burning. Species composition, density, size, age and health of existing trees vary significantly from spot to spot within the same vegetation type. Therefore, it is difficult to draw precise quantitative predictions for direct and indirect effects that would apply to all areas burned in similar existing vegetation. However there are some general assumptions that can be made regarding implementing Alternative 2:

- Overall, most mortality would be confined to brush and small trees (less than 5 inches in diameter).
- Burn mortality could vary greatly, depending on factors like tree size and health, weather, fuel ladders, fuel moisture, species, and slope position of the vegetation.
- Burning in general would not be hot enough to consume all litter on the forest floor and expose mineral soil to act as a seedbed for new tree seedlings.
- Burning would not be hot enough to kill enough trees to significantly reduce stand basal areas and promote healthier long term inter-tree competition conditions for residual conifers and hardwoods. It would, however, reduce fuel loadings and the threat of stand-replacing wildfires.

Chaparral and grass vegetation types are found in Areas 1 and 2. These are fire adapted types and should regenerate quickly following Boulder Creek burning from seeds and by sprouting from established root systems. Therefore, though there are direct effects, there should be limited indirect effects to these vegetation types under either alternative.

Alternative 2 proposes varying treatments based in part on the vegetation types. Burning in the hardwood and conifer types should have mostly positive direct and indirect effects. The burning would be done under fall and spring moisture conditions that would limit flame length and fire intensity. The FOFEM (Reinhardt et al 1997) modeling run predicts an average flame length of two feet and a scorch height of 8.7 feet. Under these conditions, about one third of trees less than five inches in diameter would be killed, along with about five percent of trees 5 to 11 inches in diameter, and three percent of trees larger than 11 inches diameter breast height (dbh). The cool-season type burns would reduce dangerously high fuel loadings, reduce the number and density of small trees and brush that form fuel ladders that threaten the crowns of larger trees, and help alleviate the threat of stand-replacing wildfires. These conditions would make it easier in the future to allow wildfires in the ecosystem without incurring unacceptable damage to the native vegetation.

Under Alternative 2 the varied ignition locations and the expected variations in burn intensity from one location to the next would create more heterogeneous stand structures than currently exist in the area. This would provide more diverse wildlife habitat and stands that are more resistant to widespread outbreaks of bark beetle populations or many tree diseases (North et al 2009). Fires are often followed by a short period of increased bark beetle damage and tree mortality as the insects discover the fire stressed trees (Fetting et al 2008). However, after initial tree losses, the surviving tree growth rates can be greater than in similar, unburned stands (Fajardo et al 2007).

As part of ecological restoration, the 2012 Giant Sequoia National Monument Management Plan gives direction to promote shade intolerant tree species (p. 45). In the Boulder Creek area shade intolerant species include pines, oaks, and giant sequoias. Prescribed burning would help promote intolerant species in the short run by removing much of the existing seedling and sapling sized white firs and incense-cedars. In order to provide a good growing site for establishing young shade intolerant trees, the prescribed fire must be of sufficient intensity to create openings in the forest canopy to provide enough light for the seedlings, and remove enough surface litter to provide a mineral soil seedbed. Overall, the low-intensity fires planned for the Boulder Creek project would not be severe enough to provide these conditions, except in scattered spots where fuel conditions would result in pockets of hotter burns and overstory mortality (Meyer and Safford 2011b, York et al 2011). As a result, the indirect effect of burning would promote the recruitment of some, but relatively few, shade intolerant tree species.

In addition, the average stands in the mixed conifer and ponderosa pine types, while not fully stocked, are growing at densities that are higher than desired for maintaining long-term healthy stands with low insect and disease levels. Under Alternative 2, limited mortality from crown scorch and over-heating the tree cambium is expected from the burning prescriptions on the Boulder Project. Mortality would be concentrated in brush and the smallest trees, so the overall benefits from reducing stand basal area stocking levels would be minor.

Cumulative Effects

The northeast boundary of the proposed Boulder Project abuts land burned in the 2010 Sheep wildfire. Under Alternative 1, if no further burning takes place, there would be no treatments to compliment the fuel reduction benefits of the Sheep Fire. In contrast, the treatments proposed in Alternative 2 would take advantage of the reduced fuels and lower the potential for future wildfires in the Sheep Fire area.

In 2009 and 2010, several dead and dying trees that posed falling hazards were removed along Forest Roads 14S02, 13S23, and 14S11 within or adjacent to the Boulder Creek project area. Prior to that, the most recent timber harvest activities in this area were conducted under the Buck Rock Timber Sale (1990 Decision Notice and Contract) (USDA 1990b), and the Boulder Timber Sale (1997 Decision Notice and Contract). The Buck Rock Sale contract contained one regeneration unit within the Boulder Creek Fuels Restoration project area. The unit was planted in 1992 and is now managed as plantation 107-0097. The Boulder Sale contract used thinning and sanitation harvests to maintain existing stands so no plantations were created.

In the foreseeable future, it is expected that there will be periodic entries to remove roadside hazard trees, as was done in 2009 and 2010 under the Roadside Hazard Tree Salvage Project. Only one plantation maintenance project is currently planned in the vicinity. The Kirkland Plantation Thin proposes to masticate small trees (less than 10 inches dbh) and brush causing overstocked conditions in the plantations near Kirkland Meadow, and underburn or pile and burn fuel concentrations leaving 80-120 trees per acre and pockets of untreated shrubs for wildlife. One of the proposed stands extends into the Boulder Creek project area. About one half of the 40 acres in the 40-year-old plantation 108-0007 extends into Area 3A of the

Boulder project. The proposed treatments in the Kirkland project are compatible with the underburning in Boulder Creek Fuels Restoration Project and should not cause unacceptable effects to vegetation in the long term.

Under either alternative, in the grass and chaparral vegetation types, there would be minimal cumulative effect because the grass and chaparral grow fast enough to have returned to their present condition within 10 to 15 years. Also under either alternative in the red fir vegetation type, there would be minimal cumulative effect because there is little ladder fuel at present to burn.

Under Alternative 1, stand heterogeneity would decrease, until natural events like bark beetle outbreak or wildfire changed stand compositions over time. Those impacts would be uncontrolled and could potentially spread to nearby forest areas outside the Boulder Creek Project. However, the Kirkland Plantation Thin activities would have beneficial cumulative benefits over time by accelerating development of old forest characteristics, increasing stand heterogeneity, promoting hardwoods, and reducing the risk of loss to wildfire. The proposed Hume Roadside Hazard Tree Removal Project along project area roads would also reduce the danger from trees dying over time by removing damaged ones likely to die soon, and the vectors these and standing dead trees provide for bark beetle infestations. Both the proposed Kirkland and Hazard Removal Tree projects overlap small portions in the southern end of the Boulder project area.

Under Alternative 2, fuel treatments on the Boulder Creek Project would add to the fuel reduction benefits that resulted from the adjacent 2010 Sheep Fire, and the proposed treatments in Kirkland Plantation Thin to create better conditions for future use of fire in this fire-adapted ecosystem, either by wildfire or prescribed burning.

Alternative 2 follows the recommendations of North et al for forest management to address the probability of long-term climate change stresses through the removal of primarily small, shade tolerant trees that make up the fuel ladders. These effects would begin immediately following treatments, and would last until stands grow enough to again reach pre-treatment fuel ladder levels, or are burned again, perhaps over the next 20 to 50 years.

As a result the direct and indirect effects of implementing Alternative 2, along with the effects of other foreseeable future activities, the Boulder Creek Project would have a minor beneficial effect on vegetation in the project area. In the hardwood, giant sequoia, mixed conifer, and ponderosa pine vegetation types, the few openings created by the Boulder Creek Project would contain some small to moderate sized trees and brush within 20 years. There would also be minor to moderate cumulative improvements in forest health, heterogeneity, and stand stocking in these vegetation types where the prescribed burning and subsequent bark beetles thin out the understory and co-dominant trees. There would be a minor beneficial cumulative effect to plantations where fire was allowed to reduce inter-tree competition or encroaching brush species within or surrounding the plantations. In conclusion, the reduced threat of stand-replacing wildfire resulting from implementing Alternative 2 would have an additional small beneficial cumulative effect on project area vegetation.

Watershed

According to the *Watershed Specialist Report for the Boulder Creek Fuels Restoration Project* (Wright 2012) there are four 6th field watersheds affected by the Boulder Burn Project. Ninety-five percent of the project is within South Fork Kings River/Lower Boulder watershed (180300100304). The remaining five percent is within South Fork Kings River/Lightning Creek (180300100302), Tenmile Creek (180300100501), and Upper Boulder Creek (180300100303). Only South Fork Kings River/Lower Boulder would be further analyzed for

the affected environment. Table 13 displays the stream class, beneficial uses, and acres of South Fork Kings River/Lower Boulder watershed.

Table 13: Watersheds and Associated Beneficial Uses*

Watershed Name	Stream Class	Watershed Number	Beneficial Uses (existing)	Acres
South Fork King River/ Lower Boulder Creek	I	180300100304	Mun, Rec, Cold, Wild, Spwn, Frsh	24,600
Mun = Municipal, Rec = Contact and/or Non-Contact Recreation, Cold = Coldwater Fishery, Wild = Wildlife Spwn = Fish Spawning, Frsh = Fresh Water				

*Beneficial uses are derived from the California Central Valley Regional Water Quality Control Board for Tulare Lake Basin, Chapter 2 (CEPA, 2004).

Historical logging, including railroad construction, in the late 1800s impacted this watershed. However the overall impacts to this watershed from these activities are difficult to quantify at this time. Over the years some roads were blocked-off and culverts were removed, and on other roads they were simply blocked from vehicle traffic and the road surface regenerated naturally. In 1999, Forest Roads (FR) 13S23D, 13S23E, 13S23F, 13S28 and 13S53A were removed from the Forest Road system by blocking the road entrance. In addition, FR 13S23E, 13S23F, and 13S53A were redesigned as hiking trails. The current condition of the decommissioned roads is unknown due to the lack of use, and it is assumed that these sites have stabilized. However, these roads would be evaluated post-project to determine the resource condition.

There are several locations where watershed improvement needs inventories conducted in the 1990s identified specific problems:

- Forest Road 13S05C in Redwood Creek (mass wasting and hillslope failure),
- Forest Road 13S06 in Lockwood Creek (erosion associated with road),
- Headwaters of Little Boulder Creek (compaction and erosion),
- Old logging road in tributary to Little Boulder Creek (erosion associated with road),
- Little Boulder Creek (grazing).

Direct and Indirect Effects

Alternative 1, No Action, would have minimal impact on water quality, stream stability, temperature, and soil loss. Based on the current level of effects, existing channel types, vegetation cover, riparian ecotypes, stream stability surveys after Pfankuch, 1978, and past management activities, stream channels would maintain stable conditions. An analysis of the Riparian Conservation Objectives was not conducted for this alternative as no activities are proposed.

However, under either alternative the areas where previous resource damage has occurred should be monitored in the future. In the case of Alternative 1, monitoring may occur when funding and resources are available. Under Alternative 2, mitigations have been added to the proposed action to reduce the erosion, mass wasting and compaction in some of these areas through the use of BMPs, and post-project monitoring of the previously disturbed sites (disturbance type is in the parenthesis):

- Forest Road 13S05C in Redwood Creek (mass wasting and hillslope failure),
- Forest Road 13S06 in Lockwood Creek (erosion associated with road),
- Headwaters of Little Boulder Creek (compaction and erosion),
- Old logging road in tributary to Little Boulder Creek (erosion associated with road),
- Little Boulder Creek (grazing), and
- Decommissioned/converted roads: 13S23D, 13S23E, 13S23F, 13S28, and 13S53A

Under Alternative 1 leaving the fuels as they are would not alter the potential for direct and indirect effects to watershed resources. In the event of a large, stand-replacing wildfire, there could be moderate to severe short-term direct and indirect effects to watersheds from sedimentation, mass wasting, and/or hydrophobic soils. In contrast, under Alternative 2 use of the BMPs would reduce the potential for direct and indirect effects to watershed resources.

Cumulative Watershed Effects

All of the on-going and reasonably foreseeable activities described on page 26-27 of this document could affect water quality. The following tables display the Cumulative Watershed Effects (CWE) analysis of the South Fork Kings River/Lower Boulder Creek area. The analysis was performed at the 6th field watershed level and provides information on: equivalent roaded acres (ERAs) available, ERAs used by project, and remaining ERAs available for management prior to reaching the threshold of concern (TOC)[4]. Table 14 displays the existing condition in the watershed.

Table 14: Equivalent Roaded Acres in the South Fork Kings River/Lower Boulder Creek Watershed

6th Field Watershed	Watershed Name	Subwatershed ERAs	ERAs Used to Date	ERAs Remaining
180300100304	South Fork Kings River/ Lower Boulder Creek	976	224.2	751.8

The CWE analysis includes implementation of the Boulder Creek Fuels Restoration Project and the reasonably foreseeable actions described above. Based on a study by Berg and Azuma (2008), it is assumed that cumulative effects of wildfire and prescribed fire-related activities recover after four years. For this project a more conservative estimate of a five-year fire recovery is being used to assess CWE.

Under Alternative 1, there is a possibility of a wildfire occurring in the next decade. Using the Sheep Fire as the example, the potential for cumulative effects were modeled with the results showing in Table 15. In the event of a wildfire, Alternative 1 would have a higher potential effect to water quality, stream stability, water temperature and soil. Wildfire has an estimated effect of 0.27 ERAs per acre (Giant Sequoia National Monument FEIS, 2012).

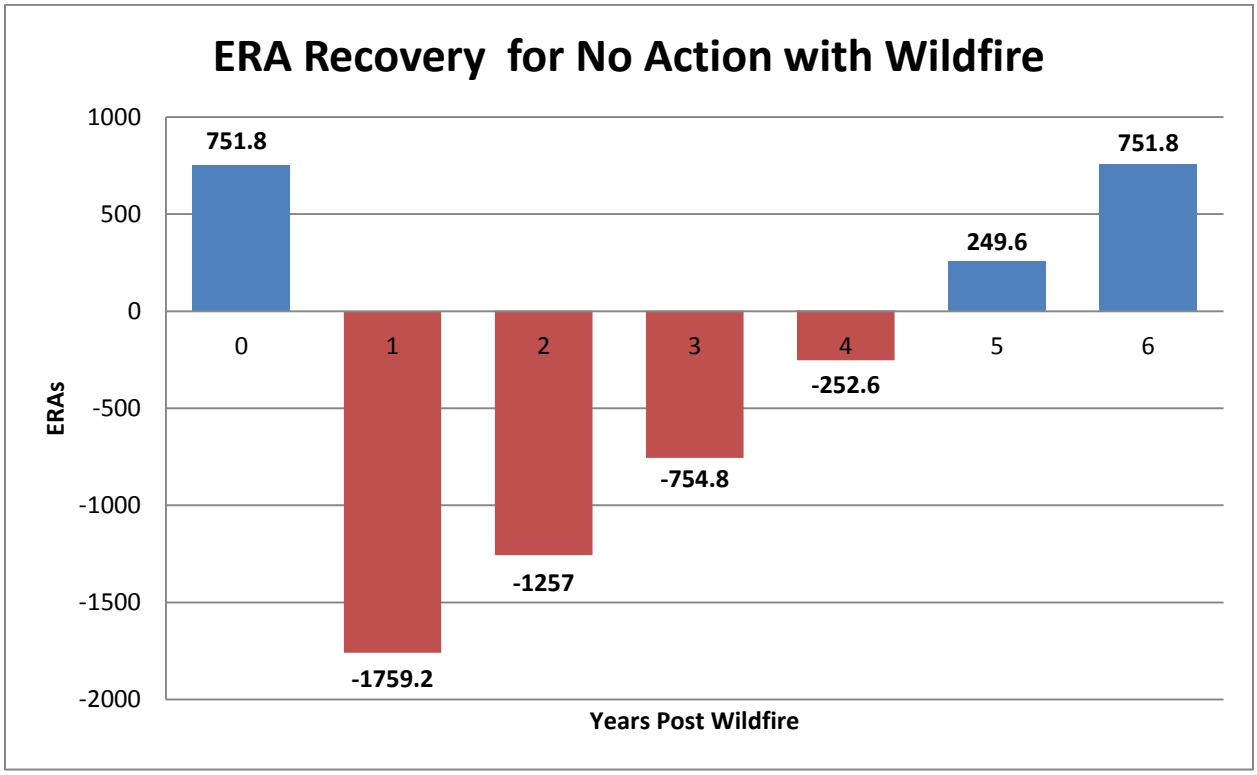
Table 15: Cumulative Watershed Effects of Wildfire in the South Fork Kings/Lower Boulder Watershed (Alternative 1)

Project Activity Year	Acres	ERAs Available	ERAs Used	ERAs Remaining
Wildfire	9300	751.8	2511.0	-1759.2
Wildfire Recovery Year 1	0	-1257.0	0	-1257.0
Wildfire Recovery Year 2	0	-754.8	0	-754.8
Wildfire Recovery Year 3	0	-252.6	0	-252.6
Wildfire Recovery Year 4	0	249.6	0	249.6
Wildfire Recovery Year 5	0	751.8	0	751.8

[2] The Threshold of Concern (TOC) is expressed as a percentage (percent of ERAs used) and represents the potential risk a subwatershed may have as it approaches and exceeds its threshold.

Figure 7 displays the 9,300 acre area proposed for the Boulder Creek Fuels Restoration Project as a wildfire. A wildfire of this magnitude could result in a dramatic increase in the potential for detrimental effects to watershed health and a corresponding drop into negative ERAs using the CWE model. As analyzed, ERAs change from 751.8 to negative 1759.2 as a result of a wildfire in the project area. However, as a result of the natural features in the Boulder Creek Fuels Restoration Project, the watershed resources are expected to recover to above threshold in approximately four years and completely recover to pre-fire conditions within five years following a wildfire.

Figure 7: Cumulative Watershed Effects (ERA Recovery) from Wildfire under Alternative 1

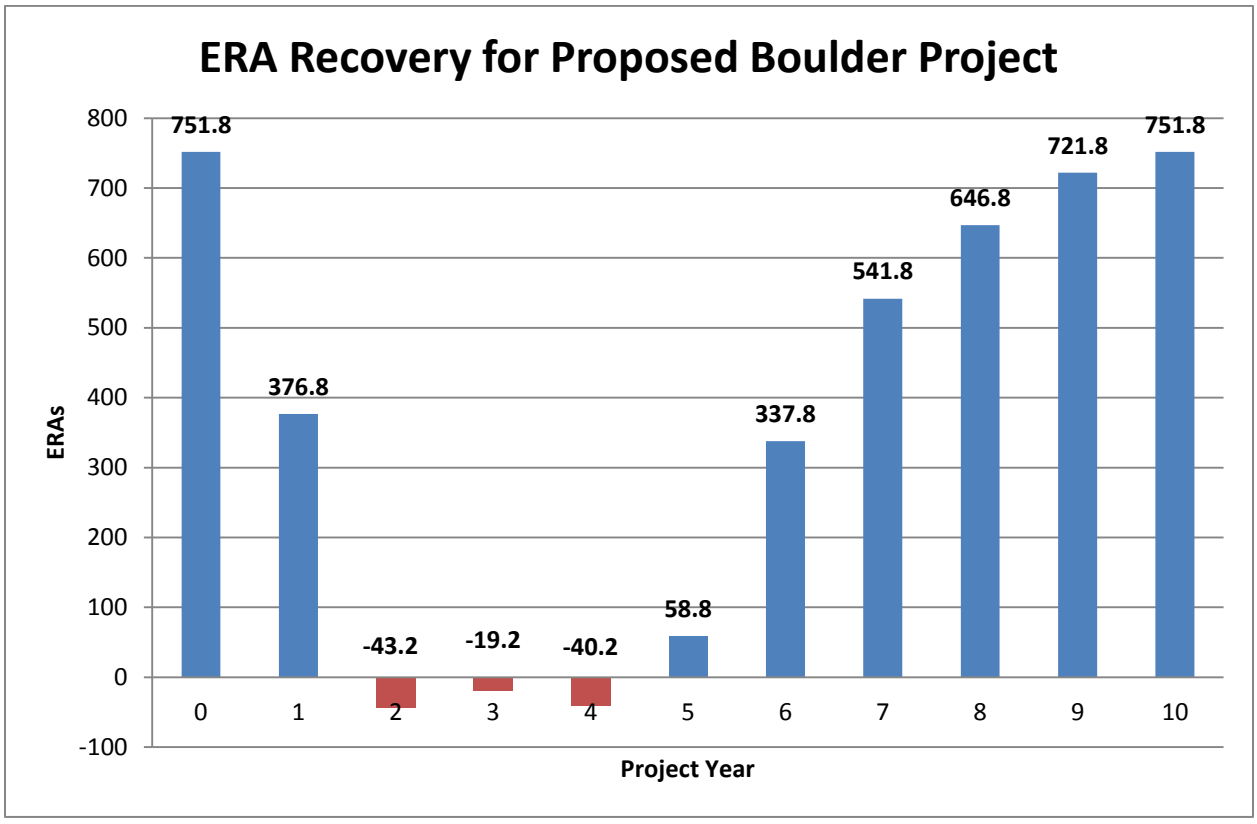


Under Alternative 2 the proposed activity increases the potential for watershed effects slightly above threshold during the project timeframe. However, as shown in Table 16 and Figure 8, the prescribed burning would avoid the extreme change in ERAs that are likely to occur from a wildfire. Instead, the planned treatments over five years would result in a more gradual change in ERAs over time.

Table 16: Alternative 2 Cumulative Watershed Effects of Burn and Recovery in the South Fork Kings/Lower Boulder Watershed

Project Activity Year	Acres	ERAs Available	ERAs Used	ERAs Remaining
Burn Year 1	2500	751.8	375	376.8
Burn Year 2	3300	451.8	495	-43.2
Burn Year 3	1000	130.8	150	-19.2
Burn Year 4	1500	184.8	225	-40.2
Burn Year 5	1000	208.8	150	58.8
Recovery Year 6	0	337.8	0	337.8
Recovery Year 7	0	541.8	0	541.8
Recovery Year 8	0	646.8	0	646.8
Recovery Year 9	0	721.8	0	721.8
Recovery Year 10	0	751.8	0	751.8

Figure 8: Cumulative Watershed Effects (ERA Recovery) from Implementing Alternative 2



Despite the potential increase for cumulative effects, watershed health is expected to be enhanced as a result of the project and be more resilient to future fires. Ash and potential sediment that does reach the channel is expected to be flushed out especially in the channels closer to the Kings River that are bedrock controlled. The nearby Sheep Wildfire in 2010 produced sediment and ash into the Kings River, however

increased groundcover in 2011 resulted in much less noticeable sediment runoff. The ability to prescribe burning within specific constraints concerning attributes such as size, relative humidity, ignition sites, avoidance areas, and wind direction would maintain watershed integrity throughout the project in the long term. As a result of the constraints, and the natural features in the Boulder Fuels Restoration Project, the watershed resources are expected to recover to above threshold approximately five years following implementation and completely recover back to pre-project conditions ten years following implementation.

Wildlife

Threatened, Endangered, and Sensitive Species

According to the *Biological Assessment and Biological Evaluation for the Boulder Creek Fuels Restoration Project* (BABE) (Cordes 2012a) no federally threatened, endangered or proposed species would be affected by this project. Hume Lake Ranger District wildlife records, NRIS wildlife records, the Sequoia National Forest Reptile and Amphibian Data Base, the California Natural Diversity Data Base (CDFG 2003), species habitat requirements, and species range information from the California Wildlife Habitat Relationships database (CDFG 2008) were used to develop the list of species likely to be found in or near the project area.

Table 17 lists the Region 5 Forest Service Sensitive wildlife species that are either known to occur, or are likely to occur in or near the project area. The BABE (BABE, Appendix B) lists the threatened, endangered and Forest Service sensitive species and the rationale for excluding species from further discussion.

Table 17: Sensitive Species known to occur in or near the Boulder Project

Common Name	**Scientific Name**
Pallid bat	*(Antrozous pallidus)*
Townsend's big eared bat	*(Corynorhinus townsendii townsendii)*
Northern goshawk	*(Accipiter gentilis)*
California spotted owl	(*Strix occidentalis occidentalis*)
American marten	*(Martes americana)*
Pacific Fisher	(*Martes pennanti pacifica*)

Direct and Indirect Effects to Pallid and Townsend's Big-Eared Bats

Pallid Bat: There have been few bat surveys in the Monument, but pallid bats are presumed present within their elevation range. A study conducted in the Giant Forest area of Sequoia National Park found the pallid bat to be one of the species most commonly associated with giant sequoias (Pierson and Heady 1996). The entire project area is within the mapped CWHR range for this species.

Townsend's big eared bats: Townsend's big eared bats have been detected in the Windy Gulch Cave Complex, which is just north of the Boulder project area. One cave in this complex, Windy Cliffs Cave, is known to contain a small maternity colony for this species (Tobin and Thomas 2010).

The direct and indirect effects of the alternatives in the Boulder Project on pallid bats and Townsend's big-eared bats were evaluated using the following metrics:

1. *Roosting areas*-Caves are used by both species; large snags and trees are also used by pallid bats. Both these species are very sensitive to disturbance of roosting sites.
2. *Foraging habitats*-Pallid bats prefer dry open areas like rock outcrops while Townsend's big-eared bats forage in mesic habitats, including riparian areas.

Alternative 1 would maintain current conditions in the short-term.

Under Alternative 2 the burning prescription is intended to result in a low intensity backing fire that would result in a mosaic of effects. No direct mortality to either of these bat species is expected as a result of prescribed fire.

Although caves offer direct protection from flames, fire near occupied cave roosts can impact bats by altering vegetation around the cave, which could affect airflow and alter the microclimate in the cave (Carter et al. 2002). The proposed action includes a mitigation to protect cave entrances (Gallagos 2012). Plastic spherical incendiary devices would not be dropped within 500 feet above cave entrances or within 200 feet below or on either side of cave entrances.

Smoke impacts to cave roosting bats depend on a cave's airflow characteristics. Airflow is largely determined by differential external and internal air temperatures. Depending on the air temperature, a fire that creates smoke up wind from an entrance could potentially fill the cave with smoke (Carter et al. 2002). Smoke has the potential to adversely affect bats, but burning would take place in the fall when it would not threaten the maternity colony. In addition, given the expected fire behavior in the proposed action, smoke impacts would be less than a wildfire in the area.

Given the burning prescription in Alternative 2, this project is not expected to change the number of acres of open foraging habitat in the area. Riparian areas may experience low-intensity backing fires, which could disrupt foraging patterns of Townsend's big-eared bats in the short-term.

Cumulative Effects to Pallid and Townsend's Big-Eared Bats

While prescribed fire could cause some short-term disruption of these species' use of the project area, fire provides long-term maintenance of the habitat. As with other native species, it is assumed that the restoration of a natural fire regime and the maintenance of a mosaic habitat conditions throughout the project area would benefit northern pallid bats and Townsend's big-eared bats.

Bat Roosting Areas:

There are no past, present or foreseeable future actions with the potential to affect caves within the analysis area. As detailed in the next section, little change in the number of large snags and large trees available to bats is anticipated through cumulative effects under either alternative (see Number of Large Snags on page 58).

Bat Foraging Habitats:

No changes in rock outcrops would occur under either alternative. Cumulative effects to riparian habitat in the analysis area would be limited to backing fire, with a small reduction in canopy cover under Alternative 2.

In accordance with FSM 2600 (USDA 2005), the determination from the Wildlife BABE is that Alternative 1 would maintain the current condition and have **no effect** on pallid bats or Townsend's big-eared bats. The area would continue to have high fuels loading and a risk of a stand-replacing fire greater than the desired condition.

The determination from the Wildlife BABE is that Alternative 2 **may affect individuals,** but is not likely to result in a trend toward Federal listing or loss of viability of pallid bats or Townsend's big-eared bats. While prescribed fire could cause some short-term disruption of these species' use of the project area, it is assumed that the restoration of a natural fire regime and the maintenance of a mosaic of habitat conditions throughout the project area would benefit northern pallid bats and Townsend's big-eared bats.

Direct and Indirect Effects to Northern Goshawk, California Spotted Owl, American Marten and Fisher:

Northern Goshawk: Eight goshawk territories have been identified on the Hume Lake Ranger District based on nest location or location of an adult and juvenile. No goshawk nesting has been documented in the Boulder Creek Fuels Restoration project area. Historically, nesting sites were found in the Lockwood Grove and near Sunset Meadow, which are adjacent to the project area. Surveys of these two sites in 2007 failed to detect goshawks. Surveys of the eastern portion of the Lockwood Grove PAC in 2012 also failed to detect goshawks. Portions of two designated northern goshawk PACs fall within the project area.

California Spotted Owl: Using the CWHR model, there are 10,235 acres of moderate and high suitability nesting and foraging habitat for California spotted owls in the Boulder project area. There have been a number of historic spotted owl detections in the Boulder project area. Based on the information available, it is estimated that there are portions of three to five territories within the project area. There are currently 20 spotted owl Protected Activity Centers (PACs) located on the Hume Lake Ranger District and all or portions of five of these PACs and their associated Home Range Core Areas (HRCAs) are located within the Boulder project area.

American Marten: Habitat relationships for this species are defined by the CWHR models, which model habitat suitability for California's terrestrial vertebrates (CDFG 2005). The CWHR habitat stages that are moderately to highly important for American marten are: 4M, 4D, 5M, 5D, and 6, particularly within red fir, lodgepole pine, subalpine conifer, mixed conifer-fir, Jeffrey pine, and eastside pine (CDFG 2005). Using the CWHR model, there are 8,891 acres of moderate and high suitability habitat for American marten in the Boulder project area. Extensive American marten surveys have been conducted across Sequoia National Forest, with numerous detections, including within the southern portion of the Boulder project area.

Fisher: Fisher habitat tends to differ in the southern Sierra Nevada from that in the northern portion of California. The CWHR model has been refined to reflect only those forest types present in the southern Sierra Nevada: Jeffrey pine, montane hardwood-conifer, ponderosa pine, Sierran mixed-conifer and white fir, terming it CWHR 2.1. Using the CWHR 2.1 model, there are 8,057 acres of moderate and high suitability habitat in the Boulder Creek Fuels Restoration project area. Survey results indicate that fishers are well-distributed in suitable habitat across the Hume Lake Ranger District.

Alternative 1 would maintain current conditions in the short-term, where Alternative 2 proposes to prescribed burn 6,000 to 9,000 acres of the Boulder Creek area (Figure 2) over a three to five year period. The entire project area would not be burned; fire may be excluded in plantations, cultural resource sites, and other areas of concern, such as the PACs. No den site buffers for American marten or fisher have been established in or near the Boulder Creek project area. The entire project area is within the Southern Sierra Fisher Conservation Area, which requires the retention of habitat structures important to marten and fisher, including canopy cover and large trees.

The effects of the alternatives were analyzed using the following habitat features for each of the four species:

- Density (canopy cover, basal area)
- Abundance of small, medium and large trees (greater than 11 inches diameter at breast height (dbh), CWHR Size Classes 4, 5 and 6)
- Number of large snags (greater than 15 inches dbh)
- Down woody debris
- Special Management Areas (PACs and HRCAs)
- Habitat Connectivity (fisher and marten only)

Density (canopy cover, basal area):

Current trends appear to be toward warmer conditions that would lead to more drought-related mortality, increased insect mortality, and greater fire severity. Under Alternative 1, the existing basal area and canopy cover would be maintained in the short-term. Indirect, long-term effects would depend on the chance of fire ignition and weather conditions.

Under Alternative 2, the underburning is expected to kill some shrubs and small trees with little mortality in larger trees. The prescribed fire would result in a short-term reduction in the understory canopy cover, and a slight reduction in basal area on some of the acres underburned. The reduction would be in small trees (less than 10 inches diameter breast height) and shrubs. Treatments in riparian areas would be limited to backing fire, so the reduction of canopy cover in these areas is expected to be minimal.

Abundance of small, medium and large trees (greater than 11 inches dbh, CWHR Size Classes 4, 5 and 6):

Under Alternative 1 there would be no change in the number of trees greater than 11 inches dbh, unless influenced by a stand-replacing event such as high severity fire or drought related mortality.

In contrast, under Alternative 2 there may be direct effects to larger trees. Trees greater than 11 inches dbh may be killed in prescribed burning or felled as safety hazards to firefighters. Modeling for the Boulder Project estimated mortality of approximately three to five percent of the conifers in the mid seral size class (CWHR size class 4) (see Vegetation discussion of FOFEM modeling). Given the burning prescription, mortality of trees greater than 24 inches dbh is expected to be rare. Some large trees that are along trails used as control lines could be felled and left on site if they are safety hazards.

Number of large snags (greater than 15 inches dbh):

Under Alternative 1 there would be no change in the number of snags greater than 15 inches dbh, unless the area is affected by a stand-replacing event such as high severity fire or drought related mortality.

Under Alternative 2 the prescribed burning is expected to both create new snags and result in the loss of some existing snags on some of the acres with active fire treatments. It is possible that a small number of snags near containment lines would be felled if they provide a safety hazard to fire personnel. Implementation of this alternative would result in little change in the number of large snags (based on predicted fire behavior).

Down woody debris:

Under Alternative 1 there would be no change in the amount of down woody debris, unless the area is affected by a stand-replacing event such as high severity fire or drought related mortality.

Under Alternative 2 there would be a reduction in small down woody debris present in the project area following underburning. However, the burn prescription is designed to to retain an average of 10 to 20 tons

per acre of down woody material.

Special Management Areas:

Under Alternative 1 there would be no change in habitat within PACs or HRCAs, unless the area is affected by a stand-replacing event such as high severity fire or drought-related mortality. Under this alternative, the indirect effect is that wildlife habitat in the project area would continue to diverge from the desired natural condition, leading to the increased risk of uncharacteristically severe wildland fire that could cause permanent loss of habitat important to these species.

As stated earier there are portions of two northern goshawk PACs, five spotted owl PACs and their associated HRCAs within the Boulder project area. Under Alternative 2 several of these areas may be affected by the prescribed burning as shown in Table 18.

Table 18: Potential Treatments in Protected Activity Centers

Species	PAC Identifier	Proposed Treatment	Treatment Year
Goshawk	R05F13D51T04	Approximately seven acres within Unit 3A which may be underburned.	Years 2-3
Goshawk	R05F13D51T07	Approximately 81 acres within Area 4B. No treatment is planned in this area.	Not applicable
Spotted owl	FRE0118	Fourteen acres in Unit 1 would be underburned.	Year 1
Spotted owl	FRE0012	Approximately eight acres within Area 2 would be underburned in the fall.	Year 2
		Approximately 149 acres within Area 3A would be underburned. For any spring burning, any active nest site would be avoided. This would require surveys prior to burning and either putting in handline around the nest stand or modifying the boundary of the burn unit to exclude the area.	Year 2-5
Spotted owl	FRE0060	Approximately 299 acres within Area 2 would be underburned in the fall.	Year 2
		About four acres are in Area 3A and may be burned.	Years 2-5
Spotted owl	FRE0061	Approximately 163 acres within Area 2 would be underburned in the fall.	Year 2
		About 199 acres are in Area 3A and may be burned. For any spring burning, active nest sites would be protected or avoided.	Years 2-5
Spotted owl	FRE0043	Most of this PAC (330 acres) is within Area 4A, which would receive no treatment.	Not applicable
		Approximately 69 acres within Area 3A and 29 acres within Area 3B may be underburned. For any spring burning, active nest sites would be protected or avoided.	Years 2-5

Habitat connectivity for Marten and Fisher:

Habitat suitable for marten and fisher in the Boulder project area is part of a nearly continuous block of habitat across the middle elevation area of the Hume Lake Ranger District. Under either alternative, any opening created by fire could reduce connectivity. Under Alternative 1, in the event of a stand-replacing fire the indirect effect could be a moderate loss of connectivity depending on the location and intensity of the fire. However under Alternative 2, the burn prescription is intended to result in a low intensity fire and little reduction in tree canopy cover is expected, which should result in little loss in connectivity.

Summary of Effects to Northern Goshawk, California Spotted Owl, American Marten and Fisher:

The return of fire to this area would provide for long-term maintenance of habitat. As with other native species, it is assumed that the restoration of a natural fire regime and the maintenance of a mosaic of old growth forest conditions throughout the project area would benefit northern goshawks, California spotted owls, American marten and fishers. Only large stand-replacing fires, as would occur from wildfires following long periods of fire exclusion (i.e. Alternative 1), would be a direct threat to these species.

As described in Alternative 2, the burn prescription is intended to result in a low intensity backing fire that would result in a mosaic of effects. No direct mortality of any of the wildlife species assessed is expected as a result of prescribed fire. The risk of direct mortality of wildlife from incineration, or asphyxiation during prescribed fire is considered to be low (Pilliod et al. 2006).

In conclusion, under Alternative 2 while prescribed fire could cause some short-term disruption of goshawk or owl use of the project area, most of the treatments would occur outside the nesting season. A limited operating period of February 15 through September 15 for activities within one-quarter mile of the nest site may be required if disturbance to nesting activities is possible (USDA 2012). Effects from spring burning would also be mitigated with the use of buffers if necessary. For American marten and fisher, while the loss in understory canopy (shrubs and small trees) may reduce the value of habitat in the short-term, most of the important resting/denning structures would be retained.

Cumulative Effects to Northern Goshawk, California Spotted Owl, American Marten and Fisher:

The spatial scale for the cumulative effects analysis of the Boulder Creek Project is composed of the Upper Boulder Creek, Lower Boulder Creek and Tenmile Creek subwatersheds, which cover approximately 68,175 acres. This scale includes all suitable habitat potentially affected by implementation of the Boulder Creek Project and the reasonably foreseeable actions.

The temporal scale for this analysis extends from 2008 (when the vegetation database was last updated) to 2017. Vegetation data for the forest includes spatial ecological and vegetation layers created from remote-sensing imagery obtained at various points in time, which are verified using photo-imagery, on-the-ground measurements, and tracking of vegetation-changing actions or events (for example, vegetation management and wildland fires).

Climate Change

Climate changes will likely cause changes in the distribution of individual species in the project area. The precise effects of climate change on individual species are difficult to predict and will not be addressed in the effects analysis. It is generally agreed that the range of some species will shift and that climate change will be an additional environmental stressor, but the effects on the individual species evaluated for the Boulder Project are not currently known to any degree of certainty. It is unclear whether climate change would benefit or adversely affect these species over the long term.

Mortality or a Reduction in Fitness from Toxins (e.g. rodenticide)

Rodenticides and other toxicants used at illegal marijuana grow sites may lead to fisher mortality or a loss of fitness (Gabriel et al. 2012). No specific information is available regarding the illegal use of toxicants in the analysis area but it is reasonable to assume they are present and a threat to many wildlife species.

Vegetation Density (canopy cover, basal area):

The prescribed fire in the action alternative could result in a short-term reduction in understory canopy cover and slight reduction in basal area on a maximum 6,000 to 9,000 acres of the Boulder Creek Project area (not all this area would be underburned). In addition to the acres of habitat potentially affected by this

project, tree canopy closure and understory shrub canopy closure was reduced on fewer than 100 acres by the Tornado Forest Health Project (1999 Decision Notice, and 2000 Tornado Thinning Timber Sale Contract). The Kirkland Thin Project would reduce tree canopy closure and understory shrub canopy closure on a maximum of 477 additional acres. The Roadside Hazard Tree Salvage Project removed a small number of trees from this habitat as well. The proposed Hume Roadside Hazard Tree Removal Project could remove hazard trees along several miles of roads in 2008 (35 miles within the Boulder Creek project boundary) in this habitat if they are safety hazards to the public or Forest Service employees. There are no other past, present, or foreseeable actions potentially affecting vegetation density within the analysis area. The sum of these projects is less than 14 percent of the Boulder analysis area. Given the prescriptions for these projects, density changes are expected to be small and limited to patches within the analysis area.

Abundance of small, medium and large trees (greater than 11 inches dbh, CWHR Size Classes 4, 5 and 6):

Modeling (FOFEM) of the Boulder Project projected mortality of zero to five percent of the conifers in these size classes. Mortality is projected to be primarily in small trees or size class 4. The Roadside Hazard Tree Salvage Project removed a small number of trees greater than 11 inches dbh. The proposed Hume Roadside Hazard Tree Removal Project could remove trees in this size class if they are safety hazards. The Kirkland Thin Project would not affect trees greater than 11 inches dbh, unless they are killed during prescribed burning. There are no other past, present,or foreseeable actions potentially affecting the abundance of small, medium or large trees within the analysis area. Therefore, trees in size classes that are most important to northern goshawks, spotted owls, American marten and fisher would be little affected by Alternative 2. No reduction in size class is expected for any of the more than 47,000 acres classed as 4, 5 or 6 within the analysis area.

Number of large snags (greater than 15 inches dbh):

In addition to the forest habitat potentially affected by this project, snags were both created and lost by the Tornado Forest Health Project on fewer than 100 acres. The Roadside Hazard Tree Salvage Project felled and removed a small number of snags that were safety hazards. The proposed Hume Roadside Hazard Tree Removal Project could fell and remove snags along roads if they are safety hazards. The Kirkland Thin Project could fell snags if they are safety hazards during project implementation and both create and remove snags through prescribed burning. Snags that are safety hazards at developed recreation sites, like campgrounds, may also be felled if necessary in the proposed Hume Roadside Hazard Tree Removal Project. There are no other past, present, or foreseeable actions potentially affecting snags within the analysis area.

Down woody debris:

In addition to the potential reduction of down woody debris from implementation of the Boulder Creek Project, there was a small reduction in down woody debris present following the Tornado Forest Health Project on fewer than 100 acres in the analysis area. Prescribed burning in the Kirkland Thin Project could result in the reduction of down woody debris on a maximum of 238[5] acres. There are no other past, present, or foreseeable future actions with the potential to measurably affect down woody debris within the analysis area. The cumulative reduction of down woody debris would occur on less than 14 percent of the analysis area. In addition, the burn prescriptions are designed to retain an average of 10 to 20 tons per acre of down woody material, especially the larger down logs considered of greater value for wildlife.

[5] The Kirkland Thin Project would involve both mastication and underburning. Only underburning is likely to affect down woody debris so the acreage differs from that considered under vegetation density.

Special Management Areas:

Within the analysis area but outside the Boulder Creek project area, the proposed Hume Roadside Hazard Tree Removal Project could potentially fell and remove trees within or adjacent to one northern goshawk PAC (T02) and three spotted owl PACs/ HRCAs (FRE0042, FRE0064, FRE0088). There are no other past, present, or foreseeable actions with the potential to measurably affect habitat quality within special management areas in the analysis area.

Habitat connectivity:

The analysis area currently provides a nearly continuous block of habitat suitable for northern goshawks, California spotted owls, American marten and Pacific fisher. The exception would be the lower elevation shrublands along the Kings River, which may pose a barrier to these species.

The reduction of understory vegetation and any openings in the canopy created by the prescribed fire in the Boulder Creek Project, along with the Tornado Forest Health Project, Kirkland Thin Project and the proposed Hazard Tree Removal Project could reduce habitat connectivity at the local scale. At the sub-watershed scale there is expected to be little or no loss of connectivity.

The determination from the Wildlife BABE is that Alternative 1 would maintain the current condition and have **no effect** on northern goshawk or California spotted owl or their habitat. The area would continue to have high fuels loading and a risk of stand-replacing fire greater than the desired condition.

The determination from the Wildlife BABE is that Alternative 2 **may affect individuals,** but is not likely to result in a trend toward Federal listing or loss of viability of northern goshawk or California spotted owl. The cumulative effects of this alternative would lead to a short term reduction of canopy cover and down woody debris on less than 14 percent of the existing habitat in the analysis area. While prescribed fire could cause some short-term disruption of these species use of the project area, most of the treatments would occur outside the nesting season. Effects from any spring burning would be mitigated with the use of buffers or limited operating periods if necessary.

The determination from the Wildlife BABE is that Alternative 1 would maintain the current condition and have **no effect** on American marten or Pacific fisher. The area would continue to have high fuels loading and a risk of stand replacing fire greater than the desired condition.

While the expected loss in understory canopy (shrubs and small trees) may reduce the value of habitat in the short-term, it would not make habitat unsuitable. Most of the important resting/denning structures would be retained and new ones (e.g. snags) would likely be created. Based upon these facts, the determination from the Wildlife BABE is that Alternative 2 **may affect individuals**, but is not likely to contribute to the need for federal listing or result in a loss of viability of Pacific fishers in the analysis area. Also, Alternative 2 **may affect individuals,** but is not likely to result in a trend toward Federal listing or loss of viability of American marten.

The restoration of a natural fire regime and the maintenance of a mosaic of old growth forest conditions throughout the project area would be expected to benefit all four of these species. Implementation of this alternative would also be expected to reduce the risk of stand replacing fire and a large-scale loss of structural elements important to these species. The *Biological Assessment and Biological Evaluation for the Boulder Creek Fuels Restoration Project* is hereby incorporated by reference.

Management Indicator Species

The Sequoia National Forest Land and Resource Management Plan (Forest Plan), as amended, requires bioregional-scale habitat and distribution population monitoring for several management indicator species (MIS) depending on the habitat present in the project area. The sections below summarize the habitat and distribution population status and trend data for the applicable management indicator species. This information is drawn from the detailed information on habitat and population trends in the *2010 Sierra Nevada Forests Bioregional MIS Report* (USDA Forest Service 2010c), which is hereby incorporated by reference.

According to the *Management Indicator Species Report for the Boulder Creek Fuels Restoration Project* (MIS Report) (Cordes 2012b) there is no habitat classified as riverine, lacustrine, montane riparian, valley foothill riparian or freshwater emergent wetland in or adjacent to the project area. There are areas in or adjacent to the project area that are classified as shrubland, oak-associated hardwood and hardwood/conifer, wet meadow, early seral coniferous forest, mid seral coniferous forest, late seral open canopy forest, late seral closed canopy forest, snags in green forest, and snags in burned forest.

Although there are 3 acres of wet meadow within the project area, this habitat would not be directly or indirectly affected by the project. Kennedy Meadow and Burton Meadow are not in areas proposed for prescribed burning. Also, there have been no recent fires and therefore no snags in burned forest within the project area. The area east of the project area was the location of the 9,020 acre Sheep Fire which was primarily low and moderate intensity. A small amount of potentially suitable habitat for black-backed woodpeckers is within the Sheep Fire perimeter but would not be affected by the Boulder Creek Project.

The MIS whose habitat would be either directly or indirectly affected by the Boulder Creek Project, identified as Category 3 in the MIS Report, are carried forward in this analysis, which evaluates the direct, indirect, and cumulative effects of the alternatives on the habitat of these MIS. The MIS selected for project-level MIS analysis for the Boulder Project are: fox sparrow, mule deer, mountain quail, sooty grouse, California spotted owl, American marten, northern flying squirrel, and hairy woodpecker.

Direct, Indirect and Cumulative Effects to Shrubland Habitat (Fox sparrow)

There are 1,878 acres of this habitat that may be treated with underburning (not all the areas will be burned; fire may be excluded in plantations, cultural resource sites, and other areas of concern). Underburning would kill some shrubs. The burning prescription is intended to result in a low intensity backing fire that would result in a mosaic of effects. Some shrubs would be trimmed along trails used as control lines. The direct, indirect and cumulative effects of the Boulder Project Alternative 2 would result in: (1) no change in acres of shrubland habitat, (2) a reduction in shrub ground cover classes on fewer than 1,878 acres following prescribed burning, and (3) a reduction in CWHR size classes of shrubs on some acres where older shrubs are killed by underburning.

Relationship of Project-Level Impacts to Bioregional-Scale Fox Sparrow Habitat Trend.

Since the Boulder Project would result in a reduction in shrub ground cover classes on less than 0.2 percent of existing shrubland habitat and a reduction in CWHR size classes of shrubs on only a small number of acres, this project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of fox sparrows across the Sierra Nevada bioregion.

Effects to Oak-Associated Hardwoods and Hardwood/Conifer Habitat (Mule deer)

There are 2,349 acres of this habitat in Areas that may be treated with underburning (not all the areas would be burned). Underburning is expected to kill some oaks, primarily small trees. Some larger oaks may

be trimmed along trails used as control lines and oaks that are safety hazards would be felled. Implementation of this alternative would result in (1) no change in acres of oak-associated hardwood and hardwood/conifer habitats, (2) a possible reduction in hardwood canopy cover classes on acres where fire burns hot enough to kill patches of trees, and (3) no change in CWHR size classes of hardwoods on any acres.

Less than ten acres of oak-associated hardwoods and hardwood/conifer habitat was underburned during the Tornado Forest Health Project. The proposed Hume Roadside Hazard Tree Removal Project could remove trees along roads in this habitat if they are safety hazards. There are no other past, present or reasonably foreseeable actions potentially affecting oak-associated hardwoods and hardwood/conifer habitat within the analysis area. The cumulative effects could result in a reduction of hardwood canopy cover on a small number of the 8,155 acres of oak-associated hardwood and hardwood/conifer habitats in the analysis area (i.e. less than one percent overall). Therefore, the direct, indirect, and cumulative effects of the Boulder Project Alternative 2 would result in: (1) no change in acres of oak-associated hardwood and hardwood/conifer habitats, (2) a possible reduction of hardwood canopy cover classes on a small number of acres due to mortality during prescribed burning, and (3) no change in CWHR size classes of hardwoods on any acres.

Relationship of Project-Level Impacts to Bioregional-Scale Mule Deer Habitat Trend.

Since the alternatives in the Boulder Project would result in no change in acres or CWHR size classes of oak-associated hardwood and hardwood/conifer habitat, and a possible reduction of canopy cover class on less than one percent of the available habitat, this project will not alter the existing trend in the habitat, nor would it lead to a change in the distribution of mule deer across the Sierra Nevada bioregion.

Effects to Early and Mid Seral Coniferous Forest Habitat (Mountain Quail)

There are 326 acres of early seral and 3,560 acres of mid seral coniferous forest habitat in areas that may be treated with underburning (not all the areas would be burned). Underburning is expected to kill some shrubs and smaller trees. Modeling (FOFEM) projected mortality of five to 34 percent of trees in early seral sizes and three to five percent of the conifers in the mid seral size class.

In addition to the 3,886 acres of early and mid seral coniferous forest habitat potentially affected by this project, tree canopy closure and understory shrub canopy closure was reduced on fewer than 100 acres by the burning in the Tornado Forest Health Project. The Roadside Hazard Tree Salvage Project removed a small number of trees from this habitat. The Kirkland Thin Project could a reduce tree canopy closure and understory shrub canopy closure on a maximum of 477 additional acres. The proposed Hume Roadside Hazard Tree Removal Project could remove trees along roads in this habitat if they are safety hazards.

The direct, indirect, and cumulative effects of Alternative 2 would result in: (1) no change in acres of early and mid seral coniferous forest habitat, (2) a possible reduction of CWHR size class on some acres, depending on mortality patterns, (3) a reduction in tree canopy closure on fewer than 4,463 acres, and (4) a decrease in understory shrub canopy closure on fewer than 4,463 acres.

Relationship of Project-Level Impacts to Bioregional-Scale Mountain Quail Habitat Trend.

Since the direct, indirect, and cumulative effects of Alternative 2 of the Boulder Project would result in no change in early and mid seral coniferous forest habitat acres, a possible reduction of CWHR size class, and a reduction in tree canopy closure and shrub understory on a maximum of 4,463 acres (less than 0.2 percent of the early and mid seral coniferous forest habitat in the bioregion), this project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of mountain quail across the Sierra Nevada bioregion.

Effects to Late Seral Open Canopy Coniferous Forest Habitat (Sooty Grouse)

There are 14 acres of late seral open canopy coniferous forest habitat in areas that may be treated with underburning (not all the areas would be burned). Underburning is expected to kill some shrubs and smaller trees, and little mortality is anticipated in trees greater than 24 inches diameter breast height. The direct, indirect, and cumulative effects of the Boulder Creek Project Alternative 2 would result in: (1) no change in acres of late seral open canopy coniferous forest habitat, (2) no change in CWHR tree size class on any acres, (3) no change in tree canopy closure, and (4) a decrease in understory shrub canopy cover on a maximum of 14 acres.

Relationship of Project-Level Impacts to Bioregional-Scale Habitat Trends.

Since the direct, indirect, and cumulative effects of Alternative 2 of the Boulder Creek Project would result in no change in the number of acres of late seral open canopy coniferous forest habitat, size classes or tree canopy closure and a reduction in shrub understory on a maximum of 14 acres, this project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of sooty grouse across the Sierra Nevada bioregion.

Effects to Late Seral Closed Canopy Coniferous Forest Habitat (California spotted owl, American marten, and northern flying squirrel)

There are 3,272 acres of late seral closed canopy coniferous forest habitat in areas that may be treated with underburning (not all the areas would be burned). Underburning is expected to kill some shrubs and smaller trees, and little mortality is anticipated in trees greater than 24 inches diameter breast height. Some trees may be trimmed along trails used as control lines and trees that are safety hazards would be felled. Implementation of Alternative 2 would result in: (1) no change in acres of late seral closed canopy coniferous forest; (2) the possibility of a slight reduction in canopy closure on some acres (estimated to be less than one percent using FOFEM); and (3) little change in the number of average large snags per acre, depending on fire behavior (underburning is likely to both create and remove snags).

In addition to the 3,272 acres of late seral closed canopy coniferous forest habitat potentially affected by this project, tree canopy closure was reduced on fewer than 100 acres by the Tornado Forest Health Project. The Roadside Hazard Tree Salvage Project removed a small number of trees and snags from this habitat. The proposed Hume District Roadside Hazard Tree Removal Project could remove trees and snags along roads in this habitat if they are safety hazards. The Kirkland Thin Project could reduce canopy closure on a maximum of 28 acres. There are no other past, present, or reasonably foreseeable actions potentially affecting late seral closed canopy coniferous forest habitat within the analysis area. The cumulative effects would occur on less than 30 percent of the 11,701 acres of late seral closed canopy coniferous forest habitat in the analysis area. Therefore, the direct, indirect, and cumulative effects of the Boulder Project Alternative 2 would result in: (1) no change in acres of late seral closed canopy coniferous forest; (2) the possibility of a slight reduction in canopy closure on some acres (estimated to be less than one percent using FOFEM); and (3) little change in the number of average large snags per acre, depending on fire behavior (underburning is likely to both create and remove snags).

Relationship of Impacts to Bioregional-Scale California spotted owl, American marten, and Northern flying squirrel Habitat Trend.

Since the direct, indirect, and cumulative effects of Alternative 2 would result in no change in acres of late seral closed canopy coniferous forest habitat, a slight reduction in canopy closure (estimated to be less than one percent), and little change in the average large snags per acre, this project would not alter the existing trend in the habitat, nor would it lead to a change in the distribution of California spotted owls, American marten or northern flying squirrels across the Sierra Nevada bioregion.

Effects to Snags in Green Forest Habitat (Hairy Woodpecker)

Prescribed fire treatments are expected to both create new snags and result in the loss of some existing snags on some of the 11,665 acres with active fire treatments. It is possible that a small number of snags near containment lines would be felled if they are a safety hazard to fire personnel. The direct, indirect, and cumulative effects of the Boulder Project Alternative 2 would result in: (1) little change in the number of medium and large snags (greater than 15 inches diameter breast height (dbh), but less than 30 inches dbh) per acre (depending on fire behavior and safety requirements); (2) little change in large snags (greater than 30 inches dbh) per acre (safety hazards may be felled and prescribed fire would have little impact).

Relationship of Impacts to Bioregional-Scale Hairy Woodpecker Habitat Trend.

Since the direct, indirect, and cumulative effects of Alternative 2 would result in little change in the number of snags greater than 15 inches dbh per acre and little change in large snags (greater than 30 inches dbh) per acre, this project would not alter the existing trend in snags, nor would it lead to a change in the distribution of hairy woodpeckers across the Sierra Nevada bioregion.

The *Management Indicator Species Report for the Boulder Creek Fuels Restoration Project* is hereby incorporated by reference.

8. The degree to which the action may adversely affect districts, sites, highways, structures or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources.

According to the Boulder Creek Fuels Restoration *Project Cultural Resources Specialist Report* a total of 43 sites are known to occur within the project area (Gassaway 2012). Determination as to whether sites in the project qualify for listing on the National Register of Historic Places (NRHP) has not yet been made. For the purposes of this project all sites have been determined eligible and would be treated as if listed on the NRHP. The Zone Archaeologist would monitor activities as necessary to ensure sites are not disturbed. In the event a new site is discovered, several standard procedures would be taken to ensure it is evaluated and protected (Appendix E, Management Requirements and Constraints). Therefore, the determination is there would be **no adverse effect** to known historic properties under NHPA under either alternative.

9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

As discussed above, according to the *Biological Assessment for Federally Listed Threatened and Endangered Plant Species and Biological Evaluation for Forest Service Sensitive Plant Species for the Boulder Creek Fuels Restoration Project* (Linton 2012) and *Biological Assessment and Biological Evaluation for the Boulder Creek Fuels Restoration Project* (Cordes 2012a) there are no known threatened or endangered plants, terrestrial, or aquatic wildlife species in the project area. Therefore, implementing either alterative would not adversely affect threatened or endangered species or their critical habitat.

10. Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

None of the proposed activities under Alternative 2 would threaten violation of applicable Federal, State or local environmental protection laws or requirements. Management requirements and constraints are set in place to protect wildlife, other resources and people throughout the project area (See Appendix E, Management Requirements and Constraints for Boulder Creek Fuels Restoration Project). These requirements assure that all the activities in the action alternative are consistent with the Monument Plan by following the standards and guidelines during project implementation.

The Proclamation and subsequent 2012 Giant Sequoia National Monument Management Plan includes guidance to restore sequoia groves and the natural fire regime (See page 3 of this document for quote). The Boulder Creek Fuels Restoration Project applies this guidance in the design of the proposed activities.

Alternative 2 would comply with the Clean Water Act, by implementing watershed best management practices (BMPs), and by keeping cumulative watershed effects below the threshold of concern in the long term (USDA 2011). Applicable BMPs have been identified for Alternative 2 to maintain water quality and reduce potential for soil movement resulting from prescribed burning within the project area (See page 21).

Forest Service Manual (FSM) 2600 (USDA 2005) provides additional direction under the National Forest Management Act (NFMA), regarding species viability. FSM 2670.32 provides direction to avoid or minimize impacts to species whose viability has been identified as a concern. This includes federally listed threatened or endangered species, and Forest Service sensitive species. Effects on threatened and endangered species and critical habitat are noted in the discussion of cumulative effects above. The plant and wildlife biological evaluations determined that the action alternative would have little effect on Forest Service sensitive species, and it would not be likely to threaten species viability because there would be minimal impact to habitat, which would mimic natural processes (i.e. fire). The MIS Report also determined that the action alternative would have minimal effects that mimic natural processes on habitat at the bioregional scale.

Under NFMA, the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives" (P.L. 94-588, Sec 6 (g) (3) (B)). The January 2000 USDA Forest Service (FS) Landbird Conservation Strategic Plan, followed by Executive Order 13186 in 2001, the Partners in Flight (PIF) specific habitat Conservation Plans for birds, and the January 2004 PIF North American Landbird Conservation Plan all reference goals and objectives for integrating bird conservation into forest management and planning. In 2008, a *Memorandum of Understanding between the USDA Forest Service and the US Fish and Wildlife Service to Promote the Conservation of Migratory Birds* was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal and local governments. Within the national forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities.

The Draft Avian Conservation Plan for the Sierra Nevada Bioregion identified montane meadows, riparian habitat, late successional/old growth forest and oak woodlands as priority habitats for conservation (Siegel and DeSante 1999). Maintaining a diversity of habitats, including those identified as important for bird conservation is identified in the Giant Sequoia National Monument Management Plan. Opportunities to promote conservation of migratory birds and their habitats in the project area were considered during development and design of the Boulder Creek Fuels Restoration Project (MOU Section C: item 1 and Section D: item 3). Also, likely impacts to habitats and select migratory bird populations resulting from the Boulder Creek Fuels Restoration Project have been assessed in detail within the project MIS report and impacts to select bird sensitive species and their habitats have been analyzed in the project Biological Evaluation (See the summary of effects to wildlife on pages 58-69 of this document).

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Appendix B-Fuel Load Reduction Plan for the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves

Hume Lake Ranger District
Sequoia National Forest and Giant Sequoia National Monument
December 6, 2012

Prepared by: _/s/_ *Judy Forbes*____Date: 12/06/12
JUDY FORBES
Fuels Specialist

Technical Review by: _/s/ *Paul Leusch*__Date: 12/06/12
PAUL LEUSCH
District Fuels Officer

Approved by: _/s/ *John D. Exline*__Date: 12/07/12
JOHN D. EXLINE
District Ranger

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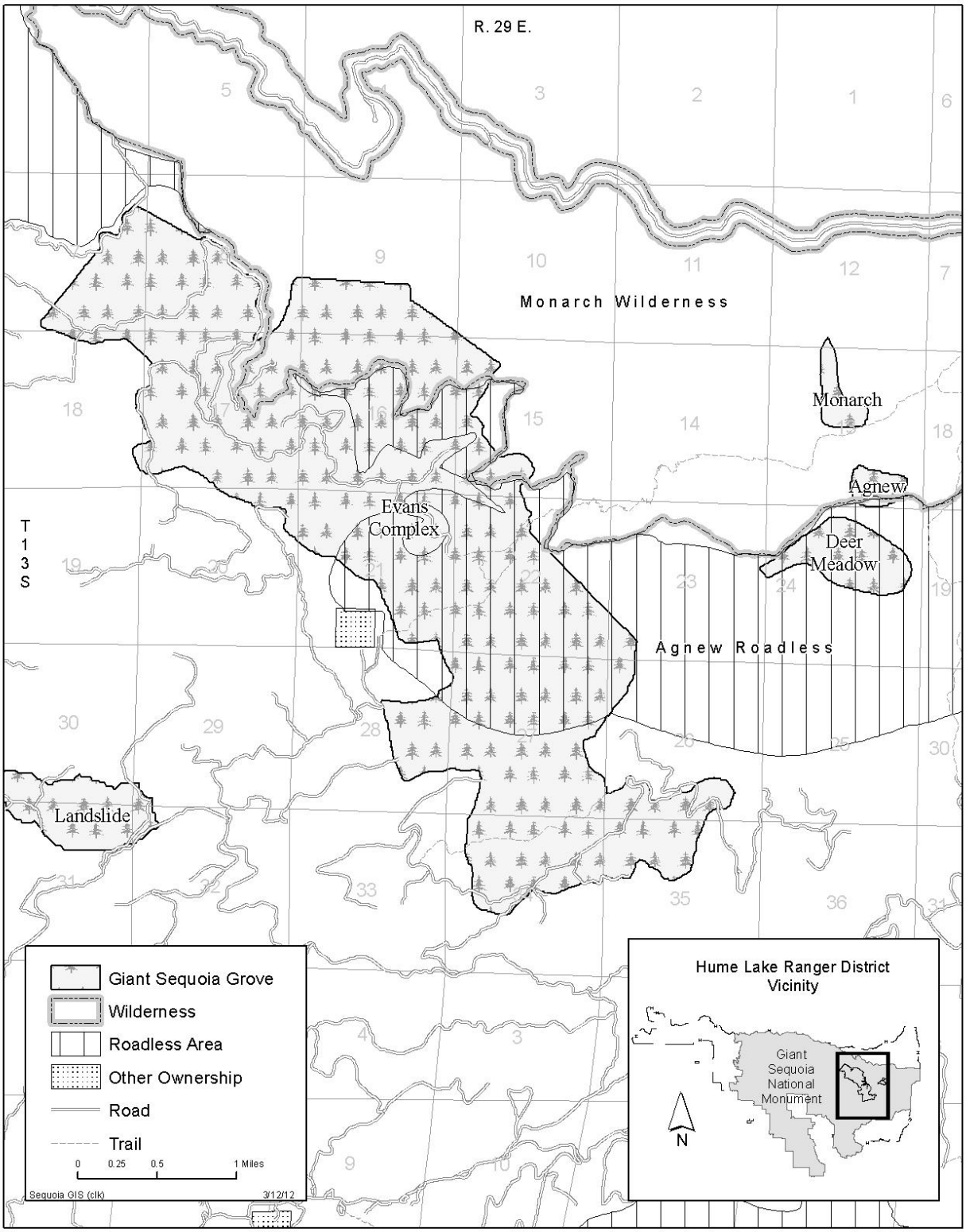
Map 1 Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves



INTRODUCTION

To begin the process of restoring the giant sequoia groves and their ecosystems, the Forest Service is preparing fuel load reduction plans for the groves. The purpose of this plan is to provide an overview of the fire history, assess current fuel conditions, and identify changes that need to be made to improve the overall fuel conditions in the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves.

The 1990 Mediated Settlement Agreement (MSA) and the proclamation establishing the Giant Sequoia National Monument (Monument) both recognized the need for fuels reduction treatments in the Monument and, in particular, in the giant sequoia groves. The MSA directed that the groves be inventoried and evaluated for their fuel load build-up:

> *Based on this inventory and evaluation, groves, or parts of groves, with risks to catastrophic fire and/or exclusion of new giant sequoia regeneration because of natural fuel load build-up will be identified and prioritized for fuel load reduction treatment (1990 MSA)*.

The Proclamation establishing the Giant Sequoia National Monument (Clinton Proclamation 2000) states the following regarding fuels build-up and giant sequoia reproduction:

> *...a century of fire suppression has led to an unprecedented failure in sequoia reproduction in otherwise undisturbed groves...These forests need restoration to counteract the effects of a century of fire suppression and logging. Fire suppression has caused forests to become denser in many areas, with increased dominance of shade-tolerant species. Woody debris has accumulated, causing an unprecedented build-up of surface fuels. One of the most immediate consequences of these changes is an increased hazard of wildfires of a severity that was rarely encountered in pre-Euroamerican times (Clinton 2000, p. 24095).*

The 2012 Giant Sequoia National Monument Management Plan (Monument Plan) includes management direction to develop a fuel load reduction plan for each giant sequoia grove in the Monument, using the most recent inventories of fuel load, in order to identify and prioritize groves or parts of groves and their surrounding watersheds for fuel reduction treatments (Monument Plan, Part 2-Strategy, pp. 50-51).

This document describes the existing conditions and need for treatment within the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves (Map 1).

Background and Disturbance History

Giant sequoias are the largest trees on the planet and are among the oldest, sometimes living for 3,200 years or more. Sequoia groves are part of the Sierra Nevada mixed conifer forest that contains giant sequoias. Groves contain a mix of tree species in which giant sequoias are a numerically minor, but visually striking, component. Numerically, most groves are overwhelmingly

dominated by white fir, with sugar pine commonly being the next most abundant species, followed by giant sequoia. Black oak, ponderosa pine, incense-cedar, Jeffrey pine, and red fir are often additional grove components (Stephenson 1996).

For at least the two or three millennia preceding Euroamerican settlement, predominantly low-to moderate-intensity surface fires burned within individual sequoia groves on the order of every 2 to 10 years (Kilgore and Taylor 1979; Swetnam et al. 1992; Swetnam 1993). Because of the loss of Native American ignitions, and suppression of lightning ignitions that followed Euroamerican settlement, most grove areas today have experienced a 100- to 130-year period without significant fire (Stephenson 1996). This lack of fire has caused important changes in grove conditions. Giant sequoia reproduction, which in the past depended on frequent fires, has effectively ceased in many groves, and reproduction of other shade-intolerant species has been reduced. Most significantly, dead material has accumulated, causing an unprecedented buildup of surface fuels. Additionally, ladder fuels, capable of conducting fire into the crowns of mature trees, have increased. One of the most immediate consequences of higher levels of fuels is an increased hazard of wildfires sweeping through groves with a severity rarely encountered before Euroamerican settlement (Stephenson 1996).

Some logging of giant sequoias in the Sierra Nevada mountain range began in 1856 on lands later designated as national forest. Logging has continued intermittently to this day on nonfederal lands in the vicinity of the Monument. Early entrepreneurs, seeing profit in the gigantic trees, began acquiring lands within the present-day Monument under the Timber and Stone Act in the 1880s. Today our understanding of the history of the Hume Lake and Converse Basin areas of the Monument is supported by a treasure trove of historical photographs and other documentation. These records provide a unique and unusually clear picture of more than half a century of logging that resulted in the removal of most of the forest in some parts of the Monument.

Between 1880 and 1920, the heaviest logging of sequoia groves occurred south of the Kings River. Nearly all pines and many firs were removed from several groves. Today, these logged groves have regenerated as complex mosaics of forest, with patches of differing structure (tree diameter, height, and density) and species composition (Stephenson 1996).

Past Management History

Agnew Giant Sequoia Grove

The Agnew Grove (Pictures 1-3) is unique in that it is both in a roadless area and, since 1984, inside the Monarch Wilderness. The grove is located on the steep, rugged slopes of the Boulder Creek and Kings River Canyons.

Available Forest Service management records date back to 1955 and show no record of past management activities in Agnew Grove. This grove has not been logged. It is managed as part of the Monarch Wilderness.

Deer Meadow Giant Sequoia Grove

The Deer Meadow Grove (Pictures 4-6) is a small grove located adjacent to Monarch Wilderness and is within Agnew Roadless Area.

Forest Service management records show no recorded management activities in Deer Meadow Grove. The grove has no history of logging.

One can see this grove from points along the Evans and Kanawyer Trails from the west which provide distant panoramic views of the grove. One excellent long distance grove vista is from the old railroad bed on the north side of the divide between Evans Creek and Windy Gulch (Willard 1994).

Evans Giant Sequoia Grove Complex

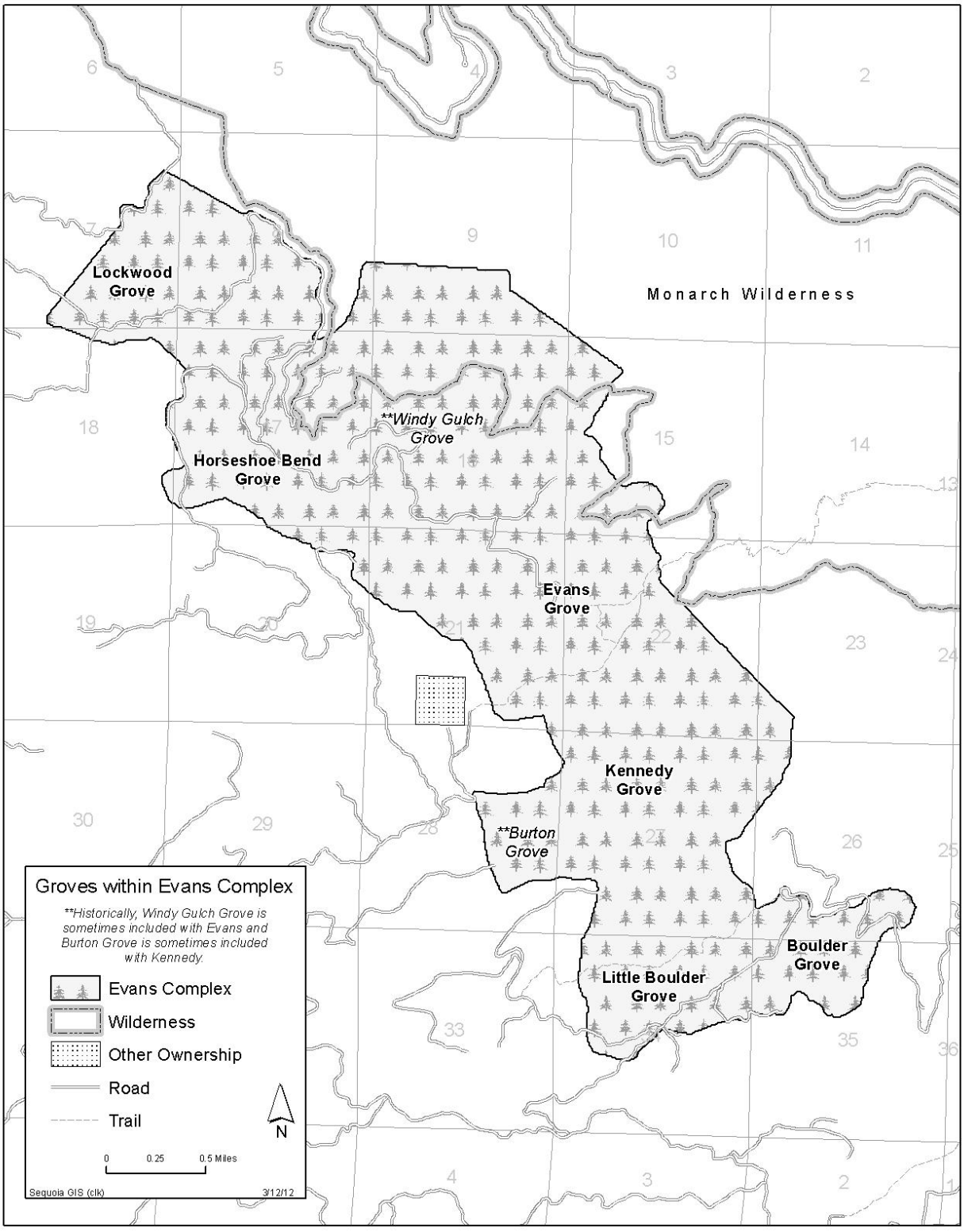
The Evans Grove Complex is comprised of six different groves (Map 2). These groves include Evans, Horseshoe Bend, Boulder, Little Boulder, Kennedy, and Lockwood. The Evans Grove Complex was mapped as a whole, not by individual groves that make up the complex. Map 2 shows the approximate locations of the individual groves based on earlier topographic map locations.

Historical records show that significant logging occurred between 1914 and 1927 in the Evans Grove Complex prior to Forest Service management, when the area was owned by the Hume-Bennett (renamed Sanger in 1917) Lumber Company.

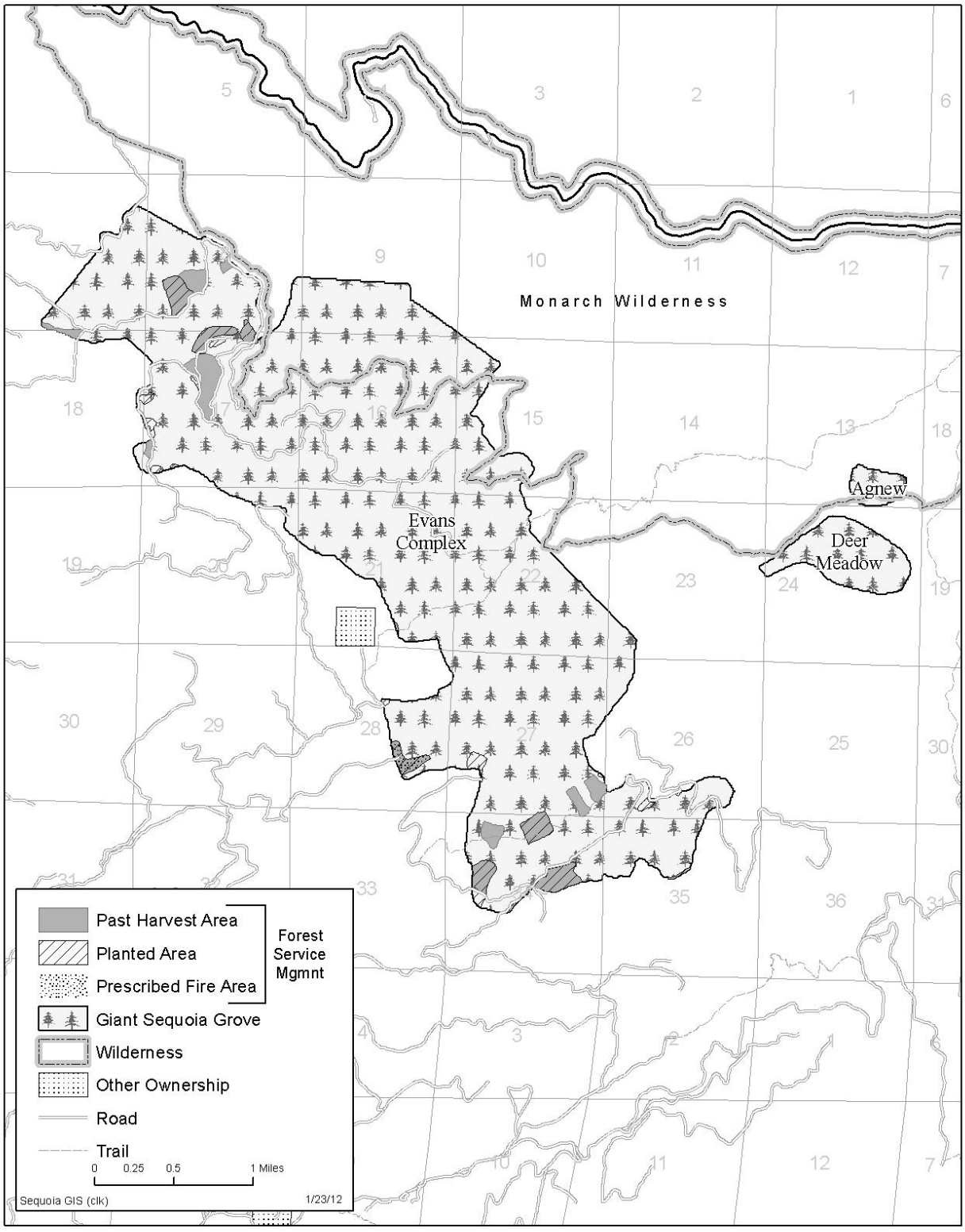
Most of the historic logging (Picture 7) occurred in four of the individual groves: Evans, Horseshoe Bend, Lockwood, and Windy Gulch (Willard 1994). Many of the old growth sequoias, with the help of a narrow gauge railroad (Pictures 9-11), were logged before 1920. As a result, there is an abrupt change in the present visual character of the groves between the historically logged areas and the sections which generally retain an old growth forest character dominated by abundant old growth sequoias (Willard 1994).

Forest Service management activities between 1971 and 1995 in the Boulder, Little Boulder, Burton, Horseshoe Bend, Lockwood, and Windy Gulch Groves included approximately 250 acres of timber harvest, 138 acres of tree planting, and 40 acres of prescribed fire. These areas are shown on the grove disturbance map (Map 3) within the Evans Grove Complex.

Map 2 Individual Groves in the Evans Grove Complex



Map 3 Disturbances in the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves



Fire History

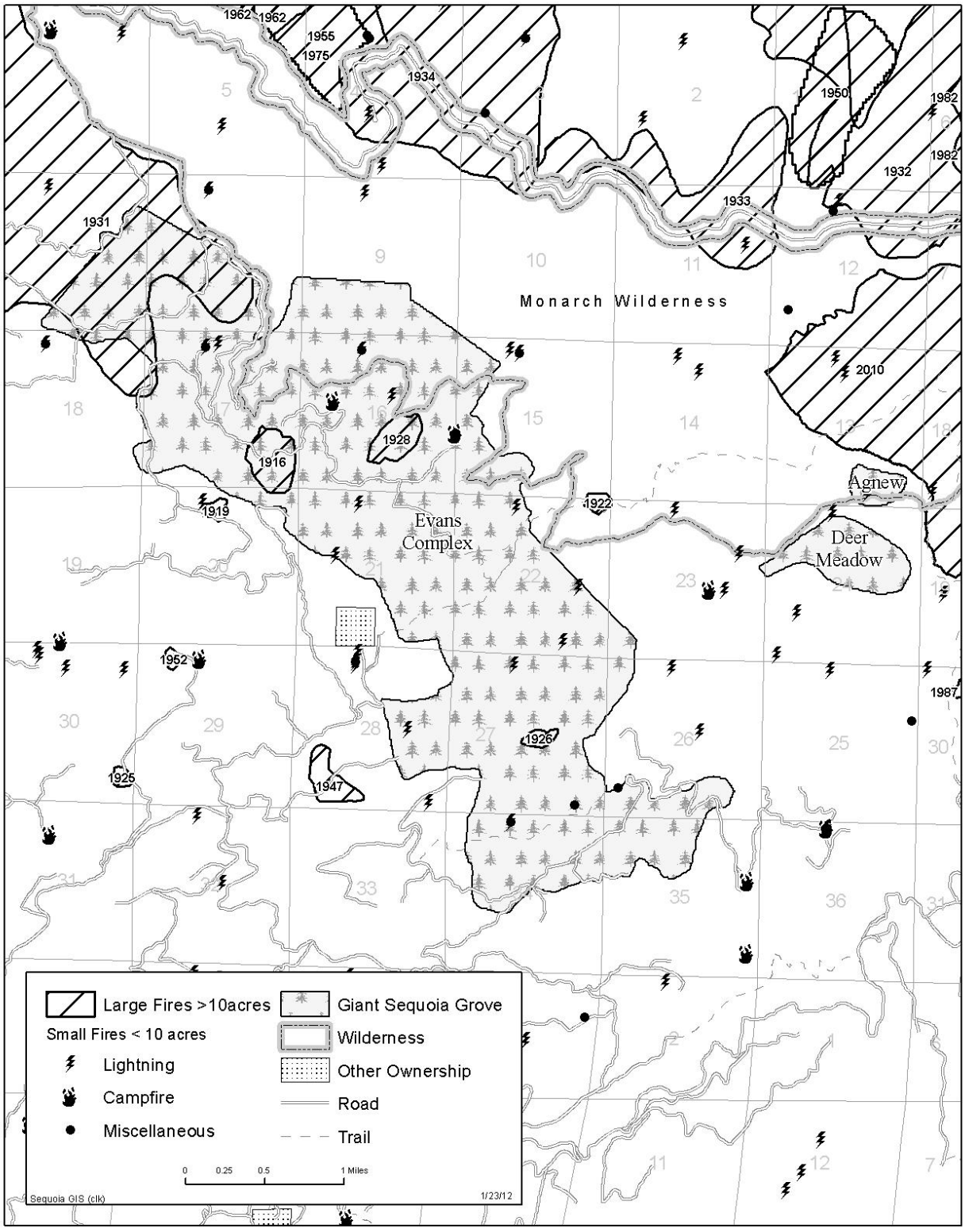
Fire history information for the groves is available back to 1910. Records for Agnew and Deer Meadow Groves show no history of fires ten acres or larger, natural or human-caused. In the Evans Grove Complex, 501 acres of fires ten acres and larger have burned since 1916 (Table 1). Several small fires, less than ten acres in size, occurred within and outside of the groves, as shown on the fire history map (Map 4).

In the summer of 2010, the Sequoia National Forest and Sequoia and Kings Canyon National Parks jointly managed the 9,000 acre Sheep wildfire. This fire was allowed to burn into the Monarch Giant Sequoia Grove, located to the north of the Agnew Grove, effectively reintroducing fire and lowering the hazardous fuel loading on fifty-two acres of giant sequoia trees.

Table 1 Fire History in the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves

Fire History	Agnew Grove	Deer Meadow Grove	Evans Grove Complex	Grand Total
Grove Acres	43	167	4255	4465
Fire History Acres	0	0	501	501
Percent of Grove	0	0	12	11

Map 4 Fire History in the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves



EXISTING CONDITION

The Agnew, Deer Meadow, and Evans Complex Groves are located within the Giant Sequoia National Monument of the Sequoia National Forest. Approximately 530 acres of the Evans Grove Complex and 36 acres of the Agnew Grove lie within the Monarch Wilderness. Approximately 1,340 acres of the Evans Grove Complex, seven acres of Agnew Grove, and 168 acres of Deer Meadow Grove are within the Agnew Roadless Area.

The majority of the area within the groves has missed the last five fire return intervals (100+ years of fire exclusion). The area is in steep inaccessible terrain with a moderate to heavy fuels layer. In some cases, groves are located on steep canyon slopes above hardwood and brush areas. The arrangement of fuels is such that the vertical and horizontal continuity provide ladder fuels that enable low intensity surface fires to move into the canopies and become active crown fires. Under extreme weather conditions, the combination of topography, vegetation, and fuel loading are such that a wildfire could not be safely suppressed. Once a fire is established, a crown fire would likely initiate and spread. Such a fire would not only be a threat to the objects of interest, including giant sequoia trees, wildlife habitat, and cultural sites, but also to life, property, and other resources in the area such as plantations and recreation improvements.

Fire Return Interval Departure (FRID)

Fire return interval describes how often fires occur in a particular location. This is a temporal attribute of the fire regime that is measurable by determining when fire occurred last on each of the acres in the area and comparing this with the historic interval between fires for the vegetation type. Fire return interval is an indicator of how close the area is to the historic fire regime. Some attributes of the fire regime that would not be addressed by simply putting fire back into the ecosystem are: seasonality, severity, intensity, fire type, and complexity.

The fire return interval for a given vegetation type can be used in conjunction with fire history maps to determine which areas have missed natural fires. This information is known as the fire return interval departure (FRID), as shown in Table 2. A fire return interval departure map was developed by Sequoia and Kings Canyon National Parks from vegetation, fire history, and historic fire frequency data to assess the departures from the historical fire return interval in areas within the Monument. A fire return interval departure index was reclassified into five categories: extreme, high, moderate, low, and rock/water.

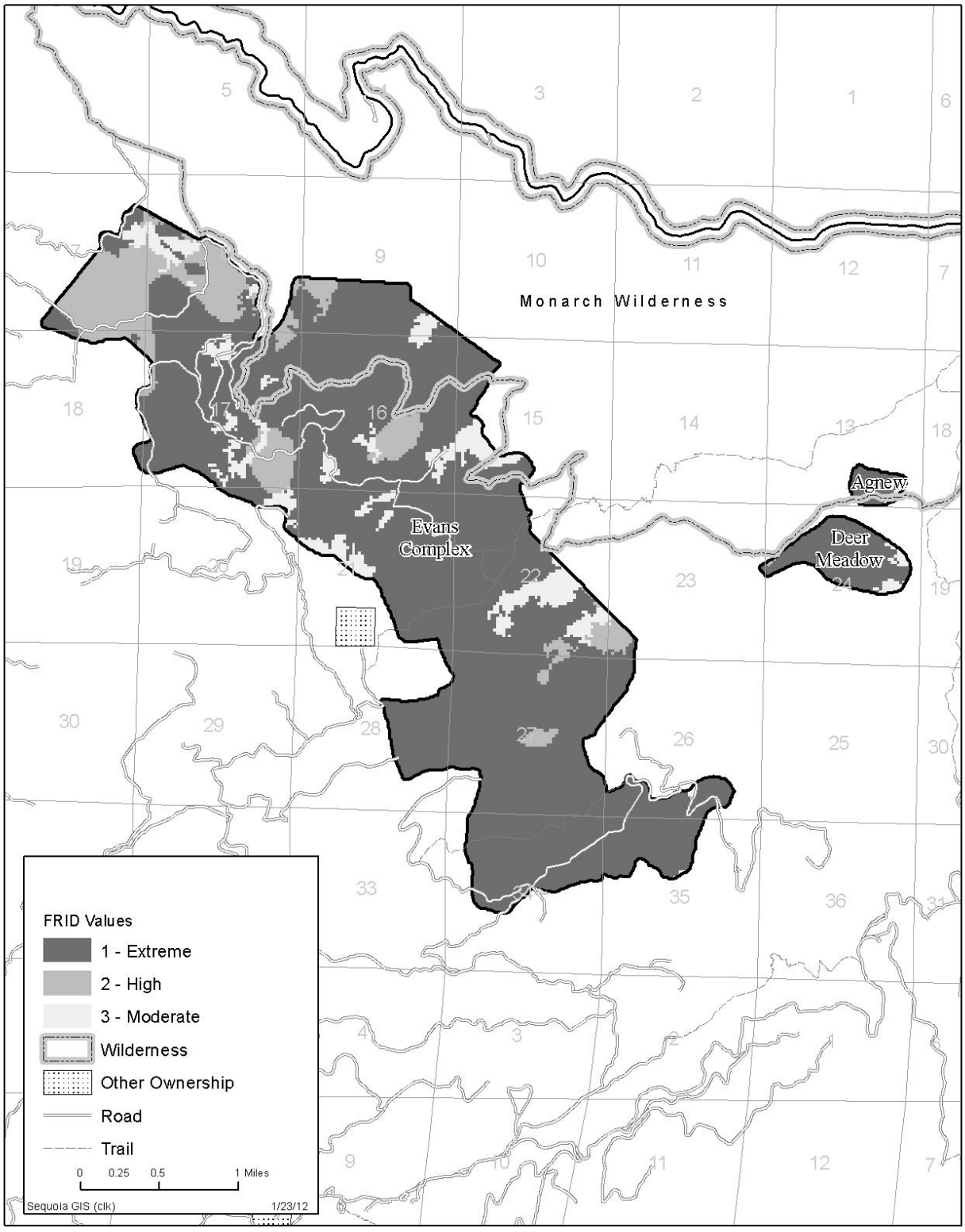
The dominant FRID category in the three groves, as shown in Table 2 and Map 5, is extreme (5 -17 intervals missed). Fire history studies in the southern Sierra Nevada show intervals between fires ranging from 2 years through 8 to 10 years for large fires in the Sierra, generally to 20-25 years in a given locality of a sequoia grove (Kilgore and Taylor 1979). This study indicates that lack of frequent, light fire has resulted in a major departure from conditions which normally evolve under giant sequoias during the past 1000 years or more (Kilgore and Taylor 1979). Though disturbances

such as wildfire, prescribed fire, logging and road and trail construction have occurred, the activities have not been large enough to affect the overall FRID.

Table 2 Fire Return Interval Departure (FRID)

		Agnew Grove		Deer Meadow Grove		Evans Grove Complex		Grand Total	
Fire Return Interval Departures	**Rating**	**Acres**	**Percent of Acres**	**Acres**	**Percent of Acres**	**Acres**	**Percent of Acres**	**Total Acres**	**Total Percent of Acres**
5 - 17 intervals missed	Extreme	39	90.73	153	91.36	3449	81.06	3641	81.55
2 - 4.9 intervals missed	High	0	0.00	1	.69	491	11.54	492	11.02
0 - 1.9 intervals missed	Moderate	4	9.27	13	7.95	315	7.40	332	7.43
Total		43	100	167	100	4255	100	4465	100

Map 5 Fire Return Interval (FRID) in Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves



Fire Behavior

Fuel models for the three giant sequoia groves are determined utilizing the Sequoia National Forest and Giant Sequoia National Monument GIS fuels layer (Map 6). Expected flame lengths and rates of spread shown in Table 3 are associated with the corresponding fuel model at eight percent dead fuel moisture content, five mph mid-flame wind speed, and 100 percent live fuel moisture.

Fires in grass fuels exhibit some of the faster rates of spread under similar weather conditions. Fires in mixed conifer, such as in Fuel Model 10, are at the upper limit of control by direct attack. A four-foot flame length is considered the maximum height that can be attacked by hand crews to create fire lines near the fire. More wind or drier conditions could lead to an escaped fire (Anderson 1982).

Much of the area in the three groves falls in Fuel Model 9 for pine and hardwood stands. Fires in these fuels would be expected to burn with a shorter flame length than those in Fuel Model 10 for mixed conifer stands, but with a similar rate of spread (Table 3).

Four of the factors that affect fire behavior are topography, weather, vegetation, and surface fuels. Two of these factors can be managed: vegetation and fuels.

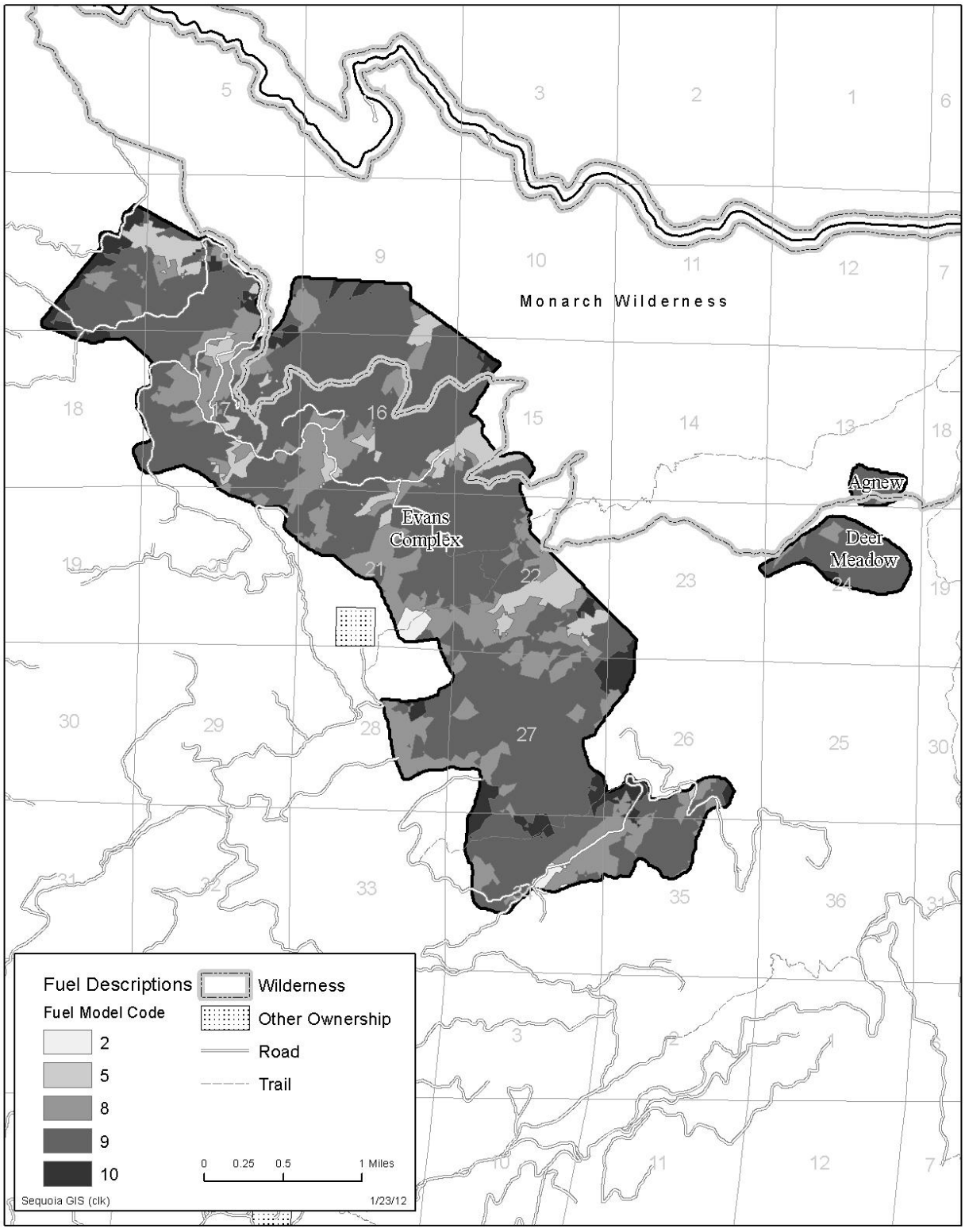
The area covered by these groves is in steep inaccessible terrain. In some cases, groves are located on steep canyon slopes above hardwood and brush areas. The amount and distribution of surface fuels and vegetation would lead to more intense fire behavior in these areas. Treating fuels here would reduce the potential flame lengths and fire intensity.

Table 3 Acres, Expected Flame Length, and Rate of Spread for Fuel Models

Fuel Model	Acres	Expected Flame Length (ft)	Expected Rate of Spread (chains*/hour)
Fuel Model 2 Perennial Grass	32	6	35
Fuel Model 5 Shrubs	282	4	18
Fuel Model 8 Short-needle Conifers	954	1	1.6
Fuel Model 9 Pine and Hardwood Stands	2948	2.6	7.5
Fuel Model 10 Mixed Conifer Stands	249	4.8	7.9

* One chain equals 66 feet

Map 6 Fuel Descriptions for the Agnew, Deer Meadow, Evans Complex Giant Sequoia Groves (Fuel Models 1-13)



Vegetation and Fuel Loading

The following are grove-specific descriptions of the vegetation and fuel conditions found in the groves during inventories in 2009. The data includes surface fuel loading, tree stocking density, average canopy closure, and species composition.

Agnew Giant Sequoia Grove

The Agnew Grove was inventoried in 2009. Surface fuel loading in the grove, including duff and litter, was approximately 24 tons of fuel per acre. Tree density was approximately 238 trees per acre, with a mean diameter of 15.0 inches. Tree basal area averaged 290 square feet per acre, and the average canopy closure was about 55 percent.

At the time of the inventory, white fir made up more than 86 percent of the trees per acre and almost 70 percent of the basal area. All other species combined, including hardwoods, made up slightly more than 30 percent of the total basal area. Giant sequoia trees accounted for approximately 22 percent of the basal area in the grove. The increased number of shade tolerant trees, particularly in the 10-16 inch diameter size class, can be attributed to the lack of fire throughout the grove (Wood 2010).

Deer Meadow Giant Sequoia Grove

The Deer Meadow Grove was inventoried in 2009. Surface fuel loading, including duff and litter, was approximately 17 tons of fuel per acre. Tree density was approximately 484 trees per acre, with a mean diameter of 9.3 inches. Tree basal area averaged 230 square feet per acre, and the average canopy closure in the Deer Meadow Grove was approximately 50 percent.

At the time of inventory, white fir made up approximately 48 percent of the trees per acre and 33 percent of the basal area (70 percent of the white fir were two inches in diameter or less). Black oak was the second most abundant species with 31 percent of the trees per acre, but none of these were greater than 20 inches in diameter (87 percent of the black oak were two inches in diameter or less). Incense cedar made up about 14 percent of the trees per acre and 10 percent of the basal area (54 percent of the incense cedar were two inches dbh or less). Giant sequoia trees accounted for less than 1 percent of the trees per acre and 49 percent of the basal area per acre in the grove. On an acre-by-acre basis, giant sequoia trees accounted for approximately 3.6 trees per acre and a basal area of 113 square feet.

Not unexpectedly, the other softwoods, such as ponderosa pine and sugar pine, are a relatively small portion of the total tree population, at less than seven percent. The reduced number of shade intolerant tree species, not including black oak, throughout all size classes can be attributed to the lack of fire or management activities throughout the grove (Wood 2012).

Evans Giant Sequoia Grove Complex

The Evans Grove Complex was inventoried in 2009. Logged areas are an important part of the history of the Evans Grove Complex, as they have formed forest patches of differing structure (tree diameter, height, and density) and species composition. In some areas, shrubs and grass are dominant on lands that were once forested, and fuel that was not burned following logging operations remains on site.

Surface fuel loading in the Evans Grove Complex, including duff and litter, is approximately 42 tons of fuel per acre. Tree density was approximately 505 trees per acre, with a mean diameter of 7.7 inches. Tree basal area averaged 164 square feet per acre and the average canopy closure was 38 percent.

At the time of the inventory, white fir made up more than 55 percent of the trees per acre and 29 percent of the basal area. Giant sequoia trees made up less than 1 percent of total trees per acre and 37 percent of the basal area. All other species combined, including hardwoods, made up 34 percent of the total basal area (Wood 2012).

The Evans Grove Complex includes 138 acres of plantations, planted between 1971 and 1995. Most of these plantations are at high risk of damage from potential severe wildfire. Brush is forming ladder fuels into the crowns of the trees in all of the plantations. Trees are only approximately 20 feet tall, with a planted species mix which includes giant sequoias.

Other Resource Conditions

Wildlife

The Proclamation creating the Monument and the Monument Plan identify the diverse array of rare animal species as objects of interest and directs the protection, proper care, and management of their essential habitat features. The three groves covered by this fuel load reduction plan currently provide suitable habitat for a number of sensitive wildlife species, including Pacific fishers, California spotted owls, and northern goshawks. Based on historic detections, the Evans Grove Complex contains four spotted owl and one northern goshawk protected activity centers (PACs). There are caves in the general area expected to be used by bats, including Townsend's big-eared bats. The giant sequoias in these groves may also be used for roosting by pallid bats.

Hydrology

The existing conditions of hydrological resources will be evaluated at a watershed or sub-watershed scale.

Cultural Resources

The Proclamation creating the Monument and the Monument Plan identify cultural resources, both historic and prehistoric, as objects of interest in the Monument. Prehistoric archaeological sites

such as lithic scatters, food-processing sites, rock shelters, village sites, petroglyphs, and pictographs are found in these groves. These sites have the potential to shed light on the roles of prehistoric peoples, including the role they played in shaping the ecosystems on which they depended. Outstanding opportunities exist for studying forest resilience to large-scale (historic) logging and the consequences of different approaches to forest restoration. Historic sites consist mostly of historic logging sites (Pictures 10-12), remains of homestead properties, Forest Service administrative sites, and mining sites.

Recreation/Wilderness

The Proclamation creating the Monument and the Monument Plan provide for and encourage continued public and recreation access and use consistent with protecting the objects of interest. The Deer Meadow and Agnew Groves have no recreation infrastructure. The Agnew Grove is located within the Monarch Wilderness and the Deer Meadow Grove is located in the Agnew Roadless Area, adjacent to the Monarch Wilderness. Portions of the Evans Grove Complex also lie within the Monarch Wilderness and Agnew Roadless Area. There are prohibitions that must be adhered to within these designated areas, such as those on the use of motorized and mechanical equipment.

Sections of the Evans Grove Loop Trail, Kanawyer Trail, and the Little Boulder Grove Trail lie within the Evans Grove Complex, as well as their trailheads. These trails and their associated infrastructure could be damaged by wildfire (erosion, burned signs, etc.).

Scenic quality is a fundamental element of recreation experiences. According to recent studies most people find extreme conditions, such as dense vegetation (i.e., ladder fuels) or scorched trees and blackened landscapes, to be unattractive (Ryan 2005). Scenic integrity is a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes which have little or no deviation from the character valued by visitors for its aesthetic appeal. The scenic integrity rating for the Agnew Grove is Very High, and the rating for the Deer Meadow Grove is High. The Evans Grove Complex has a few small areas with a Low rating, but the remainder is rated High.

FUEL TREATMENT GOALS

This fuel load reduction plan provides an assessment of the current fuel conditions in Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves based on the fire and management history of the groves. As described in the discussion of existing conditions, there are a number of differences in conditions between and within these three sequoia groves. Conditions vary in terms of fuel loading, type and density of vegetation, management and small fire history, and topography.

Fuel treatment goals for the Agnew, Deer Meadow, and Evans Complex Giant Sequoia Groves have been identified in compliance with the 2012 Giant Sequoia National Monument Management Plan (Monument Plan). Fuel treatment goals include:

- Maintain lower, manageable levels of surface and ladder fuels to reduce the risk of uncharacteristic stand-replacing fires.
- Restore fuel conditions such that an average live crown base tree height of 20 feet and average flame lengths of six feet or less can be maintained should a wildfire occur under 90th percentile fire weather conditions.
- During fuel load reduction activities, emphasize the protection of large giant sequoia trees and large trees of other species including pines.

Photos

Picture 1 Agnew Giant Sequoia Grove looking west

Picture 2 Agnew Giant Sequoia Grove looking north

Picture 3 Agnew Giant Sequoia Grove showing an area with 81% Canopy Cover

Picture 4 Deer Meadow Giant Sequoia Grove looking west

Picture 5 Fuel loading in Deer Meadow Giant Sequoia Grove looking south

Picture 6 Deer Meadow Giant Sequoia Grove looking east

Picture 7 1936 view of a logged area in Evans Grove, looking northeast across the basin of Upper Redwood Creek, toward Monarch Divide.

Picture 8 Current view of Evans Giant Sequoia Grove Complex

Picture 9 View of Evans Giant Sequoia Grove looking west on the railroad grade used during historical logging that is now a hiking trail.

Picture 10 Railroad ties used during historical logging in the Evans Grove.

Picture 11 Railroad bridge in the vicinity of Road 13S44 in the Evans Grove.

Picture 12 Showing cultural resource conditions, this rock wall is located in a railroad bed along the Evans Grove Trail.

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Appendix C-Management Tool Determination for the Boulder Creek Fuels Restoration Project, and Tree Felling Criteria for the Boulder Creek Fuels Restoration Project

Management Tool Determination for the Boulder Creek Fuels Restoration Project

The decision tree presented in the Giant Sequoia National Monument Management Plan (Monument Plan, pp. 80-82) was used to determine which methods of forest restoration and maintenance to use in the Boulder Creek Fuels Restoration Project. The risks, feasibility, and effectiveness of managed wildfire, prescribed burning, mechanical treatments without tree removal, and mechanical treatments with tree removal, or a combination of two or more of these management tools were assessed.

The risk assessment considered local conditions such as slope, fuel loadings, and proximity to communities, giant sequoia groves, fisher den sites, and nest trees. The Boulder Creek Fuels Restoration Project lies partially within the Agnew, Deer Meadow, and Evans Complex Groves. Using the most recent inventories of fuel load, a fuel load reduction plan was completed for these groves (see Appendix B).

Purpose and Need

The purpose of the Boulder Creek Fuels Restoration (Boulder) Project is to protect, restore, and maintain the giant sequoia groves, the surrounding forest, and the other Monument objects of interest in the Boulder Creek area, and allow for safe and efficient fire suppression activities on fires burning out of the Monarch Wilderness and Agnew Inventoried Roadless Area. This project is needed to:

- Reduce excessive fuel loads across the landscape, particularly in the Monarch Wilderness.
- Re-establish fire to this fire-adapted ecosystem, particularly within the giant sequoia groves.
- Reduce the risk of loss of old-growth forest habitat to uncharacteristic large, stand-replacing fires.
- Reduce the risk of loss of cultural resources to wildfires.
- Establish conditions that allow for a highly diverse vegetation mosaic of age classes, tree sizes, and species composition.

Timing is critical for the Boulder Creek Fuels Restoration (Boulder) Project. In 2010, the Sheep Fire burned through a portion of the Monarch Wilderness and Agnew Inventoried Roadless Area. The Sheep Fire was ignited by lightning and was managed to reintroduce fire and lower hazardous fuel loading. It was stopped on the eastern edge of the Boulder Creek Drainage, which created a temporary natural fuel break. To take advantage of this fuel break created by the Sheep Fire, the Boulder Project needs to be implemented as soon as possible.

1. Use Managed Wildfire

Risks and complexities for naturally-ignited wildfires were analyzed to determine if they could be successfully managed for ecological benefit and to meet the purpose and need for the Boulder Creek Fuels Restoration Project. If a wildfire does occur, the risks and effectiveness of managing it will be weighed using the Wildland Fire Decision Support System (WFDSS). Managed wildfire in the Boulder

Creek Fuels Restoration Project area is likely to meet the purpose and need of the project to reduce fuels to protect, restore, and maintain the objects of interest. Managed wildfire will be considered throughout the project area if a naturally-ignited wildfire becomes available, except under extreme conditions such as drought or unfavorable long-term weather forecasts, or shortages of firefighting resources. Managed wildfires will use strategies and tactics which provide for the protection of human health, safety, and natural and cultural resource values.

2. Use Prescribed Burning:

A risk assessment was conducted of local conditions such as slope, fuel loadings, and proximity to communities, giant sequoia groves, fisher den sites, and nest trees. The use of prescribed burning would not pose unacceptable risk to the objects of interest, forest users, or communities. Mitigation measures to reduce potential risk will include some hand treatments (i.e., clearing fuels by hand, using backing fire and similar lighting techniques) around giant sequoias, cave entrances, cultural resources, and other objects of interest.

Prescribed burning would be effective in meeting ecological restoration objectives and helping to protect the objects of interest. Prescribed fire is likely to meet the purpose and need of the project to reduce fuels, maintain fuel conditions that support fires characteristic of Monument ecosystems, encourage fire to resume its ecological role, allow for a diverse vegetation mosaic, and reduce the risk of loss of old-growth forest habitat and cultural resources. Prescribed burning can be timed to improve the ecological condition of the giant sequoia groves, their ecosystems, and wildlife habitat in the project area, while minimizing the potential for negative effects on cultural resources.

Prescribed burning would be feasible, considering factors such as the availability of personnel and favorable burn days. Preparation and burning would incur a moderate cost per acre over the entire project area. Some portions could be more costly in personnel time, especially where hand treatments are needed prior to burning.

3. Use Mechanical Means without Tree Removal

Prescribed burning alone (or in addition to managed wildfire if it becomes available) does not pose unacceptable risk, and is considered effective and feasible to meet the purpose and need in the project area. Therefore, additional assessment was not needed to evaluate mechanical treatments.

4. Use Mechanical Means with Tree Removal

Prescribed burning alone (or in addition to managed wildfire if it becomes available) does not pose unacceptable risk, and is considered effective and feasible to meet the purpose and need in the project area. Therefore, additional assessment was not needed to evaluate mechanical treatments with tree removal.

Conclusion

Managed wildfire will likely be used if it becomes available. Prescribed burning will be the primary method of treatment for forest restoration and maintenance in the Boulder Creek Fuels Restoration Project area. Prescribed burning is proposed to begin restoring ecological conditions in the lower portion of the Boulder Creek Drainage in the Hume Lake Ranger District of the Giant Sequoia National Monument and the Sequoia National Forest.

Tree Felling Criteria for the Boulder Creek Fuels Restoration Project

The Boulder Creek Fuels Restoration (Boulder) Project re-introduces fire to Monument ecosystems with prescribed burning. During implementation of the Boulder Project, it is likely that trees will need to be felled to reduce safety hazards to firefighters and to protect some of the Monument objects of interest.

> Any projects which propose the felling of trees inside the Monument will be subject to the following five criteria (numbered F1 through F5) for tree felling. These five criteria shall apply to any treatments which involve the felling of trees…(Monument Plan, page 79).

F1. Resiliency: If maintaining one or more standing trees on a site would deplete moisture, light, or nutritional resources critical to the health and survival of the plant community or forest.

F2. Regeneration: If maintaining one or more standing trees on a site would adversely affect the regeneration, longevity, or growth of giant sequoias and other desired species.

- There may be trees that serve as ladder fuels that need to be felled and moved away from the base of trees to protect giant sequoias from crown fires (Monument Plan, page 45, Strategy #s 6, and 9).

F3. Heterogeneity: If maintaining one or more standing trees on a site would adversely affect the desired diversity or structure of a stand or forest.

- Criteria F1 and F3 will not be applied in determining tree felling that may be necessary for the Boulder Creek Project but, following implementation, it is expected that stands will be more resilient to forest stressors, that there will be some regeneration in the giant sequoia groves and other forested areas, and that heterogeneity will be improved in forested areas.

F4. Public Safety: If maintaining one or more standing trees on site would create a public safety hazard. Forest Service policy is to eliminate safety hazards from recreation sites, administrative sites, and the public transportation system of roads and trails, including trees or tree limbs identified as hazardous (FSM 2332).

- There may be some trees that are safety hazards for the firefighters that need to be felled before a fire can be ignited.
- Mortality may occur in some trees after prescribed burning operations are complete. Trees which pose a hazard to firefighters working to repair any damage to trails or roads will need to be felled.

F5. Recreation and Administrative Sites: Other projects that may be proposed in the Monument that could require tree felling include recreation or administrative site development and maintenance, scenic vistas, and road access and parking for these sites. These activities would meet the intent of the Proclamation, which provides the following:

- There may be trees that need to be felled because they present a hazard to Monument objects of interest such as cultural resource sites, recreation sites, wildlife trees, and caves.

Appendix D-Plantation Data

Stand	Origin	Acres	Year(s) Planted	Trees/ Acre	BoulderSub-division	Giant Sequoia Planted	Underburn OK*	Comments
102-0002	Heart 3	5	1973,74	128	3C	No	Yes	
102-0008	Heart 6	7 of 10	1973,77,85,99	97	3C	No	No	
102-214	Pebble 214	15	2005	287	3C	No	No	
104-0011	Spiro 11	16	1990	90	4B	No	No	
104-0024	Spiro 24	28	1990,98,02	163	4B	No	No	
104-0031	Spiro 31	6 of 30	1990	214	4B	No	No	
104-0034	Spiro 35	3	1990	38	4B	No	No	
104-0038	Horse Corral 4	15	1966	82	4B	No	Yes	
104-0042	Horse Corral 10	25	1967	110	4B	No	Yes	
104-0044	Horse Corral 8	26	1967	144	4B	No	Yes	
104-0227	Horse Corral 10A	5	1967	110	4B	No	Yes	
107-0003	Kennedy 8	11 of 21	1971	71	3A,4A	No	Yes	
107-0004	Boulder 24	8	1978	260	4A	No	No	
107-0005	Kennedy 1	2 of 13	1971	172	3B	No	Yes	
107-0006	Kennedy 4	6 of 24	1971,72	165	4A	No	Yes	
107-0007	Kennedy 15	14	1971	115	4A	No	Yes	
107-0011	Boulder 9&10	5	1978	80	3B	No	Yes	
107-0012	Boulder 12	2	1978	160	3B	No	Yes	
107-0013	Boulder 14	9	1978	440	4A	No	No	
107-0014	Boulder 21	3	1978	329	4A	No	No	
107-0015	Boulder 18 a&b	3	1978	292	4A	No	No	
107-0016	Boulder 16&17	6	1978	248	3B	No	No	
107-0017	Boulder 23	3	1978	583	4A	No	No	
107-0018	Little 1	33	1989	203	4A	Yes	No	
107-0019	Little 2	23	1989	200	4A	Yes	No	
107-0020	Spiro 4	23	1990	66	4B	No	No	
107-0021	Spiro 12	23	1990,98	63	4B	No	No	
107-0022	Spiro 21	35	1990,94,98	65	4B	No	No	
107-0027	Boulder 23A	1	1978	583	4A	No	No	
107-0028	Evans 6	2	1980	436	3A	No	No	
107-0030	Pellet 4	12	1975	194	4B	No	Yes	
107-0031	Pellet 9	15	1975	187	4B	No	Yes	

107-0032	Pellet 6	34	1975	167	4B	No	Yes	
107-0033	Pellet 5	12	1975	126	4B	No	Yes	
107-0035	Spiro 28	12	1990,95	131	4B	No	No	
107-0038	Boulder 8	3	1978	181	3B	No	No	
107-0039	Boulder 15	6	1978	248	3B	No	No	
107-0041	Boulder 18	2	1978	292	3B	No	No	
107-0042	Boulder 22	2	1978	292	4A	No	No	
107-0049	Boulder 20	2	1978	50	4A	No	No	
107-0050	East Grove 50	7	1988	88	3B	No	No	
107-0051	East Grove51 Buck 19 & 23	32	1988,93,95	94	4A	No	No	
107-0054	East Grove 54	6	1988,91	38	4A	No	No	
107-0062	East Grove 62	14	1988,92,95	61	3C	No	No	Some natural GS present
107-0067	East Grove 67	28	1988,89,92,95	133	4A	Yes	No	
107-0080	Pellet 2	6	1975	187	4B	No	No	
107-0092	Boulder 25	3	1978	260	4A	No	No	
107-0097	Buck Rock 97	12	1992	325	3A	Yes	No	
107-0109	Buck 9	9	1987	171	3B	No	No	
107-0113	Buck 13	6	1987,94,98,01	128	3B	No	No	
107-0120	Buck 20	25	1988	238	3B,4A	No	No	Overstory present
107-0121	Buck 21	16	1988,99	297	4A	No	No	Overstory present
107-0124	Buck24	17	1989	404	4A	Yes	No	Overstory present
107-0127	Buck 27	14	1987	54	4A	No	No	
107-0128	Buck 28	7	1990,91,98	36	3C	No	No	
107-0129	Buck 29	9	1990,91,98	125	3C	No	No	
107-0130	Buck 30	7	1992,94	69	3C	No	No	Overstory present
107-0131	Buck 31	17	1988,91	167	3C	No	No	
107-0132	Pellet 3	23	1975	194	4B	No	Yes	
107-0133	Pellet 7	20	1975	126	4B	No	Yes	
107-0134	Buck 34	20	1992	190	3B	No	No	
107-0185	Boulder 11	1	1978	160	3B	No	Yes	
107-0186	Boulder 13	2	1978	160	3B	No	Yes	
107-0214	Kennedy 9	16	1971	71	3A	No	Yes	
107-0215	Kennedy 9a	2	1971	71	3A	No	Yes	
107-0293	Pellet 1	9	1975	187	3A	No	Yes	
108-0006	Evans 5	3	1980	436	4B	No	No	
108-0007	Kennedy 11	20 of 40	1971,72	150	3A	No	Yes	
108-0008	Kennedy 10	11 of 32	1971,72	105	3A	No	Yes	
108-0022	Evans 1	4	1980	186	3A	No	No	

108-0023	Evans 4	3	1980	186	3A	No	No	
108-0024	Evans 3	16	1980	186	3A	No	No	
108-0035	Evans 2	5	1980	186	3A	No	No	
	Total acres	853						

*This column reflects whether or not a prescribed under burn, or a creeping, cool un-prescribed under burn would or would not cause unacceptable damage to Boulder area plantations. The criteria are based on District records, field examinations, and the Boulder Project plantation decision tree shown on the next page. These criteria are meant as guidelines. Exceptions or changes are allowable at time of burning. Examples of plantations considered burnable or not are shown in Appendix D

Boulder Project Plantation Decision Tree.

1a. Plantation trees ≥ 40 years old. Go to 2.
1b. Plantation trees < 40 years old. Go to 3.

2. Burning is OK.

3a. Trees ≤ 20 years old. No burning.
3b. Trees 20 to 40 years old. Go to 4.

4a. Brush is ≥ 25% the height of the trees. No burning.
4b. Brush is < 25% the height of the trees. Go to 5.

5a. Slopes ≥ 45%. No burning.
5b. Slopes < 45%. Burning OK

Figure 9: Plantation 1070005-Ok to Burn

Figure 10: Plantation 1070018-Not OK to Burn

Appendix E-Management Requirements and Constraints

The items listed below were determined by the ID team to be actions necessary to carry the results of their analysis into the design phase of the Boulder Creek Fuels Restoration Project planning. Implementation of best management practices (BMPs) is mandatory even though they may not necessarily be required to avoid unacceptable environmental effects.

Specialty	Action or Constraint	Responsibility and When to Accomplish	How and When Accomplished[6]
Fuels/Air	A smoke management plan must be submitted and approved by the San Joaquin Valley Air Pollution Control District (District) prior to the project. As part of the plan the Forest Service must provide a detailed meteorological prescription that must be met prior to igniting any of the burning operations. At a minimum the prescription must include acceptable wind direction. Other considerations include wind speed, temperature profile, winds aloft, humidity, temperature, actual and predicted inversions, burn day status and forecast, precipitation forecast, and any other meteorological conditions which may affect smoke dispersion and/or fire behavior. The plan must also contain contingency measures in the event smoke impacts smoke sensitive areas. Smoke sensitive areas must be delineated in the plan.	Fuels officer; During design and implementation.	
	The Sequoia National Forest operates a comprehensive air quality and smoke monitoring program. The program emphasizes instrumentation that provides near real-time data for fine particles, ozone and meteorology. Instrumentation would be placed at smoke sensitive areas and would be used to coordinate with the District and the Great Basin Unified Air Pollution Control District. Information would be coordinated to assist in mitigating public exposure. In addition, an Air Quality Specialist would be assigned to provide smoke forecasts utilizing the monitoring data and predictive models.	Air Quality Specialist; During design and implementation.	
	Prescribed fire operation plans would follow San Joaquin Valley Air Pollution Control District guidelines.	Fuels officer; During design and implementation.	
	Prior to implementing fire operations, public notification aimed at sensitive individuals and groups would be conducted in both the San Joaquin and Great Basin Air Districts..	Fuels officer and Public Affairs officer; Prior to and during implementation.	
Geology/ Caves	Protect cave entrances from all activities, including prescribed fire, hand treatments, and recreation. Cave entrances would need to be protected from fire by preventing direct ignition of plastic spherical incendiary devices (PSD) in cave entrances. PSD should not be dropped within 500 feet above cave entrances and should	Fuels officer; During design and implementation.	

[6] This section can be brought forward into a contract, and would be filled in as the project is implemented.

	not be dropped within 200 feet below or on either side of cave entrances. Locations of cave entrances would be given to the project implementation team in order to protect the entrances.		
	Monitor soil in the Boulder Project area to determine the degree of soil burn severity and soil cover, especially in the first entry of Area 1. If the impacts to ground cover and burn severity are not as expected in Area 1, the prescribed fire prescription should be adjusted to achieve desired results.	Fuels officer and geologist; During implementation.	
	Monitor conditions in Boyden Cave and Church Cave to evaluate sediment deposition in cave passages. If sediment is deposited in cave passages from this project, removal of the sediment to allow access through the cave should be considered.	Geologist; During and after implementation.	
Heritage Resources	Information where and how site boundaries are delineated would be communicated to the appropriate personnel prior to work occurring in the vicinity of the sites. The Zone Archaeologist, in conjunction with the fuels, vegetation management, or fire specialists as necessary, shall develop treatment measures for *at risk* historic properties designed to eliminate or reduce potential adverse effects to the extent practicable by utilizing methods that minimize surface disturbance, and/or by planning project activities in previously disturbed areas or areas lacking cultural features.	Zone archaeologist, fuels officer; During design and implementation.	
	Protect all "At-Risk Historic Properties": All at-risk sites would receive the following protection (Region 5 PA). • Sites that are determined to need protection may receive any of the appropriate protection measures: i) Fire crews may monitor sites to provide protection as needed. j) Fire lines or breaks may be constructed off sites to protect at-risk historic properties. k) Vegetation may be removed and fire lines or breaks may be constructed within sites using hand tools, so long as ground disturbance is minimized, and features are avoided, as specified by the Zone or Forest archaeologist. l) Fire shelter fabric or other protective materials or equipment (e.g., sprinkler systems) may be utilized to protect at-risk historic properties. m) Fire retardant foam and other wetting agents may be utilized to protect at-risk historic properties and in the construction and use of fire lines. n) Surface fuels (e.g., stumps or partially buried logs) on at-risk historic properties may be covered with dirt, fire shelter fabric, foam or other wetting agents, or other protective materials to prevent fire from burning into subsurface components and to reduce the duration of heating underneath or near heavy fuels.	Zone archaeologist, fuels officer; During design and implementation.	

	o) Trees which may impact at-risk historic properties should they fall on site features and smolder can be directionally felled away from and left in the vicinity of properties prior to ignition, or prevented from burning by wrapping in fire shelter fabric or treating with fire retardant or wetting agents. p) Vegetation to be burned shall not be piled within the boundaries of historic properties unless the location (e.g., a previously disturbed area) has been specifically approved by the Zone or Forest Archaeologist. • The Zone or Forest archaeologist shall determine whether prescribed fire treatments within site boundaries shall be monitored, and how such monitoring shall occur. • If the standard protection measures cannot provide appropriate protection, the undertaking shall be subject to the provisions of 36 CFR 800.		
	Post burn ATV use and casual collection ○ Protect exposed, sensitive cultural resources from looters or vandalism to sites by placing barriers to block off illegal travel routes and maintenance level 1 roads (13S05C and 13S44). ○ Forest Service law enforcement, and patrol personnel would be increased. Patrols are expected to be effective as a Forest Service presence in the burned area and reduce the opportunity for potential vandals and looters. Patrols should continue until public interest decreases, and re-growth has served to obscure previously exposed artifacts and features. ○ Archaeological site stewards certified through the California Archaeological Site Steward Program and part of the Sequoia National Forest Site Steward Program would be assigned to monitor selected sites. ○ All law enforcement officers, forest service personnel and site stewards assigned to the project would receive annual Archaeological Resources Protection Act (ARPA) and cultural resource protection training conducted by the Zone Archaeologist and a law enforcement officer.		
	Trail maintenance work On all historic trails work would be limited to routine trail maintenance limited to brushing and light maintenance of existing tread with hand tools.		
	When Avoidance Is Not Possible: If a procedure described above cannot be implemented to protect cultural resources, the Zone or Forest Archaeologist shall immediately consult with State Historic Preservation Office (SHPO). If the SHPO and Forest agree that the activity would not diminish or destroy those qualities that may make the property eligible or potentially eligible	Zone archaeologist, fuels officer; During design and implementation.	

	(including potential visual impacts if NRHP criteria A or C may be relevant) then the permitted use may continue without further mitigation.		
	Unanticipated Discoveries: There is always the possibility that surface and sub-surface cultural resources would be located during project operations. Should any additional project cultural resources be located, the find must be protected from operations and reported immediately to the Cultural Resource staff. All operations in the vicinity of the find would be suspended until the sites are visited and appropriate recordation and evaluation is made by the Zone or Forest Archaeologist.	Zone archaeologist, fuels officer; During implementation.	
Noxious Weeds	Avoid any known noxious weed infestations during project implementation and staging of fire crews	Botanist and Fuels officer: During implementation.	
	Require equipment and personnel (boots/tools) to be free from noxious weeds and soil before working in the project area (i.e. power wash prior to accessing work area)	Botanist and Fuels officer: During implementation.	
Recreation	Notify public through notices on trailheads, recreation information boards, and press releases prior to implementing each phase of project. This includes residents of the local communities and potentially affected air districts (including the Great Basin-Owen's Valley)	Recreation Officer, Fuels officer and Public Affairs: During design and implementation.	
	Repair signs that are damaged during project implementation.	Recreation and Fuels officers, During implementation	
	Remove man-made debris including plastic spherical incendiary devices that may be found in project area, especially near the trail system, after implementation.	Recreation and Fuels officers, During implementation	
Silviculture	Protect young trees (less than or equal to five inches diameter): • Burn under a cooler prescription (i.e. low intensity fire), • Construct fire control lines by hand to exclude fire from reaching the young trees, • Break up and scatter fuel concentrations, or employ hose lays to reduce fire intensity near small trees.	Fuels officer and Ecosystem Mgt. staff; During implementation	
	Protect large, old-growth sequoias by: • Pulling surface and ladder fuels away from the stems and exposed basal fire scars of live and dead old-growth sequoia, • If necessary for protection, remove ladder fuels by hand that would cause a crown fire in live old-growth sequoias.	Fuels officer and Ecosystem Mgt. staff; During implementation	
Watershed/Soils	Implement BMPs as appropriate to selected alternative and final project design.	Fuels Officer and Hydrologist; During design and implementation.	
	Conduct post-project monitoring as necessary along specified roads and streams.	Hydrologist; After implementation.	

Wildlife	Notification of the district wildlife biologist is required should a nest or den site of any TES species become known during project implementation.	Wildlife biologist and Fuels officer; During design and implementation.	
	For spring burning, active northern goshawk and spotted owl nest sites would be avoided. This would require surveys prior to burning and either putting in handline around the nest stand or modifying the boundary of the burn unit to exclude the area. Portions of two designated northern goshawk PACs fall within the project area. A limited operating period of February 15 through September 15 for activities within one-quarter mile of the nest site may be required if disturbance to nesting activities is possible.	Wildlife biologist and Fuels officer; During design and implementation.	
	For prescribed fire treatments, use firing patterns, fire lines around snags and large logs, and other techniques to minimize effects on snags and large logs.	Wildlife biologist and Fuels officer; During design and implementation.	