Chapter 3. Affected Environment and Environmental Consequences

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

The information presented in this chapter was derived from more detailed specialist reports, survey reports, resource inventories, and other records that are on file in the Perk-Grindstone Fuel Reduction project record, located at the Smokey Bear Ranger District office in Ruidoso, New Mexico.

The glossary following this chapter contains simple definitions for the technical or agency-specific terms used in this chapter.

This chapter is not an encyclopedic evaluation of each resource in the area. It focuses on the significant issues identified in chapter 1, along with brief discussion of the other issues in chapter 1, to explain why they do not warrant indepth analysis. This approach to narrow the scope of the analysis is consistent with National Environmental Policy Act (NEPA) regulations.

Vegetation, Fuels, and Fire

Affected Environment

Wildfire behavior is governed by topography, weather, and fuels. Compared to surface fires, crown fires exhibit higher spread rates and flame lengths, and result in higher severity impacts to human populations and the environment (Scott and Reinhardt 2005). After briefly describing the project area's relevant topography and weather patterns, this section focuses on the fuels, which is an element that the Forest Service can influence to reduce the potential for a severe crown fire.

Slope is one topographic element that affects fire spread and intensity. Fire burns faster and hotter upslope than downslope or on level ground. Fires spread through tree crowns more readily on steeper slopes. About a third of the project area has very steep slopes (over 40 percent slope), a third has moderately steep slopes (20 to 40 percent slope) and a third has relatively gentle slopes (less than 20 percent slope). A slope map is displayed in the "Water and Soil" section. The project area's topography is complex, with intersecting east-west and north-south ridges, as can be seen on the cover page of this EIS. The aspect, or direction the slope faces, strongly influences fuels and fire behavior in this mountain range (Hanks and Peddie 1974). South- and west-facing slopes tend to be drier and more open while north and east aspects tend to be moister and have dense stands with heavy fuel loads. Fuel conditions vary considerably across the project area not only due to the complex topography, but also because of past thinning, grazing and wildfire disturbances that occurred in some locations and not in others (past disturbance events are described in appendix A).

Weather also affects fire spread and intensity, especially in this arid part of New Mexico. The "fire season" in this area typically occurs in the spring, from April through mid-July. It is characterized by low humidity, strong winds, and an unstable atmosphere. Wind aids in the drying of fuels which makes fires burn hotter and spread faster. During the dry, windy fire season, monthly rainfall averages 0.5 to 3 inches. Winds typically blow in a southwest to northeast direction. Winds are usually 10 to 15 miles per hour (at eye level) during this season, with daily

high wind speeds averaging 25 miles per hour and 2-minute sustained wind speeds up to 50 to 60 miles per hour (New Mexico State University 2007). Depending on specific weather conditions, if a fire ignites in the project area during fire season, it would be expected to spread quickly to the northeast—directly toward the Village of Ruidoso. There are over 1,000 residential properties within a mile of the project area boundary, and the municipal water supply in Grindstone Reservoir lies directly adjacent to the project area.

Data collected for fuels analysis including changes in vegetation and fire behavior is based on using site-specific stand data and computer applications, combined with scientific research and onsite observations by forestry and fuels specialists. Forest stand examinations were completed from 2004 through 2006 with additional site visits by specialists in 2006 and 2007. Thus, the data cited in this section comes from those databases together with computer generated outputs from the Forest Service computer models designed for this type of analysis: INFORMS–Integrated Forest Resource Management System model (Williams et al. 1998) and FVS-FFE–Forest Vegetation Simulator with Fire and Fuels Extension (Reinhardt and Crookston 2003, Dixon 2003). Where stand data was lacking, the stand database was populated using the Most Similar Neighbor program (Moeur and Stage 1995). The MSN populated 14 of the 194 stands (7 percent) in the project area with data. The INFORMS and FVS-FFE applications were used together to help predict wildfire behavior under different management scenarios based on forest composition and structure, together with topography and weather variables. The project objective and evaluation criteria for this project analysis is based on changing the crown fire hazard potential, which is derived from the stand density, crown base height, crown bulk density, and other factors that influence crown fire behavior. Thus, this “Vegetation, Fuels and Fire” section evaluates changes in wildfire behavior by considering each of the following interrelated vegetation and fuels characteristics:

- Species composition;
- Stand density;
- Ladder fuels and crown base height;
- Canopy cover and crown bulk density;
- Fuel models and surface fuels; and
- Crown fire hazard.

Species Composition

Forest cover types are defined by the most dominant tree species in the overstory canopy of a forest. The project area is composed primarily of mixed conifer, ponderosa pine and piñon-juniper forest cover types, with very small amounts of oak woodland (3 percent), and negligible patches of shrubland or grassland (less than 0.1 percent). The mixed conifer is considered a “dry zone” mixed conifer, and there is no spruce-fir or aspen forest that can be found at more mesic sites. Figures 20 and 21 show the percent of the project area covered by each major vegetation type and a map of the distribution of vegetation types within the project area.

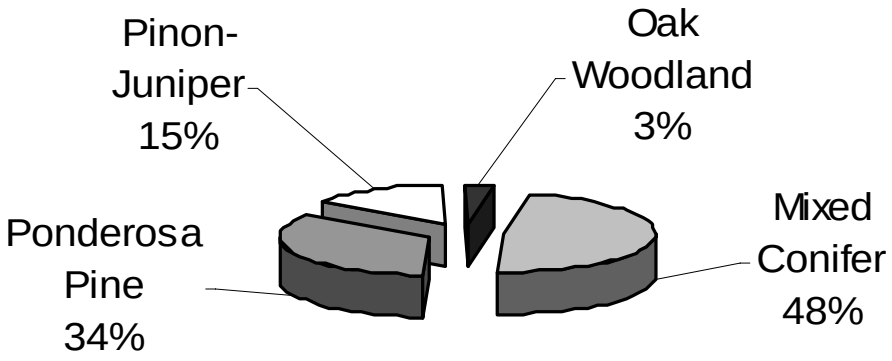

Figure 20. Percent of project area in each vegetation type

Historic fire disturbance patterns (fire regimes) played a key ecological role in the sustainability of southwestern forests, prior to the past 100 years of fire suppression. Most fires on the Lincoln National Forest and throughout the Southwest were started by lightning strikes, although human-caused fire ignitions have increased in the past few decades (Wilkinson et al. 1996, Kaufmann et al. 1998). Native people also ignited fires for a variety of purposes (Arno 1985, Gruell 1985, Barrett 1988, Savage and Swetnam 1990, and Veblen and Lorenz 1991); however, lightning strikes are common in this area and lightning ignition alone could produce the fire frequencies found in fire scar studies (Schroeder and Buck 1970, Swetnam and Baisan 1996). Historically, wildfires could burn until they ran out of fuel or were extinguished by rain, so they could burn for months and cover thousands of acres (Swetnam 1990, Swetnam and Baisan 1996). Most southwestern forest cover types burned every 2 to 30 years experiencing low to moderate intensity, area-wide fires (Dahms and Geils 1997). On moist aspects in the mixed conifer stands, fires sometimes burned as single tree, low intensity fires while other fires involved small to medium size group torching (Grissino-Mayer et al. 1995, Minnich et al. 2000). Fires that once burned regularly through these ecosystems naturally thinned out many of the seedlings, saplings and small trees. Fires historically maintained many of the ponderosa pine and piñon-juniper stands in an open “park-like” condition (Biswell et al. 1973; Brown and Davis 1973; Cooper 1960; Hall 1976). Fire history studies in ponderosa pine stands all indicate that fire return intervals in these stands were consistently frequent, while fire return intervals in mixed conifer varied more widely. Fire history studies indicate that the average pre-settlement frequencies of area-wide fires in Arizona and New Mexico forests are as follows (Dahms and Geils 1997, Kaufmann et al. 1998, Paysen et al. 2000):

- Ponderosa pine—every 2 to 10 years;
- Mixed conifer—every 5 to 25 years; and
- Piñon-juniper—every 10 to 30 years.

Current fire regimes have changed substantially in the ponderosa pine, dry mixed-conifer, and piñon-juniper forests that dominate the project area, due to 100 years of fire suppression and other human activities (Peterson et al. 2005). Fires that started in the project area over the past 100 years were quickly suppressed resulting in minimum fire growth, so there have been no large fires

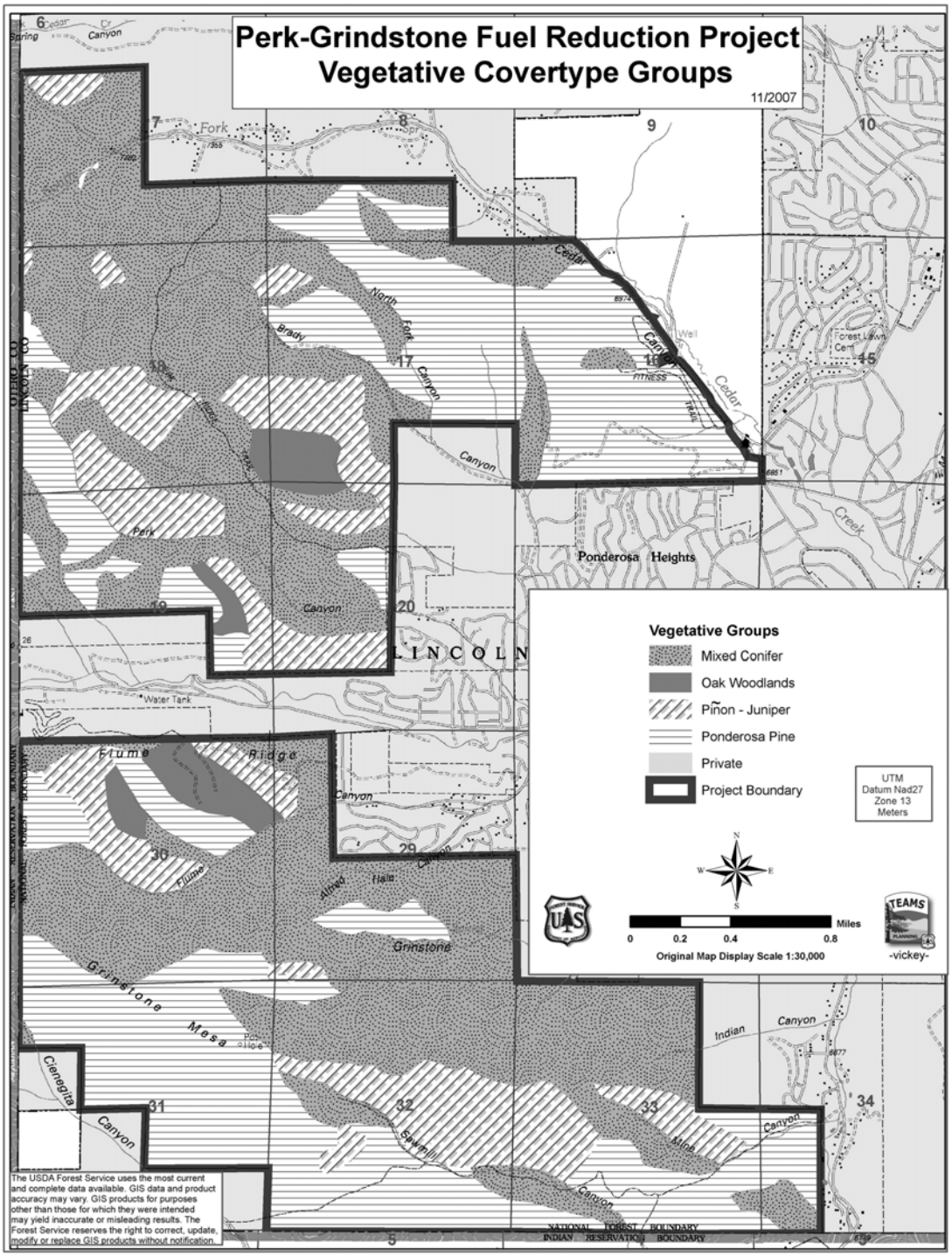

Figure 21. Distribution of major vegetation types within the Perk-Grindstone project area

(>10 acres) in the area since 1945 (appendix A). While there has been a lack of low to moderate intensity surface fires in the ponderosa pine and a lack of small, stand-replacing fires in the mixed conifer forest, there have been more and more high intensity crown fires occurring throughout the Southwest (Graham et al. 2004). There have been at least five large-scale, high-intensity crown fires that occurred within 1 to 8 miles of this project area within this past decade (appendix A). The number of uncharacteristic wildfires has increased in New Mexico over the past decade, some of which have taken human lives and destroyed properties and natural resource values. Crown fires in ponderosa pine forests are absent in the local and regional fire scar records (Touchan and Swetnam 1991), indicating that current stand conditions are a historic aberration attributable to modern human-caused fire exclusion, past vegetation management practices, and historic grazing (Graham et al. 2004).

Forest species composition has changed dramatically as a result of the long-term lack of natural fire regimes. A heavily shaded closed canopy forest blankets most of the project area, which once had many more openings and areas with wider spaces between trees or clumps of trees. Evidence from pre-settlement research in this project area indicates that the mixed conifer and ponderosa pine forests in the project area were once dominated by large Douglas-fir and ponderosa pine trees. Currently, nearly 50 percent of the area is classified as mixed conifer forest due to dominance by white fir trees. Evidence from down logs and stumps indicate that this area historically was dominated by ponderosa pine trees with few white fir trees, meaning more stands would have historically been classified as ponderosa pine (Denton 2006, Kaufmann et al. 1998). Now most of the project area is filled with high densities of white fir seedlings and saplings. White fir, a shade-tolerant species that grows well in the shade of other trees, is not adapted to survive fires (Schmidt 1985). The large, thick-barked ponderosa pine and Douglas-fir trees that once dominated this project area could survive low to moderate intensity fires (Biswell et al. 1973). Losses in the abundance of some of the larger ponderosa pine and Douglas-fir trees occurred as some were selectively removed in the early 1900s; while others were killed by dwarf mistletoe and bark beetle attacks after becoming suppressed from over-competition with other trees. Thus, the area has a noticeable deficit of large pine and Douglas-fir trees, along with a deficit of ponderosa pine and Douglas-fir seedlings.

Piñon-juniper woodlands historically had a greater diversity in their relative stand densities than adjacent ponderosa pine stands (Dahms and Geils 1997). These woodlands are comprised of mostly alligator juniper, one-seed juniper, and two-needle piñon pine. These woodlands have increased in both density and extent over time due to lack of fire (Paysen et al. 2000). The pattern of tree patches in woodlands is influenced by soil depth, nutrients, microbes, drought, plant competition, fire, grazing, and insect-pathogen attack (Gehring and Whitham 1995; Klopatek et al. 1990; Leopold 1924). Some piñon-juniper stands in the project area are sufficiently open to naturally decrease the probability of a running crown fire while others are quite dense and a running crown fire could quickly spread from tree to tree.

Grass, forbs and shrub species are negligible on the forest floor throughout the project area, due to the lack of fires and increases in tree canopy cover. As tree canopy cover increases, understory herbaceous vegetation decreases (Cooper 1960, Agee 1993, Miller and Tausch 2002). Periodic fires also release soil nutrients and increase understory vegetation (Kozlowski and Ahlgren 1974). This lack of surface vegetation reduces the ability of the area to support natural surface fires, while reducing wildlife habitat quality, biological diversity, and the overall functionality of these ecosystems. In addition, grasslands or open grassy meadows appear to comprise a smaller proportion of the landscape than what evidence indicates occurred in the past when fire played a

role in creating and maintaining more openings. Historic meadows, once free of trees, have been encroached upon by conifer trees, which has resulted in meadow vegetation gradually declining or disappearing altogether. Historically, there was more oak in the understory of the drier ponderosa pine and piñon-juniper stands, as well as more scattered open patches of oak (both Gambel and scrub oak species). Thus, the change in understory vegetation has been as pronounced as the change in overstory vegetation, due to the lack of natural fire regimes. Currently, most of the ground surface in the project area is covered by conifer needles and other duff (partly decayed organic matter) rather than by the grass, forbs and shrubs that once occupied much of the forest floor.

Stand Density

The primary indicator of stand density and its effect on fire behavior is stand density index (SDI), which measures competition between trees and the relative density of a stand. The SDI measure accounts for both the tree diameter (quadratic mean diameter) and trees per acre, so SDI is considered a more comprehensive and accurate indicator of stand density than tree diameter, basal area (square feet of wood mass per acre) or trees per acre alone (Ducey and Larson 2003). The SDI was used in and is recommended by the "Lincoln National Forest Capability Assessment" to evaluate thinning treatments in wildland-urban interface areas and spotted owl habitats (Ortega et al. 2005). The "Lincoln National Forest Capability Assessment" and Dixon (2006) suggest the following maximum SDIs for this analysis as: 560-595 for mixed conifer (based on Douglas-fir species), 450 for ponderosa pine, and 415-465 for piñon-juniper. At about 25 percent of the maximum SDI, trees begin competing for site resources; at 35 percent of the maximum, the site resources are fully utilized and competition begins to cause suppressed tree growth and ladder fuels begin to accumulate; and at 55 percent of the maximum SDI, competition between trees results in insufficient moisture, nutrients and light for trees like ponderosa pine, Douglas-fir and piñon pine to survive (Long 1985). Most stands in the project area exceed 55 percent of the maximum SDI and are within the "zone of imminent mortality" (Long 1985). Table 10 shows the percent of each forest cover type within the project area with a SDI greater than 55 percent of the maximum for that forest type. The SDI data for this project area indicate that the area has unnaturally high tree densities in the majority of the stands; stands are at high risk of mortality from insects, disease, drought and wildfire (Denton 2006, Dahms and Geils 1997, Paysen et al. 2000).

Table 10. Percent of each forest type in the project area with a stand density index greater than 55 percent of the maximum.

Forest Type	Percent at Over 55 Percent of the Maximum SDI
Mixed Conifer	75%
Ponderosa Pine	99%
Piñon-Juniper	97%

In addition, a tree's resistance to disease and insect pests declines at SDI levels over 55 percent (Cochran 1992, Cochran et al. 1994). The over-crowding of trees and competition for moisture also causes trees to be severely stressed, and frequent drought periods common to southwestern forests make this situation even worse. There has been an increasing trend in dwarf mistletoe and bark beetle activity in the area as stand density has increased, and it worsened during the last

drought period. Dwarf mistletoe can be found in many of the Douglas-fir and ponderosa pine trees in this area. Dwarf mistletoe robs the host tree of its nutrients and water, making it more susceptible to mortality from bark beetles or fire (Conkin and Armstrong 2002, Harrington and Hawksworth 1990). Severe dwarf mistletoe infection can also kill the host tree. In addition, the mistletoe forms into “brooms” on the tree branches which are highly flammable. The range of bark beetle species, found to be killing nearly all species of trees in the project area, are primarily the fir engraver beetle, Douglas-fir bark beetle, and mountain pine beetle. In over half the stands in the area, 10 to 40 percent of the trees are already dead. Dead trees retaining red needles are known to increase wildfire intensity and once the needles drop, the dead trees become a hazard to the public and fire fighting crews.

Basal area is another measure generated from stand exam data that indicated the area had a high stand density. Basal area describes the amount of wood biomass contained in the tree trunks on a given acre of land. Most of the project area (over 50 percent of each of the forest types) has high basal areas that range from 75 to 120 square feet per acre. About 25 to 30 percent of the forest stands in the project area have basal areas ranging from 125 to 225 square feet per acre.

The average number of trees per acre is another indicator of stand density in this area. Table 11 shows the average number of trees per acre by diameter class and forest cover type within the project area. Trees per acre, excluding seedlings, range from 369 to 513 per acre. Tree seedlings and oak sprouts, less than 1 inch in diameter, average in the thousands per acre and, therefore, are not shown in the table. The table shows that the smallest trees are the most prevalent in terms of trees per acre, and there is a limited number of large trees.

Table 11. Average number of trees per acre by diameter class and forest type within the project area

Forest Type	Diameter Class (Inches)	Average Number of Trees Per Acre
Mixed Conifer	1.0 to 5.9	315
	6.0 to 11.9	93
	12.0 to 17.9	31
	18.0+	8
Total average trees/acre		**447**
Ponderosa Pine	1.0 to 5.9	263
	6.0 to 11.9	68
	12.0 to 17.9	30
	18.0+	8
Total average trees/acre		**369**
Piñon-Juniper	1.0 to 4.9	388
	5.0 to 8.9	90
	9.0 to 15.9	26
	16.0+	9
Total average trees/acre		**513**

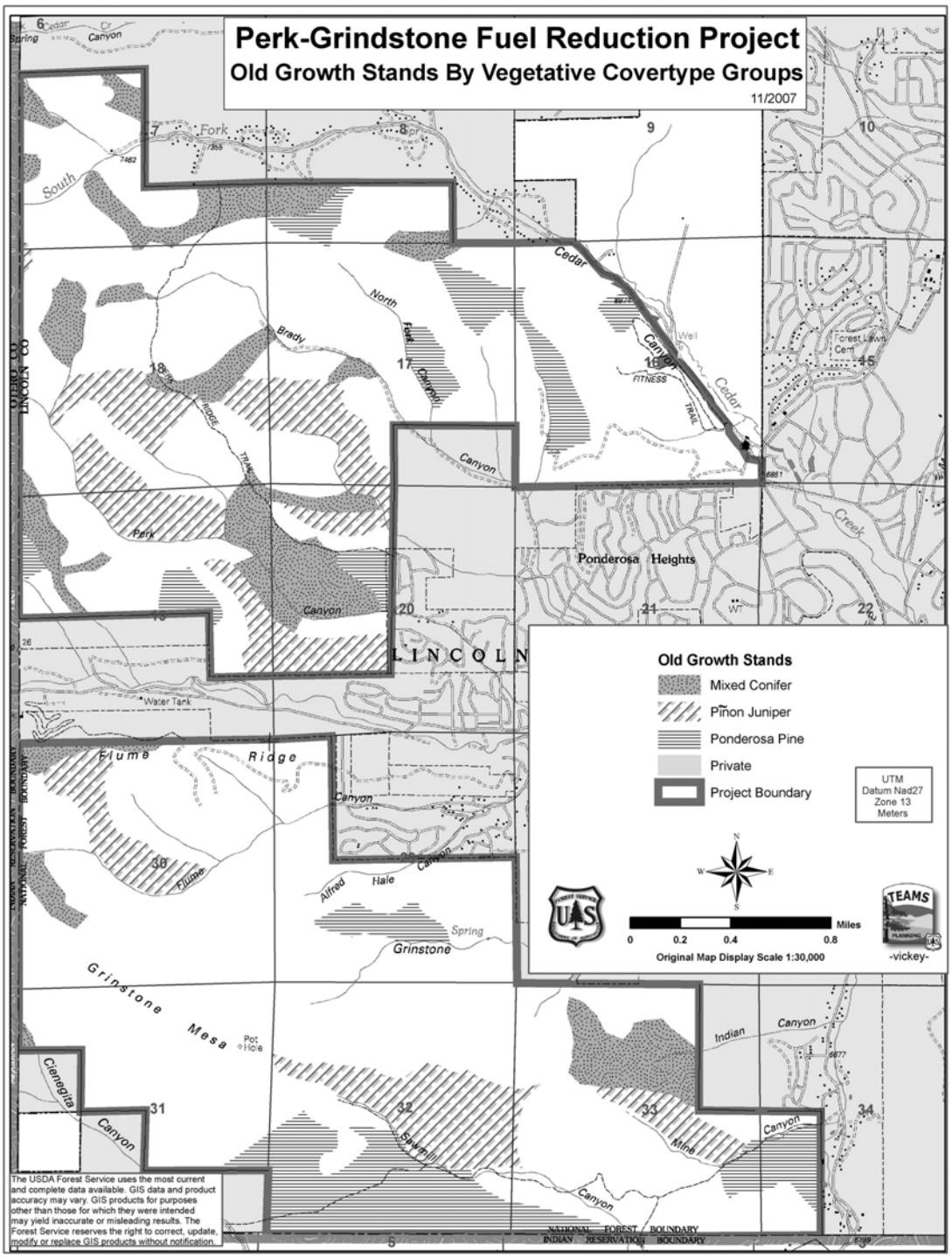

Figure 22. Old growth management areas within the project area, by vegetation cover type

Old growth stand structure is lacking in the project area as a result of high numbers of small trees per acre. The forest plan for the Lincoln National Forest defines the attributes to be used in defining old growth, which typically relate to the number of large trees, snags and down logs, along with canopy cover and other stand attributes. The forest plan specifies a process for allocating stands to be managed toward old growth within each "ecosystem management area" (U.S. Forest Service 1986: 38A-38B). In considering old growth management, all of the virtually contiguous national forest land in and surrounding the project area was evaluated. This is the land area that would be considered the "ecosystem management area" for purposes of allocating stands to be managed as old growth in accordance with the forest plan. The forest plan specifies that at least 20 percent of each ecosystem management area is to be managed for old growth characteristics.

As a result of the potential old growth assessment process, 1,623 acres or 29 percent of the ecosystem management area was classified as old growth. This includes about 20 percent of mixed conifer, 28 percent of ponderosa pine and 79 percent of piñon-juniper, based on the stands exhibiting characteristics closest to the old growth criteria. In assessing stands that may meet old growth characteristics, conservative assumptions about site quality were made so that more acreage could be considered for management as old growth, especially in ponderosa pine. Most of the stands classified in this process as old growth meet the forest plan criteria for number of live trees per acre by age or size, stand basal area, and canopy cover criteria. The forest plan allows for old growth stands to be thinned during fuel reduction projects as long as old growth characteristics are maintained or enhanced.

Canopy Cover and Crown Bulk Density

One factor affecting crown fire spread and intensity is the canopy closure. Canopy closure refers to the degree to which the tree crowns block sunlight and obscure the sky. A closed canopy is one that is dense enough that tree crowns fill or nearly fill the canopy layer so that sunlight cannot reach the forest floor. The majority of the project area contains closed canopy forest, with an average of 40 to 60 percent canopy closure. The highest canopy closure generally occurs on the north- and east-facing slopes in the higher elevation mixed conifer forest type. At over 40 percent canopy closure, tree crowns are close enough to support a rapidly spreading crown fire (Van Wagtendonk 1996).

A related factor affecting fire behavior is crown bulk density (CBD), which is a measure of the weight of the canopy fuels (needles and branches) per unit of crown volume (pounds per cubic yard). The crown bulk density is measured for stands rather than for individual trees. Increased numbers and sizes of trees result in more fuel in the crowns. Studies have found that higher crown bulk densities contribute to sustaining crown fires (Fule et al. 2003). Crown bulk density of 0.17 pounds per cubic yard (lb/yd^3) or higher can sustain a crown fire (Agee 1996). Crown bulk densities in the project area average 0.76 lb/yd^3 based on the FVS-FFE data that converts tree numbers and sizes to crown bulk density.

Ladder Fuels and Crown Base Heights

Ladder fuels (small trees, shrubs and low branches) prevalent in this area can easily carry a surface fire up into the crowns of overstory trees. It is well known that ladder fuels are a key factor that promotes crown fire behavior, and eliminating ladder fuels can encourage crown fires to return to the forest floor (Van Wagner 1977, Scott and Reinhardt 2001). **Crown base height** is

one measure of the arrangement of ladder fuels and refers to the distance from the ground to the base of the tree crowns. Stands with small understory trees, shrubs or low branches have a low crown base height and would be expected to initiate crown fire behavior (Alexander 1988). Crown base heights in the project area currently range from 1 to 17 feet, with the majority of stands having crown base heights of 1 to 10 feet. When ladder fuels like small trees torch (ignite) or surface logs and branches burn with higher flame lengths as expected in this area, the flame would be able to reach the lower limbs of overstory trees and initiate a crown fire. Photos in chapter 1 show examples of ladder fuels in the project area.

Fuel Models and Surface Fuels

Fuel models are representations of surface fuels, including the quantity and distribution of those surface fuels. Fuel models are also used as inputs to the FVS-FFE model to help predict wildfire behavior. In analyzing surface fuels in the project area, representative fuel models were assigned to each stand, using a combination of Scott and Burgan's 40 fuel model photos (Scott and Burgan 2005) and Anderson's 13 fuel model photos (Anderson 1982). This analysis found that the most dominant fuel models in the project area are the "timber litter" models, typified by an accumulation of needles, twigs and branches on the forest floor under a dense tree canopy. Timber litter fuel models 8, 9 and 10 all occur in the area, with fuel model 9 being the most prevalent. Fuel models dominated by grasses and forbs, represented by an "herbaceous" fuel model, cover a very small portion of the project area due to the amount of closed canopy forest. Fuel models in the project area vary primarily with respect to the quantity of down woody material on the forest floor.

Fire behavior varies within different fuel models under the same weather conditions. Light fuel loadings that occur in grassy openings typically contain 4 to 8 tons per acre, which allows for a less intense fire with lower flame lengths. The average surface fuel loading across the project area is 14 to 55 tons per acre, which is considered a heavy fuel load that will promote a high intensity fire (Sackett 1979). Surface fuel loading is continuing to increase in this project area due to the severe over-crowding of trees causing suppression of tree growth and vigor, which results in a high rate of mistletoe and bark beetle attack, resulting in trees dying and eventually falling over.

Crown Fire Hazard

The crown fire hazard rating is based on a combination of the forest and fuel characteristics previously described, along with slope, which generate a torching index and crowning index. Torching index is a measure of the wind speed (in miles per hour at a 20-foot height) at which a surface fire will climb up surface fuels and ignite the tree crown. The crowning index is the wind speed (in miles per hour at a 20-foot height) required to sustain fire in the crowns of trees. So although crown fire hazard ratings are generated based on a combination of crowning and torching indices, the crowning index is the primary measure used for describing crown fire hazard (Fiedler and Keegan 2003).

A low crowning index, such as 30 or 40, results in required average winds of 30 to 40 miles per hour to create an active crown fire. An active or running crown fire is a continuously spreading fire that is the most difficult fire to control. The lower the index or wind speed, the more susceptible the stand is to crown fire initiation and spread. Currently, the average crowning index in the project area ranges from 20 to 30 miles per hour. Average daily sustained wind speeds of 20 to 30 miles per hour are common during the normal fire season in this area, with sustained winds

reaching 40 to 50 miles per hour during windy periods. Thus, a running crown fire could easily occur in the area under current conditions and normal weather patterns. The desired condition is to have torching and crowning indices higher than 35 or 40 mile per hour wind speeds.

To improve crown fire hazard and meet desired conditions, a reduction in susceptibility to low winds speeds must be achieved. Reducing the number of small, ladder-fuel trees per acre, which would raise the crown base height, would improve stand resistance to crown fire.

There are five crown fire hazard rating classes, from low to extreme. The five classes are based on the combination of the stand's susceptibility to torching and crowning. The higher the crown fire hazard rating, the lower the wind speed required to initiate and sustain an active crown fire.

Currently, over 60 percent of the project area has a high, very high or extreme crown fire hazard rating. Table 12 shows the percent of the project area within each crown fire hazard class.

Table 12. Percent of the project area within each crown fire hazard rating class

Crown Fire Hazard	Low	Medium	High	Very High	Extreme
Percent of Project Area	7%	33%	31%	23%	6%

In addition, the existing Fire Regime Condition Class for the project area is Class 3, meaning that forest conditions that support fire have changed substantially from historic conditions, as previously described in chapter 1.

Environmental Consequences

Alternative 1—No Action

With the no action alternative, there would be no immediate, direct effects on vegetation if none of the proposed actions are implemented. There would be no attempt to reduce the existing hazardous fuels within the project area. With no reduction in existing hazardous fuels, no application of prescribed fire will occur, thus fire will not play a natural role in the long-term sustainability of these fire adapted ecosystems. Wildfires would be suppressed in order to avoid unacceptable impacts to people, property and resources in this wildland-urban interface. However, suppression would become more difficult as conditions worsen with time.

Species composition would continue to experience the following changes if no action is taken:

- Shade-tolerant species (e.g. white fir) regeneration would continue to increase with decreases in large (>18 inch) trees of all species.
- Grasses and shrubs would continue to decline.
- Piñon-juniper stands would continue to expand their coverage and become denser with less open canopies.

Vegetation structural stages are expected to remain dominated by the early to middle successional stages. The number of larger and mature trees in the area would likely decrease as larger trees die and fall over as a result of the high stand density index and associated mortality risk, leaving smaller trees that are less susceptible to bark beetle mortality. Over a long period of time, the

largest, oldest trees would eventually die from disease, insects, or wildfire. If many of the larger trees die out, the stands would primarily shift over time to an early successional stage where more of the basal area (wood biomass) is in the smaller trees.

Stand density would continue on the same trajectory with the following stand changing processes occurring over time:

- Stocking levels would continue to be much greater than desired.
- Most of the forested area in the project area (75 percent of mixed conifer, 97 percent of piñon-juniper, and 99 percent of the ponderosa pine cover types) exceed 55 percent of the maximum SDI and are within the “zone of imminent mortality” (Long 1985). The trend will continue but over time as large trees die naturally, there will be a shift in size class distribution to younger size classes.
- Stocking levels would continue to increase until some kind of disturbance such as a fire or insect outbreak reduces the stocking (Oliver 1995). An increase in bark beetle activity is inevitable and a landscape level outbreak is possible. Landscape level outbreaks would result in mass mortality of trees across all diameter ranges with large trees being killed first, trends which are indicated by current bark beetle activities.
- Competition related mortality would continue to occur (Long 1985), resulting in increases in suppressed tree growth and the increasing formation of ladder fuels.
- Basal areas would remain high at greater than 100 ft^2 per acre.

Canopy cover and crown bulk density would remain dense if no action is taken, with increasing problems over time which are as follows:

- Percent canopy closures, currently about 40 to 60 percent for the majority of the project area, would continue to increase until stabilizing at extremely high canopy closure percentages, increasing the potential of a rapidly spreading crown fire (Van Wagtendonk 1996). The stabilization of canopy closure at high percentages would result in stagnant growth of understory plants as a result of nutrient deficiencies (Long 1985). The stand would become stagnant until a disturbance, such as a fire or insect outbreak, reduces the stocking.
- Crown bulk densities in the project area, currently about 0.76 lb/yd^3—high enough to sustain a crown fire, would continue to remain at levels suitable for supporting crown fire.

Ladder fuels and crown base heights would be unchanged if no action occurred on the landscape.

- Stands would continue to have multiple stories with an abundance of ladder fuels.
- Crown base heights would continue to range from 1 to 17 feet, with the majority of stands having crown base heights of 1 to 10 feet.

Fuel models and surface fuels which comprise the components which contain the primary carriers of fire would continue to gradually increase under the no action alternative. As trees continue to die and fall over, combined with an absence of fire, more of the project area would become

dominated by timber litter or slash fuel models 8, 9, 10, 11, and 12, which have relatively high surface fuel loads.

Crown fire hazard is currently rated as “high” to “extreme” for approximately 60 percent of the project area. The Fire Regime Condition Class is currently 3 which would remain unchanged under the no action alternative, resulting in no change to crown fire hazard under the modeled fire weather conditions.

No Action with Crown Fire

Species composition in forested areas burned, should a crown fire occur, would revert to grass-forb-shrub cover types. Shade intolerant trees (i.e. Douglas-fir and ponderosa pine) would become established in heavily burned areas while the percentage of white fir in the project area would be greatly reduced. The time required for re-establishment of conifer forest would be seed source dependent but could take centuries.

Vegetation structural stages would revert to early successional stages, dominating all Perk-Grindstone stands that are heavily impacted as a result of a crown fire.

Stand density would be reduced by the removal of trees across all diameter classes in areas that are burned. The loss of small trees would also reduce the basal area in forest stands, although large trees that survived a crown fire would still contribute to remaining basal area.

Canopy cover and crown bulk density would be reduced immediately to nearly zero as a result of few, if any, live trees remaining after a crown fire. It would take 15 to 30 years, if not longer, to have a measurable canopy bulk density. Likewise, canopy closure would be almost zero after a wildfire until replaced by a new stand.

Ladder fuels and crown base heights would be dramatically altered under this alternative after being consumed—along with most of the overstory tree crowns—by crown fire. Thus, immediately after this loss of ladder fuels and tree crowns, there would be no crown base heights. Where portions of the forest are spared from crown fire, existing ladder fuels could be either partially reduced (such as by surface fire behavior), or could remain essentially the same as current conditions.

Fuel models and surface fuels, as seen in other large crown fires in New Mexico over the past decade, would typically be consumed. No fuel models represent the surface fuels immediately after a crown fire. However, after about 1 to 2 years, surface fuels could be dominated by the establishment of grasses and/or shrubs, thus the grass or shrub fuel models with no overstory tree canopies would dominate. Within 10 to 20 years, dead, fallen trees would add to the surface fuel loading and would change the fuel model to one with surfaces dominated by a heavy fuel load of down logs.

Crown fire hazard would be dramatically reduced immediately after crown fire as a result of the reduction in trees per acre, canopy bulk density, canopy base height, and ladder fuels.

Alternatives 2 and 3

Since the effects of alternatives 2 and 3 are very similar, they are discussed together. Differences between the alternatives are noted where applicable.

Species composition would be altered with a significant reduction in the number of white fir trees, although they would continue to be present in all age and size classes, and continue to regenerate in patches of closed canopy forest. The abundance and diversity of grass, forb, and shrub species, would noticeably increase, especially in the tree canopy openings where more sunlight penetrates the forest floor. There would be more acres in grassland cover types where historic meadows and grassland areas once encroached by conifer trees are restored to their historic condition by the combination of thinning and prescribed burning. The native hardwood species would continue to occur as they would be specifically retained by the mitigation measures applied. All other native species that existed prior to thinning would continue to occur on the landscape in approximately the same proportions as under the no action alternative.

Vegetation structural stages, on average, would change slightly after thinning and burning treatments. Some of the stands would shift toward a later successional stage where the larger size trees would be more prevalent after smaller trees are reduced.

Stand density would be reduced in all forested and woodland cover types in the project area. However, not all pockets of trees within stands across each cover type would experience reduced stocking levels. As shown in table 13, proposed treatments would significantly reduce the percentage of cover type exceeding 55 percent maximum stand density in the project area.

Table 13. Percent of each forest cover type in the project area exceeding 55 percent maximum stand density index, by alternative

Cover Type	Alternative 1 No Action (Existing)	Alternative 2 or 3 (After Treatment)
Mixed Conifer	78%	14%
Pinyon-Juniper	98%	19%
Ponderosa Pine	100%	17%

Bark beetle risk, as directly related to stand density, would be greatly reduced in most stands and at the landscape level by the treatments proposed for alternatives 2 and 3. The bark beetle risk for stands within the landscape or groups of trees within stands are directly affected by stand densities as a result of competition for resources which affect the overall health of trees. Following the treatments, a small portion of the mixed-conifer (14 percent), ponderosa pine (19 percent), and piñon-juniper (17 percent) cover types within the project area would be considered high risk. These remaining high risk stands comprise a small portion of the area and are distributed across the landscape, so the risk of a landscape level bark beetle epidemic would be quite low (Oliver 1995). Within treated stands where clumps of trees are left untreated, there would be denser groups of trees that would be at high risk for beetle attacks, however, these areas would cover a small portion of the overall stand area. These denser groups of trees may experience isolated bark beetle attacks, but the risk of stand level outbreaks would be quite low (Oliver 1995).

Old growth characteristics would be maintained or improved by the thinning prescriptions developed for this project. Most of the stands classified as old growth would be thinned in order to meet fuel management objectives for this project while retaining old growth characteristics. In

thinning old growth stands, most of the mixed conifer and about 66 percent of the piñon-juniper would be thinned from below up to a maximum 18-inch diameter limit. Most of the ponderosa pine would be thinned from below to a 14-inch diameter limit, and 34 percent of the piñon-juniper in the area (low site) would be thinned from below to a 9-inch diameter limit. Thinning from below to variable densities while creating some canopy gaps has been shown to be useful in accelerating development of late successional forest characteristics (Harrington et al. 2005). The thinning and burning prescriptions applied to both alternatives would be expected to result in retaining or enhancing old growth characteristics consistent with forest plan direction.

In addition, thinning stands allocated to old growth management would maintain or improve the structural diversity of stands by reducing the number of small trees which would reduce competition and aid in balancing the number of trees in each diameter class. Over time, the old growth trees and landscape in general would be dominated by large, thick-barked, fire-resistant Douglas-fir and ponderosa pine trees, while retaining many patches of younger trees and other tree species. The old growth stands would be more characteristic of historic old growth stand conditions under historic fire frequencies as previously discussed.

Canopy cover is currently, and would continue to be, the most highly variable structural component on this landscape after treatment with a mosaic of canopy cover percentages throughout the landscape. The mosaic created will be caused by thinning which will leave groups of trees within stands denser while creating openings in areas of the same stand. Although canopy cover changes across the landscape, the overall change in canopy cover will not be as dramatic as the overall change in trees per acre. The thinning methods that will be utilized will remove smaller trees that do not contribute a great deal of canopy cover in reference to the amount of sunlight that hits the ground. While small trees do provide canopy cover (shade), in many instances the trees that will be removed during thinning will be small trees located under larger, dominate trees. Canopy cover distributions would attempt to mimic historic fire related distributions with north- and east-facing slopes retaining more canopy cover as a result of site quality, and south- and west-facing slopes retaining more openings between trees as a result of fire frequency regimes that historically occurred. Canopy cover distribution would continue to mimic natural forest structure by retaining higher canopy cover in moist drainage bottoms and retaining less canopy cover on harsh, dry ridgetops.

Crown bulk density in thinned areas would be reduced to an average of less than 0.048 lb./cu. yard. However, crown bulk density would be highly variable across the landscape, with patterns similar to the canopy cover patterns: higher crown bulk density in moist, cool aspects of mixed conifer and much lower crown bulk density on drier aspects and in other forest types. The expected reduction in crown bulk density would reduce the potential for a fire to spread horizontally through the tree crowns (Peterson et al. 2005).

The low to moderate intensity broadcast burns proposed in “burn only” treated areas would reduce the excessive numbers of tree seedlings and saplings. These burns would also regenerate the young grasses and shrubs similar to changes that would have historically occurred when fire played a more active role in shaping the ecosystem. These “cool” burns would generally not be expected to kill the 6- to 12-inch diameter trees. The reduction of seedlings, saplings and young trees less than 5 inches in diameter would reduce ladder fuels, which would reduce the potential for crown fire initiation. As there are very few mid-size or larger trees within the burn only treatment areas, canopy cover and crown bulk density are not major concerns in these treatment units.

Low to moderate intensity broadcast burns proposed throughout the thinned areas would greatly reduce the amount of small trees, i.e. ladder fuels, to further raise crown base heights. Many studies have shown that low intensity prescribed burns are effective in reducing surface fuels, seedlings and small diameter saplings that can act as ladder fuels (Biswell 1960, Biswell 1989, Harrington 1987, Kalabokidis and Wakimoto 1992, Sackett 1980, Wagle and Eakle 1979). Treatments to reduce small trees would not stop a fire from igniting; however, they would help keep the fire on the surface rather than promoting crown fire behavior.

Ladder fuels would be reduced, thereby raising crown base heights to an average of 11 to 25 feet from the ground surface, in thinned areas. Thinning from below would increase crown base heights, which in turn, would reduce the ability of surface fires to climb up other fuels into upper level tree crowns. Raising the crown base height above 10 feet would be expected to reduce the potential for a surface fire with average flame lengths to climb into the tree crowns. Prescribed fires would be designed to emulate low to moderate intensity surface fires which would result in average flame lengths of less than 4 feet.

Fuel model representations and surface fuels would change after implementation of the proposed treatments. Currently the area has mostly “timber litter” fuel models that show primarily needles, duff and fallen branches (dead fuels) on the forest floor under a dense canopy cover, which is represented in the area by fuel models 8, 9, and 10. Immediately after thinning, and before slash burning, the fuel models would shift to slash models (models 11-13) for at least 1 year or until slash is burned. The change to slash fuel models for the 1 year between thinning and slash burning would create a temporary increase in the risk of a high intensity surface fire. The slash lowers the crown base height and provides the ladder fuel that can promote crown fire behavior. During any given period during the life of the project, approximately 500 to 1,000 acres could be represented by a slash fuel model. Once the slash is burned, ground vegetation would become the dominant surface fuel, and the area would have a high number of stands represented by the grass or shrub surface fuel model. The change from a timber litter or slash dominated surface fuel model to a grass or shrub fuel model would reduce the potential for crown fire initiation.

Broadcast burning would be utilized to remove small surface fuels. Broadcast burning the thinning generated slash would be expected to spread a low to moderate intensity surface fire over 75 percent or more of the burn unit. This type of burn mimics natural surface fires and has many beneficial side effects in fire adapted pine forests (Paysen et al. 2000). Low to moderate intensity fire would typically only consume the fine fuels 3 inches and less in diameter, while leaving mostly larger logs (12 inches and greater). The retention of 3 large logs per acre, and an average of 5 to 15 tons per acre of down wood, would meet the requirements for retaining adequate down woody material. The retention of down woody material to meet forest plan requirements would not increase overall crown fire hazard because the logs would be retained in a manner that would not promote torching in surrounding trees. Mastication units covered with various depths of shredded wood (less than 4 inches at the deepest), would be expected to burn in a similar manner as scattered slash units which would mimic historic surface fires (Hatchett et al. 2006). Large logs within the areas have been known to last for decades, and charring by prescribed burns would tend to slightly lengthen that time.

Crown Fire Hazard

Crown fire hazard would be reduced by reducing stand densities, canopy closure, crown bulk density, and ladder fuels (thus raising the crown base height). Table 14 shows the changes in

crown fire hazard ratings over the project area after implementation of alternatives 2 or 3, in comparison with the current condition. The data show that both action alternatives would reduce the amount of the landscape that is currently in a high, very high, or extreme rating from covering about 60 percent of the landscape to covering only 21 percent of the landscape. In addition, crown fire hazard for all lands within at least 200 feet of the community boundary would have either a low or moderate fire hazard rating.

Table 14. Crown fire hazard ratings for stand acreages within the Perk-Grindstone project area

Crown Fire Hazard Rating	Current Condition	Alternative 2	Alternative 3
Low	7%	25%	25%
Medium	33%	54%	54%
High	31%	16%	17%
Very-high	23%	3%	2%
Extreme	6%	2%	2%
Total	100.0%	100%	100%

Fire regime and condition class would be reduced, after all treatments are completed, from predominantly condition class 3 to condition class 1 or 2. This would be reflective of conditions that support a natural historic fire frequency, size and intensity, without the likelihood of a large, high intensity crown fire. The changed conditions would allow for prescribed surface fires to burn without becoming large, high-intensity, running crown fires.

Studies have documented that crown fires often drop to the ground when reaching thinned and slash treated areas (Agee 1996, Kalabokidis and Omi 1998, Pollet and Omi 1999, Scott 1998, van Wagner 1993). Research has validated what resource management professionals have observed for many years—that the most effective fuel reduction treatment involves mechanical thinning followed by burning the slash to reduce surface fuels (Agee et al. 2000, Buckley 1992, Edminster and Olsen 1995, Graham et al. 1999, Gruell et al. 1982, Helms 1979, Nakamura 1996, Pollet and Omi 1999, Scott 1998, Van Wagtendonk 1996, Weatherspoon and Skinner 1996). There are numerous other examples of crown fires where the severity was lessened within thinned and burned units compared to adjacent untreated areas including: 2002 Hayman Fire on the Pike National Forest, the 2003 Aspen Fire on the Coronado National Forest, the 2003 Davis Fire on the Deschutes National Forest, the 2004 Power Fire on the Eldorado National Forest, and the 2004 Fischer Fire on the Wenatchee National Forest (Omi et al. 2007).

Torching and spotting potential would also be reduced for any wildfire burning in the treated area. These fuel treatments have been found to reduce fire hazards to homes within the wildland-urban interface (Schmidt and Wakimoto 1988).

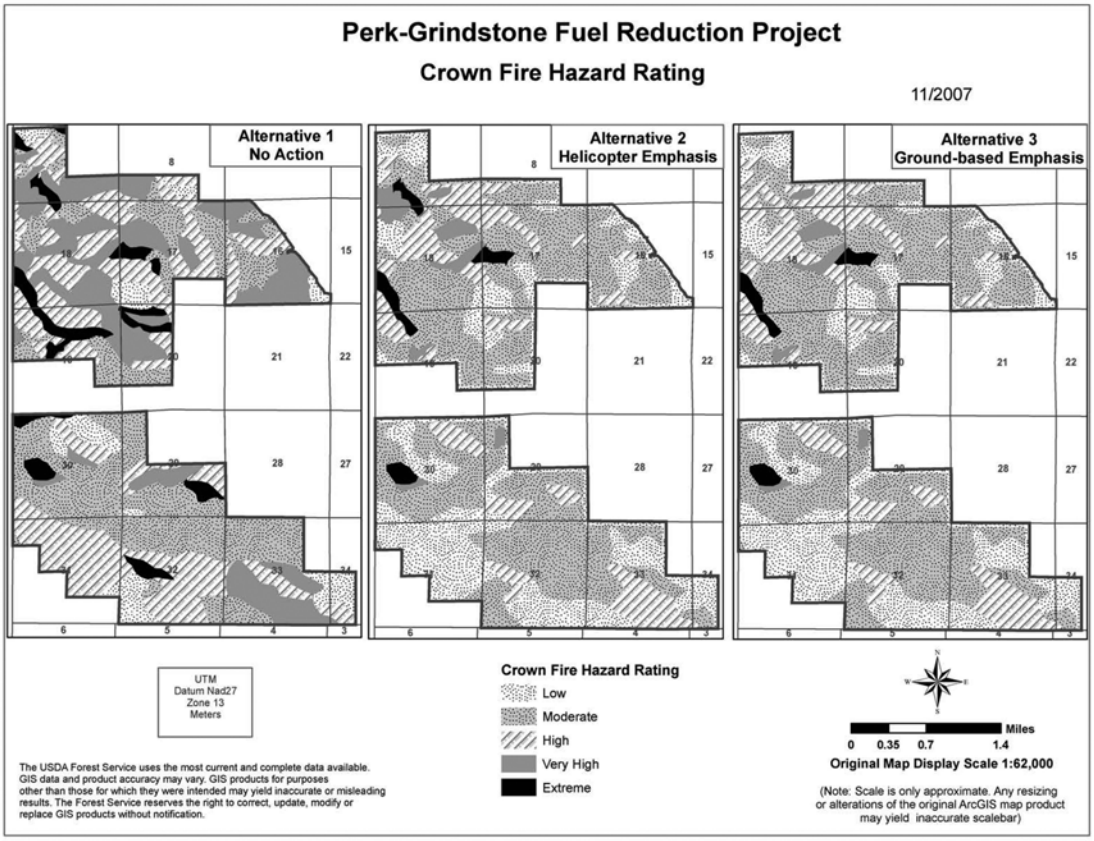

Figure 23. Distribution of crown fire hazard ratings in the project area under each alternative

Suppression tactics on wildfire become enhanced when working in thinned and slash treated areas (Green 1977), primarily along road corridors and in the areas where fuels are reduced along ridges. Studies have demonstrated that well designed shaded fuel breaks, like those proposed for the community interface boundary, are very effective in reducing crown fire severity when fires enter these zones (Agee et al. 2000, Omi 1996, Weatherspoon and Skinner 1996). The effectiveness of fuel breaks greatly increases when fuels outside the fuel break are also treated (van Wagtendonk 1996), emphasizing the need to treat across the entire project area. Aerial fire retardant drops are also more effective in thinned areas where the retardant can reach the ground and is not intercepted by tree crowns.

Crown fire potential will be reduced by reducing stand densities, canopy closure, crown bulk density, and ladder fuels (thus raising the crown base height) and maintained at lower levels using maintenance burning. The understory grasses and other vegetation that will grow as a result of thinning will help carry surface fires during future maintenance burns. Conducting frequent prescribed surface burning in fire return intervals that would vary throughout the project area

would maintain the desired conditions over time and continue to minimize the risk of severe crown fire impacts.

Cumulative Effects

The cumulative effects analysis area focuses on the 5,700 acres of national forest lands within and directly adjacent to the project area (including the Cedar Creek area). Cumulative effects were also considered within the community wildfire protection plan's wildland-urban interface boundary within the greater Ruidoso area (appendix A).

Past, ongoing and foreseeable future activities considered in this cumulative effects analysis are listed in appendix A, which includes maps of the fuel reduction projects throughout the CWPP-WUI area. Other fuel reduction activities within and surrounding the project area would have the most potential to contribute to cumulative effects. There are also past thinning and burning projects that were completed in the Perk-Grindstone project area, and there is a similar project currently occurring in the Cedar Creek area adjacent to the project area. Stocking is being reduced to an average of 40-60 ft^2 basal area range in the Cedar Creek area. At this stocking level, bark beetle risk can be considered low.

Adjacent land ownerships have completed similar projects on Village of Ruidoso forested lands closest to the project area boundary, and on Mescalero-Apache Reservation lands to the south and west. All of the fuel reduction treatments reduced live fuel loads and pushed stands back toward historic conditions, although in some cases the thinning was not sufficient to truly return the stands to a Fire Regime Condition Class 1, consistent with historic fire regimes. As far as one can tell, it appears that the other fuel reduction treatments are effectively moving stands toward the historic range of variability as described in the CWPP (Village of Ruidoso 2004).

Effects of alternatives 2 and 3 would add to the very similar beneficial effects expected as a cumulative effect from all the fuel reduction projects combined, which is thousands of acres throughout the greater Ruidoso area. All of the effects and changes in vegetation and fuels and fire behaviors described for alternatives 2 and 3 would be enhanced by the other fuel reduction activities on other lands in the area. Due to the large number of fuel reduction acres in the wildland-urban interface area as a whole, it may have a substantial cumulative effect on minimizing the risk of bark beetle infestations in the area, in addition to minimizing the risk of having a large size high severity crown fire event. None of the other past, present or anticipated other activities described in appendix A would have a substantial cumulative effect on the structure, composition or functioning of vegetation and fuels when combined with effects predicted for this project.

Invasive and Sensitive Plants

Invasive Plants

Affected Environment

Invasive plant species, also commonly referred to as noxious weeds (weeds) are those plants that are out of their natural range and generally out-compete and displace native plants. The competition which occurs with native plants interferes with native plant germination and survival by changing soil functions and contributing to a host of other factors that can dramatically alter

vegetation composition and structure. When any ground-disturbing activity is proposed, the Forest Service must determine the risk of introducing or spreading weeds associated with the proposed project. Current Lincoln National Forest policy also requires proposed projects to include mitigation and treatment of weeds related to land management projects.

Weeds most often become established in an area that has recently been disturbed in some way. Wildfire disturbances, as well as mechanical disturbance of the soil, commonly promote weed establishment. Disturbed and exposed bare soil creates conditions favorable for the invasive plants. Wind events or human and animal deposition may spread invasive plant seeds into the soil where they remain dormant until a disturbance event occurs. Most weeds have no natural predators, such as insects or birds, and are not usually consumed by domestic livestock or native wildlife. Thus, once established they have opportunity to flourish if not controlled.

Biologists on the Lincoln National Forest conducted two extensive surveys, in 1990 and 1993, to identify the initial extent of weeds and to establish a baseline for weed conditions. An additional weed survey of the project area was conducted in August 2007. Based on results from those surveys, a weeds inventory map was developed for the Smokey Bear Ranger District and project area. There are currently very few weed populations within the project area. The weeds inventory for the project area shows that musk thistle and bull thistle occur in three main areas, of approximately 0.1 acre, 6.2 acres, and 58.8 acres in size. The two smaller patches occur in the Sawmill and Mine Canyon area of the Grindstone block, and the larger patch occurs along Cedar Creek and Cedar Creek Road in the Perk block, including the area across the road outside the project boundary. All other areas including the upper elevation slopes and mesa tops are dominated by native vegetation with no signs of weeds. Other weed species found in other parts of the Smokey Bear Ranger District that have not been found in the project area are: Canada thistle, hoary cress (whitetop), Russian knapweed, Dalmatian toadflax, houndstongue, black henbane, poison hemlock and common hemlock.

Based on the weeds primarily occurring along road corridors, the main vectors for spread are likely vehicles. Small all-terrain-vehicles are commonly used along Mine Canyon and Sawmill Canyon Roads, which are gated as closed to larger vehicles. Other forms of transportation and recreation that may be adding to the spread of weed seeds in the area are equestrian use, mountain bikes, hikers, animals, and wind.

Environmental Consequences

Alternative 1 - No Action

If no action is taken, there would be no increase in the spread of weeds through fuel reduction project activities. The current rate of spread of existing weed populations would continue to be low and would remain generally constant. The general absence of weeds in most of the project area would likely continue. General contributors to weed invasion and spread such as road traffic, animals, wind, and other known causes would continue to be present in the area. Effects of these contributors could be affected in the future by the forest-wide travel management plan, which is scheduled for a decision and implementation to begin in 2008. Regardless of implementation of this proposed project, weed monitoring and treatment would still be expected to begin in 2008, which could substantially reduce the size and number of weed infestations.

No Action with Crown Fire

Under this scenario, a high intensity crown fire event would remove a large proportion of both the overstory tree canopy and surface vegetation, along with the organic layer on top of the soil. It has commonly been observed that invasive plants become prevalent in areas where large, high intensity crown fires occurred (Zouhar et al. 2007). All factors that facilitate weed establishment are present after high intensity crown fire: disturbed soils, removal of native plant populations, and opening the canopy to sunlight. Although there would not be many weed seed sources after such a fire event, weed seeds would be expected to be present in the soil or to be easily transported into the area by people, equipment, vehicles, or animals. Crown fire suppression activities would likely result in bulldozed firelines (like new roads) and hand-dug firelines that further exposes bare mineral soil.

Overall, this alternative would be expected to result in hundreds if not thousands of acres of newly disturbed and exposed soil. The area would be susceptible to substantial increases in the amount of weed populations over existing conditions. The more extensive the weed populations become, the more difficult it would be to re-establish native species ground cover. This would be a serious problem at least in the short term until monitoring and weed control treatments are implemented to curtail the situation.

Alternatives 2 and 3

The two action alternatives would increase the opportunity for weed establishment through soil disturbance or temporary aboveground reduction of surface layer vegetation. The main activities that would be expected to facilitate weed establishment under both action alternatives are the road reconstruction/construction work and creation of skid trails and landings for log removal. Other proposed activities which are expected to cause some degree of soil disturbance are thinning and burning activities. These activities would be expected to expose soil but to a lesser degree which would result in maintaining a higher portion of the area under existing ground cover. Maintaining a higher ground cover would reduce the establishment and spread of weeds. The slash burning activities which may expose soil will be designed so that extensive areas of bare mineral soil would not be anticipated. The reconstruction/construction of roads and creation of skid trails and landings would remove native plant communities while exposing bare mineral soil. These activities could import weed seeds onto the site but would more likely release dormant weed seeds already present in the soil. The risk of spreading weeds in the area would increase in the treatment areas which currently have small weed infestations such as Mine Canyon, Sawmill Canyon and near the Cedar Creek area. Spreading weeds to new locations typically occurs when project activities are located near an existing weed seed source.

Thinning and burning activities would create more openings in the trees for sunlight to penetrate to the forest floor, providing optimal circumstances for weed growth. The reduction of trees per acre is known to increase the abundance of weeds when the ground cover has been disturbed. The increase in vehicle traffic associated with implementing this project would further increase the potential spread of weed infestations. Field crews and thinning equipment would likely increase the spread of weeds from the roadsides into interior forest areas where they conduct thinning, burning and road management operations.

Where sites are lightly disturbed or not scraped down to the mineral soil layer, especially on units treated during frozen ground conditions, the native ground vegetation would be expected to recover following one growing season, but the possibility of weed invasion would still exist.

Areas with more disturbances such as skid trails, landings, and roads, would be rapidly rehabilitated after use to restore native vegetation on the ground surface, in accordance with mitigation measures in chapter 2. The exception to rapid rehabilitation would be the roads to remain as closed roads, in storage for future management use. Current road density in the project area is low with less than 1 mile of road per square mile of land. Road density would be even lower after project completion including road decommissioning. The overall reduction in total road density may aid in reducing potential weed proliferation following project work. However, the roads and trails that would remain in the area would be used for hiking, horseback riding, mountain biking, and other recreational uses that could promote the spread of weed seed to disturbed sites.

Weed occurrence may unavoidably increase in some areas initially as a result of the proposed activities. This unavoidable increase would be minimized by virtue of design features and mitigation incorporated into the proposal (chapter 2). The design features and mitigation would result in expectations that weeds would not increase substantially in the short term nor should they become established for the long term at a level greater than the current condition. Among other mitigation measures, there is a requirement for washing vehicles and equipment to remove potential weed seeds before they can enter the project area.

While vigilance to monitor and treat weeds may help to slow the occurrence and spread of weeds, it is unlikely that infestations can be entirely stopped or eliminated. Prevention by limiting vector opportunities and the amount of bare ground is the best way to keep weeds out of an ecosystem. Once established it is hard to eradicate some weeds without also adversely affecting desirable plants on the site. However, the district plans to closely monitor effects of the proposed project and survey for weeds in each area after it is treated. Where weed populations are found, they would be added to the inventory database and treated to eradicate or control the population. Monitoring of populations would continue to determine the level of control and whether additional treatment is needed. The Forest Service’s weed monitoring and treatment program is a high priority not only on the district but also in the Southwestern Region, and effectiveness of weed control treatments must be reported annually.

Cumulative Impacts

The area of consideration for cumulative effects of the proposed action on invasive plants is the project area and associated access roads. In addition to roads, lands immediately adjacent to the project area must be analyzed because weeds can easily be spread from the contiguous land areas adjacent to the project area boundary. Roads serve as the main vector for transport of invasive plant seeds or parts, not only within but also into or out of the area.

All past actions contributed to the current baseline conditions, which is a very low occurrence of invasive plants in the project area. The current program of prevention, control, and monitoring has been effective to date at preventing any major potential weed invasions, even with current road densities and several thinning and burning projects occurring within the project area.

The most important foreseeable future action within this area is the invasive plant control project scheduled to begin in the Perk-Grindstone area in 2008 and continue annually as needed. In addition, just outside the project area there are community groups making diligent efforts to control thistles and other weeds in the Village of Ruidoso, such as the active Weed Warrior group.

Activities that disturb and expose bare soil, especially soil that receives increased sunlight, tend to promote invasive species introduction and spread. All of the activities described in appendix A, including other fuel reduction actions, recreation activities, residential construction on the project area boundary, and others, would be expected to contribute to cumulative effects. However, there is an offsetting effect of the prevention, monitoring, and control programs in place that appears to be working.

The proposed project is likely to cause an observable short-term increase in the occurrence of nonnative invasive plants. These new weed occurrences would temporarily add to the overall current low level of weed infestation that exists in the area in part due to other actions. However, any expected increase would be expected to occur in areas already occupied by nonnative invasive plants. This is because current weed infestations are likely to remain controlled and not expand as a result of the proposed action. It is also due to the monitoring and weed control treatment program currently in place and project-specific design features to avoid spread of weeds in or from these areas. The adverse cumulative impact of new weeds that may unavoidably occur in new areas despite project-specific prevention measures is expected to be short term and of low intensity due to the required mitigation along with monitoring and control. Thus, this cumulative impact should not lead to a long-term or cumulatively significant increase in the amount of weed establishment in the area.

Sensitive Plants

Affected Environment

The Southwestern regional forester's 1999 list of sensitive species was originally used in analyzing effects on sensitive plant species from proposed project activities (U.S. Forest Service 1999b). In September 2007, the regional forester approved a revised list of sensitive species for the Southwestern Region (U.S. Forest Service 2007b). The wildlife biologist for the Lincoln National Forest reviewed both the 1999 and 2007 lists of sensitive species, to determine which species from either of those lists would occur or have suitable habitat in the project area. Results of those reviews are contained in appendix B: Sensitive Species. appendix B describes the key habitat requirements for each species, and whether the habitat or species occur in the project area.

After reviewing the regional forester's 1999 and 2007 lists of sensitive plant species that may occur on the forest, species were dropped from further study that do not have habitat or occur in the project area. The sensitive plants that have potential to occur in the area are listed in table 15, along with their habitat descriptions. Surveys conducted in potential habitat in the project area for each of these species in 2005 and 2006 indicate that these plants do not occur in the project area.

Table 15. Forest Service sensitive plant species with potential habitat in the project area.

Common Name and Scientific Name	Habitat Requirements
Wooton's Hawthorn *(Crategus wootoniana)*	Occurs in openings in the lower montane coniferous forest, generally between 6,500 and 9,000 feet. It is currently only known to occur on three sites within the forest. It has been found in the Sacramento Mountains on the Smokey Bear and Sacramento Ranger Districts.

Common Name and Scientific Name	Habitat Requirements
Scarlet Penstemon *(Penstemon cardinalis)*	Occurs in the mixed conifer forest and transition zone to the ponderosa pine forest between 7,000 and 9,100 feet, only in the Sacramento Mountains. It is currently known from only five sites on the forest.
White Mountains Larkspur *(Delphinium novomexicanum)*	Plants are known from the Sierra Blanca (White Mountains) and Cloudcroft areas. Suitable habitat occurs in the mixed conifer and spruce-fir forests from approximately 7,200 to above 10,000 feet. It is reported to grow in canyon bottoms and forest meadows.
Sierra Blanca Cliff Daisy *(Lonactis elegans)*	The plant has only been found in a single canyon on the east side of Sierra Blanca. Suitable habitat is on diorite rock in openings of mixed conifer at approximately 8,000 feet in elevation.
Wright's March Thistle *(Cirsium wrightii)*	Found around springs, in wetlands, and along streams. Project area does not have year-round springs, wetlands or streams. Downstream habitat is protected by the no treatment stream channel buffers.
Virgin's bower *(Clematis bigelovii)*	Moist mountain slopes and shady, rocky canyons; 5,000 to 7500 feet in elevation. Surveys have not found this plant and the forest botanist believes this plant does not occur on the forest.

Environmental Consequences

All Alternatives

Surveys of potential habitat in the project area did not find any of the sensitive plant species listed in table 15. Thus, none of the alternatives would be expected to affect sensitive plants. If sensitive plant populations are found during project implementation, mitigation measures in chapter 2 include a provision for protecting sensitive plants with a 50-foot radius, using a no-treatment buffer around the plant population.

Wildlife

This section describes the wildlife species and their habitat that could be affected by the proposed project. It is organized by species groups as follows: federally-listed threatened or endangered species, Forest Service sensitive species, Forest Service management indicator species, migratory birds, and important game species. This analysis was conducted by a team of three Forest Service wildlife biologists, in consultation with wildlife biologists from the U.S. Fish and Wildlife Service and New Mexico State Department of Game and Fish, in addition to peer reviews from other wildlife biologists. Information about existing habitat is based on site-specific stand examination data collected and wildlife habitat surveys conducted in the project area. Predictions of effects are based on a combination of scientific research and knowledge gained from past experience with many other fuel reduction projects in similar habitat types.

No federally-listed plants occur in the project area. Forest Service sensitive plant species are evaluated in a separate section of this EIS. No fish species occur in the project area. Thus, this section exclusively discusses animal species that may be affected by proposed activities.

It is not possible to predict with any certainty how proposed fuel reduction activities may affect various species, and animal behavior is highly variable even for the same species and situation. Knowledge of the effects of different fuel reduction techniques on most wildlife and invertebrate species is limited (Pilliod et al. 2006). This section estimates wildlife impacts based on expected changes in key habitat components that each species seems to prefer for breeding or foraging activities.

Detailed descriptions of proposed activities for each alternative and applicable forest plan management direction for various wildlife species is contained in chapter 2, and only briefly referred to throughout this "Wildlife" section.

Threatened and Endangered Species

Affected Environment

A review of the threatened or endangered species list was conducted in consultation with the U.S. Fish and Wildlife Service (USFWS) in accordance with the Endangered Species Act (U.S. Fish and Wildlife Service 2007). Four animal species that occur in Lincoln County were listed as threatened or endangered: bald eagle (*Haliaeetus leucocephalus*), northern aplomado falcon (*Falco femoralis septentrionalis*), black-footed ferret (*Mustela nigripes*), and Mexican spotted owl (*Strix occidentalis lucida*). The first three species were dropped from further study for this proposed project for the following reasons: the bald eagle was delisted as a threatened or endangered species and is now listed as a Forest Service sensitive species. Project-related effects on bald eagle are analyzed in the subsequent section on Forest Service sensitive species. Northern aplomado falcon does not occur or have habitat in the project area, and the black-footed ferret does not occur or have habitat in the area and has been extirpated in New Mexico. The Mexican spotted owl is the only federally-listed animal species (listed as threatened) that occurs within the project area.

The Mexican spotted owl (owl) inhabits mixed conifer and pine/oak forests, canyons, desert caves, and riparian areas throughout the Southwest. Mature and old growth mixed conifer forests with relatively closed canopies and a complex uneven-aged structure are most commonly used as nesting and roosting habitat (U.S. Fish and Wildlife Service 1995). Nests are often located on cliff ledges, on debris platforms in trees (such as in "witches brooms" from mistletoe infected trees), in tree cavities or in nests built by other birds (U.S. Fish and Wildlife Service 2005). The owls evolved in forests structured by frequent, low intensity fires, which was historically the fire regime in Southwestern ponderosa pine and mixed conifer forests (Jenness et al. 2004).

Foraging usually occurs in other forest and woodland types that have more openings in the tree canopy so the owls can better see their prey species—such as wood rat, deer mice and voles (Ward 2001). Primary habitat components for adequate prey species habitat are high volumes of fallen trees and other woody debris; a diversity of tree and plant species including hardwoods; and adequate levels of residual plant cover to maintain fruits, seeds, and plant regeneration (U.S. Fish and Wildlife Service 2005).

Annual breeding season for the owl is from March through August. Breeding occurs sporadically and does not occur every year. Environmental conditions greatly affect reproduction and survival of nestlings through fledging and into adulthood (U.S. Fish and Wildlife Service 2005).

Population trend data for the owl is sparse. Most owl populations studied across their range in Arizona and New Mexico have either declined slightly in the recent past or are still declining (U.S. Fish and Wildlife Service2005). Reproduction of Mexican spotted owl is inherently variable; hence, populations can fluctuate greatly over time (U.S. Fish and Wildlife Service 2005). Owl surveys conducted on the Lincoln National Forest indicate that the owl population trend on the forest is stable.

The project area and entire Lincoln National Forest lies within the Basin and Range East Recovery Unit for the owl, as identified in the recovery plan (U.S. Fish and Wildlife Service 1995). Based on the recovery plan, which was incorporated into the forest plan (U.S. Forest Service 1996:206A-E), the owl habitat management areas within the project area are as follows (as shown in figure 24):

- **Protected Habitat** (2,395 acres). Protected habitat includes habitat inside protected activity centers (PACs), which are occupied nesting/roosting areas consisting of at least 600 acres around the nest site. Most of the protected habitat in the project area (80 percent) is within three PACs. Protected habitat also includes habitat outside PACs, consisting of all other mixed conifer forest on over 40 percent slopes where timber harvest has not occurred in the last 20 years. Within the PACs, there are designated 100-acre nesting activity centers where no treatment may occur.
- **Restricted Habitat** (809 acres). Restricted habitat consists of all other mixed-conifer forest stands outside of the protected habitat areas.
- **Critical Habitat** (1,959 acres). Critical habitat was originally designated by the USFWS in 1994, rescinded in 1998, and then finalized in August 2004 (U.S. Fish and Wildlife Service 2005). Critical habitat is designated as habitat essential for the conservation of the owl based on physical and biological features called “primary constituent elements” (U.S. Fish and Wildlife Service 2005). The 1,959 acres of critical habitat in the project area overlaps 66 percent of protected habitat (nearly all within PACs), 10 percent overlaps restricted habitat, and 24 percent occurs outside protected or restricted habitat. Refer to figure 24.

Table 16. Percent of the project area in each Mexican spotted owl habitat management area

	Protected Habitat		Restricted	Critical
	Inside PACs	Outside PACs		
Acres and Percent of Project Area	1,923 ac (37%)	472 ac (9%)	809 (16%)	1,959 ac (38%)
	-------- 2,395 ac (46%) -------			

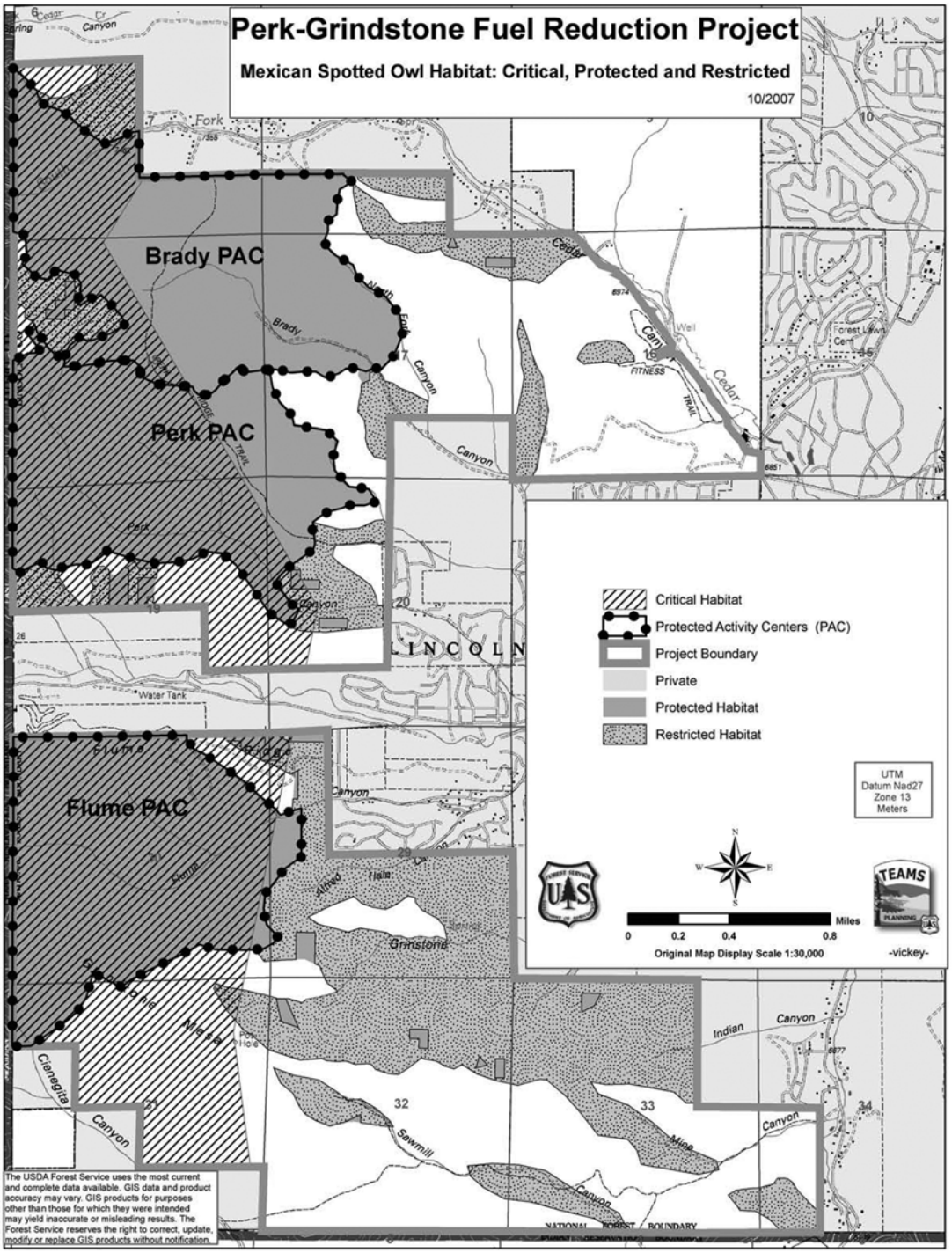

Figure 24: Mexican spotted owl habitat management areas within the project area

Of the 2,395 acres of protected habitat in the project area, 1,923 acres or 80 percent of it occurs within the three PACs: the Perk, Brady and Flume PACs. The remaining 472 acres, or 20 percent of protected habitat, occurs as scattered patches throughout the project area. Forest types in the PACs consist of approximately 62 percent mixed conifer forest and 38 percent ponderosa pine and piñon-juniper habitat. The ponderosa pine or piñon-juniper cover types occur on the drier, south- and west-facing slopes. There is no riparian, pine/oak, spruce/fir or aspen habitat types anywhere within the project area.

The 809 acres of restricted habitat in the project area, consisting of mixed conifer stands on less than 40 percent slopes, is currently not meeting the desired conditions for restricted habitat as defined in the forest plan. According to the forest plan, the restricted habitat should be managed toward having at least 10 percent at 150 square feet per acre of basal area per acre and another 10 percent at 170 square feet of basal area per acre, and an average of 20 trees per acre greater than 18 inches in diameter (U.S. Forest Service 1986: 206D). In accordance with the forest plan, four large and productive sites within the restricted mixed conifer habitat in the project area, totaling 168 acres, were identified to be managed toward those conditions.

Surveys of all potential owl habitat areas have been completed in accordance with Forest Service protocols for the Southwestern Region. Additional surveys were conducted throughout the project area in order to further try to detect spotted owl occupancy and use. Survey results found that the Brady PAC has never had confirmed reproduction success (fledglings), although a pair of owls were noted in 2001 and a single owl was sighted in 2002 and 2007. In the Brady PAC, reproduction success has never been confirmed. In the Perk PAC, a pair of owls was confirmed in 2006 and a single owl was sighted in 2005 and 2007. However, reproduction success could not be confirmed. In the Flume PAC, reproduction was confirmed in 2005 and a pair found in 2006 and 2007.

Table 17 shows the acres of critical habitat and number of PACs within the project area, on the Smokey Bear Ranger District, and on the Lincoln National Forest.

Table 17. Acres of Mexican spotted owl critical habitat and number of protected activity centers (PACs)

	Perk-Grindstone Project Area	Smokey Bear Ranger District	Lincoln National Forest
Acres of Critical Habitat	1,959	54,185	203,620
Number of PACs	3	21	145

Based on the recovery plan for this species, the primary constituent elements of critical habitat are listed as follows (U.S. Fish and Wildlife Service 1995):

For maintaining nesting/roosting habitat:

- A range of tree species sizes and ages, 30 to 45 percent of which are large trees at least 12 inches in diameter;

- Canopy cover averaging at least 40 percent; and
- Large dead trees (snags) with at least a 12-inch diameter.

For maintaining canyon habitat:

- Water (no year-round streams or waterbodies occur in the project area);
- Clumps or stringers of mixed-conifer (no riparian or pine/oak occur in the project area);
- Canyon walls containing crevices, ledges, or caves; and
- High percentage of organic matter and woody material on the forest floor.

For maintaining adequate prey species habitat:

- High volumes of fallen trees and other down woody material;
- A wide range of tree and plant species, including hardwoods; and
- Adequate plant cover to maintain fruits, seeds, and allow plant regeneration.

The primary constituents in shortest supply in critical habitat (and protected and restricted habitat) are:

- Large trees at least 12 inches in diameter covering 30 to 45 percent of the nesting habitat;
- Water; and
- Plant cover adequate to support and maintain prey species habitat.

Other constituent elements appear to be adequately represented.

Based on current conditions, the biggest threat to all owl habitat areas is the high potential for a large-scale, high intensity crown fire. All of the owl habitat management areas contain proportionately high numbers of small and mid-size trees and low numbers of large trees compared to historic conditions, as described in previous sections of this EIS. Nearly all stands in the PACs show a stand density index over 55 percent of the maximum SDI, which results in trees that are stressed, have reduced growth, and are at a high risk for bark beetle attacks and tree mortality. As a result of density-induced insect and disease attacks, there are relatively high numbers of dead and dying trees in owl habitat areas. Beetle-killed trees are most abundant in the mixed conifer stands, and beetles have attacked the larger, growth suppressed trees. In addition, high stand densities across large portions of the landscape have resulted in most of the PACs having a high to extreme crown fire hazard rating; with a slightly lower crown fire potential in the Flume PAC (refer to “Vegetation, Fuels and Fire” section).

Environmental Consequences

Alternative 1—No Action

Under this alternative, there would be no effect on the owl or its habitat areas from the proposed project because it would not be implemented. Current management plans would continue to guide existing activities authorized to occur in the project area, such as improving and designating

mountain bike trails, treating invasive plant species, implementing travel management plans, and other actions.

Without thinning or prescribed burning to restore forest conditions in these once fire-adapted ecosystems, the quality of critical, protected and restricted owl habitat would continue to decline. Without prescribed burning, there would continue to be a lack of surface fires on the landscape, which would continue to reduce habitat quality over the long term. There would continue to be an excess of highly dense stands spread over most of the landscape, creating a deficit of foraging or prey species habitat. The lack of forested gaps or openings would limit the prey species habitat constituent elements. Owls evolved in a more complex mosaic of habitat conditions than what currently exists, ranging from open, park-like stands to patches of younger age trees and patches with dense canopies in canyon bottoms and on moist north aspects (U.S. Fish and Wildlife Service 2002).

Tree growth and size would continue to be suppressed by stand density, which would limit the abundance of large mature trees favored by the owl for nesting habitat. With the large trees continuing to be stressed by severe competition, stands would continue to have high levels of insect and disease caused tree mortality in the larger trees. This would add to the number of snags suitable as nesting/roosting trees. However, the snags would eventually fall over and the resulting canopy openings would fill in with tree seedlings, due to the continued lack of surface fires. Thus, stands in owl habitat would shift toward dominance by smaller, younger age trees, further detracting from optimal owl habitat.

No Action with Crown Fire

This alternative would be expected to have the most adverse impact on the owl and its habitat. This is due to the likelihood that without the proposed fuel reduction treatments, owl habitat areas would continue to be dominated by stands in a high, very high or extreme crown fire hazard potential such that a large-scale, high severity wildfire would likely occur. The analysis of forest composition and structure in the project area indicates that a fire ignition in this area (from human causes or lightning) would have a high probability of becoming an active, fast-spreading crown fire if the fire starts during dry, windy, high fire danger conditions that periodically occur from about April through July (refer to the “Vegetation, Fuels and Fire” section of this chapter).

Crown fires remain a significant threat to the owl and its habitat in both the short and long term (Jenness et al. 2004). The magnitude of such effects on the owls would depend largely on fire severity (Smith 2000). Crown fires are known to cause a loss of suitability of spotted owl habitat (Bevis et al. 1997). A stand-replacing fire would typically destroy the owl habitat components (Jenness et al. 2002). A crown fire could result in long-term displacement of owls, reduced reproduction, and abandonment of the affected PACs. A crown fire occurrence in the PAC during a normal fire season (April through July) would coincide with the owl’s egg laying, hatching of nestlings, and feeding the fledglings by parents that occurs from March through August. If a high intensity crown fire occurs during nesting season, mortality of nestlings or fledglings would be likely.

Large, stand-replacing fires were identified in the recovery plan as one of the key threats to owl habitat (U.S. Fish and Wildlife Service 1995). A large, stand-replacing crown fire in this project area would likely destroy or adversely modify a large proportion of the critical, protected and restricted habitat areas. After a large crown fire, habitat components for nesting, roosting, and

foraging are reduced or eliminated (U.S. Fish and Wildlife Service 2001). Crown fires typically consume the entire tree canopy cover, leaving just the stems and large branches of the larger trees. Ground cover including the plants, branches, logs and other organic matter on the forest floor would also be consumed. The one habitat element that would dominate the burned area would be the snags, which eventually would fall to become down logs. All other primary constituents of critical nesting/roosting habitat would be lost, along with prey species and their critical habitat features. It would take decades to regain an overstory tree canopy approaching 40 percent, and would take longer to develop stands with 35 to 40 percent in large diameter trees (12+ inches). The replacement stand that eventually regenerates in the burn area would be an even-aged and fairly homogeneous stand of mostly ponderosa pine and Douglas-fir trees, lacking in multistoried stands of diverse tree species, ages and sizes.

The resulting damage from a high intensity crown fire to owl habitat could be irreparable in the foreseeable future (U.S. Fish and Wildlife Service 2001). Based on stand data from this area and stand development processes that follow a high severity crown fire, it would be estimated to take up to 200 years to restore the mature forest and primary constituent elements associated with a mature forest. The interior of the severely burned area may not have enough living trees to achieve regeneration of conifer trees and may become dominated by oaks and other shrubs or grasses.

Alternatives 2 and 3

Under alternative 2 or alternative 3, proposed activities would likely have some potential adverse effects to owl habitat along with some beneficial effects. Some thinning prescriptions for this project would allow cutting trees over 9 inches in diameter, which is not consistent with the forest plan limitation on cutting trees 9 inches or larger in diameter in protected habitat (U.S. Forest Service 1986: 206C). This project-specific deviation from forest plan direction is based on the project's purpose and need—to reduce landscape level crown fire potential, to protect the Ruidoso community, municipal water supply, and threatened species habitat (described in chapter 1). Based on fire behavior modeling and analysis, it was determined that this limited and short-term deviation from this particular habitat requirement in some stands is necessary in order to adequately reduce crown fire hazard ratings and the associated threat of a large-scale, high severity crown fire (refer to "Chapter 2: Alternatives Considered and Eliminated from Detailed Study").

Under either alternative, treatments would remove a portion of the living trees over 9 inches in diameter on a maximum of 621 acres of protected owl habitat, or 26 percent of the protected habitat in the project area. This includes 199 acres inside PACs and 422 acres of protected habitat outside PACs. This does not include the sanitation treatment units because they do not allow thinning out living trees over 9 inches in diameter, even though sanitation treatments would involve cutting dead and dying trees up to 18 inches in diameter. Sanitation units contain relatively high levels of bark beetle caused tree mortality. To better protect owl nesting/roosting habitat in those sanitation thinning units, no living trees over 9 inches in diameter would be thinned. Dying trees that may be cut in those units are trees where mortality is imminent; i.e. they would be expected to have no needles within 2 years and be completely dead within approximately 3 years. The dead and dying trees are not considered trees that significantly contribute to canopy cover for the owl, although they would add to the snag component until they fall over. Despite removing the insect or disease infested snags up to 18 inches in diameter, all

snags over 18 inches would be retained to help ensure an adequate number of the larger, more desirable snags would be available for owl nesting/roosting habitat.

Acres where living trees over 9 inches in diameter may be removed within owl habitat areas are as follows:

- 621 acres, or 26 percent, of protected habitat in the area:
  - 199 acres inside PACs
  - 422 acres outside PACs
- 586 acres, or 30 percent, of critical habitat in the area
- 728 acres, or 90 percent of restricted habitat in the area

Table 18 displays the proposed treatments in critical, protected and restricted owl habitat areas, including those inside and outside PACs, expressed as treatment acres and percent of total acres of critical, protected or restricted habitat. Treatments are described in detail in chapter 2. The only difference in treatment types between the two alternatives is the additional 74 acre prescribed burn unit that occurs in alternative 3 and not in alternative 2. The differences in wood removal systems between alternatives would not alter the effects on primary constituent elements for the owl.

Table 18. Proposed treatments in critical, protected and restricted owl habitat areas including those inside and outside PACs, expressed as acres and percent of total habitat acreage in the project area.

Treatment Types	Critical Habitat Acres	Protected Habitat Acres	Restricted Habitat Acres
Thin from below up to 18-inch diameter limit	577 ac (29%)	199 ac (8%) – inside PAC 354 ac (15%) – outside PAC	535 ac (66%)
Community defense zone up to 18-inch diameter limit	9 ac (1%)	68 ac (3%) – outside PAC	193 ac (24%)
Sanitation thin live trees up to 9-inch diameter limit, and dead/dying trees to 18-inch diameter limit	264 ac (14%)	488 ac (20%) – inside PAC	0 ac (0%)
Thin from below up to 9-inch diameter limit	489 ac (25%)	703 ac (29%) – inside PAC	42 ac (5%)
Community defense zone up to 9 inches	0 ac (0%)	15 ac (1%) – outside PAC	39 ac (5%)
Burn only (no trees over 9 inches in diameter would be killed)	299 ac (15%)	115 ac (5%) – inside PAC (+74 acres more in Alt. 3) 35 ac (1%) – outside PAC	0 ac (0%)
No treatment	321 ac (16%)	418 ac (18%) – inside PAC (-74 acres less in Alt. 3)	0 ac (0%)
Total Acres by Habitat	**1,959 ac**	**2,395 ac**	**809 ac**

Figures 25 and 26 (maps) display the treatments proposed for each alternative in relation to the protected and restricted spotted owl habitat areas, including treatments within PAC boundaries.

To protect owls during the critical breeding season, treatments within PACs would only be allowed to occur outside the spotted owl breeding season.

Treatments in critical, protected and restricted habitat areas were designed to help maintain or promote development of the primary constituent elements previously listed. Thinning from below to create a mosaic of variable density patches including some canopy gaps has been shown to accelerate development of forest structure favored by species associated with late successional forests (Harrington et al. 2005). Proposed treatments would reduce the severity of the competition for moisture, light and nutrients currently occurring, and promote growth of the larger trees that would be retained. This would move the area toward having large trees dominate at least 30 to 40 percent of the owl habitat areas. This is the primary constituent element currently in shortest supply in owl habitat.

The thinning treatments in owl habitat areas would also increase resistance to insects and disease in the dominant and co-dominant trees so the large trees would last longer. All treatments would retain all snags over 18 inches in diameter, down logs over 12 inches in diameter, hardwoods over 9 or 10 inches in diameter (depending on the site), 10 to 15 tons per acre of down woody material in mixed conifer stands (5 to 7 in ponderosa pine), and an uneven-age variety of tree sizes and patch densities. The thinning and burning treatments would move stands toward more mature and old growth forest conditions. At least 30 percent of the project area would be retained in or moved closer toward old growth conditions (as previously described in this document). In some of the old growth stands, the diameter limit would be reduced from an 18-inch limit to a 9- or 14-inch limit, depending on the forest cover type and site quality, in accordance with old growth attributes defined in the forest plan.

Treatments would result in a more complex mosaic of stand densities and canopy covers. While stand density would generally average 25 percent of the maximum stand density index, there would be patches at higher and lower stand densities. Thinning densely packed stands to reduce competition and increase the growth of large trees is thought to enhance owl habitat (Jenness et al. 2004). Canopy cover in mixed conifer within PACs would have areas that remain at or above 40 percent canopy cover, along with some more open areas or canopy gaps. Where patches of large overstory trees currently exist (generally over 12 inches in diameter), they would be retained, and would continue to provide a partially closed to closed canopy cover in owl habitat areas (30 to 50 percent canopy cover). However, the geographic extent of continuous forest canopies having 40 to 60 percent cover would be reduced.

Within 20 to 30 years after thinning, a larger portion of the stands in the protected and critical owl habitat areas would likely have an average canopy cover of at least 40 percent, in part due to promoting growth of the larger trees and retaining groups of large trees within each stand. In mature tree patches where canopy cover would remain denser, thinning from below while retaining large mature trees would make a significant reduction in ladder fuels and potential for crown fire ignition while retaining a dense overstory canopy cover. For example, a mixed conifer patch several acres in size could be thinned to remove 25 percent of the basal area and 50 percent of the trees over 1 inch in diameter (reducing trees per acre from 195 to 90), and to raise the crown base height from 3 to 16 feet, while only reducing canopy cover from 60 to 50 percent (Scott and Reinhardt 2005).

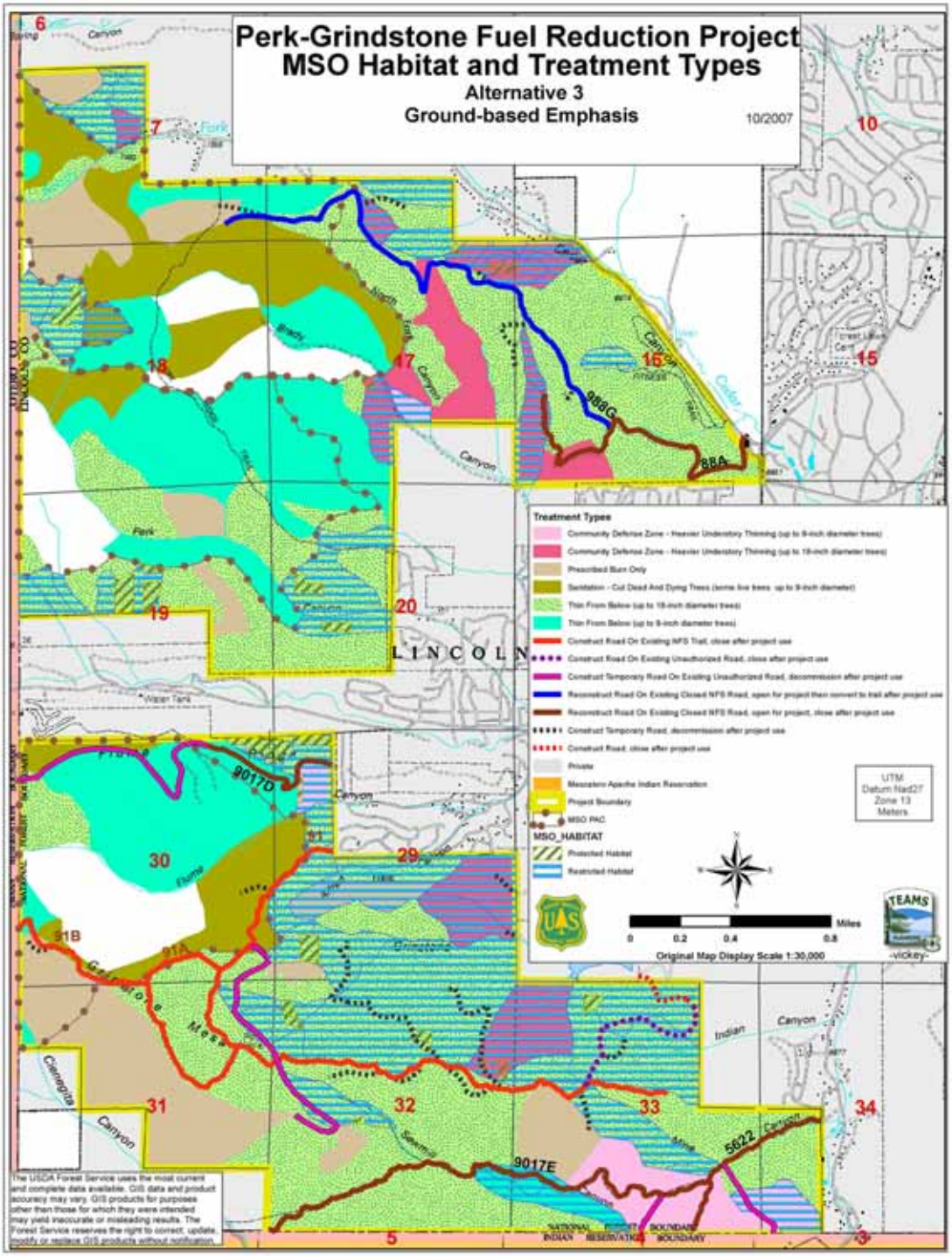

Figure 25. Alternative 2 treatments in relation to Mexican spotted owl protected and restricted habitat areas within the project area

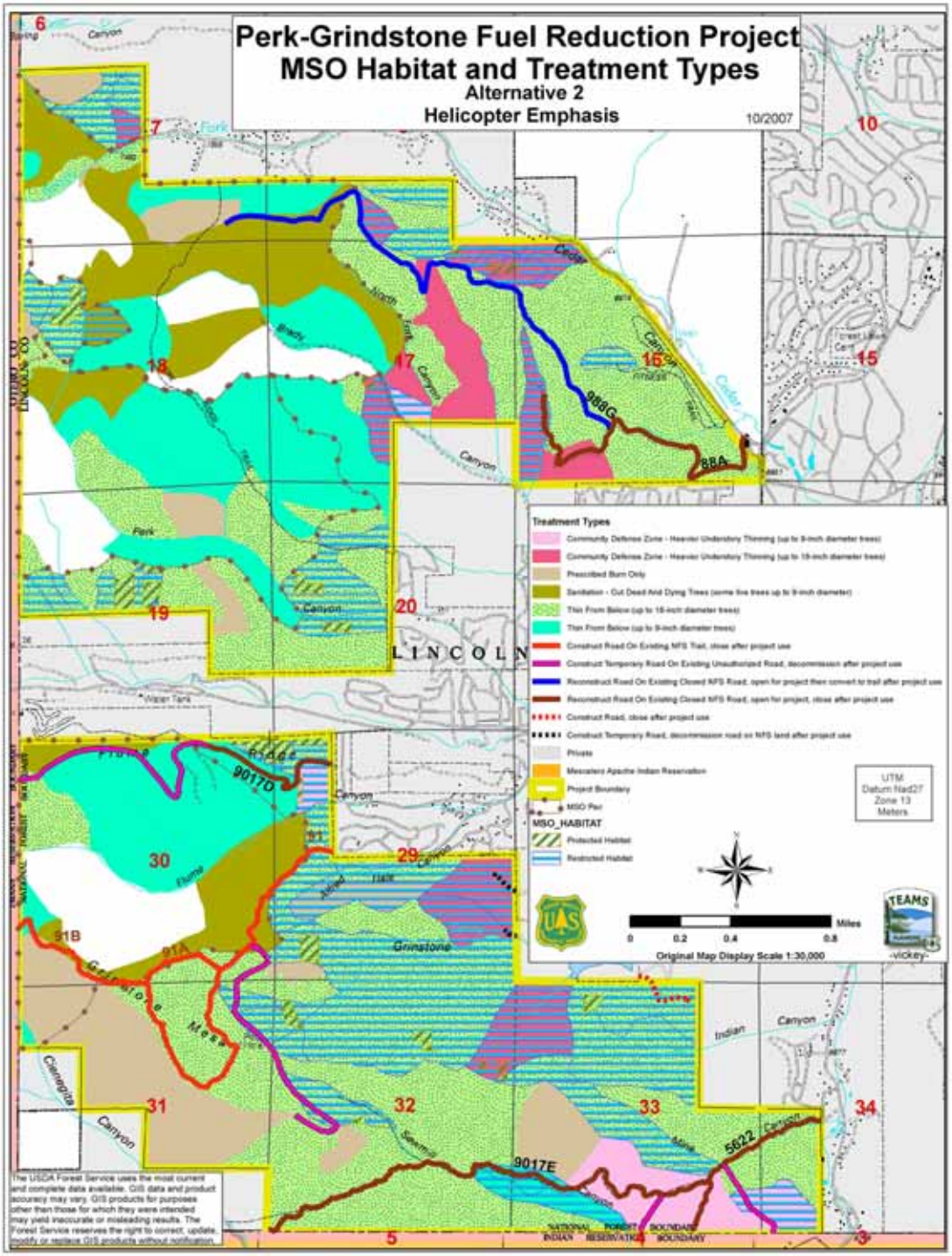

Figure 26. Alternative 3 treatments in relation to Mexican spotted owl protected and restricted habitat areas within the project area

The low intensity broadcast burning that would occur in owl habitat would reduce the amount of fine fuels while leaving the down logs and branches over 4 inches in diameter. Burning would also not be expected to kill the larger trees in the stand, particularly the larger ponderosa pine and Douglas-fir that are known to survive surface fires (refer to broadcast burn descriptions in chapter 2). Patches of seedlings and saplings retained in draws and some north- to east-facing slopes would not likely burn at all due to higher fuel moistures. Burning should not adversely impact any of the primary constituent elements, including those for prey species. Overall, thinning followed by low to moderate intensity broadcast burns, have been found to enhance owl habitat by reducing densely packed stands and the tree competition for water and nutrients (Jenness et al. 2004).

Treatments in portions of the restricted habitat, totaling 168 acres, would be designed to encourage development of future nesting/roosting habitat, in accordance with specific forest plan requirements for developing “threshold conditions” in restricted habitat (U.S. Forest Service: 206D). For example, treatments in those areas would help stands move toward developing at least 20 trees per acre over 18 inches in diameter, which currently does not exist. Treatments would also maintain or enhance existing basal areas to maintain or move those areas toward the basal area requirements in the forest plan of 150 square foot and 170 square foot of basal area per acre. Other portions of restricted habitat scattered through the project area would be thinned toward more open understories or more park-like stands, thereby increasing prey species habitat. Restricted habitat would be thinned in a manner that also results in a complex mosaic of different stand densities and age classes. Thinning in restricted habitat would similarly emphasize retaining and promoting the older age classes that are in shorter supply on this landscape.

Potential adverse effects to nesting/roosting habitat in the owl habitat areas would be attributed to the substantial reduction or elimination of a multistoried (vertical) canopy structure, resulting from the need to minimize ladder fuels that contribute to crown fire behavior. Groups of saplings and young trees would be retained, but in separate patches from the larger size tree groups, where small ladder fuels are not directly underneath larger tree crowns. Another potential adverse effect of treatments would be the loss of extensive acreages of continuously dense, closed canopy forest. Canopy cover and density within critical and protected habitat would be more variable than currently exists. The forested landscape would include more scattered gaps in the overstory canopy, ranging from 20 to a maximum of 200-feet wide. Although the sanitation treatment units would have the most potential for reduction in tree stems over 9 inches and removal of dead/dying trees up to 18 inches, those treatments would retain all living trees over 9 inches in size and, therefore, would not substantially reduce overstory canopy cover. Removing dead or dying trees (trees that will be completely dead within the next 2 to 3 years), would create the same canopy gaps as would occur over time if the trees were not cut down. If they were not cut down, they would provide very little canopy cover as snags, and would eventually fall over on their own. Although there would be a loss of a portion of the snags in the sanitation harvest units by cutting the dead/dying trees up to 18 inches, there would continue to be ample numbers of dead and dying trees in the 9- to 18-inch diameter class remaining throughout many of the surrounding treatment and non-treatment stands, in addition to all the dead/dying trees over 18 inches in size that would be retained unless they need to be felled for safety purposes. In addition, mistletoe and bark beetle mortality is expected to be reduced, but not eliminated, thus the weaker trees would continue to die, adding to future snags.

Another potential adverse impact would be from building roads and landings and other ground disturbing activities causing an increase in invasive plant species entering into owl habitat.

However, it is not expected that owl habitat would be substantially degraded or native vegetation lost as a result of invasive plant invasion. This is because invasive plant surveys would be done after treatments to check for increases in invasive plant species. Those found would be quickly treated to eradicate or control those infestations before they grow large and begin to out-compete native plant communities.

Treatments would increase and improve the primary constituent elements needed for prey species habitat, due to the more open understory canopy layer and scattered canopy gaps. Owls may select habitats partially based on prey availability, and prey availability would increase as a result of the proposed treatments (Jenness et al. 2004). Thinning followed by prescribed burning would promote an abundance of grasses, forbs and shrubs in places where there are canopy openings. Grasses would become re-established within one growing season after a prescribed burn. Ground vegetation is a primary constituent element that is currently in short supply in the owl habitat areas due to high stand density. Burning would restore historic patches of oaks and meadows that have been gradually taken over by conifer trees due to lack of surface fires. The proposed future maintenance burns would mimic surface fires that once occurred in this area, which would improve the long-term sustainability of the forest.

The most beneficial effect of the proposed treatments would be related to reducing the potential for a severe, fast-spreading crown fire, especially in these owl habitat areas that have high to extreme crown fire hazard ratings. Other beneficial effects to owl habitat would be attributed to treatment design features or habitat conservation measures that comply with forest plan direction for recovery of the owl, such as these (see “Mitigation Measures” in chapter 2 and forest plan for details):

- No treatments in the 100-acre nesting activity centers.
- No activities in protected habitat during the owl breeding season (unless it is determined to be unoccupied).
- Retaining the largest trees possible while meeting fuel reduction objectives (prescriptions include a mix of 9-inch, 12-inch, 14-inch and 18-inch diameter limits).
- Retaining all large snags (18+ inches in diameter) and a minimum of at least 2 snags per acre.
- Retaining all existing large logs (12+ inches in diameter) with a minimum of at least 3 logs per acre.
- Promoting development of large trees, which contributes to development of higher basal areas and overstory canopy cover.
- Retaining large hardwoods over 10 inches in diameter (a 9-inch limit in oak woodlands).
- Retaining clumps of trees of various sizes, densities and canopy covers, enhancing the patchiness and variability in structural diversity across the landscape.
- Retaining 10 to 15 tons per acre of down wood in all mixed conifer stands.
- Designing burns to keep fire and smoke away from nest trees.
- Avoiding road building in PACs except where necessary; no new routes would be constructed in PACs except for 0.2 mile of temporary road in alternative 3; other roads

would be built on existing routes; all roadwork in PACs would occur outside the breeding season.

- Limiting openings to a maximum of 200-foot widths.

Thus, within critical, protected and restricted habitat as a whole, thinning and burning treatments would likely retain or improve all of the primary constituent elements for nesting/roosting habitat and prey species habitat, including those elements currently in short supply. Also, habitat modifications would reduce the potential for losing those habitat components to a high-severity crown fire. Limiting the chance of a large-scale catastrophic fire is of utmost importance in owl conservation (U.S. Fish and Wildlife Service 2001). The Fish and Wildlife Service and research biologists have acknowledged that some fuel reduction treatments in wildland-urban interface areas should be exempted from some recovery plan standards if needed to reduce the risk of a large, high-severity crown fire (U.S. Fish and Wildlife Service 2002, Jenness et al. 2004).

Noise, smoke or visual disturbances would not be expected to adversely impact the owl, because all proposed activities would be prohibited in the PACs during the owl's breeding season. Research has found that use of chain saws, helicopters, and large mechanized equipment has the potential to temporarily disturb or displace an owl roosting or nesting if the activity occurs within about 300 feet of the occupied habitat (Delaney et al. 1999). Chain saw noise was found to be more disturbing to owls than helicopters at comparable distances, although owls have also been found to habituate (become less reactive) to sounds that repeat throughout the season (Delaney et al. 1999, Delaney and Grubb 2003). By prohibiting all project activities within PACs during breeding season, disturbance related impacts to breeding owls would be avoided or substantially minimized.

Approximately 2.8 miles of existing road or trail routes would be reconstructed for this project within critical or protected owl habitat within two of the PACs. Constructing/reconstructing and using those roads for this project would have minimal impacts on owl or owl habitat quality. This is because roadwork activities would be prohibited in PACs during owl breeding season; and the road widening and drainage improvement work would be done primarily within these existing road/trail corridors so that there would be minimal removal of trees or other vegetation. The road construction or reconstruction needed on these particular segments involve widening a few feet on each side, to approximately a 12- to 14-foot widths, and grading the surfaces to improve drainage and meet Agency standards for low level (level 2) native surface roads. No stream crossings or major road construction activities would be required on road segments in the PACs. After the thinning and burning treatments, Road 988G would be closed at the entry point and converted to a narrower trail, the 1.2 miles of road formerly used as Trail 91B would also be closed, and the 1 mile of unauthorized road used for the project would be decommissioned, restoring native vegetation along that route. These actions would reduce or eliminate potential disturbance impacts to the owl from future vehicular traffic after project completion. After project use the road would be closed to vehicular traffic and use would consist of light recreation use from hikers. Recreation use may cause some disturbance to owls, especially when it occurs during the spring breeding season. Table 19 shows specific road activities in the Brady and Flume PACs that would occur before and after project use.

Table 19. Proposed road activities in PACs that would occur before and after thinning and burning treatments

PAC	Road Construction/Reconstruction Before Thinning and Burning Activities	Road Closure and Decommissioning After Thinning and Burning Activities
Brady	0.5 mile of System Road 988G	0.5 mile to close and convert to a trail
Flume	1.2 miles of Trail 91B (existing roadbed) 1.1 miles of unauthorized road	1.2 miles to close 1.1 miles to decommission
TOTAL	2.8 miles (plus an additional 0.2 mile of temporary spur road in alternative 3)	2.8 miles (plus decommission the additional 0.2 mile of road in alternative 3)

Landings—which are level clearings for temporarily storing logs—would be created or improved along those 2.8 miles of roads to be used in the Brady and Flume PACs. Impacts from landings to owl habitat would be minor because activities avoid the owl breeding season, and landings utilize existing disturbed or open canopy areas along existing roads. Thus, there would be little nesting/roosting habitat modification, and a minor reduction in prey species habitat. Along the 2.8 miles of road within protected or critical habitat (in the PACs), there would be 5 to 8 landings, under either alternative. The landings may need to be cleared of some trees and vegetation. However, landings located within the PACs would be located in roadside openings that contain few, if any, large trees (12 inches or larger). Landings for ground-based and skyline methods in owl areas would be ¼ acre to 1 acre in size. Slightly more acres would need to be used as landings under alternative 2 than alternative 3. This is because under alternative 2, helicopter landings would be larger, averaging 1 to 2 acres in size, and helicopters would be used to treat most acres in alternative 2, along with some ground-based harvest methods. Under alternative 3, landings would accommodate some ground-based and skyline units, but fewer landings would be needed due to most of the acres being treated with no-harvest manual and mastication methods. Under either alternative, landings would not result in a significant reduction in the owl's nesting/roosting habitat acreage. Also, after treatments are completed, all landings and skid trails would be rehabilitated to restore native vegetation, and would be available as prey species habitat.

There are few differences between how alternatives 2 and 3 would affect the owl and its habitat. Alternative 2 would remove more down wood material over 6 inches in diameter within owl habitat compared to alternative 3, due to the inclusion of some no-harvest manual and mastication methods within owl habitat. The manual method units in alternative 3 would leave more down woody material, even after prescribed burning reduces the finer fuels, usually less than 4 inches in diameter. Mastication methods in alternative 3 would require cutting and retaining some logs to meet down log requirements, as the rest of the larger tree boles would be masticated, or left as shredded pieces of wood across the forest floor. There would be no other notable differences in terms of how the alternatives would affect primary constituent elements in critical, protected or restricted owl habitat. Neither of the alternatives would conduct treatments in the 100-acre core nesting activity areas.

There is limited data regarding effects of fuel reduction treatments in dry coniferous forests in the West on owl behavior and reproduction success in the long term (Pilliod et al. 2006). Thus, future habitat occupancy and reproductive success of the owls in PACs following proposed treatments

cannot be estimated with certainty. A species response to habitat changes from fuel reduction treatments depends on what habitat that species needs for its survival and reproduction (George and Zack 2001).

Thus, in summary, proposed project activities were designed to maintain or improve the primary constituent elements required by the owl over time. Project design and conservation measures including seasonal restrictions would minimize the near term adverse effects. Short-term adverse effects to nesting/roosting habitat may occur from removing portions of the trees in the 9- to 18-inch diameter class, some snags, some canopy cover, stand density and multistoried canopy structure. Overall, treatments would help restore or move toward the complex presettlement mosaic of habitat conditions that the owl historically evolved in, ranging from open, park-like stands to patches of younger age trees and patches with dense canopies in canyon bottoms and on moist north aspects (U.S. Fish and Wildlife Service 2002). Preventing severe fires and restoring a surface fire regime with dominance by large mature trees would have long-term benefits for the owl.

Cumulative Effects

The cumulative effects analysis area includes the entire wildland-urban interface area comprising the project area and surrounding lands in the Village of Ruidoso area that are managed by the State of New Mexico, Village of Ruidoso, and Mescalero-Apache Tribe. State and private lands were excluded from the critical habitat designation for Basin and Range East that encompasses the Sacramento Mountains adjacent to the Village of Ruidoso, New Mexico (U.S. Fish and Wildlife Service 2005).

The greater Ruidoso community that abuts the north and east boundaries of the project area would not be considered suitable owl habitat due to the human developments and populations living in that area.

However, densely forested mountains on Mescalero-Apache Reservation land lie directly adjacent to critical habitat and PACs in the project area. That area provides a large amount of potential owl habitat. In addition, the White Mountain Wilderness, located 5 miles northwest of the project area, contains over 70 square miles of unroaded and undeveloped forests, designated as critical habitat (U.S. Fish and Wildlife Service 2005).

There are a variety of activities within the cumulative effects boundary that could combine with effects of the proposed project that were previously described. Most of these are described and shown on maps in appendix A.

High-severity crown fires burned through 20 owl PACs on the Lincoln National Forest from 1994 to 2004, reducing the quality of nesting/roosting habitat in those PACs. On the Smokey Bear Ranger District, the Cree and Peppin Fires, in 2000 and 2004 respectively, impacted 50 percent of a PAC. On the neighboring Sacramento Ranger District, the Penasco, Scott Able and Penasco Fires of 2000-2003 impacted 13 PACs (Ortega et al. 2005). The crown fires substantially reduced tree density, canopy cover and nesting/roosting habitat quality in portions of those PACs.

Residential growth and development activities in the Village of Ruidoso area continue to increase, reducing the quality of owl habitat in lands surrounding the north and east sides of the project area. Some of the less disturbed forested areas would likely be cleared of trees to accommodate new homes and other built structures in this growing mountain community. However, because

there is no critical habitat or PACs within those community areas, effects to owl habitat or populations would be minor. As the population increases, recreational activities would continue to increase. People would likely continue to hike or ride mountain bikes or horses into the PACs during the spring breeding season. Hunters also use the area, so shooting would be an ongoing disturbance as well. These human activities in the project area could cause minor habitat disturbance effects. They would not combine with breeding disturbance effects of the proposed project because project activities would avoid disturbance in PACs during the breeding season.

Fuel reduction projects and private land thinning activities in and around Ruidoso started in 2001 and are ongoing. This includes past, ongoing, and planned future treatments on the Mescalero-Apache land to the west and south of the project area. Treatments conducted in and around Ruidoso by various land managers and private landowners, combined with project treatments in the north and east perimeter of the Perk-Grindstone project area, would be expected to increase the quality prey base habitat for the owl while reducing the amount of dense, multiple-canopied forest habitat that owls favor for nesting/roosting habitat. Thinning prescriptions on lands surrounding the project area typically follow guidelines contained in the community wildfire protection plan (Village of Ruidoso 2004). The land in the Ruidoso community does not contain a high proportion of steep, mixed conifer forest, or undisturbed habitat. In addition, treatments on those lands also do not require the same level of owl habitat protection that would be provided for in the proposed project. In the long term, thinned and burned stands would move closer toward historic mature forest characteristics with a more equal proportion of large to small trees. In the many unthinned stands surrounding the community, especially in the less accessible mixed conifer and spruce fir zones, there would be increased numbers of large snags and down logs over time as a result of density related insect and disease infestations. The most substantial cumulative effect from all fuel reduction projects and activities on surrounding lands, combined with proposed project effects, would be the reduced risk of a large-scale, high-severity crown fire that could cause a much greater loss of potential nesting/roosting owl habitat.

Other actions that may have effects that combine with project related effects to the owl would be the expected treatments to eradicate or control invasive plants in and surrounding the project area. These would occur during the same timeframe and would help minimize the introduction and spread of invasive plant species that would otherwise occur due to the increase in disturbed soil from project activities. Invasive plant control treatments would not otherwise modify owl habitat in the area.

Another ongoing action and potential cumulative action is the Forest Service’s implementation of new travel management regulations. The designation of motorized travel routes throughout the Lincoln National Forest could result in either increasing or decreasing motorized travel routes in the project area. Eliminating motorized travel routes in the project area in the long term would better protect PACs and owls in the area, and would complement the project related road closures and decommissioning proposed to immediately follow thinning and burning treatments.

In summary, there would be some very minor cumulative effects to owl habitat. None of the other actions described would be expected to significantly increase or decrease the magnitude, duration or extent of effects to owl habitat predicted for alternative 2 or 3. Also, no other activities listed in appendix A would cumulatively combine with the project related effects on owl habitat.

Sensitive Wildlife Species

The Forest Service's sensitive species program is designed to help maintain biodiversity and viable populations of species in accordance with National Forest Management Act regulations (36 CFR 219.19). The goal in managing sensitive species habitat is to prevent a trend toward listing under the Endangered Species Act. Sensitive species to be considered in land management planning activities are those designated by the regional forester (FSM 2670.5).

The Southwestern Regional Forester's 1999 list of sensitive species was originally used in analyzing effects on sensitive species from proposed project activities (U.S. Forest Service 1999b). In September 2007, the regional forester approved a revised list of sensitive species for the Southwestern Region (U.S. Forest Service 2007b). The wildlife biologist for the Lincoln National Forest reviewed both the 1999 and 2007 lists of sensitive species, to determine which species from either of those lists would occur or have suitable habitat in the project area. Results of those reviews are contained in "Appendix B: Sensitive Species." Appendix B describes the key habitat requirements for each species, and whether the habitat or species occur in the project area.

After reviewing the Regional Forester's 1999 and 2007 lists of sensitive animal species that may occur on the Lincoln National Forest, 40 species were dropped from further study because they do not have habitat or occur in the project area such that they would be affected by proposed project activities. The bald eagle, northern goshawk, Sacramento Mountains salamander, and Ruidoso red squirrel were identified as species that have habitat and occurrence in or adjacent to the project area that could be affected by proposed activities. Table 20 displays those species names, taxonomic group and key habitat requirements. The red squirrel is discussed separately, under "Management Indicator Species."

Sensitive plant species are described in a separate section of this EIS.

Table 20. Forest Service sensitive animal species with potential habitat in the project area

Common Name	Scientific Name	Group	Habitat
Bald Eagle	*Haliaeetus leucocephalus*	Bird	Large trees adjacent to lakes and rivers with fish. A winter migrant to the forest, arriving in late fall and leaving in early spring.
Northern Goshawk	*Accipter gentilis*	Bird	Large tracts of mature, closed canopy, deciduous, coniferous, and mixed forests with an open understory.
Sacramento Mountains Salamander	*Aneides hardii*	Amphibian	Coniferous forest above 8,000 feet in elevation; moist areas under logs and rocks.
Red Squirrel *	*Tamiasciurus hudsonicus lychnuchus*	Mammal	Dense closed canopy mixed conifer forests with large, cone-bearing trees and scattered openings.

* Red squirrel is discussed in a subsequent section of this EIS, as a management indicator species.

Bald Eagle

Affected Environment

The bald eagle is a long-lived raptor closely associated with aquatic habitats. They do not breed on the Lincoln National Forest, but often spend winters in the area. They require large lakes or rivers that support fish and waterfowl for their food supply. For winter foraging habitat, eagles need large trees along the shorelines of fish-bearing lakes or streams to use as overnight roosts or daytime perches from which to look for food.

Bald eagles have been spending winters at Grindstone Reservoir, which is directly adjacent to the eastern boundary of the project area. Three bald eagles have been observed at Grindstone Reservoir every winter since the reservoir was constructed in 1992. The bald eagles typically arrive at Grindstone Reservoir at the beginning of November and leave sometime in March. The bald eagles have been seen using the reservoir primarily to feed on fish and small waterfowl. They do not appear to roost overnight at the reservoir or in the adjacent project area. Bald eagles have also been observed during the winter at nearby Mescalero and Bonito Lakes, within 2 to 5 miles of Grindstone Reservoir. They use Carrizo Creek, which flows outside the project area, as a flight corridor between foraging areas at Grindstone Reservoir and Mescalero Lake.

Eagles prefer large snags or leafless deciduous trees to perch in during the day when they are looking for food (Jackman and Jenkins 2004). Eagles foraging at Grindstone Reservoir tend to perch in tall trees or snags on shorelines outside the project area (personal communication with Larry Cordova, district wildlife biologist, September 2007). Forest and district biologists find that bald eagle wintering populations have been increasing on the forest, and the recent 2007 delisting of the bald eagle from the Endangered Species Act list indicates an upward trend in bald eagle populations across its range.

Environmental Consequences

No Action

Under this alternative there would be no impact to bald eagles or their habitat from the proposed project because the project would not be implemented. Current management plans would continue to guide existing and previously authorized activities in the project area. Recreational activities such as boating, fishing, hiking, horseback riding and driving, along with thinning and burning activities, have occurred and would likely continue to occur on the private land around the reservoir. These human activities may cause some disturbance to wintering eagles, although the eagles can become habituated (accustomed) to such noise disturbances (Grubb and King 1991). They would likely continue to use the Grindstone Reservoir area during the winter months as non-breeding habitat indefinitely into the future.

No Action with Crown Fire

Under this alternative, a large-scale, high intensity crown fire event may impact individual bald eagles, but is not likely to result in a trend toward Federal listing or loss of viability for the bald eagle or its habitat. Population viability would not be impacted because eagles do not breed in this area and could relocate to other lakes in the Sacramento Mountains during the winter months if feeding habitat at Grindstone Reservoir is damaged or destroyed.

If a fire starts in the project area during fire season, the dry southwesterly winds are likely to direct a crown fire toward the reservoir. A large crown fire event in the project area would burn most of the vegetation in the forest and expose bare soil. The heavy monsoon rains that typically follow the fire season would likely send a tremendous flow of water runoff filled with sediment, ash and woody material rushing down the canyon drainages into the reservoir. Post-fire effects would likely be an accumulation of large amounts of sediment, ash, organic matter and wood in the water, as described in the "Water and Soil" section). As a result water would be displaced, water quality damaged, and fish would die. This would result in insufficient feeding opportunities for wintering bald eagles at Grindstone Reservoir. This impact has occurred after other crown fire events such as when Los Alamos Reservoir was totally destroyed after the Cerro Grande Fire in 2000, and the eagles could no longer use that reservoir until it had been dredged and rebuilt. The duration of this impact would be until the reservoir and its fisheries population is restored.

Alternatives 2 and 3

Either of these action alternatives has the potential to cause minor noise or visual disturbance effects to individual bald eagles, although effects are likely to be insignificant and discountable. Population viability would not be impacted because bald eagles do not have breeding habitat in the area. Noise and visual disturbance could potentially come from the use of chain saws, heavy mechanized equipment, helicopter flights, log trucks and other vehicle traffic, as well as workers on foot that may be visible from eagles feeding at the reservoir. Workers on foot can be more disruptive to eagles than helicopters or vehicles (Grubb et al. 1991). While those activities may occur within ¼ mile of the reservoir, those activities would not occur within 300 to 500 feet of the forested shoreline where eagles typically perch, in tall trees across the reservoir from the project area. Thus, disturbance impacts would be expected to be insignificant, due to the distance from project activities to the perching habitat area, along with the varied mountain topography and forested vegetation where activities would occur. In addition, eagles may already be (or may become) habituated to these disturbances, because the Village of Ruidoso has been conducting the same fuel reduction project activities on other forested areas directly adjacent to Grindstone Reservoir for the past few years, and the reservoir is a year-round recreational area for the Ruidoso community in which it is located. Human activity in the area during the winter is quite common.

After project completion, roads that were constructed and used near the reservoir would be closed, and could be used for hiking, horseback riding and similar recreational uses that already commonly occur in the area. After project completion, recreational activity in the vicinity of the lake would remain stable to increasing over time, but would not likely have a significant long-term impact on the eagle's use of the area.

All applicable recommendations for avoiding disturbance at foraging areas would be followed, in accordance with the National Bald Eagle Management Guidelines (U.S. Fish and Wildlife Service 2007:14). Helicopter flight paths would differ from the eagles predicted flight path along the rivers outside the project area, to further avoid disturbing the eagle's flight path, as described in chapter 2, "Mitigation Measures."

Treatments proposed near Grindstone Reservoir would not change habitat suitability for bald eagles. All of the largest snags in the area (over 18 inches in size) would be maintained in all treatment units, except where a snag needs to be cut for safety purposes. Thus, an adequate number of potential future roosting trees would be retained near the reservoir, and it's unlikely

that any large snags would need to be cut for safety purposes near the shoreline. Thinning and burning treatments would also enhance growth of the larger residual trees in the area, which are preferred by bald eagles for roosting and perching if no snags are available.

Treatments would not be expected to indirectly impact water quality in the reservoir such that it would be detrimental to fish survival (refer to the “Water and Soil” section). Overall, treatments would not be expected to adversely impact winter foraging habitat used by the bald eagles in this area. The proposed project would be consistent with the intent of protecting this species, as described in the Bald and Golden Eagle Protection Act (16 USC 668-668c) and Migratory Bird Treaty Act (16 USC 703-712), as well as in the National Bald Eagle Management Guidelines (U.S. Fish and Wildlife Service 2007).

Cumulative Effects

Cumulative effects were evaluated in the vicinity of Grindstone Reservoir. Activities further away or at other lakes would not combine with effects of proposed activities in their impact on wintering eagles. Eagles typically return to the same waterbodies to feed in the winter, although they may utilize different lakes and rivers throughout the Sierra Blanca (White Mountains) range.

Many different human activities would continue to occur in and around the reservoir, as described under the no action alternative. This includes: other fuel reduction treatments on Village of Ruidoso lands directly adjacent to the reservoir; recreational activities on the water like boating and fishing; and hiking, horseback riding, mountain biking, all-terrain-vehicle use, and other vehicle use all around the shoreline areas. Roads would continue to encircle the reservoir, which is in a popular year-round recreation area. Eagles have been returning to this reservoir each winter despite the ongoing thinning, burning, and recreational activities that have been occurring on adjacent forest lands. This indicates the eagles may be habituated to these kinds of disturbances to some degree, and the additional thinning, burning and other proposed activities in the project area are unlikely to significantly increase the magnitude of the disturbance effect to the eagle. Also, the fact that eagles do not typically use the forests within the project area that would be directly affected by proposed activities, would further minimize potential effects. Overall, cumulative disturbance effects of other activities combined with proposed project activities would likely remain insignificant in their influence on bald eagle foraging use of this area.

Northern Goshawk

Affected Environment

The northern goshawk is a generalist species that utilizes a wide range of mature and immature forest habitat types. The principal forest types occupied by the goshawk in the Southwest are ponderosa pine, mixed conifer, and spruce-fir (Reynolds et al. 1992). In general, goshawks nest in mature to old forest stands of relatively large trees with closed canopies and an open understory. Goshawks typically prefer forests with a relatively high canopy closure and greater tree density (Beier and Drennan 1997). The best goshawk foraging habitat is believed to consist of forested stands with complex structure having large amounts of down woody material and snags. Adequate perches for hunting and flight space for maneuvering are other important characteristics of forested stands used for foraging by goshawks. Jays, flickers and squirrels make up the bulk of their diet.

Breeding habitat includes a nesting area, a post-fledging family area (PFA) and a foraging area. The Southwestern Region of the Forest Service established direction for managing goshawk habitat, which is contained in all forest plans in the region (U.S. Forest Service 1986: 208A-E). Forest plan direction that applies to protecting goshawk habitat that may be affected by this project is summarized in the chapter 2, “Mitigation Measures” section.

Two goshawk PFAs totaling 1,384 acres were established in the project area, in accordance with Agency requirements. They include core nesting areas totaling 375 acres. The Grindstone PFA lies adjacent to the Ruidoso community boundary in the lower Grindstone block of the project area, while the Brady PFA lies in the Perk block to the north. There are a total of 14 PFAs on the Smokey Bear Ranger District, and 47 PFAs on the Lincoln National Forest (some active, some historic).

Annual surveys for goshawks have been conducted within the project area since 1996, in accordance with regional protocols and the Northern Goshawk Inventory and Monitoring Guide (Woodbridge and Hargis 2005). No nest was ever found in the Grindstone PFA. However, two goshawk fledglings were observed near the PFA in 1996, and goshawks have been sighted in the PFA in 1997, 1999 and 2007. In the Brady PFA, a nest was discovered in 2004 and a new nest found in 2007. Goshawks were sighted in that PFA in 1996, 1997, and 2004 through 2007. The PFAs are to be managed for as nesting and fledgling habitat. However, where the goshawk PFAs overlap Mexican spotted owl protected or restricted habitat, the spotted owl habitat management requirements take precedence over goshawk habitat requirements (U.S. Forest Service 1986: 208A). Outside the PFAs, the entire project area is to be managed as goshawk foraging habitat, as it is entirely comprised of mixed conifer, ponderosa pine, and piñon-juniper forest.

The Brady and Grindstone PFAs primarily consist of mixed conifer forest, with smaller amounts of ponderosa pine and piñon-juniper cover types. The north- and east-facing slopes have more mixed conifer, dense stands, higher canopy cover, and larger trees. The nest areas are almost all located in the denser, mixed conifer stands. Large snags and down woody material are abundant in those stands. The south- and west-facing slopes tend to be drier, covered by more ponderosa pine, piñon-juniper woodlands, and oak groves. Water can be found only seasonally in the Brady PFA, while water is more available to goshawks in Grindstone PFA due to a small spring, a wildlife umbrella water tank, and Grindstone Reservoir located just outside the PFA and project boundary.

The two PFAs overlap portions of two Mexican spotted owl protected activity centers (PACs). The Brady goshawk PFA is almost entirely overlapping with the Brady owl PAC, and the Grindstone goshawk PFA overlaps about one-third of the Flume owl PAC. Management requirements for the owl, which is a threatened species under the Endangered Species Act, take precedence over requirements for the goshawk, which is a Forest Service sensitive species.

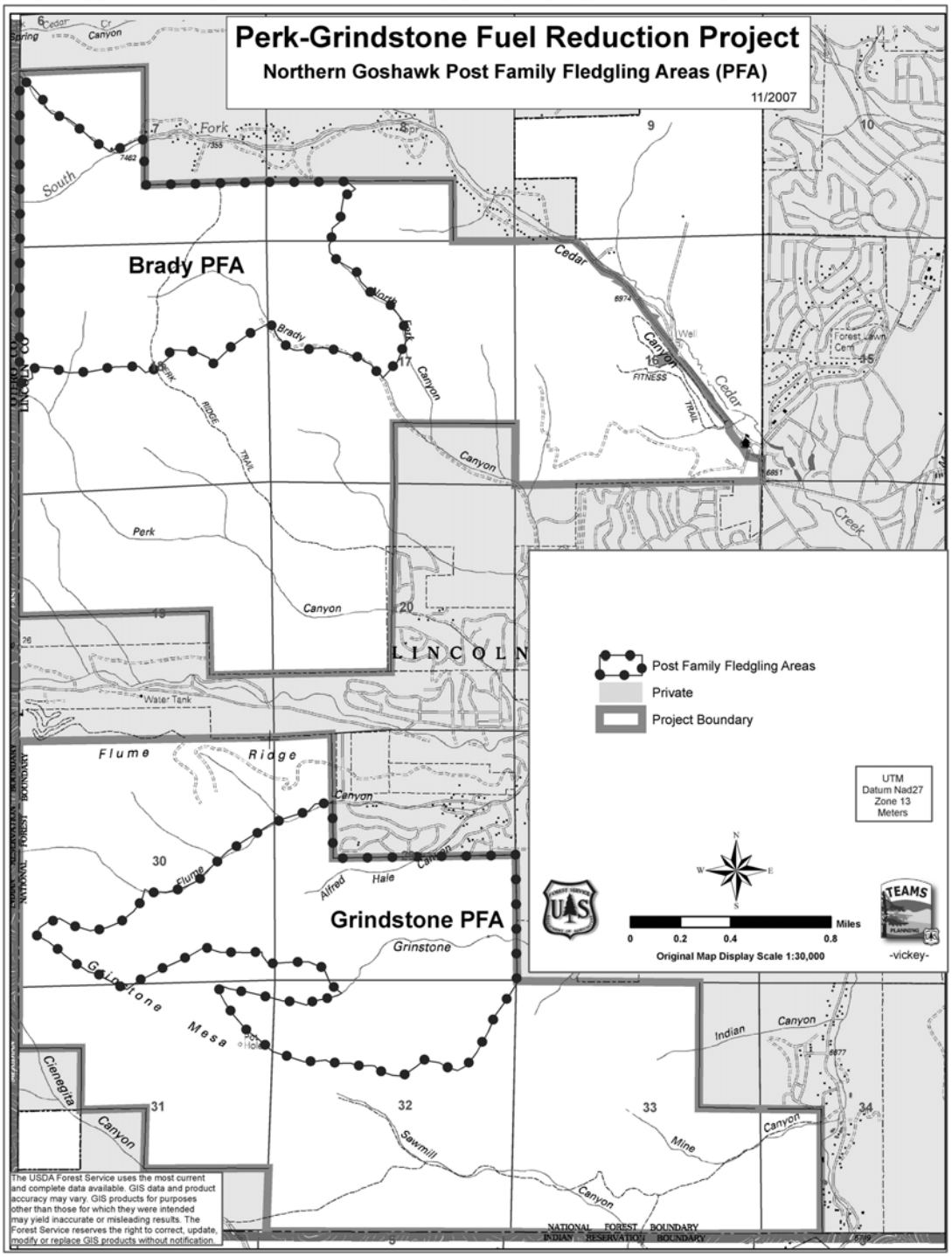

Figure 27. Northern goshawk post-fledgling family areas (PFAs) within the project area.

Vegetative structural stages (VSS classes) within the PFAs and in goshawk foraging habitat outside PFAs, are dominated by the young and mid-age VSS classes (74 to 84 percent in VSS 3 and 4). Table 21 shows the VSS class distribution within the project area. The project area is entirely composed of potential goshawk habitat, with nesting habitat in PFAs and foraging habitat outside PFAs.

Table 21. Vegetative structural stage classifications of stands in the project area, expressed as total acres in each classification, based on stand averages

	VSS 1 Grass Seedling <1" diam.	VSS 2 Sapling 1-5.9" diam.	VSS 3 Young 6-11.9" diam.	VSS 4 Mid-Age 12-17.9" diam.	VSS 5 Mature 18-23.9" diam.	VSS 6 Old > 24" diam.
Project Area Acres and Percent	27 ac (1%)	34 ac (1%)	1,738 ac (34%)	1,534 ac (30%)	1,709 ac (34%)	0 ac (0%)

VSS classes shown in the table were calculated from the vegetation inventory as stand averages. Stand average VSS classes do not reflect the complex and dynamic structural classes at the smaller site scale or broader landscape scale. The average VSS for a stand is based on the trees with the most basal area (square feet of biomass) in the stand. Therefore, the stand average VSS classes do not accurately indicate the high proportion of small trees that are under 6 inches in diameter. It would require a much greater resolution of data than is available to calculate VSS in groups of trees within each stand. Across the project area landscape (also called an ecosystem management area), the small groups of different VSS classes within each stand provide a complex mosaic of structural heterogeneity. Considering number of trees by diameter class at other various scales, there is an over-representation of VSS 1-2. For example, in the ponderosa pine and mixed conifer forest across the entire project area, there is an average of roughly 2,000 seedlings per acre under 1 inch in diameter (VSS 1), 300 saplings per acre (VSS 2), plus 100 to 200 young to mid-age trees per acre (VSS 3-4), and the area would classify as VSS 3-4. Thus, in summary, within the stand or larger landscape scale, there are numerous sites of different VSS classes. Goshawk habitat consisting mostly of VSS 3 stands, contain many sites with trees over 12 inches in diameter (VSS 4), sites with trees over 18 inches in diameter (VSS 5), and a few sites with trees over 24 inches in diameter (VSS 6). The forest plan noted that within VSS 3 stands there may be many patches of VSS 4 and 5, which is the case in this project area (U.S. Forest Service 1986: 208C).

There are also a few distinct differences in VSS distribution based on vegetation cover types. One difference is that over 80 percent of the piñon-juniper woodland stands are classified as VSS 5, and only 15 and 30 percent of the mixed conifer and ponderosa pine stands respectively are in VSS 5. However, the high percent of VSS 5 stands in piñon-juniper woodlands is mostly due to the many ponderosa pine and fir trees over 18 inches in diameter mixed into those woodlands stands. Another difference is that the majority of the VSS 3 stands are in the mixed conifer forest type, which contains the highest densities of young white fir trees in the understory canopy. Table 22 shows the VSS distribution by forest cover types, and table 23 shows the diameter class distribution.

Forest plan guidelines require managing goshawk habitat within and outside PFAs toward a much more balanced diameter class distribution. The VSS 1 and 2 stands should comprise about 10 percent each, and VSS 3-6 stands should comprise about 20 percent each. Table 22 shows the VSS class distribution by forest cover type, based on the percent of the stands within each class (weighted averages) and the forest plan goshawk guidelines for VSS distribution.

Table 22. Vegetative structural stage distribution by forest cover type, expressed as a percent of the stands in the project area, and in comparison with goshawk guidelines in the forest plan

	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
Mixed Conifer	1	0	56	28	15	0
Ponderosa Pine	0	1	20	49	31	0
Piñon-Juniper	0	2	0	15	83	0
Goshawk Guidelines	10	10	20	20	20	20

Table 23. Average number of trees per acre by diameter class in the project area, with the corresponding VSS classification.

Diameter Classes	No. of Trees per Acre
< 1.0" (VSS-1)	> 450
1.0 to 5.9" (VSS-2)	322
6.0 to 11.9" (VSS-3)	84
12.0 to 17.9" (VSS-4)	29
18.0+" (VSS-5-6)	8

Considering the VSS classes and tree numbers by diameter class, the project area has an excess of seedlings, saplings, young and mid-age trees, VSS 1-4 or trees under 18 inches in diameter, and a deficit in mature and older age trees, VSS 5-6 or trees over 18 inches in diameter. The highest numbers of trees in the area by far are under 12 inches in diameter, and substantially decline in the number of trees per acre over 12 inches in diameter. However, over 50 percent of the stands in the project area contain more than 20 trees per acre greater than 12 inches in diameter. Although the area contains an excess number of seedlings (VSS 1), there is a notable deficit of grasses and forbs on the forest floor (also VSS 1), due to the very high stand densities that dominate the area. The lack of plant cover reduces the quality of goshawk foraging habitat.

The lack of large trees over 18 inches in diameter is partly due to some large trees that were removed during historic logging operations. Another reason is that the lack of surface fire regimes and high stand density situation described in the “Vegetation, Fuels and Fire” section, trees are unable to grow to their potential size and are dying prematurely. However, even with the general under-representation of trees over 18 inches and over 24 inches, over 30 percent of the project

area contains stands that meet minimum structural attributes of old growth forest as defined in the forest plan. The “Vegetation, Fuels and Fire” section shows a map of those old growth stands.

Canopy closure percentages are quite variable within each stand. Like VSS, the stand averages for canopy closure do not accurately reflect the high degree of within-stand variability. Canopy closure calculations are also highly variable based on the methodology used. Canopy cover calculations using Forest Vegetation Simulator (FVS) are consistently lower than canopy cover estimates calculated by other means (Fiala et al. 2006). Using the FVS method, canopy cover for the two goshawk PFAs averages 32 to 42 percent. Using a stand densiometer method, canopy cover in sampled stands in goshawk PFAs averages approximately 50 to 90 percent (Denton 2006). Canopy cover measurements using stand densiometers, hemispherical photo images, or similar methods derived from field-based plot data would be consistently higher than FVS-derived measurements. The forest plan requirements for canopy cover are based on measurements from stand densiometers or similar field-based data. Forest plan requirements call for canopy cover percentages in VSS 4, 5, and 6 stands to be 40 to 60+ percent, depending on forest type and location inside or outside the PFAs. In piñon-juniper woodlands within PFAs, the forest plan calls for maintaining the existing canopy cover. The forest plan calls for managing nesting areas in goshawk PFAs toward VSS 5-6, with canopy covers averaging 50 to 70 percent. Currently, the stand averages for VSS 4 and 5 stands are approximately 40 to 45 percent canopy cover based on FVS calculations, which would translate to approximately 50 to 60+ percent canopy cover based on a stand densiometer method. Table 24 shows the forest plan requirements for VSS 4-6, in the mixed conifer and ponderosa pine forest types (U.S. Forest Service 1986: 208D).

Table 24. Forest plan requirements for minimum average canopy cover percentage, in mid to mature forest stands (VSS 4-5), inside and outside goshawk post-fledgling family areas (PFAs)

	Inside PFA	Outside PFA
Mixed Conifer	VSS 4: 60% VSS 5: 60% VSS 6: 60%	VSS 4: 1/3- 60%, 2/3-40% VSS 5: 50% VSS 6: 60%
Ponderosa Pine	VSS 4: 1/3-60%, 2/3: 50% VSS 5: 50% VSS 6: 50%	VSS 4: 40% VSS 5: 40% VSS 6: 40%

Changes in forest structure and composition have reduced the quality of goshawk habitat. Mostly due to long-term fire suppression and resulting lack of surface fire regimes, stands are unusually dense. The excess trees are mostly shade-tolerant white fir trees that are not fire-resistant like Douglas-fir and ponderosa pine. White fir trees did not dominate the dry southwestern mixed conifer forests like they do today. Stand density is at a level where competition is severe, resulting in a high risk for bark beetle attacks and tree mortality. The growth of large trees is suppressed by overly dense stand conditions. These trends are degrading the quality of nesting and foraging goshawk habitat. The very high stand densities are exacerbating the deficits of large trees and mature forest habitat needed for nesting/roosting, and the open understories and grassy openings needed for foraging habitat. Ladder fuels and high stand densities create a high probability of a

large-scale crown fire that could cause a serious loss of goshawk habitat. (Refer to “Vegetation, Fuels and Fire” section for more details about these conditions and trends).

Environmental Consequences

Alternative 1—No Action

Under this alternative there would be no impact to goshawks or their habitat from the proposed project because proposed activities would not be implemented. Current management plans would continue to guide existing and previously authorized activities in the project area. There would be no goshawk habitat disturbance that could otherwise result under action alternatives from road construction/reconstruction, mechanical thinning, prescribed burning, and increased vehicle use or helicopter flights. There would be no reduction in canopy cover in the VSS 4-6 stands or groups, except where tree mortality continues to cause a loss of the larger trees.

The current conditions and trends described under “Affected Environment” would continue to have some detrimental consequences to goshawk nesting/roosting habitat as well as foraging habitat. There would continue to be fewer large trees as they would continue to be growth suppressed and die out prematurely due to the severe competition for moisture, light and nutrients. As large trees die and eventually fall to the ground, without prescribed burns to reduce surface fuels and seedlings, excess small tree densities would dominate the habitat. There would continue to be an excess in VSS 2-3. Mature and old growth forest characteristics dominated by large mature trees, would not develop as well without reducing stand density and restoring large surface fires. There would continue to be a deficit of VSS 5-6. Without prescribed fire, the resilience and sustainability of these fire-adapted ecosystems would continue to decline. There would continue to be a lack of VSS-1 grass, forb and shrub habitat components. Historic meadows and shrublands would continue to be encroached (taken over) by conifer trees. In addition, white fir would continue to dominate rather than fire-resistant pine and Douglas-fir trees. As a consequence of all these conditions and trends, the area would remain very susceptible to a large high-intensity crown fire and loss of suitable goshawk habitat.

No Action with Crown Fire

The no action “with crown fire” scenario may impact individual goshawks and their habitat, but is not likely to result in a trend toward Federal listing or loss of viability for the goshawk population as a whole. Even if both PFAs were lost in a large crown fire event, there are many other suitable goshawk PFAs on the district and forest, including large amounts of suitable nesting habitat in the White Mountain Wilderness, approximately 5 miles northwest of the project area. Thus, goshawks could continue to nest and forage in surrounding forested lands unaffected by the wildfire.

A large, high-intensity crown fire would reduce the quality of goshawk nesting and foraging habitat within the burned area, as the fire would consume most of the tree canopies and ground vegetation in its path. Nesting and fledgling season overlaps the typical wildfire season, so the goshawk nestlings/fledglings in the fire’s path would also likely be killed, and adult goshawks could also die in such a fire. Fire suppression activities would also typically occur within the breeding season, as it overlaps fire season. Aerial and ground fire fighting and post-fire rehabilitation activities would cause noise and visual disturbances in the PFAs and nesting areas for several months or longer. Rapidly bulldozed fire lines and hand lines would reduce canopy cover and habitat quality, creating new road pathways until they are rehabilitated. Overall,

impacts of this alternative would be detrimental to the habitat conditions as well as the reproduction success of individual goshawks in this area.

A large crown fire could easily consume most of the vegetation within the 5,200-acre project area in less than 12 hours (as described in the “Vegetation, Fuels and Fire” section). Some patches of forest would likely survive in the moist north slopes and canyon bottoms. However, most of the goshawk habitat in the PFAs and other areas would likely be destroyed. A large crown fire would substantially reduce the canopy cover required for goshawks. A high-intensity crown fire would typically consume nearly all the surface vegetation, organic matter and down woody material. Only the larger snags would remain. It would take about 200 years to restore mature forest habitat suitable for goshawk nesting habitat. Foraging habitat would be restored somewhat more quickly. If areas lack sufficient seed sources to restore conifer forest, burned areas could remain as shrub fields for an indefinite period of time.

Alternatives 2 and 3

Alternative 2 may impact individual goshawks, but is not likely to result in a trend toward Federal listing or loss of population viability. Proposed fuel reduction treatment activities would primarily have beneficial effects to goshawk habitat, and potential adverse impacts would be minimized by application of mitigation measures.

Noise and visual disturbance from roadwork activities, thinning, or burning operations would not likely substantially impact goshawk nesting or reproductive success because all proposed activities are prohibited within PFAs during the breeding season (March 1 to September 30). Noise and visual disturbance from activities outside the PFAs and breeding season are not expected to have an adverse impact on the goshawks foraging use of the project area, although goshawks may temporarily avoid portions of the project area where activities are being conducted.

All proposed thinning treatments would reduce the average canopy cover to below approximately 40 percent, as measured by the FVS methodology. However, overstory canopy cover reductions in VSS 4-6 groups would be avoided or minimized to a large extent. Treatments that would reduce the number of live trees in the 12- to 18-inch size class (VSS 4-5) would affect up to 39 percent of the PFAs, as shown in table 24. That 39 percent constitutes the percent of PFAs where a portion of living trees up to an 18-inch diameter limit would be thinned, starting with the smaller trees. Those are the areas that would most likely see reductions in canopy cover within some larger VSS 4-5 areas in the PFAs. Of that 39 percent where trees up to 18 inches may be thinned, 5 percent (66 acres) would be thinned in the community defense zone units. That is where the understory trees would be thinned to lower stand densities and canopy cover, due to occurring adjacent to the community interface boundary. Sanitation treatments that retain all live trees over 9 inches and only remove dead/dying trees up to 18 inches in diameter would not substantially reduce canopy cover. This is because the large trees felled would either be totally dead or partially dead. The dying trees that would be thinned are those that would be expected to lose all needles within 1 to 2 years and be completely dead within approximately 3 years. Thus, with or without felling those trees, they would not provide canopy cover and would eventually fall to the ground on their own. The remaining prescribed burn-only treatments and thin from below up to 9-inch diameter limit treatments would not reduce any trees over 9 inches or canopy cover in the VSS 4-6 clumps. No treatments would occur in the 178 acres of designated nest site habitat within the PFAs. This is due to their occurrence within spotted owl PACs where

treatments are not allowed. Table 25 shows the various treatments that would occur within the two PFAs under alternative 2 or 3.

Table 25. Acres of each treatment type in PFAs for alternatives 2 and 3

Treatment Type	Alternatives 2-3
Thin from Below (18" limit)	478
Community Defense Zone (18" limit)	66
Sanitation Thin (9" live tree limit; 18" dead/dying tree limit)	428
Thin from Below (9" limit)	162
Prescribed Burn Only	72 (146 in Alt.3)
Untreated Areas	178
Total Acres	1,384

The forest plan would be amended to exempt this project from full compliance with the high canopy cover specifications for all VSS 4-6, and all woodlands in PFAs. It would not be feasible to meet crown fire hazard reduction objectives in the wildland-urban interface while retaining all VSS 4-6 at over 40 percent or higher canopy cover, or all existing canopy cover in woodlands within PFAs, per forest plan specifications. This was described in greater detail under the “Alternatives Considered but Eliminated from Detailed Study” section in chapter 2.

Thinning from below in all treated stands would substantially reduce the smaller and more suppressed understory trees, especially where they occur under larger trees as ladder fuels. By thinning from below to retain the largest trees with the best crowns, much of the existing overstory canopy would be maintained. The 31 percent of the project area allocated to old growth would continue to meet old growth attributes after thinning. Reducing the heavy stand density in the understory, while retaining the larger overstory trees, would improve the growth of the larger, residual trees. Improving development of mature and older stand conditions, with larger overstory trees and a more open understory, would improve goshawk habitat conditions within and outside PFAs. Treatments would retain all snags over 18 inches (except where necessary to fell for safety purposes), down logs over 12 inches, large hardwood trees, and 5 to 15 tons per acre of down, woody material (depending on forest type). These mitigation measures, and others described in chapter 2, would maintain or enhance the quality of goshawk habitat in accordance with forest plan standards and guidelines.

Treatments would result in creating small, scattered canopy gaps, up to a maximum of 200 feet wide. This would promote an increase in VSS 1 grasses, forbs and shrubs, which are proportionately under-represented on this landscape. Treatments would add to structural and compositional diversity across the landscape, creating more of a mosaic of size classes and stand densities across the landscape. Treatments would move forest stands and clumps within stands closer toward the more balanced distribution of vegetative structural stages (VSS) for goshawk habitat, in accordance with forest plan direction. Treatments would result in the majority of stands either maintaining or increasing in the average VSS class across the landscape. There would be an increase in stands and groups within stands in VSS 4-6, dominated by larger, more mature trees

rather than young to mid-age trees. This would help reduce the shortage in those size classes, while improving habitat quality for goshawks, in accordance with goshawk direction in the forest plan (U.S. Forest Service 1986: 208C).

Despite the canopy cover reductions in some VSS 4-6 patches of goshawk habitat within and outside the PFAs, all other goshawk habitat management guidelines would be met, as described in "Mitigation Measures," chapter 2. Within the next 20 to 30 years, average overstory canopy cover would again be above 40 percent in the majority of stands, as the larger trees would be released from severe competition to grow. Maintenance burns would help retain a more open understory, with patches of seedlings and saplings retained in areas where they are not directly under larger trees.

Stands in Grindstone PFA that are closer to the community boundary and in drier pine and woodland sites would be more open compared to the north slope mixed conifer and moist draw areas. The more open areas would not likely provide quality nesting habitat, but would be available as quality foraging habitat. It cannot be predicted to what extent goshawks would use the Grindstone PFA for nesting as opposed to foraging habitat, but the PFA would contain variable forest patches of different densities and age classes. In the Brady PFA, a nest site currently exists within 200 feet of a proposed new spur road, in an area thinned in the past. Seasonal restrictions on road construction and use would protect that goshawk nest from disturbance. Retaining the large trees and down wood in accordance with the alternative design criteria would maintain the habitat quality at this nest site.

The prescribed burning would further enhance diversity and would not have adverse effects on goshawks or their habitat. Burning would be designed to move fire and smoke away from nest trees. The proposed low to moderate intensity surface burns would not be expected to consume logs over 4 inches in size, or kill standing trees with diameters of over about 6 inches. The prescribed burning would further improve the structural complexity and habitat heterogeneity, typical of most prescribed burns (Pilliod et al. 2006). Burning together would reduce the numbers of seedlings and tons of fine woody fuels, and encourage vigorous plant regeneration on the forest floor. Overall, plant diversity, prey habitat and prey abundance would be expected to increase.

Treatments would create a greater diversity of ages, sizes, and densities of trees, along with an increase in the abundance of grasses, forbs and shrubs. The clumpy, mosaic pattern of forest patches would resemble historic patterns left by historic surface fire regimes, with patches of larger trees and higher stand densities on moist north- and east-facing slopes and in drainage bottoms, and lower densities on the drier, south- and west-facing slopes, along ridgetops and along the community boundary (Hanks and Peddie 1974). Treatments would also improve the forest species composition, moving conditions closer to historic conditions considered to be more sustainable over time. There would be fewer white fir trees and, thus, greater dominance by large ponderosa pine and Douglas-fir trees that can withstand frequent surface fires without promoting crown fire behavior.

Construction or reconstruction of roads and roadside landings (storage sites) would not substantially alter the quality or quantity of goshawk habitat. Some trees would need to be cleared to accommodate widening existing road corridors a few feet on each side, constructing some new road spurs, and improving landing sites. However, most road construction/reconstruction would occur within existing route corridors, including Trail 91 that is actually an old road currently used as a trail. Similarly, existing clearings along roads would primarily be used for landing sites,

usually ¼ to 1 acre in size. Cutting large trees (over 12 inches in size) to accommodate roads or landings would be avoided wherever possible. Thus, proposed roads and landings would not result in a major reduction in mid-age to mature habitat within each of the PFAs. Table 26 shows the proposed miles of road construction or reconstruction that would occur in PFAs outside the breeding season. Alternative 2 would involve a total of 2.1 miles in PFAs, and alternative 3 would involve a total of 3.6 miles of roads within the PFAs. After project completion, all roads used would be closed or decommissioned, so there would be no open roads once the project is completed. Decommissioned roads and landings would be restored to native vegetation, which would provide foraging habitat.

Table 26. Proposed road construction and reconstruction miles in the Brady and Grindstone PFAs for alternatives 2 and 3 (Miles of roadwork under alternatives 2 and 3 are the same except where otherwise noted)

Road Construction/Reconstruction	Brady PFA (miles)	Grindstone PFA (miles)
Construct road on Trail 91 (roadbed); close after project ends.		1.0
Construct road on unauthorized road; decommission after project ends.		0.4
Reconstruct closed Road 988; convert to trail after project ends.	0.5	
Construct new road segments' decommission after project ends.	Alt. 2: 0.0 Alt. 3: 0.2	Alt. 2: 0.2 Alt. 3: 1.5
Total Road Construction/Reconstruction Miles	Alt. 2: 0.5 Alt. 3: 0.7	Alt. 2: 1.6 Alt. 3: 2.9

Cumulative Effects

The Smokey Bear Ranger District is the analysis area used for cumulative effects analysis because goshawk habitat is widespread across the district, and goshawks could reasonably be expected to move between habitat areas on different parts of the district. Goshawk habitat is not continuous or linked between the other three districts on the Lincoln National Forest.

Other cumulative effects considered in the analysis are those listed in appendix A, along with similar activities that occur in other parts of the district. Wildfires of differing intensities have affected goshawk PFAs. Large crown fires are shown on maps in appendix A. The Cree Fire severely burned 50 percent of the Gavilan PFA. No goshawk reproduction has been reported since, although adult goshawks have been observed in the area in 2001 and 2003. The Peppin Fire burned through a portion of the Gum Springs PFA, although mostly as a low intensity underburn that enhanced goshawk habitat. No other wildfires are known to have affected goshawk PFAs elsewhere on the Smokey Bear Ranger District within the past 50 years. It is likely that wildfires of varying intensities would continue to occur each year on the district and effect habitat conditions for goshawks in the area. Lower intensity surface wildfires would have favorable effects, while higher intensity crown fires would likely have adverse effects.

Fuel reduction treatments on and off national forest lands would also have a cumulative effect on goshawks and their habitat, especially due to the number of acres treated in recent past, ongoing and foreseeable future projects (see list in appendix A). Together these treatments would cumulatively reduce the risk of a large, high-intensity crown fire. Fuel reduction treatments on national forest lands would continue to preserve key goshawk habitat features and avoid activities during breeding season in PFAs. Cumulatively, treatments would promote development of large trees and mature forest conditions with open understories, and a greater abundance of grasses and forbs. Cumulatively, the improved balance in VSS classes would be further enhanced by the addition of other similar projects, on and off national forest lands. Large snags and down logs would continue to be plentiful in both treated and untreated forest areas. Insects and diseases would continue to kill the larger, more stressed trees, but at a greatly reduced rate. Thus, goshawk habitat conditions would improve over a larger geographic area in combination with other activities in the surrounding forest lands within the district boundary.

New residential developments, including some that may occur directly adjacent to the Brady and Grindstone PFAs, would cause unavoidable disturbance and habitat modification impacts to goshawks along the project area boundary. Residential construction and homeowner activities could remove nesting habitat, especially as the Village of Ruidoso continues to expand.

The cumulative thinning and burning activities throughout the greater Ruidoso area and district would likely encourage slightly more off-road motor vehicle use within potential goshawk nesting areas, as the understories would be more open. Recreational activities would not be prohibited within PFAs during breeding periods and may continue to cause increases in disturbance as the population of Ruidoso grows. However, recreational activities are fairly well dispersed and would not likely occur in concentrated areas in potential nesting areas at the same time. Goshawks disturbed by noise in one area may relocate to another stand of mature forest habitat elsewhere on the district. The large, undeveloped White Mountain Wilderness contains contiguous blocks of suitable goshawk nesting habitat within 5 miles of the project area, which would continue to remain available if goshawks become disturbed by forest activities adjacent to Ruidoso.

No other habitat altering or major disturbance activities would be anticipated to occur in goshawk habitat at the same time as the proposed project. Therefore, considering the various activities and events just described, no significant cumulative effects to goshawk populations or habitat trends would be expected from the combined effects of other activities and the proposed project.

Sacramento Mountain Salamander

Affected Environment

The Sacramento Mountain salamander (salamander) is an amphibian that uniquely occurs in the Capitan, White, and Sacramento Mountains of southern New Mexico. It is on the State of New Mexico list of threatened and endangered species. It inhabits moist sites in coniferous forests at elevations over 8,000 feet in the Sacramento Mountains. Substantial forest canopy and ground surface cover such as rocks, logs and organic material are key elements of preferred salamander habitat. Logs in an advanced state of decomposition are preferred microhabitat for the salamander. The salamander lives below ground most of the time, occasionally surfacing during rainy conditions in the summer months. It feeds mainly on insects such as ants, spiders, and beetles (NM Department of Game and Fish 1996).

Within the 5,200-acre project area, there are 162 acres identified as potential salamander habitat, consisting of all the mixed conifer forest above 8,000 feet in elevation. The potential salamander habitat area lies within a Mexican spotted owl protected activity center (PAC). Within the potential habitat, there is a 45-acre stand classified as occupied salamander habitat, based on locating a salamander in that area in August 2005. Additional surveys conducted in 2006 and 2007 failed to locate the salamander within potential habitat in the project area. Population distribution of this species is considered relatively stable (NatureServe 2007). Salamander sightings have been reported in 11 areas of the Smokey Bear Ranger District (McCaw et al. 2007).

Environmental Consequences

Alternative 1—No Action

The no action alternative would have no impact to the salamander or its habitat from proposed activities because they would not be implemented. Current management plans would continue to guide existing and previously authorized activities in the project area.

Under this alternative the existing forest conditions and trends would continue to change as previously described for other wildlife species and in the “Vegetation, Fuels and Fire” section of this EIS. Stand density related mortality in the larger trees would continue to increase. This would have negative and positive effects on salamander habitat. The loss of large tree canopy cover would be a loss of that habitat feature, although the salamander would benefit by the increase in numbers of large, down logs.

No Action with Crown Fire

The no action “with crown fire” scenario may impact individuals, but is not likely to result in a trend toward Federal listing or loss of viability of the salamander population or its habitat. However, the 162 acres of potential and occupied habitat in the project area would easily be lost in a high-intensity crown fire, if the fire burned through that single block of high elevation forest. It is unlikely that the salamander would be above ground during the fire, as it usually only surfaces during wet weather conditions. Thus, the salamander may survive such a fire. It is uncertain whether the salamander would be able to move into adjacent unburned areas of mixed conifer forest over 8,000 feet. The remaining salamander populations that have been found at 10 other sites on the district would remain unaffected.

If a high-intensity crown fire burns through the salamander habitat in the project area, it would be expected to destroy the suitability of that habitat to support the salamander for about 50 to 100 years.

This is because the key habitat requirements for this species would be lost—the moist, cool, forest canopy and accumulations of down, woody material on the forest floor. All of the trees, ground vegetation, and organic material on the forest floor would be expected to be burned in the path of a high-intensity crown fire. This would result in increased sunlight and temperatures on the forest floor and reduced surface moisture and water holding capacity. Amphibians in forested areas are closely tied to the woody material that accumulates slowly in the decades and centuries after stand-replacing fire (Smith 2000). Prey habitat and arthropod abundance for salamanders would be reduced in areas severely burned by fire (Ramontnik 2007). Salamander populations have been found to be lowest on sites severely burned in wildfires, and remain low for at least 5

years (Ramontnik 2007). Reoccupation of severely burned sites would not likely occur until canopy cover develops, depth of organic material on the forest floor increases, and large trees become more common (Ramontnik 2007). Thus, the substantial changes in habitat and surface conditions typically resulting from a high-intensity fire would be expected to affect salamander use and occupancy within the burned area for quite some time.

Alternatives 2 and 3

Alternatives 2 and 3 may impact individual salamanders, but would not likely result in a trend toward Federal listing or loss of viability of the salamander or its habitat. No salamander mortality is anticipated because proposed activities would not occur during wet periods when salamanders may be above ground. Activities would only occur when salamanders are protected underground. Proposed activities would retain the key habitat requirements for the salamander to maintain habitat suitability.

Within potential salamander habitat, alternative 2 includes treatments on 117 acres and alternative 3 includes treatments on 156 acres. The difference is that under alternative 3, an additional 39 acres would be treated with a low-intensity, burn-only treatment, and it would occur within the 45-acre occupied habitat. Alternative 2 would exclude treatments within the 45-acre occupied habitat. All thinning treatment areas within salamander habitat under either alternative would include a low-intensity surface burn. All thinning and burning activities would be prohibited during wet periods when salamanders could be above ground. No roads or landings would be constructed or reconstructed within any of the potential salamander habitat. No heavy mechanized equipment would be used in potential salamander habitat. All thinning and burning activities in salamander habitat would be conducted with manual thinning and burning crews. Under alternative 2, helicopters would remove the felled trees, while under alternative 3 felled trees would remain onsite with the activity slash scattered on the forest floor. Table 27 shows the proposed treatments and acres treated under each alternative within the 162 acres of potential salamander habitat in the project area. The only treatments within the occupied habitat are the prescribed burn-only treatments.

Table 27. Treatments and acres treated in potential salamander habitat by alternative

Treatment Type	Alternative 2	Alternative 3
Thin from Below (Up to 18 in. dbh)	27	27
Thin from Below (Up to 9 in. dbh)	35	35
Sanitation Thin (Up to 9 in live trees; up to 18 in dead/dying)	51	51
Prescribed Burn Only	4	43
Total Treatment Acres in Salamander Habitat	117	156

The thinning treatments involve thinning from below and would remove the smallest trees in the understory and fewer of the live overstory trees and overstory canopy. The result would be a reduction in tree density, canopy cover and shading of the forest floor. The largest canopy openings may occur within the 51 acres of sanitation thinning, in order to remove the dead and dying trees and prevent further tree losses to insects and disease. Openings would be a maximum of 200 feet wide. In sanitation treatment units, all living trees over 9 inches in diameter would be

retained (trees not expected to die within the next few years), along with snags over 18 inches. The reduction in the amount of shade and stand density from any treatments would affect on the microhabitat (e.g. temperature and humidity) of salamander habitat. The more open understory and overstory gaps in the tree canopy would reduce the moisture and increase temperatures to the forest floor, which would slightly reduce quality of the habitat. Salamanders would be expected to avoid the warmer, drier openings created on the ground as a result of thinning. However, to protect spotted owl and salamander habitat quality on these sites, dense clumps of trees and relatively higher overstory canopy cover would be retained to provide adequate shading on the forest floor. In addition, there would be an increase in woody debris on the forest floor to improve soil moisture and microhabitat quality for the salamander. The overall changes in humidity, soil moisture and temperature would be minimal and not substantially impact potential suitability of the habitat.

Within a year following thinning and burning treatments, there would be a substantial increase in the abundance of grasses and forbs, especially in the small canopy gaps. Increases in grasses and forbs in the understory would increase substrate for the ground dwelling arthropod prey species of salamanders.

Down logs and wood are key habitat features. Thinning would not remove existing down logs, but would generate additional down logs and woody material (tree stems and branches). At least 10 to 15 tons per acre is required to be retained. In alternative 2 there would be substantially less down wood remaining due to helicopters removing whole trees over 6 inches in diameter, although 10 to 15 tons per acre would be left onsite for habitat improvement purposes. In alternative 3, there would be no log removal in this area. The prescribed surface burning would burn the fine fuels, typically less than 4 inches in diameter, and leave all the larger down wood. It would also leave a portion of the organic matter, especially in the more moist areas. There would be sufficient down logs and woody material to maintain or enhance salamander habitat and insect food sources in this area.

Snags are considered future replacement down logs, as they eventually fall to the ground. Thinning would remove a portion of the snags, especially the smaller snags less than 18 inches in diameter. Mitigation measures require retaining all snags over 18 inches in diameter unless required to be felled for safety purposes. The snags retained in treatment units, combined with the snags in adjacent untreated forest stands that are experiencing insect/disease infestations, would likely result in continuation of snag abundance within potential and occupied salamander habitat. Thus, large logs and down wood should continue to remain abundant in the future as snags fall to the ground over time.

The prescribed burning would temporarily reduce the soil moisture available for the salamander and its prey species for the first year. Grasses and forbs would rapidly grow in and replenish the soil moisture, along with the additional down wood left from thinning. Within 5 years, there would additionally be new tree seedlings and more mature plants on the forest floor, substantially improving the microclimate and forest floor habitat conditions for the salamander. The fire-charring of down logs from prescribed burns may harden parts of the logs and reduce their rate of deterioration. This may slightly reduce potential abundance of insects and other invertebrate prey species (Pilliod et al. 2006). Future maintenance burning in this high elevation mixed conifer portion of the project area would occur about every 20 years or so, to maintain the reduced risk of crown fire ignition and spread.

Cumulative Effects

The mixed conifer habitat over 8,000 feet in elevation that occurs within and adjacent to the project boundary that would be affected by this project is considered the cumulative analysis area for this project. Survival of the salamander population within the project area is not expected to be adversely impacted by the proposed project, due to treatment design and mitigation measures as previously described. Proposed project activities would not result in any significant loss of potential or occupied habitat for the salamander. The salamander population trend on the district and forest would not be affected by this project.

The salamander occupies a narrow niche in the moist, high elevation mixed conifer forests. The minor effects to salamander habitat from alternatives 2 and 3 would be expected to be localized to within the 162 acres of potential habitat in the project area, and would not be expected to adversely impact salamander survival or population viability. Other activities and events that could affect salamander populations in the Sacramento Mountain range would not overlap or combine with project related effects. There are no other activities or wildfire events that have recently occurred, are ongoing, or expected to occur within or directly adjacent to the potential or occupied salamander habitat in the project area (including adjacent Mescalero-Apache Reservation lands). Thus, there would be no cumulative effects to the salamander or its habitat in this area as a result of project activities combined with effects of other activities.

However, a brief summary is provided here as additional information regarding effects on potential salamander habitat within its entire range, which is the Smokey Bear and Sacramento Ranger Districts of the Lincoln National Forest. There have been wildfires of varying intensities within the salamander habitat on these two districts. The 2004 Peppin Fire burned approximately 1,000 acres of salamander habitat on the Smokey Bear Ranger District, although the fire did not burn severely in salamander habitat. Additional salamander habitat was burned in wildfires on the Sacramento Ranger District (past fires are described and shown on maps in appendix A). Where these fires burned through high elevation salamander habitat, they removed some tree canopy and shading, while retaining portions of the overstory trees. They generally burned through salamander habitat at low to moderate intensity. They reduced the quality of habitat by reducing humidity and moisture, and increasing temperatures and canopy openings. The wildfires also increased the amount of ground vegetation, aspen tree regeneration, and down wood, improving habitat conditions in the long term. Five timber harvest and fuel reduction thinning projects on the Sacramento Ranger District during the last 10 years reduced habitat quality on 7,163 acres of occupied salamander habitat. Those projects also reduced the shading and moist microclimatic conditions favored by the salamander, while increasing ground vegetation in the long term. A foreseeable future fuel reduction project in occupied salamander habitat on the Smokey Bear Ranger District is the Bonito Fuels Reduction project. Development of new hiking or mountain biking trails in elevations above 8,000 feet (potential salamander habitat) is also possible in the near future. No other activities are planned or expected in salamander habitat, although wildfires are expected to occur somewhere in the Sacramento Mountains each year. Effects on the salamander population from those other activities are unknown. Monitoring potential and occupied salamander habitat in the Sacramento Mountains will continue to occur.

Management Indicator Species

Management indicator species (MIS) are defined in the forest plan for the Lincoln National Forest to serve as barometers for species diversity and viability (U.S. Forest Service 1986: 31). Wildlife biologists survey for and monitor populations of management indicator species on the forest, and compile annual assessments of their population and habitat trends. At the project level, biologists and land managers assess the effects of management activities on management indicator species and their habitat, as an indicator of effects to species with similar habitat needs.

The forest plan identifies nine management indicator species. Of those, the following two bird species and three mammal species would likely occur or have potential habitat in the project area, and are, therefore, carried forward in this analysis process:

- Juniper titmouse (*Baeolophus ridgwayi*),
- Pygmy nuthatch (*Sitta pygmaeais*),
- Red squirrel (*Tamiascurus hudsonicus*),
- Elk (*Cervus elaphus*), and
- Mule deer (*Odocoileus hemionus*).

Juniper Titmouse

Affected Environment

The juniper titmouse (titmouse) is a bird that is commonly seen year-round on the Lincoln National Forest (forest) in piñon-juniper and oak woodlands with scattered openings. The titmouse requires large, mature trees that provide cavities for nesting and roosting. Nests are often placed in crevices in twisted trunks of mature junipers. The titmouse prefers mature, open woodland habitat, with large trees and snags and canopy openings. It is often found in woodlands with canopy cover averaging 11 to 25 percent (LaRue 1994). Its winter diet is made up of large seeds—piñon nuts, juniper berries and oak acorns. It primarily eats insects the rest of the year (Rustay and Norris 2006, Kucera 2005).

The titmouse has shown declining population trends in New Mexico and the Southwest region, particularly since 1980 (Rustay and Norris 2006). Monitoring surveys conducted on the Lincoln National Forest found the titmouse only occurs on the Guadalupe Ranger District, and does not occur in the higher elevation woodlands that occur on the Sacramento or Smokey Bear Ranger Districts. There is an upward population trend for the titmouse on the Guadalupe Ranger District, based on the past 8 years of surveys (Salas 2006:13-15). The closest the juniper titmouse has been found in relation to the project area was the juniper titmouse found on a breeding bird survey route near Carrizozo, about 20 miles north of the project area (Sauer et al. 2007). Surveys conducted in potential habitat in the Eagle Creek area about 2 miles north of the project area did not find any occurrences, presumably because it was too high in elevation (Salas 2006).

Surveys for juniper titmouse on the Smokey Bear and Sacramento Ranger Districts since 2001 indicate that the woodlands habitat on those districts is too high in elevation for the juniper titmouse (Salas 2006). Thus, it is unlikely that the species would occur in the project area. However, the titmouse is briefly evaluated here due to the uncertainty regarding potential habitat suitability of the woodlands at the lowest elevations in the project area (6,500 feet). The project

area contains a total of 919 acres of piñon-juniper and oak woodlands (18 percent of the project area). Woodland habitat in the project area is only about 0.17 percent of the 525,703 acres of woodland habitat on the forest (Salas 2006).

Environmental Consequences

Alternative 1 - No Action

Under this alternative, there would be no project related effect on titmouse habitat or population trends because the proposed project activities would not be implemented in this project area. Current management plans would continue to guide existing and previously authorized activities in the project area. There would be no noise or visual disturbance from proposed activities or any reduction in habitat components. However, the vegetation trends associated with the lack of large, low-intensity surface fires would continue to degrade habitat quality within the fire-adapted woodland habitat, as described in the “Vegetation, Fuels and Fire” section. In particular, there would be continued declines in large trees due to growth suppression and insect caused mortality. These trends may affect individual birds, although the titmouse habitat and forest-wide population trends would likely continue to remain relatively stable.

No Action with Crown Fire

Under this scenario of a large, high-intensity crown fire burning through the project area, there would be an expected loss of woodlands habitat for the titmouse at the project level and forest-level. However, because of the small proportion of woodlands habitat in this area relative to the forest as a whole, this loss would not likely cause a decline in the forest-wide population trend.

As described in other sections of this EIS, a large, high-intensity fire would remove nearly all the vegetation in its path, leaving only dead tree stems and some branches. Obviously, the magnitude and extent of this loss of habitat would depend on the location and amount of woodland habitat affected by such a fire. Because the woodland habitat within the project area is widely scattered in about 11 different places, some habitat would likely be spared, depending on fire behavior. Fire effects on birds depend largely on fire severity (Smith 2000). Changes to the quality and quantity of habitat available to the juniper titmouse in areas burned by wildfire could vary widely.

Since the bird’s breeding season overlaps the normal wildfire season in the spring, a loss of bird eggs and/or nestlings could occur in the burn area if the birds are present and nesting at that time. The oak would rapidly resprout after such a fire, providing foraging substrate and buds for juniper titmouse, but mast production (acorns) would not be available for at least 20 years. Not only would all live trees and plantlife be consumed in a high-intensity fire, but the smaller standing dead trees commonly used for nesting would also be destroyed in a high-intensity crown fire. As this bird requires mature woodland habitat with sufficient large tree canopy cover, titmouse habitat and populations would be slow to recover to the pre-fire composition and structure (Smith 2000). The nesting and foraging habitat for the titmouse and associated species in the burned woodland areas would be lost for at least 50 to 100 years.

Alternatives 2 and 3

The changes expected in potential titmouse habitat from these action alternatives would not be expected to adversely impact the forest-wide population or habitat trends for this species. Most piñon-juniper woodlands in the project area are in a mature to old growth condition, although tree

density is well above historic ranges due to the long-term lack of large surface fires. Treatments in all woodland stands are designed to maintain or enhance mature and old growth characteristics, with variable densities and size classes, which would maintain or enhance habitat requirements for the titmouse.

Treatments proposed would not reduce the suitability of potential titmouse habitat in the project area, even though nearly all the piñon-juniper habitat within the project area would receive some type of thinning and/or surface burning treatment. There are no major differences in the woodland treatments or effects between alternatives 2 and 3. About 34 percent of the piñon-juniper woodlands would be thinned from below up to a 9-inch diameter limit and 66 percent would be thinned from below up to an 18-inch diameter limit. In units thinned to an 18-inch diameter limit, some of the individual trees and clumps of trees 12 to 18 inches in size would be retained, in addition to dense clumps of smaller trees where they are not directly under larger trees. Most of the thinning would open up the understory and reduce the ladder fuels or multistoried canopies. Reducing density in the smaller understory trees and in a much smaller proportion of the 12- to 18-inch diameter trees (where needed to reduce crown fire potential), would not reduce habitat quality for the titmouse. Treatments would retain adequate numbers of the large piñon, juniper and oak used by the titmouse, and promote the growth and development of large mature trees. Treatments would maintain old growth characteristics where they exist. In addition to promoting development of large trees, treatments would promote a more complex and uneven variety of tree ages, sizes and densities. Some woodland stands or patches would have widely spaced mature trees, or savannah-like woodland habitat, with abundant oak shrubs and other ground vegetation. Others would be managed at higher densities. The effects of treatments would improve diversity and improve the habitat features required for nesting and foraging habitat for the titmouse.

The large snags would also be retained, as described in mitigation measures, unless necessary to fell snags for safety purposes. Mitigation measures designed to retain sufficient quantities of snags, in accordance with forest plan requirements for indicator species, would retain cavity nesting and roosting habitat needed by the titmouse and other cavity nesting birds (Pilliod et al. 2006).

The limited number of oak woodland patches in the project area would be treated with thinning trees up to a 9-inch diameter limit followed by burning, or by burning alone. These treatments would enhance oak woodland habitat by improving growth and mast production in the remaining oaks and stimulating regeneration of new oaks. Because the treatments would encourage larger trees and mature habitat conditions along with areas of new oak regeneration, the quality and quantity of nesting and foraging habitat in the oak woodlands would also improve.

Proposed activities could cause noise and visual disturbance to the titmouse, if it were to occur in an area where the bird was present and nesting. Potential disturbance sources include mechanical equipment used for road construction/reconstruction, chain saws and mechanical equipment used in thinning operations, helicopters and log trucks, and workers. Activities that occur in woodland habitat during the breeding season (April through June) would cause noise and visual disturbances that could impact reproduction of the titmouse for that year. However, the majority of the woodlands habitat (over 80 percent) is within Mexican spotted owl protected activity centers and/or northern goshawk post-family fledgling areas, which prohibit project activities during the same spring nesting season. The remaining 20 percent of the woodlands outside the seasonally restricted habitat areas totals 183 acres. Disturbance in those small areas during breeding season could cause some minor displacement effects, or loss of eggs or nestlings, if the

bird were to occur and nest in the area. These disturbance effects would be of limited duration, extent and magnitude relative to the widespread amount of mature woodland habitat available. Thus, potential disturbance impacts would not be significant. In addition, there are also no known titmouse nests in the project area, and woodlands in the project area may be too high in elevation to support breeding titmouse populations.

Cumulative Effects

Cumulative effects were analyzed across the project area and in relation to habitat and population trends across the forest, because the titmouse is a forest-wide management indicator species. Based on the forest-wide monitoring report, 19 percent of the existing piñon-juniper habitat on the forest has been altered by a combination of wildfires, insect/disease infestations, or vegetation management activities since 1986, as displayed in table 28 (Salas 2006).

Table 28. Acres of piñon-juniper habitat affected by wildfires, insect/disease infestations and vegetation management activities on the Lincoln National Forest

Total Forest Acres of P-J	Acres Burned in Wildfires	Acres Infected by Insect and Disease	Acres Harvested and/or Thinned	Total Acres Impacted
527,630	19,938 (4%)	10,776	71,912	102,626

Within the project area, little to no piñon-juniper habitat has been lost from wildfires in at least the past 60 years, as the last large fire in the area was in 1945. Appendix A describes and maps past wildfires in the area surrounding the project area. Wildfires in the project area since that time have been contained to within 10 acres in size to meet forest plan guidelines. They have caused no measurable change in the piñon-juniper woodlands. Thinning and prescribed burning fuel reduction treatments conducted over the past few decades in the project area generally did not involve the piñon-juniper woodlands.

All of the harvesting or thinning operations on the forest were designed to maintain snags and down logs in accordance with forest plan standards in order to protect the management indicator species habitat and other wildlife habitat on the forest. The many other fuel reduction projects occurring in woodlands habitat surrounding the project area and across the forest would have the same effects as described for this project. Cumulatively, those fuel reduction treatments combined with the proposed fuel reduction treatments, would yield a net long-term improvement in titmouse nesting and foraging conditions by increasing the development of mature, relatively open woodlands habitat preferred by the titmouse.

The effects expected from proposed alternatives 2 or 3, even when added to effects of other activities in the surrounding area, would not change the stable population trend for the titmouse that currently exists. Cumulatively, there would be a slight increase in potential noise disturbance effects from the added disturbance from recreational activities or residential development activities in the adjacent area. Fuel reduction treatments on surrounding woodlands would add to disturbances. Fuel reduction thinning and surface burning projects would add to the habitat improvement effects expected from the proposed project. Those projects would add to the cumulative acres of restored fire-adapted ecosystems in the woodlands. Cumulatively, the most noticeable cumulative effect would be the reduction in crown fire potential, which would provide long-term protection to mature woodland habitat for the titmouse and associated species.

Pygmy Nuthatch

Affected Environment

On the Lincoln National Forest, the pygmy nuthatch (nuthatch) is a year-round bird found in ponderosa pine forests. It is considered one of the best indicators of ponderosa pine health (Hugh and Cameron 2001). The density of pygmy nuthatches is strongly correlated with high amounts of foliage volume and numerous snags (Ghalambor and Dobbs 2006). The nuthatch needs mature or older ponderosa pine stands with relatively open understories, and prefer open, park-like stands (Hugh and Cameron 2001). They need snags with cavities for nesting and roosting. They feed 60 to 80 percent on insects, then switch to pine seeds in the winter months. They feed in trees, shrubs, and on the ground (Hugh and Cameron 2001). The availability of multiple potential snags with cavities is an important component of it's habitat during winter conditions (Ghalambor and Dobbs 2006).

Pygmy nuthatch populations are secure in New Mexico with an upward population trend (NatureServe 2007). Monitoring surveys conducted on the Lincoln National Forest since 2001 indicate the nuthatch population has an upward trend on the Smokey Bear Ranger District where the project area is located, and it is a common year-round resident in the project area (Salas 2006: 15-18). The nuthatch population on the neighboring Sacramento Ranger District declined after the Scott Able Fire burned severely through some mature ponderosa pine habitat, but has been on an upward trend over the past several years. Despite fluctuations in populations on specific districts, overall, the population on the forest is estimated to also be stable (Salas 2006). Bird surveys conducted in potential nuthatch habitat in the Eagle Creek area—2 miles from the project area—did not find occurrences of the nuthatch until 2005. Additional nuthatch occurrences have been documented along the breeding bird survey route near Carrizozo, 20 miles from the project area (Sauer et al. 2007).

Within the project area, there are 1,790 acres (34 percent of the area) classified as ponderosa pine cover type. However, roughly 60 percent of the ponderosa pine forest in the project area is in stands of young to mid-age trees, most at very high tree densities. Those stands lack the mature, open habitat conditions that are considered suitable for the nuthatch. A majority of the larger trees are found along the drainages and private land. These areas have the highest potential as nesting habitat. The forest contains 101,374 acres of ponderosa pine forest, 72 percent of which are on the Smokey Bear Ranger District.

The project area has a relatively high density of snags, estimated to be at least nine per acre of at least 14 inches in diameter, in part due to the high levels of insect and disease related mortality. Many stands in the project area average 10 to 30 percent mortality in the largest trees. However, snags over 18 inches in diameter are limited due to the lack of large trees.

Environmental Consequences

Alternative 1—No Action

Under this alternative, there would be no project-related effect on the nuthatch habitat or population trends because the proposed project activities would not be implemented in this project area. Current management plans would continue to guide existing and previously authorized activities in the project area. There would be no noise or visual disturbance from proposed activities or any reduction in habitat components. However, the vegetation

trendsassociated with the lack of large, low-intensity surface fires would continue to degrade habitat quality within the fire-adapted ponderosa pine habitat, as described in the “Vegetation, Fuels and Fire” section. In particular, there would be continued declines in large trees due to growth suppression and insect caused mortality. These trends may affect individual birds, although the habitat and population trends would likely continue to remain relatively stable.

Within the project area and in ponderosa pine stands across the district and forest, tree mortality in the larger trees due to insects and disease would be expected to continue, providing increasing numbers of large snags for nesting nuthatches. Foliage loss on dying large ponderosa pine could decrease foraging habitat for the nuthatch. The amount of mature trees and snags providing nesting habitat would remain relatively stable as the trees remain suppressed in growth and development. The amount of foraging habitat would continue to decrease over time as the amount of plantlife in the area declines due to tree competition and shading.

Alternative 1—No Action with Crown Fire

The effects of a large, high-intensity crown fire on ponderosa pine habitat that may be used by the nuthatch would be essentially the same as the effects predicted for the woodlands habitat used by the titmouse. This alternative may adversely impact individuals and result in a loss of suitable ponderosa pine habitat in the project area. However, with the large amount of suitable nuthatch habitat that would remain on the district and forest, the forest-wide population trend would not be expected to change.

Alternatives 2 and 3

Either of these action alternatives may affect individuals but would not be expected to have a significant impact on habitat or change forest-wide population trends. Treatments in this project area would affect a maximum of 2.5 percent of the ponderosa pine habitat on the district and a much smaller fractional amount of ponderosa pine habitat on the forest. Within the project area, treatments are proposed on nearly all ponderosa pine habitat in the area (96 percent), although only about 40 percent of the ponderosa pine stands contain mature, suitable habitat for the nuthatch.

Nearly all the effects of proposed activities on nesting and foraging habitat for the nuthatch would be the same as the effects previously described for the titmouse, because most of the treatment types and methods would be the same. Those effects include maintaining or improving the overall quantity and quality of mature and old growth ponderosa pine habitat that is used by these birds for nesting and roosting, while also improving foraging habitat conditions over time. Potential noise and visual disturbance effects would also be the same as previously described for the titmouse, only applied to the ponderosa pine forest stands. The main difference is that sanitation treatments would occur in the ponderosa pine and would remove the dead or dying trees (expected to be dead within 3 years) up to 18 inches in diameter. This would remove a portion of the snags that would otherwise be potential cavity nesting habitat. However, it is expected that there would continue to be sufficient numbers of snags in the 12- to 18-inch class available in the surrounding stands, and all snags over 18 inches in diameter would be retained. Thus, there would not be a significant impact to cavity nesting habitat. All of the treatments would move stand conditions closer to habitat features required by this species, including more dominance by larger, mature trees, a shift from younger to older structural classes, a more open understory including small scattered openings in the canopy, and more ponderosa pine instead of white fir tree species.

Retaining the largest trees and promoting growth and vigor in residual trees would enhance foliage production as well as cone (seed) production for the nuthatch.

Cumulative Effects

Cumulative effects were analyzed across the project area and in relation to habitat and population trends across the district and forest because the nuthatch is a forest-wide management indicator species. The district has 72 percent of the ponderosa pine habitat on the forest.

Across the forest there has been a decline in the quantity and quality of mature ponderosa pine forest habitat, cumulatively resulting from a combination of wildfires, insect/disease infestations, and long-term fire suppression. The lack of natural fire regimes in the fire-adapted ponderosa pine has resulted in declines in ecosystem composition, structure and processes, as described in the "Vegetation, Fuels and Fire" section of this EIS. Pine stands are too dense with young white fir trees to be considered quality nuthatch habitat. In addition, historic logging practices removed the largest ponderosa pine trees that were accessible to roads, and historic grazing practices reduced abundance and height of grasses needed to support large surface fires. Those activities contributed to the lack of natural fire regimes and the long-term decline in mature and old growth ponderosa pine habitat conditions on the district and forest. Degradation of mature ponderosa pine forests through timber harvesting and fire suppression have reduced pygmy nuthatch foraging, breeding, and roosting habitats by shifting forest structure from an open canopy comprised of few large trees to a closed canopy comprised of many small trees (Ghalambor and Dobbs 2006).

However, the effects of project activities would not add to the decline in habitat quality or quantity being experienced across the forest. The most substantial and net effect of either action alternative would be beneficial in terms of habitat quality and quantity, and would offset some of the negative effects occurring in the untreated areas of the district and forest. Restoring the ponderosa pine forest to a fire-adapted ecosystem that could once again support low to moderate intensity surface fires rather than high-intensity crown fires would greatly benefit the habitat and population trend in the long term.

Red Squirrel

Affected Environment

Red squirrel principally utilizes closed canopied mixed conifer forests with a clumped distribution of large, mature cone-bearing trees (Reynolds et al. 1992). Large trees with interlocking crowns provide the squirrel with a means of escape, access to foraging habitat, and immigration into new areas. Red squirrels prefer to nest in cavities of large snags, but also nest in live trees with thick crowns, and in mistletoe formations (Hedwall et al. 2006). They also construct nests out of grasses or other materials, and use ground burrows (NatureServe 2007). The squirrel's diet includes pine cones, fungi, fruit, seeds, sap, acorns, buds, conifer pollen, birds and small mammals. The most important food source is cones, and the best cones are from old Douglas-fir trees. The squirrel stores seeds, cones and acorns in food "caches" to use throughout winter. They place the caches in moist, shady areas, often under dense vegetation, in tree cavities or at the base of large logs in order to help prevent the cones from opening (Reynolds et al. 1992). A home range for the red squirrel is less than 2.5 acres. Approximately 9 to 25 large, mature, cone-producing trees per territory are required to sustain one red squirrel for a single year. The squirrel is often used as prey by the northern goshawk (Reynolds et al. 1992).

Red squirrel populations are secure in New Mexico (NatureServe, 2007). Monitoring red squirrel populations on the Lincoln National Forest found their population trend is stable (Salas 2006). Red squirrels are known to occur within the project area. Red squirrel populations have been studied on the forest as part of a research thesis project, and additional research on this species is continuing (Frey and Wampler 2005). A viable population is considered to be 1,440 individuals, and each population requires approximately 3,600 acres of suitable habitat (U.S. Forest Service 2003a). The red squirrel was recently added to the "Regional Forester's list of Sensitive Species for the Southwestern Region" (U.S. Forest Service 2007).

There are approximately 216,769 acres of mixed conifer habitat on the forest, of which about 27 percent occurs on the district (Salas 2006). About 2,481 acres or 48 percent of the project area contains mixed conifer forest stands. Mixed conifer stands in the project area are dominated by white fir and Douglas-fir, although evidence in the area indicates that historically these dry mixed conifer stands were dominated by ponderosa pine and Douglas-fir, with substantially less white fir (Denton 2006, Dahms and Geils 1997).

Of the mixed conifer in the project area, about 20 percent meets the structural attributes listed in the forest plan to be classified as old growth, and roughly 80 percent of the stands are classified as being in the young and mid-age vegetation structural stage classes. Within those stands dominated by younger or mid-age trees, there are patches or clumps of large mature trees. Suitable red squirrel habitat is considered to be the mature and older stands and patches of mature trees within stands. Mixed conifer stands in the area have an excess of seedlings, saplings and young white fir trees—averaging hundreds per acre. Red squirrel typically nests in stands with less than 100 trees per acre (Young et al. 2002). Thus, current habitat conditions in mixed conifer stands in the project area are not optimal for squirrels, due to the high density of small trees. The competition between trees is also restricting growth and vigor of the larger trees and causing premature mortality of those large trees. The dominance by white fir trees that are not adapted to these sites detracts from habitat quality and makes habitat more susceptible to crown fires. Mixed conifer stands are also lacking in ground vegetation due to the high stand densities (Denton 2006). Thus, suitable habitat in the project area is generally comprised of 20 percent of the mixed conifer stands that have mature or older forest patches. Refer to the "Vegetation, Fuels and Fire" section for details about forest conditions.

Environmental Consequences

Alternative 1—No Action

Under this alternative, there would be no project related effect on red squirrel habitat or population trends because proposed project activities would not be implemented in this project area. Current management plans would continue to guide existing and previously authorized activities in the project area. There would be no noise or visual disturbance from proposed activities or any reduction in habitat components. Squirrel caches, cavity trees and witches' brooms would continue to occur. However, the vegetation trends previously described would continue to cause a decline in the quality of mature, mixed conifer forest habitat for this species.

Density related tree mortality in the larger trees (350 to 550 trees per acre) would be expected to continue. Remaining trees would remain growth suppressed, causing a further decline in the largest, most mature trees and a shift toward more seedlings and saplings. As the larger trees continue to die and fall over prematurely, there would be a loss of large overstory canopy cover

and a decline in the average tree sizes and ages. Thus, the imbalance in proportions of small young trees to large mature trees would continue to be significant. There would be plenty of snags and down logs, which are key habitat requirements for the squirrel.

No Action with Crown Fire

Under this scenario of a large, high-intensity crown fire burning through the project area, there would be an expected loss of mature mixed conifer habitat for the squirrel. Because of the abundance of mature, mixed conifer habitat throughout the district and forest, such a fire would not likely result in a downward trend in the forest-wide population.

As described in other sections of this EIS, a large, high-intensity fire would remove nearly all the vegetation in its path, leaving only dead trees. All habitat components needed by the squirrel would be lost within the area burned, except snags and future down logs. Individual squirrels would likely be killed where they occur in the fire's path (Koprowski et al. 2006). Juvenile squirrels in natal nest cavities would likely die in a high-intensity crown fire, and the loss of caches could cause individual red squirrels to starve or may affect reproduction of squirrels due to poor physical condition of adult females. Loss of canopy cover even in partially consumed stands would increase red squirrel vulnerability to predation. As a crown fire event is expected to spread quickly through a large landscape area if it occurs during high fire danger conditions (as described in other sections of the EIS), it is reasonable to expect that a significant amount of suitable squirrel habitat would be completely lost. It would take at least 200 years to restore the mature and old growth mixed conifer stands to the area destroyed in a high-intensity crown fire.

If suitable squirrel habitat in the project area were impacted, it would reduce a small fraction of the total amount of mature mixed conifer habitat available to the red squirrel on the Smokey Bear and Sacramento Ranger Districts on the Lincoln National Forest. Therefore, it would not likely affect the overall forest-wide population trend. A crown fire would need to consume 3,600 acres of suitable habitat or impact 1,400 individuals to affect population viability (U.S. Forest Service 2003a).

Alternatives 2 and 3

Either of these alternatives may affect individual red squirrels but is not likely to impact forest-wide population or habitat trends. The net effect of treatments would be an improvement in suitable habitat conditions, due to mitigation measures that retain key habitat components and treatment designs that promote large trees and mature habitat with a stand structure and tree stem density closer to conditions preferred by the squirrel (as previously described).

Thinning from below up to 18-inch diameter trees would allow for partial reduction of trees in the 12- to 18-inch diameter class as needed to reach fuel reduction objectives. However, trees over 9 inches in size retained would be sufficient to maintain mature and old growth conditions wherever they occur. Thinning from below treatments would reduce the numbers of smaller trees that currently dominate the mixed conifer forest stands. This would move stands toward tree numbers found to be preferable to the squirrel (Young et al. 2002). All treatments would retain the larger individual trees and clumps of large trees, including all trees over 18 inches and the majority of trees over 9 inches. Thinning would not result in a significant loss of mature cone-bearing or cavity-nesting trees, due to mitigation measures and a thin-from-below design that would provide for ample numbers of large, mature trees. The reduction in understory tree density would increase the risk of predation on red squirrels by goshawks or other predators. However,

the high number of residual trees, including some dense patches and clumps of smaller trees and large overstory trees with dense crowns, would continue to provide adequate hiding cover for the squirrel.

Sanitation thinning treatments would remove mostly snags under 18 inches in diameter, as it removes dead and dying trees (likely to be dead within the next 3 years). Treatments would retain all the largest snags except where they need to be felled for safety purposes. Treatments in mixed conifer would not result in a significant loss of large snags. This is due to mitigation measures for snag retention based on forest plan standards, snags remaining in untreated areas, and continued insect and disease caused tree mortality. Mitigation measures also require retention of sufficient quantities of large, down logs and woody material of at least 10 to 15 tons per acre. The expected amount of down logs and wood retained, and increase in vegetative ground cover, would be adequate to maintain suitable squirrel cache sites and foraging opportunities.

Prescribed low to moderate intensity surface fires could burn up some of the food caches (cone storage sites on the ground). However, the mitigation measure that prohibits project activities within a 0.1 acre perimeter (37.3-foot radius) around squirrel cone caches found during implementation would minimize potential losses of cone caches. In addition, prescribed burns would not be expected to consume the large, down logs or woody material over approximately 4 inches in diameter. At least 10 to 20 tons per acre of down wood would be retained, including large, down logs—in accordance with mitigation measures. Potential squirrel habitat would likely contain ample amounts of logs and other down, woody material following thinning and burning treatments.

In the long term, treatments would promote growth of smaller, residual trees to become large, mature trees. Treatments would also retain high canopy cover within the clumps of larger, more mature trees based on forest plan requirements for goshawks. Large patches and clumps of mature trees next to small openings in the canopy would help maintain a mix of suitable nesting and foraging habitat for the squirrel. Within the mid-age to mature and older mixed conifer sites in the project area, suitable habitat conditions for the squirrel would generally be maintained or enhanced by proposed treatments under either action alternative. Although there would be different treatment methods associated with each alternative, there would be no measurable difference between these alternatives in terms of how they would affect key habitat requirements for the squirrel.

Noise and visual disturbance effects from proposed activities would be nearly the same as those described for other management indicator species. Nearly all suitable (mature) mixed conifer habitat for the squirrel overlaps the Mexican spotted owl protected activity centers and/or northern goshawk post-family fledgling areas. Therefore, proposed activities would be prohibited within those areas during nesting seasons, which overlap the breeding season for the squirrel. Thus, disturbance would not affect breeding squirrels.

Within 20 years after treatment, understory seedlings and saplings would fill the canopy openings. Maintenance burning approximately every 15 to 20 years in the mixed conifer would continue to thin out some of the regeneration, although many patches of regeneration would remain intact. Over time, there would continue to be an increase in the mosaic of dense groups of trees of various size classes mixed with more openly spaced trees. The squirrel is known to prefer structurally complex mixed conifer forests, and proposed treatments should improve structural habitat complexity. Mistletoe infections would still be present and used by squirrels, and there

should be an ample amount of cones, seeds, acorns and other food sources. Furthermore, the most significant benefit of treatments would be the reduced potential for a high-intensity crown fire that would otherwise cause a substantial loss of habitat.

Cumulative Effects

Cumulative effects were analyzed across the project area and in relation to habitat and population trends across the Smokey Bear Ranger District and Lincoln National Forest because the red squirrel is a forest-wide management indicator species. The district has a large proportion of the best red squirrel habitat on the forest.

The effects of past crown fires, historic logging and other activities previously described for other indicator species would have similarly affected the squirrel's potential habitat. Across the district and forest, there has been a decline in the mature and old growth mixed conifer forest habitat. This has been the cumulative result from a combination of large, high-intensity fires that destroyed some of the mature forests, historic logging of large trees, and long-term fire suppression that caused very high stand densities. These past activities and trends led to the current deficit of large trees and old growth forest conditions preferred by the squirrel, and increased the vulnerability of losing squirrel habitat to an uncharacteristically large and high-intensity crown fire.

Thinning and prescribed burning treatments were also conducted over the past few decades in a few mixed conifer stands in the project area. Effects of other recent past, ongoing and foreseeable future fuel reduction thinning and burning treatments throughout the district and forest would add to the same effects as described for alternatives 2 and 3. They would cumulatively add to the net improvements in squirrel habitat by similarly promoting development of mature, mixed conifer habitat with greater proportions of larger trees and smaller proportions of smaller trees. Cumulatively, treatments would be expected to retain adequate amounts of snags, down logs and other habitat required by the squirrel.

Cumulatively, there would be an increase in potential disturbance, including some disturbance during breeding season. Other disturbance effects would be from residential development along the project boundary where it abuts the Village of Ruidoso. And from the expected increases in recreational activities as Ruidoso continues to expand. However, the magnitude of other activities in combination with project activities would be insignificant and discountable.

Considering other activities and their effects as listed in appendix A, there would be no major cumulative reduction or loss of suitable squirrel habitat. Effects of the proposed project in combination with those other activities that occur around the project area and across the district would not result in any major cumulative impacts on squirrel habitat or population trends on the district or forest. The most noticeable cumulative effects from all fuel reduction projects on the forest would be the restoration of a more fire-adapted ecosystem and a reduced risk of a landscape level, high-intensity crown fire.

Elk and Deer

Affected Environment

On the Lincoln National Forest, elk and mule deer are both management indicator species and important game species. Elk and deer populations are regulated by the State Department of Game

and Fish. The State manages elk and deer populations through hunting regulations and licenses. The Forest Service is responsible to manage their habitat, in cooperation with the State. The project area is within part of New Mexico Game Management Unit 36.

New Mexico's elk and deer populations have fluctuated dramatically over the past 100 years. Populations of both elk and deer bottomed out around the turn of the century, and then rebounded as logging, grazing, and burning activities opened up more grasslands and shrublands. The elk population throughout its range is rated as secure and common, widespread and abundant (NatureServe 2007). The elk population trend in Game Management Unit 36, as well as on the entire Lincoln National Forest, is also rated as stable to increasing, based on results of the past 6 years of monitoring (Salas 2006:18-19). Mule deer numbers in New Mexico peaked to over 300,000 in the mid-1960s, and then declined to today's population of about 200,000. The deer population in the State has been declining from the unusual high in the 1960s (NM Department of Game and Fish 2006). Although the deer population trend on the forest declined since the 1960s, monitoring over the past 5 years shows an increasing population trend (Salas 2006:11-12). Elk and deer populations in 2002 were approximately 4,000 elk and 10,000 deer, which exceeds forest plan requirements for maintaining viable populations (U.S. Forest Service 2002). The forest contains twice the amount of elk habitat required by the forest plan (U.S. Forest Service 2002). Elk and deer populations on the Smokey Bear Ranger District are approximately 1,000 elk and 2,900 deer (NM Department of Game and Fish 2006).

The forest plan identifies elk as an indicator species for open, mixed conifer habitat (i.e. less than 40 percent canopy cover) with a mountain meadow component. The forest plan identifies mule deer as an indicator species for piñon-juniper woodlands (U.S. Forest Service 1986:31). However, elk and deer are generalist species with a wide distribution. They are adaptable to a wide variety of forest types and vegetation structural stages. They also use a variety of slopes, but prefer slopes under 30 percent (Slovin 1982).

Elk and deer are commonly seen in many parts of the district and forest. Elk and deer are commonly seen in all forest cover types in the project area, which are distributed as follows: mixed conifer (48 percent), ponderosa pine (34 percent), piñon-juniper (15 percent) and oak (3 percent). Most of the project area would be considered generally suitable habitat for elk and deer to utilize year-round, although forage and water availability are quite limited. Areas of use depend on the amount and timing of snowfall. Seasonal movement often occurs along the drainages during spring and fall. Elk and deer tend to use the higher elevations to cool off during the hotter spring and summer months (Salas 2006). Elk calving and deer fawning take place in the spring—usually May or June—when adults are en route to higher elevations for the summer. The breeding season for elk and deer occurs in the fall.

Elk are grazers and browsers, meaning they graze on grasses and also browse on sedges, forbs and shrubs. Deer are primarily browsers, with a majority of their diet comprised of leaves, stems and buds of woody shrubs, although they also eat forbs and grasses. It is very important to the survival of both these species to have sufficient openings in the forest with grasses, forbs and shrubs to meet their year-round foraging needs. Cover-to-forage ratios are widely used as an index of elk and deer habitat quality. Prime elk habitat has been estimated to consist of a mix of about 40 percent tree cover and 60 percent forage openings, a 40:60 ratio (Hoover and Wills 1984). The cover-to-forage ratio has been gradually improving on the forest over the past 5 years as a result of wildfires and thinning and burning treatments (Salas 2006:12). Patches of multistoried, closed canopy forest provide quality thermal cover for elk during hot summers and

cold winters (Hoover and Wills 1984). While elk require cover for protection against heat and extreme cold, ideal forests have meadow habitat interspersed with forest cover, with large amounts of edge (Skovlin 1982). Mule deer benefit more from a slightly lower tree canopy cover (less than 40 percent), abundant and diverse ground vegetation, and stimulation of important forage species following a prescribed burn (Heffelfinger et al. 2006). Deer also require an intermixing of forest cover and forage openings.

Stand examination data and field observations indicate that elk and deer habitat conditions in the project area have declined over time, mostly due to the lack of frequent surface fires. Compared to desired cover-to-forage ratios, the project area currently contains an overabundance of forest cover (hiding and thermal cover) and a shortage of forage openings filled with grass, forb and shrub species. Historic meadows and oak groves are nearly all covered with conifer trees. Hiding and thermal cover are abundant due to the very large numbers of small seedlings, saplings, young and mid-age trees. Tree stem numbers average 350 to 550 per acre, which is about 10 times higher than historic conditions (described in chapter 1). Stand density is highest in the moist, mixed conifer forest patches on north- and east-facing slopes and in drainage bottoms, where elk and deer can cool off during the summer. Canopy cover averages over 40 to 50 percent in the forest types, which is considered relatively closed canopied, but is highly variable from patch to patch within each stand.

Unlike other parts of the forest, within the project area there is no competition for forage between elk and livestock because there is no authorized livestock grazing in the project area. Road density within the project area is low, under 1 mile per square mile, including system and unauthorized roads. All system roads are closed, thus motor vehicle traffic is light and limited mostly to occasional Forest Service vehicles. Roads and their uses are known to influence elk behavior patterns and an excessive number of roads that are open to vehicle use can reduce habitat effectiveness. Deer and elk hunting seasonally occur in the project area. Natural predators in the project area are coyotes, mountain lions and bears.

Environmental Consequences

Alternative 1—No Action

Under this alternative, there would be no project related effect on the currently stable elk and deer population trends on the district and forest because proposed project activities would not be implemented. Current management plans would continue to guide existing and previously authorized activities in the project area. There would be no noise or visual disturbance from proposed activities or any temporary increase in open road density.

Forest and woodland vegetation trends in the project area, as described in the “Vegetation, Fuels and Fire” section, would continue to degrade elk and deer habitat quality in these fire-adapted ecosystems. Cover-to-forage ratio would remain suboptimal. Forage availability would continue to be quite limited, due to the high stand densities that dominate the project area and lack of canopy openings. Forest-wide population and habitat trends would not measurably change as a result of this alternative.

No Action with Crown Fire

Under this scenario of a large, high-intensity crown fire burning through the project area, there would be an expected loss of all thermal and hiding cover as well as an initial loss of grasses,

forbs and shrubs on the forest floor. As described in other sections of this EIS, a large, high-intensity fire would remove nearly all the vegetation in its path, leaving only dead tree stems and branches. Thus, all habitat components needed for elk and deer would be consumed within the high-intensity burn area. Thermal cover would be reduced or lost for at least 50 to 100 years, while hiding cover from saplings and young trees would recover within 20 to 50 years. Grasses would recover rapidly, usually within the first year after the fire, and forbs and shrubs would also recover quickly. The new growth of forage plants would be more tender and palatable with a higher nutrient content than the older plants that existed before the fire.

Because elk and deer utilize virtually all habitat types in the project area, some of their cover and forage habitat may remain unaffected, depending on the fire size, location and intensity. Because ungulates are sensitive to alterations in vegetation structure, their net response to fire depends on its severity and uniformity (Smith 2000). Although elk and deer are highly mobile and have large home ranges, some individuals would likely be killed in a large-scale, high-intensity crown fire event in the area (Smith 2000). Surviving elk and deer would move to another location outside the burn area (Smith 2000). Because of the abundance of suitable elk and deer habitat throughout the district and forest, even a large-scale fire within the project area would not likely result in a downward trend in the district or forest-wide population.

The large numbers of fire-fighting crews, together with helicopters, planes, water tank trucks, and other vehicles would cause a major increase in existing habitat disturbance in the project area. In addition, bulldozers would likely create wide fire lines that are often difficult to entirely eliminate from the landscape and may encourage unauthorized use by motor vehicles in the future. Elk and deer would move out of the area during fire suppression activities and post-fire rehabilitation activities, which could take weeks or months. A minor indirect result of the loss of habitat would be reduced hunting opportunities in the burn area for at least the first year.

Alternatives 2 and 3

Either of these alternatives may affect individual deer and elk, but would not likely impact forest-wide population trends. Most of the treatments proposed in mixed conifer and other habitat within the project area would move habitat toward a more optimal cover and forage ratio, which would improve habitat quality.

Thinning and burning treatments would occur on 92 percent of the 5,200-acre project area. The excluded areas consist of dense mixed conifer stands serving as core nesting areas for Mexican spotted owl, which would also continue to contribute to high quality thermal cover for deer and elk.

Removing a substantial amount of the understory trees would reduce hiding cover and make elk and deer much easier to kill during hunting season. Reductions in the canopy cover in some areas would reduce the amount of thermal regulation provided to elk and deer. However, numerous large and small patches of dense forest cover would be retained, providing long-term thermal and hiding cover. Thin from below treatments would be applied to all treated areas other than the burn-only areas. Treatments would remove portions of the trees, starting with the smallest diameter trees that are much more abundant, until an adequate stand density is reached (averaging 25 percent of the maximum stand density index, as described in the “Vegetation, Fuels and Fire” section). Retaining the largest trees available and promoting growth of the residual trees by reducing the severe competition between trees would provide for ample amounts of overstory canopy cover. Canopy cover in patches would continue to be closed, and others would close in

within approximately 20 years after treatment. Dense patches of saplings and young trees would be retained where they are not directly under larger trees, and those patches would continue to provide hiding cover. There would continue to be more thermal and hiding cover in the higher elevation mature and older mixed conifer forests that would not be thinned as heavily, in accordance with mitigation measures for spotted owl and goshawk habitat. They also would not be burned as frequently in maintenance burns. Treatments would increase the landscape level diversity of tree densities, patch sizes, and diameter size classes, which would improve habitat for elk and deer. There would be sufficient quantities of hiding and thermal cover after the thinning treatments within this project area to support current populations of elk and deer.

Proposed thinning combined with the low to moderate intensity surface burning would substantially increase forage quantity and quality for elk and deer (Pilliod et al. 2006). Regeneration of grasses, forbs and shrubs would increase their palatability and nutritional value. Areas along the Ruidoso community boundary would be thinned the heaviest, and would provide the most foraging habitat, although all treatments would increase the number of small, scattered openings. This would increase forage habitat. Openings would not exceed 4 acres in size or 200 feet in width, per mitigation measures. The skid trails and log landings along roads, together with decommissioned roads, would be restored to grass and shrub cover, providing more forage habitat for elk and deer after project completion. Eventually conifer trees would regenerate into the forage areas created by project treatments, although subsequent periodic burns would again thin them out. Thus, overall, treatments would result in a shift toward the desired cover-to-forage ratio described in the “Affected Environment” section.

The various proposed activities would cause short-term habitat disturbance effects. Alternative 2 would have more helicopter related disturbance while alternative 3 would have more ground-based, machinery related disturbance and slightly more road construction disturbance. The differences in overall disturbances and other habitat effects between the two action alternatives are negligible. Disturbances would cause some elk or deer to avoid portions of the project area where operations are occurring that year, moving into adjacent areas not being treated that year, or adjacent forest stands on tribal lands. There are large expanses of undeveloped forest lands to the south and west of the project area. Disturbance or displacement of elk and deer would be minimized within the Mexican spotted owl PACs and active goshawk PFAs due to seasonal restrictions on activities in those areas during the months of March through September. Seasonal operating restrictions cover approximately 50 percent of the project area’s habitat used by elk and deer. Those seasonal restrictions would minimize disturbance effects to elk and deer during calving and fawning periods to negligible levels.

The miles of roads open to motor vehicle traffic would increase for the duration of project activities. Refer to chapter 2 for descriptions of the roads that would be constructed or reconstructed and used for project implementation. These roads would be expected to decrease the value and use of habitat for distances up to a half mile from the road (Hoover and Wills 1984). The actual density of roads would not increase much over current road density because most roads needed for this project are existing system or unauthorized roads, or wide trails that were formerly roads (refer to chapter 2 for miles of new roads on and off existing routes). After project completion, road density would be reduced over current conditions through decommissioning. Roads that are not decommissioned would be closed to public motorized use so that the post-project open road density could be reduced to zero. Recreation activities along trails and closed roads in the area would continue after project completion. The forest’s travel management

planning process currently in progress will result in decisions about where motor vehicle routes will be designated, including decisions about motorized travel in the Perk-Grindstone area.

Elk and deer use of the project area could potentially increase as a result of substantially increasing the amount of forage while retaining adequate hiding and thermal cover, along with more of a mosaic of densities, age classes, and cover and forage areas. There would be an open road density of zero after project completion, and fewer old closed roadways would exist due to decommissioning activities. Under either action alternative, no measurable change in district or forest-wide elk or deer populations would be anticipated.

Cumulative Effects

Cumulative effects were analyzed across the project area, and considered in relation to habitat and population trends across the district, forest and Game Management Unit 36. The effects of past crown fires, historic logging and grazing, past fire suppression activities, and all other past activities contributed to what was described in the “Affected Environment” for elk and deer habitat conditions. Primarily the lack of widespread surface fires contributed to a decline in grasslands and shrublands, and an overall decline in forage habitat availability. Large fires that occurred in the same game management unit surrounding the project area are described and shown on maps in appendix A. Effects of past fires was an increase in forage habitat and reduction in cover habitat.

Fuel reduction projects have been occurring and are continuing to occur in other parts of the same wildland-urban interface, as described and displayed in appendix A. These projects would have the same general effects as the proposed project, although mitigation measures applied in the project area for retaining spotted owl and goshawk nesting habitat would not likely be applied on other land jurisdictions. As a result, there would be slightly less canopy cover or retention of dense patches of mature forest on surrounding lands. The improvement in cover:forage ratio and forage habitat availability would be cumulatively expanded by other similar fuel reduction projects in the surrounding forest lands in Game Management Unit 36.

Residential and commercial land development in Ruidoso, together with expansion of recreational uses of the national forest, would continue to slightly reduce the amount and suitability of potential deer and elk habitat in the surrounding forest lands. However, those uses would not substantially affect population or habitat trends within Game Management Unit 36. The forest-wide travel management decisions and motor vehicle route designations to be made within the next few years would have some long-term effects on deer and elk habitat due to changes in open road density and use. Another foreseeable future action to occur within the project area, surrounding the project area and across the entire forest, is the control of invasive plant species. Those treatments would cumulatively contribute to improvement of native plant communities used as forage habitat by deer and elk. Although there are no grazing allotments within the project area, livestock grazing on adjacent tribal land and on other lands in Game Management Unit 36 would continue to reduce forage availability to deer and elk.

The proposed project would result in a net long-term improvement in habitat quality for deer and elk within the project area, but would not have any major cumulative impacts when combined with the effects of past, present or foreseeable activities described. Cumulatively, there would be no major consequences to population trends on the forest or within Game Management Unit 36.

Migratory Birds

The evaluation of effects to migratory birds uses the Forest Service Southwestern Region's protocol that focuses on effects to migratory birds on the New Mexico Partners in Flight's Highest Priority Species list, along with considering effects to important bird areas and important over-wintering areas for migratory birds (Rustay and Norris 2006). The proposed project design and evaluation complies with the 2001 Executive Order 13186 regarding Responsibilities of Federal Agencies to Protect Migratory Birds. The proposed project is designed to help maintain or improve habitat for migratory birds and to reduce the likelihood that the habitat would be lost to a large-scale crown fire.

Affected Environment

No designated important bird areas (IBAs) or important over-wintering areas (large wetlands) exist in the project area or in the vicinity of the project area where they would be expected to be impacted by activities proposed for this project. The closest important bird area is near Hondo, over 25 miles from the project area. The closest important over-wintering area is at Bonito Lake, about 8.5 miles from the project area.

No year-round streams, wetlands or waterbodies exist in the project area. Although scattered riparian plants occur in some canyon bottoms, there is no riparian habitat in the project area that would support riparian dependent animal species. The Rio Ruidoso, Cedar Creek and Carrizo Creek that flow just outside the project area boundary contain patches of riparian vegetation that could support riparian dependent species and higher numbers of bird species. However, the Rio Ruidoso and Cedar Creek reaches closest to the project area lie within the greater Ruidoso area where human activities and habitat disturbances commonly occur.

Reviews were made of priority bird species for the Southern Rockies/Colorado Plateau Conservation Region, considering species that could occur on the Lincoln National Forest and Smokey Bear Ranger District, based on vegetation type, elevation and the species' known range. Results from breeding bird surveys conducted annually on the Smokey Bear Ranger District from 2001 through 2006 were also reviewed.

Vegetation types within the project area are mixed conifer, ponderosa pine, and piñon-juniper and oak woodlands. Elevations range from about 6,700 to 8,200 feet. Species dependent on riparian or grassland ecosystems would not likely occur in the area and were, therefore, eliminated from further analysis. Other species like ferruginous hawk and Bendire's thrasher were also eliminated from further analysis because their breeding ranges in New Mexico do not overlap the project area. The gray flycatcher and the dusky flycatcher have been observed in other parts of the district but are not likely to occur in the project area or vicinity likely to be affected by proposed project activities. Gray vireos and red-faced warblers have ranges that overlap the Sacramento Mountains even though they have not been confirmed in Lincoln County. Table 29 displays the highest priority bird species for New Mexico that would potentially occur within the project area including their associated habitat type (Rustay and Norris 2006). The last column on the table shows whether the species is also on the Partners in Flight's Watch List based on their continental importance within the Southwest biome of North America (Rich et al. 2004).

Table 29. Highest priority migratory birds that would occur or have breeding habitat in the project area, including whether they are species of continental importance in the Southwest biome

Highest Priority Birds for New Mexico	Habitat Associations	Watch List for North America
Gray flycatcher	P-J woodlands with shrubs and grasses	No
Gray vireo	P-J woodlands; open with shrubs and grasses	Yes
Black-throated gray warbler	P-J woodlands with shrub or grass edges	No
Montezuma quail	P-J and oak woodlands with tall dense grass cover	Yes
Northern goshawk	Ponderosa pine and mixed conifer forests	No
Mexican spotted owl	Ponderosa pine and mixed conifer forests	Yes
Flammulated owl	Ponderosa pine forest	Yes
Virginia's warbler	Ponderosa pine forest	Yes
Grace's warbler	Ponderosa pine forest	Yes
Red-faced warbler	Mixed conifer forest	Yes

Habitat conditions for the potentially affected migratory bird species have been altered and degraded over time by a combination of human activities in the area. Historic stand-replacing fires prior to 1945 removed many trees, logging in the early 1900s removed the larger conifer trees in accessible areas, and historic livestock grazing reduced the abundance of tall grasses in some areas. Those activities, combined with fire suppression since the early 1900s, resulted in a lack of frequent surface fires that once maintained these fire-adapted ecosystems.

Birds listed in the table all require ground surface plant cover underneath the conifer trees or as edge habitat in openings next to clumps of trees. The grass-shrub habitat component is currently in short supply in this project area, especially new regeneration of grasses and shrubs. Conservation recommendations for these migratory birds state that "thinning dense pine stands, timber harvest practices that leave snags and some older trees, and restoring a cool fire regime would improve conditions significantly" (Rustay and Norris 2006). Reducing livestock grazing was also mentioned as a conservation recommendation and grazing has already been removed from this project area. Refer to the "Vegetation, Fuels and Fire" section for more detail about changes in vegetation.

Environmental Consequences

Effects to Mexican spotted owl (a threatened species) and northern goshawk (a sensitive species) were previously evaluated in this wildlife section and those effects are not repeated here.

Effects of all alternatives on the gray flycatcher, gray vireo, black-throated gray warbler and Montezuma quail and other migratory birds associated with woodland habitats would be the same

as effects previously described for the juniper titmouse (see “Management Indicator Species” section).

Effects of all alternatives on the warblers, flammulated owl and other migratory birds associated with mid-elevation ponderosa pine and mixed conifer habitat would be essentially the same as effects previously described for the northern goshawk, spotted owl, or pygmy nuthatch. Thus, estimated effects to the migratory birds and their nesting and foraging habitat under the no action, no action “with crown fire”, and alternatives 2 and 3 including the cumulative effects would be the same as those described for birds in the previous wildlife sections.

These effects on migratory bird habitat from Alternatives 2 or 3 can be summarized as follows:

- Negative effects on species displacement or reproductive success from increasing human-caused habitat disturbances during breeding season and the potential for loss of individual nest trees or ground nests. Those effects would be negligible due to the mitigation requirements for retaining key migratory bird habitat features such as large trees, large snags, large down logs, and native hardwood species, along with breeding season restrictions on activities over nearly half of the project area.
- Positive effects from increasing the amount of grasses, forbs and shrubs.
- Positive effects from increasing habitat diversity in terms of a more patchy distribution of tree sizes and stand densities across the landscape; retaining high-density patches of various ages along with creating more openings and edge habitat between dense forest and open forest.
- Positive effects on habitat conditions from prescribed burning that helps restore surface fire regimes in a wildland-urban interface area where wildfires cannot be allowed to burn across the landscape.
- Positive effects from the landscape-level reduction in the potential for large, stand-replacing crown fires.

Other Wildlife Species

Affected Environment

Other wildlife species occur in the project area that could be potentially affected by proposed activities in the area. These include small mammals like gophers, chipmunks and squirrels, several types of reptiles, and other birds. No fish occur in the project area. As other sections of the EIS already described the affected vegetation and habitat conditions and predicted effects to the vegetation and habitat conditions for many other species, this section is quite brief and summarizes some additional information not already covered. This section focuses on some additional effects disclosures for two important game species that occur in the area: Merriam’s turkey (*Meleagris gallopavo merriami*) and black bear (*Ursus americanus*).

Merriam’s Turkey

Merriam’s turkey is a wild turkey whose population is regulated by the State of New Mexico as a hunted game species, similar to deer and elk as previously described. Turkey hunting regulations issued for Game Management Unit 36 apply to the project area.

Turkeys use a wide variety of forest or woodland habitat types. They have several important habitat components: water, roost and nest sites, and a summer/brood area (Kamees 2002). Winter roost trees are typically large trees with horizontal branches. Trees also provide food, escape and resting cover. Turkeys breed in the springtime. Nests are built on the ground, often in branches at the base of large trees. Proximity to water is important too. They usually roost on the cooler north- and east-facing slopes. During colder months, they prefer dense clumps of trees that provide protection from cold air and winds. Turkeys prefer to forage in more open canopy forest interspersed with shrubs and/or tall grasses and forbs. Turkeys feed on plants, fruits, and insects in spring and summer and on piñon nuts, pine seeds, oak acorns and juniper berries in autumn and winter. They commonly move 5 to 20 miles between their summer and winter habitats.

The turkey occurs throughout forests in New Mexico, with state-wide populations of about 35,000 to 40,000. They are found on the district and forest, and the entire project area is commonly used year-round by turkeys. The project area provides adequate nesting, roosting and foraging habitat as evidenced by occurrence of turkeys. However, the abundance of open canopy forest and tall grassy meadows is more limited than what historically occurred under frequent surface fire regimes, and there is no year-round stream or waterbody in the project area. There is also a limited amount of nuts and acorns available in some areas. Portions of the project area directly adjacent to the Village of Ruidoso receive a relatively high amount of human use, primarily from people hiking, horseback riding and mountain biking.

Black Bear

The black bear (bear) covers a wide range of elevations and forest and woodland types, and has a home range of 5 to 25 square miles (Costello et al. 2001). New Mexico's black bear population is estimated at 5,947. The bear is a common year-round resident throughout the forest and district including the entire project area. Bears are opportunistic omnivores with a diet that varies according to seasonal availability of food. Their diet includes young grasses, forbs, roots, berries, fruits, acorns, nuts, insects and small dead animals. Stumps, snags and down logs are important prey substrate (larval insects, termites, ants, and yellow-jacket nests) for bears. Trends in bear reproductive success have also been found to be highly influenced by fall acorn and nut crops (Costello et al. 2001).

Black bears often sleep during the day, preferring areas under large trees with an abundance of grasses or pine needles. They also sleep during much of the winter in dens, usually found under very large rock outcrops or tree roots on steep slopes of closed canopy forests or woodlands (Costello et al. 2001). Bears go into dens between September and February, and emerge between March and May. Female bears give birth to cubs in the dens. Bears typically avoid roads and other areas of frequent human activity.

In New Mexico, black bear habitat encompasses approximately 14.6 million acres (13.5 percent) of which 75 percent is primary habitat (Costello et al. 2001). The local district biologist has observed that the project area appears to be used by bears mostly as a travel corridor. The district and forest biologists estimate that the forest and woodland habitat in the project area is close to the optimum cover and forage ratio for black bears, which is considered 80 percent cover to 20 percent forage (LeCount and Uarchin 1990). Because of the close proximity to the Village of Ruidoso, the project area receives a high degree of human use, primarily recreational as previously mentioned for the turkey. While road density is low (about 1 mile per square mile) and Forest Service system roads in the area are closed, bear habitat is considered better in the south

and southwest sections of the project area due to lower road densities and distance from the community.

Environmental Consequences

Alternative 1—No Action

Under this alternative, there would be no project related impacts to the turkey or bear or their habitat in the area because the project would not be implemented. Current management plans would continue to guide existing and previously authorized activities in the project area. There would continue to be adequate breeding and foraging habitat conditions in the area to continue to support turkeys and bears. The numbers of snags and down logs would continue to increase from the anticipated high levels of mistletoe and bark beetle infestations. That would improve the availability of insects and fungi for the turkey and bear to eat. However, the quantity and quality of shrubs, nuts, acorns, fruits, berries, and tall young grasses and forbs would all continue to decline due to the high densities of trees that would dominate this landscape. As high densities of larger trees die out, high densities of seedlings and saplings would fill in, especially due to the continued lack of prescribed surface fires. Overall, habitat conditions for the turkey and bear in the project area would not improve.

No Action with Crown Fire

Where a large, stand-replacing fire burns through the area, there would be a loss of both breeding and foraging habitat for turkeys, bears and other wildlife species. Bears and large mammals often avoid being killed in fast-moving crown fires while turkeys and many species of small animals would typically be killed in such a fire (Smith 2000). Grasses and shrubs would recover quickly after the burn, usually within a year or two. The mature, closed canopy forest habitat used for nesting/roosting habitat by turkeys and as denning habitat by bears would not recover for up to 200 years. Where tree seed sources are lacking in the interior of the burned area, shrubs may dominate for an indefinitely long period of time. Parts of the project area would likely be spared by the fire. Turkey and bear populations would continue to thrive in other parts of the district, forest and Game Management Unit 36. Overall, the effects to turkey and bear habitat from a high-intensity crown fire would be the same as previously described in the other wildlife sections.

Alternatives 2 and 3

Effects of these alternatives on turkey and bear habitat would be nearly the same as effects on other wildlife species previously described, such as effects to deer, elk and red squirrel. There would be increases in habitat disturbance, with more helicopter related disturbance under alternative 2 and more ground-based equipment disturbance under alternative 3. Both alternatives would temporarily increase the open road density until after the project is completed. Roads generally decrease the value of habitat for distances up to a half mile from the road (Hoover and Wills, 1984). The most noticeable negative effect to bears would likely be the large reduction in hiding cover, thereby increasing vulnerability to being killed by hunters. However, there would remain scattered thickets of trees and oak shrubs available for hiding cover. Hiding cover for turkey would improve rapidly after treatment as grasses, shrubs and conifer seedlings quickly regenerate. Thermal cover would be reduced to some degree, although most large trees would be retained.

Most effects to turkey and bear habitat would be beneficial improvements to the quality and quantity of forage—grasses, forbs, shrubs, nuts, acorns, berries, fruits, etc. There would be a beneficial increase in the amount of edge habitat where patches of dense trees are interspersed with small openings, and an improvement in the overall diversity of tree sizes and stand densities throughout the landscape.

Key habitat components needed for turkey nesting/roosting would be retained and treatment activities would be prohibited during turkey breeding season on portions of the turkey's potential nesting/roosting habitat, as described in "Mitigation Measures" in chapter 2.

Otherwise, the changes in habitat for bear and turkey would be essentially the same as changes and predicted effects for deer and elk and other wildlife species previously described in this EIS. There would be no major long-term impacts on these populations or habitat trends under any alternative.

Cumulative Effects

Cumulative effects analysis for turkey and bear are the same as described for elk and deer that are regulated in Game Management Unit 36. The same past, present and foreseeable activities that affect elk and deer would affect turkey and bear, and would combine with project related effects in the same general manner. There are no differences in the cumulative effects for these two species compared to cumulative effects described for elk and deer that use the same forest and woodland types and occur in the same game management unit. Thus, there would be no significant cumulative effects to turkey or bear populations in the game management unit from the effects of past, ongoing and foreseeable activities combined with proposed project activities.

Water and Soil

The environmental analysis in this section is based on a combination of the forest's terrestrial ecosystem survey data on soils, topography, potential vegetation, and climatic factors; the forest's Geographic Information Systems (GIS) databases for soil, topography, and streams; field assessments by Forest Service watershed specialists, and a Forest Service computer application that is used to predict erosion and sediment delivery—the Water Erosion Prediction Project (WEPP). The WEPP model is used as an analysis tool to help estimate erosion and sediment delivery potential from forest roads, harvest activities, prescribed fires, and wildfires (USDA-ARS 2007). The WEPP model was originally developed for agricultural and range lands, but has been adapted to forest lands and fuel reduction thinning and burning treatments by scientists at the Rocky Mountain Research Station (Elliot et al. 1999, Elliot et al. 2000, Elliot and Robichaud 2006). The WEPP model has some known limitations, particularly in how it predicts downslope sediment yield from roads, although some limitations were compensated for in the analysis. Also, estimates of erosion and sedimentation are not considered absolute values, but rather as estimated values for the purpose of comparing alternatives and identifying general magnitude and duration of effects. More information about the WEPP limitations, calculations, and assumptions used can be found in the project record.

Affected Environment

Hydrology and Water Quality

Weather in the area is typical of other mountain ranges in New Mexico, based on data evaluated from local weather stations. Annual rainfall for the Ruidoso area averages about 22 inches and annual snowfall averages about 47 inches. Nearly 60 percent of the rainfall occurs doing the summer monsoon season that ranges from June through September, with most of the rain occurring in July and August. April and May are the driest months of the year. Annual rainfall runoff is approximately 2.5 inches. A 2-year rainfall return interval (50 percent chance of occurring in a given year) is a 1.1 inch/hour rainfall intensity storm for the Ruidoso area.

The 5,200-acre project area is located within two 6th Hydrologic Unit Code (HUC) watersheds1: the Upper Rio Ruidoso (30,827 acres) and the Carizzo Creek (15,741 acres) watersheds. These two 6th code watersheds are part of the larger 5th code Rio Ruidoso watershed. The project area covers 12.5 and 12 percent of the Upper Rio Ruidoso and Carrizo 6th code watersheds respectively. It covers only 3 percent of the entire 5th code watershed. Both 6th code watersheds carry water runoff in an east-southeasterly direction to streams in the Village of Ruidoso and into Grindstone Reservoir. Figure 28 shows the two 6th code watersheds in relation to the project area. It also shows the streams and lakes adjacent to the project area.

No perennial (year-round) streams or waterbodies exist within the project area boundary. However, there are perennial streams just outside the project area—Rio Ruidoso, Cedar Creek and Carrizo Creek. Rio Ruidoso flows through private land between the Perk and Grindstone areas, Cedar Creek flows adjacent to the northeast portion of the project area, and Carrizo Creek is just south of the project area. The project area contains some intermittent and ephemeral streams that flow periodically in response to precipitation events. The intermittent and ephemeral streams in the project area are considered low gradient response channels that do not typically transport water or sediment very quickly. No lakes or ponds occur in the project area. However, Grindstone Reservoir (41 acres) and Mescalero Lake (105 acres) are in close proximity to the project area (as shown on several maps in this EIS). Grindstone Reservoir is used for non-motorized boating and fishing, and as a water supply for the Village of Ruidoso. Figure 29 shows the streams in the project area and within the two 6th code watersheds.

No wetlands occur in the project area, but there is a small spring located in upper Grindstone Canyon. Other small seeps or springs may periodically occur during long periods of wet weather. No riparian vegetation occurs in the project area, or soil types that indicate saturated soils sufficient to support riparian vegetation (U.S. Forest Service 1984).

[1] A watershed is the land area that drains water into the same river, river system or lake.

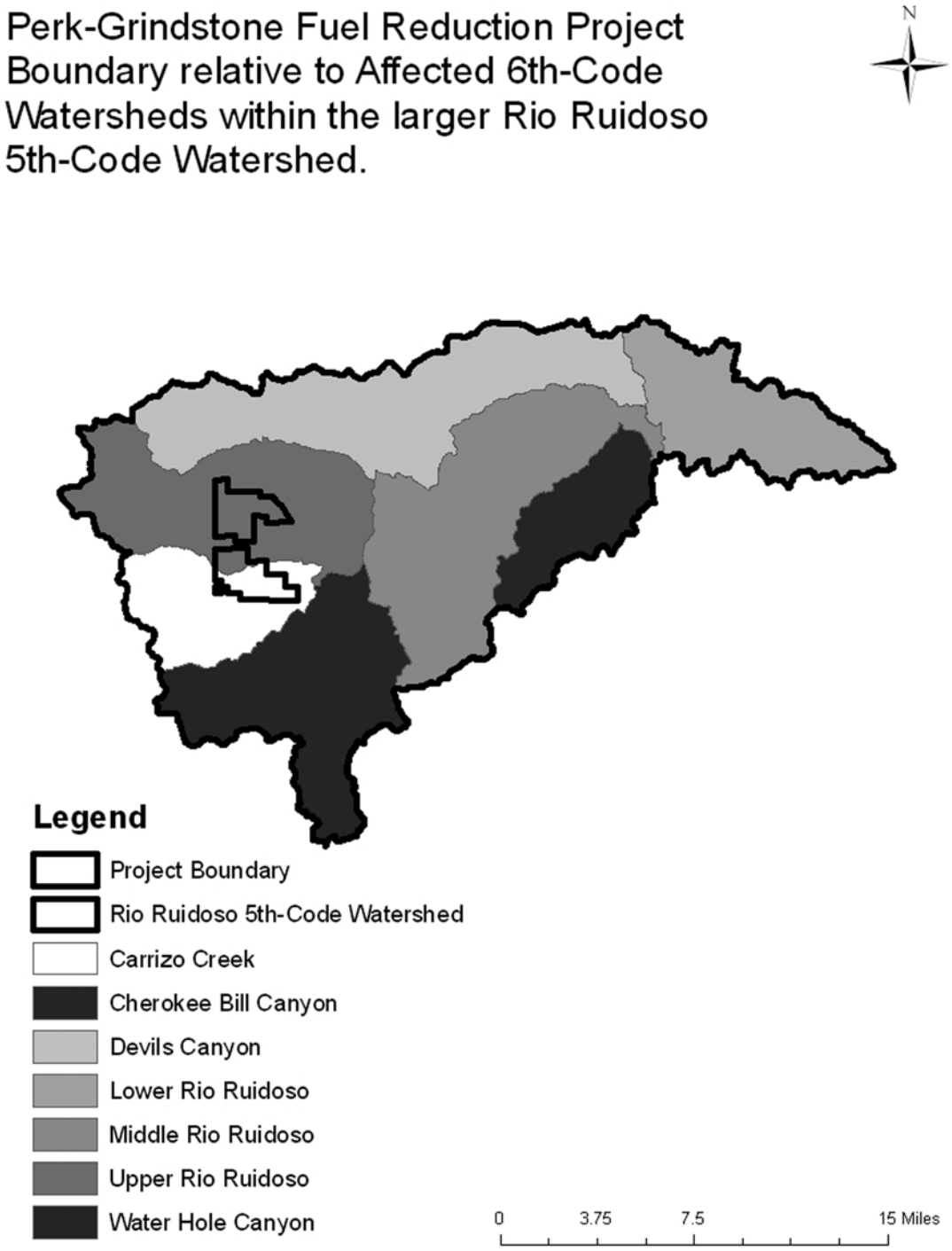

Figure 28. The project area lies within the Upper Ruidoso and Carrizo Creek watersheds, which are part of larger Rio Ruidoso 5th-code watershed.

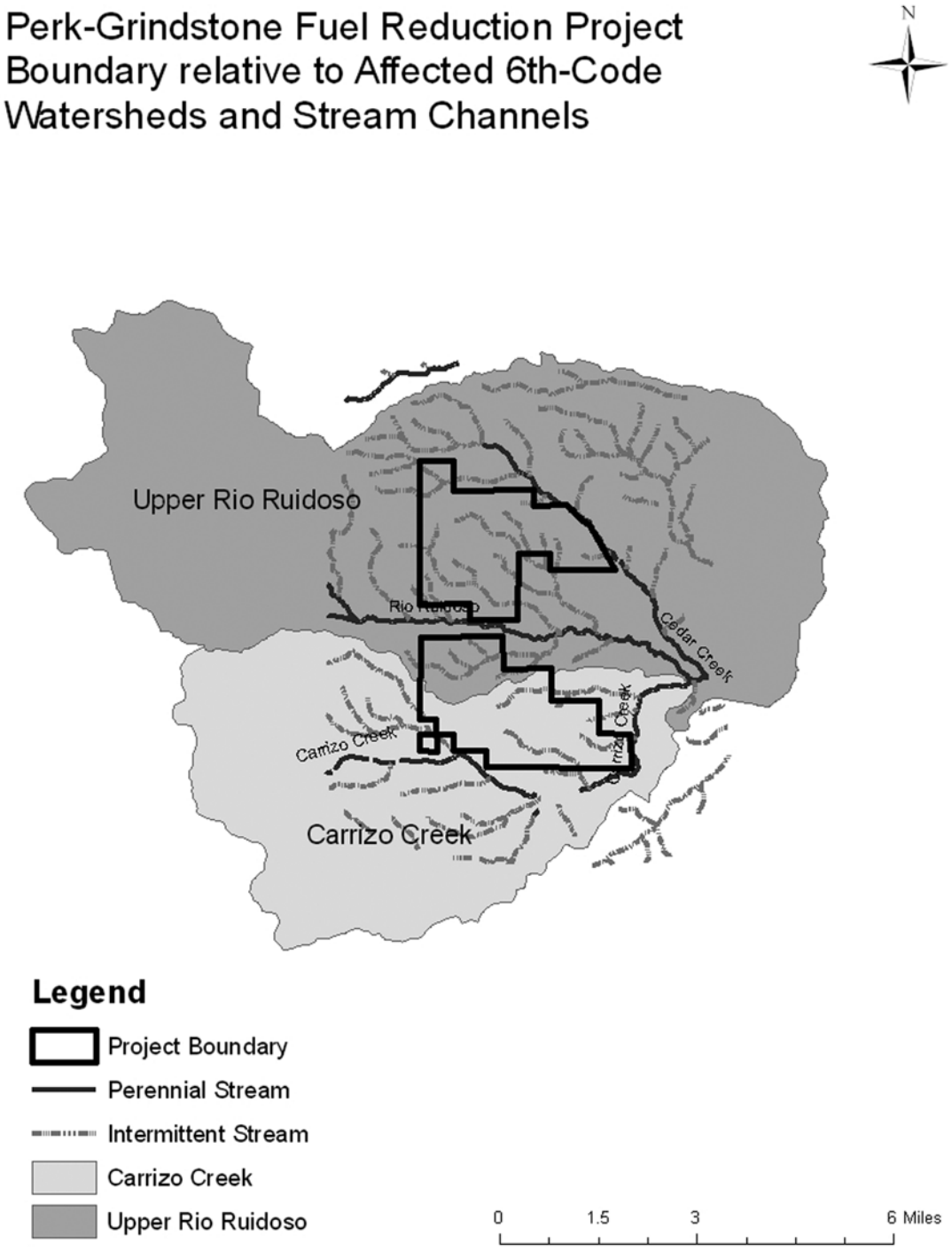

Figure 29. Streams in relation to the project area within affected 6th code watersheds

Rio Ruidoso is designated as a high-quality, cold-water fishery stream. Water quality in Rio Ruidoso is listed as “impaired” in the State of New Mexico 303d report, due to sediment deposits that exceed Clean Water Act standards (NM Environment Department 2006). Water quality in Carrizo Creek, a tributary that flows into Rio Ruidoso, is listed as “limited,” due to levels of coliform bacteria from human and animal waste (NM Environment Department 2006).

Grindstone Reservoir was constructed in 1992 to contain water as a supply for the Village of Ruidoso. When there is adequate flow in the Rio Ruidoso to protect instream uses, flow is diverted from the Rio Ruidoso into this reservoir. This reservoir also periodically captures water runoff from Grindstone Canyon. When the village added large amounts of copper sulphate into this reservoir, it appears to have killed some fish (NM Department of Game and Fish 2005). Also, a 2003 survey by the New Mexico Environment Department’s Surface Water Quality Bureau found that the water quality standard for dissolved copper was exceeded in this reservoir. Based on State water quality testing of Grindstone Reservoir in 2006, results showed that water quality was within Federal and State water quality thresholds for all contaminants, including testing for microbial, organic, inorganic, radioactive and other contaminants (NM Environment Department 2006).

Stream channels are generally at a functional level of stream stability, although they have some road related impacts, based on the 2005 roads analysis process report and an additional 2006 stream channel assessment. There are some stream segments in the project area which are either directly impacted by roads cutting through them or are recipients of eroded road sediments. Roads in the project area are not a result of Forest Service authorized road construction projects, which is why they do not meet Agency road design standards for watershed protection. Most existing roads resulted from historic logging, emergency fire suppression, or off-road vehicle use. They all have an unimproved, native (dirt) surface. All Forest Service system roads in the project area are closed to public motor vehicle traffic, although small all-terrain vehicles are currently allowed on Sawmill Canyon Road. There are few relief culverts installed in drainage ditches. Sediment can be readily detached from cut-slopes, road treads, and fill-slopes to be transported to nearby streams. A few of the roads are in drainage bottoms and have deep ruts and gullies in them. Figure 30 shows the roads and trails in the project area. Trail 91 was an old road that was closed (gated) at the bottom and is now used as a trail.

Road density in this area is considered low, including both system and unauthorized roads, based on the 2006 GIS roads inventory for the Lincoln National Forest. The project area averages less than 1 mile of road per square mile of land area. Table 30 shows the total road miles and road density (in miles per square mile) within the project area, differentiating the data by each of the two 6th code watersheds that dissect the project area.

Table 30. Road miles and density in the project area by watershed.

Watershed	Existing Roads (miles)	Area within Project (sq.mi)	Road Density (mi/mi^2)
Upper Rio Ruidoso	2.8	4.04	0.7
Carrizo	3.6	2.99	1.2
Total	6.4	7.03	0.91

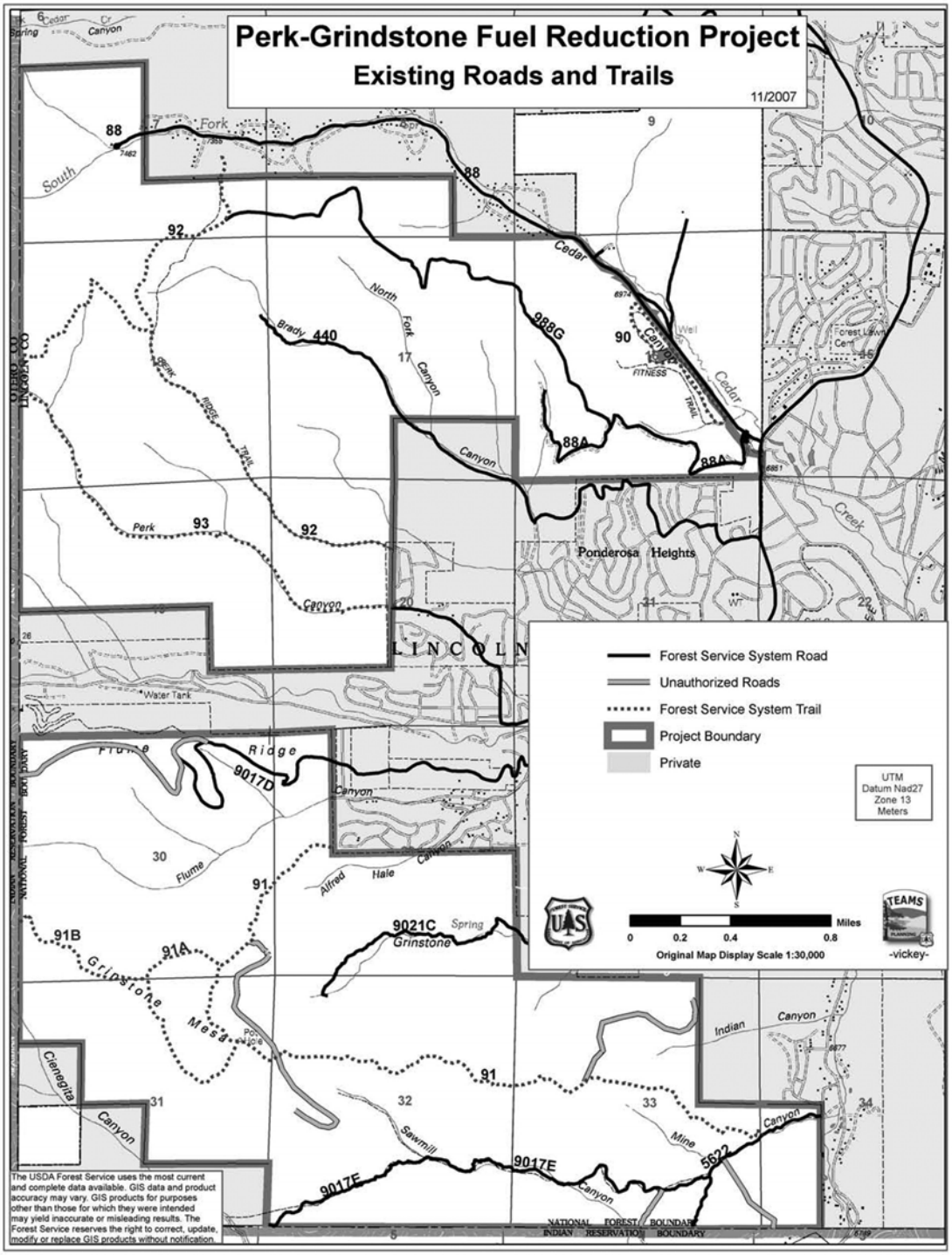

Figure 30. Roads and trails in the project area

Roads that show some evidence of poor road drainage and road surface erosion are: Helispot (88A), Barnyard Ridge (988G), Flume Ridge (9017D), Alfred Hale (no number), and Sawmill Canyon (5622 and 9017E) Roads, along with Perk Ridge Trail. Segments of Sawmill Canyon Road cross the stream channel several times, and in some locations the road is within 25 feet of the creekbed and causes rutting in the canyon bottom. Based on the comprehensive roads analysis process conducted for the project area, Sawmill Canyon Road (9017E) was the only road identified as a potential for "high risk" to watershed condition (U.S. Forest Service 2006). The former Grindstone Mesa Road, now a designated trail is also poorly located on steep slopes. It has deep ruts and gullies, some 3 feet wide by 1 foot deep. In several locations, the trail acts as a drainage channel. Other roads and trails in the project area are not causing significant soil erosion or sedimentation.

Sediment delivery from roads in the project area is relatively low. The WEPP modeling results indicate sediment delivery into stream channels (from all roads and trails within 100 feet of channels) is estimated to be approximately 25 tons per year. This is likely due to low road density, road closures, and low traffic volumes. The sediment delivery source is from the 1.7 miles of road in Sawmill Canyon (Road 5622/9017E) that is within 100 feet of a stream channel. Other roads and trails in the project area are outside of stream channel zones and not contributing to stream sedimentation. Other than the minor amount of soil erosion and sediment from existing roads and trails, there are no other land developments or activities in the project area impacting watershed conditions in the two affected watersheds. Impacts to watershed conditions in the Upper Rio Ruidoso and Carrizo Creek watersheds occur from developments and human activities outside and downstream from the project area, within the Village of Ruidoso. Watershed conditions within the project area and upper watershed portions are considered to be satisfactory in terms of hydrologic responses to rainfall and snowmelt runoff events.

Topography and Soil Quality

The project area consists of rugged mountainous terrain with diverse topographic features, covered primarily with dense forest vegetation (refer to "Vegetation, Fuels and Fire" section for details). Elevations range from about 6,700 to 8,200 feet. Topographic features range from nearly level canyon bottoms and elevated mesas to steep mountains. About 30 percent of the area has steep slopes of over 40 percent slope. Figure 31 shows the areas of steep slopes in the project area.

The underlying soil parent material in the higher elevation portion of the area is composed of volcanic rocks of the Sierra Blanca Series. Lower elevation portions of the area are underlain by interbedded sandstone and shale. Mancos shale is the dominant geology in Sawmill Canyon.

Inherent soil erosion hazard ratings based on soil type, slope and other factors, are part of the "Terrestrial Ecosystem Survey for the Smokey Bear Ranger District on the Lincoln National Forest" (U.S. Forest Service 1984). Erosion hazard ratings indicate the potential for soil movement if all the vegetation is removed, such as would occur following a high-intensity wildfire. It does not indicate the erosion rates when the soil is covered with trees and surface vegetation. Table 31 shows the soil map units, their acreage and erosion hazard rating, along with the percent coverage of each soil map unit within the treatment units of the project area. Treatment units cover 92 percent of the project area.

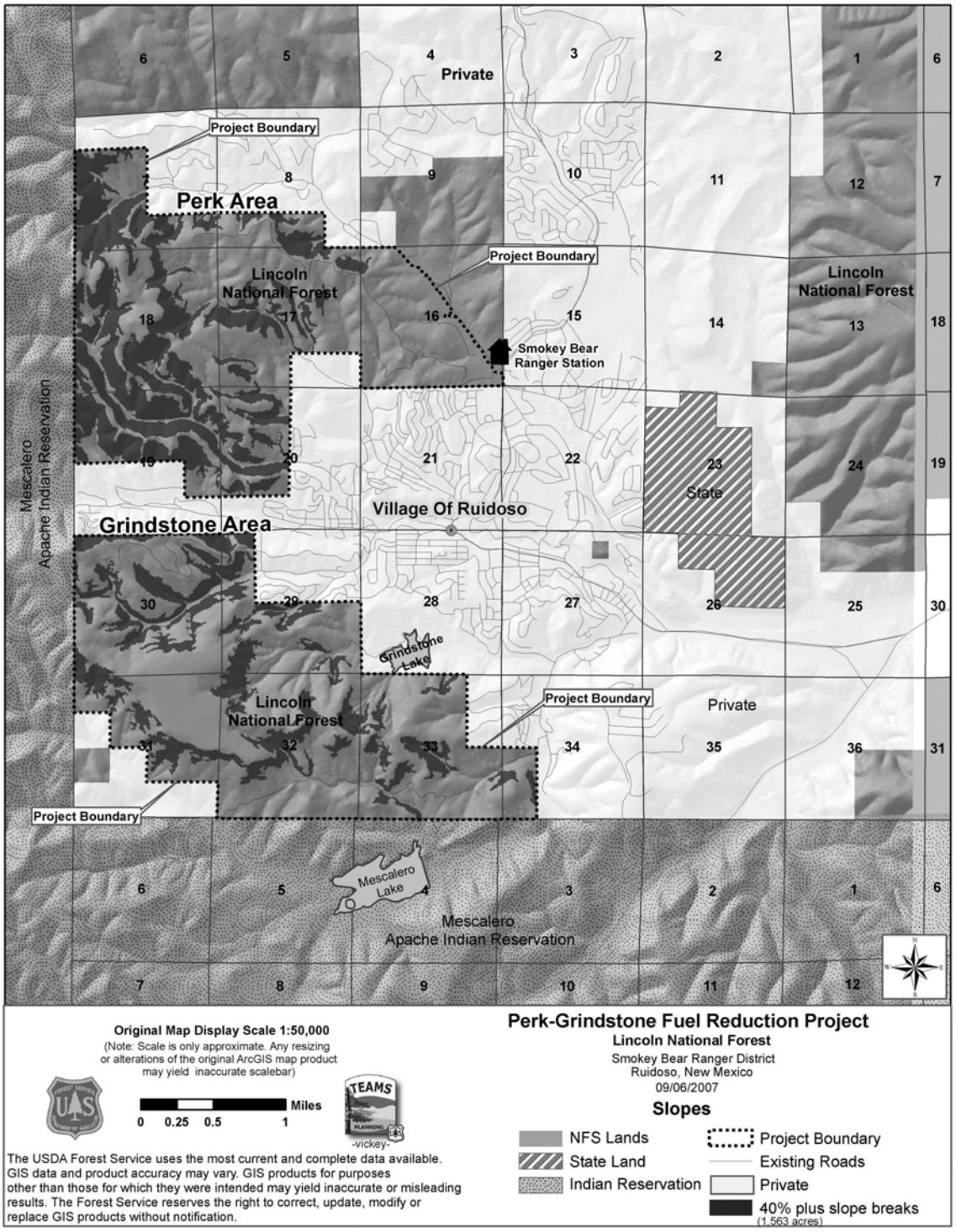

Figure 31. Slopes greater than and less than 40 percent grade in the project area.

Table 31. Soil map units and associated acres, erosion hazard rating and percent coverage within the treatment units of the project area (U.S. Forest Service 1984)

Soil Map Unit	Acres	Erosion Hazard Rating	Percent of Project Area in Map Unit
3034	2,060	Severe	43%
321	1,502	Moderate	31%
320	395	Low	8%
326	333	Moderate	7%
3054	183	Severe	4%
349	127	Moderate	3%
3194	108	Severe	2%
5	45	Low	1%
6	30	Low	1%

Soil stability is satisfactory and current erosion rates throughout the project area are within tolerance limits, as described in the terrestrial ecosystem survey (U.S. Forest Service 1984). The only small, scattered sites in the project where erosion is excessive are on some roads and trails, as previously described. The WEPP modeling estimates that annual erosion rates average less than 1 ton per acre per year, which are well within acceptable rates as described in the terrestrial ecosystem survey report (U.S. Forest Service 1984). Low erosion rates are due to the moderately deep to deep loams and clay loam soils in the project area, combined with the ample ground cover from high numbers of trees, surface plants, down logs and branches, needles and other organic matter. Thus, long-term soil productivity is satisfactory throughout the area.

Soil hydrology, including infiltration rates, are satisfactory over all the treatment units, based on field observations made by the watershed specialist in a 2006 survey. Soil compaction is generally low throughout the area, except in localized areas along roads and trails as previously mentioned. The soils have a high capacity for water infiltration during light to moderate rains. Heavy downpours during the summer monsoon season rains can exceed the infiltration capacity of these soils, causing naturally occurring, short duration surface flows of water and fine soil particles.

Soil productivity and nutrient cycling processes are slightly reduced by the dense tree canopies that have resulted from the lack of historic fire regimes. The limited amount of sunlight and moisture able to penetrate through dense tree canopies to the forest floor inhibits growth of grasses, forbs and shrubs. Snow intercepted by the continuous interlocking tree crowns tends to evaporate rather than adding moisture to the soil surface. Also, decomposition of biological material on the forest floor is already naturally quite slow in this project area due to the very dry conditions. Without surface fires in these fire-adapted ecosystems, there is a reduction in soil nutrient recycling of the organic matter and nutrients stored in the needles, twigs and branches on the forest surface. Historically, frequent fires regularly released and recycled the nutrients on the forest floor that are essential for plant growth, which helped sustain soil and vegetative productivity (Andreu et al. 1996; Kutiel and Inbar 1993).

Environmental Consequences

Alternative 1—No Action

There would be no direct effects on soil conditions or water quality if none of the proposed project actions occur. The current conditions and trend just described under “Affected Environment” would continue. Soil erosion rates would remain at less than 1 ton per acre per year, and sediment delivery would remain below 25 tons per year. All of the other soil and water conditions described would remain essentially the same for at least the next several decades.

No Action with Crown Fire

Hydrology and Water Quality

Hydrologic functions and water quality would be detrimentally impacted by the aftereffects of a large, stand-replacing fire. The fire and fuels analysis found that the project area, like most of the forest, has a high crown fire potential. Research scientists agree that current stand density conditions on the Lincoln National Forest create a tendency toward more extreme fire events with catastrophic results for soil structure and watersheds (The Nature Conservancy 2006). Where a high-intensity crown fire were to occur in the area, the trees, ground vegetation, woody material and organic matter on the forest floor would be lost. The surface would be bare soil covered by ash. The high heat intensity of the fire would cause some soils to be hydrophobic, meaning water would run off rather than infiltrate the soil. Studies that compared fuel reduction thinning projects and wildfires in the Southwest found that wildfires typically produce nearly 70 times as much sediment as a thinning treatment (U.S. Forest Service 2005).

Severe soil erosion and sediment impacts would be expected, especially on the 49 percent of the project area with soil map units rated as severe for erosion hazard following removal of all vegetation. The heavy rains of the monsoon season (July through August) typically follow immediately after the wildfire season. Thus, after a large crown fire and subsequent rainstorms, there would likely be areas of mass erosion, excessive water and sediment runoff, gully formation, and some flooding of the perennial streams just downstream from the project area. These impacts would be reasonably foreseeable in this area based on current conditions and trends described in the “Vegetation, Fire and Fuels” section. Large amounts of surface water carrying topsoil, ash, tree needles, and woody material would run down the canyon slopes and into Rio Ruidoso and Grindstone Reservoir. Flooding of Rio Ruidoso could occur, impacting residents and businesses in the Village of Ruidoso. Sediment delivery could increase by a factor of 10 to greater than 1,000 times pre-fire conditions (Debano 1998). The magnitude, duration and intensity of such mass erosion, runoff and flood events would be a function of the area’s geomorphology and other factors, including slope steepness, slope length, stream channel gradients, and flood plain areas.

The WEPP modeling estimates that sediment delivery rates within the affected watersheds could be as high as 193,128 total tons of sediment, split between the two affected watersheds as 64,632 tons for the Carrizo watershed and 128,496 tons for the Upper Rio Ruidoso watershed.

These sediment yields indicate that if a large, stand-replacing crown fire did occur in the project area, there would be severe water quality impacts to both Grindstone Reservoir and Mescelero Lake. The sedimentation, turbidity, and accumulation of topsoil, ash, tree branches and twigs, needles and other organic material would not only severely impact water quality, but also the

water quantity in the reservoir. Impacts to Grindstone Reservoir would affect its function as a municipal water supply for the Village of Ruidoso. The Los Alamos Reservoir was devastated by similar impacts after the Cerro Grande Fire in New Mexico, and required dredging and other costly efforts to restore it. Sedimentation rates could return to annual base rates within 5 to 10 years.

Overall, water quality impacts would be expected to result in exceedances of State and Federal water quality standards for numerous water quality criteria. The Village of Ruidoso may not be able to use the water supply from Grindstone Reservoir for several years. Fishing and other recreational uses of Rio Ruidoso, Grindstone Reservoir and Mescalero Lake would also be impaired for several years.

Soil Quality

Soil movement and erosion would exceed soil tolerance limits defined in the terrestrial ecosystem survey and Forest Service standards for maintaining long-term soil productivity. The loss of ground cover and organic matter followed by heavy rains would cause areas of mass soil movement. The amount of erosion depends on the residual vegetation cover, burn severity, soil type, and slope factor according to the convention used for soil loss calculations. Soil loss or erosion rates would be approximately 12.6 and 16.3 tons per acre respectively for Upper Rio Ruidoso and Carizzo Creek watersheds based on WEPP modeling results.

Soil hydrology processes and infiltration rates would be severely affected. The high heat intensity of the fire would cause some soils to be hydrophobic. This means the soil has a thin “seal” on it that causes water to run off rather than to infiltrate the soil. It also facilitates excess erosion. In some areas the soil erosion and runoff would be very deep, exposing bedrock layers and causing a long-term disruption of the soil hydrologic functions.

Long-term soil productivity and soil nutrient status would also be detrimentally impacted for a relatively long time. The loss of vegetative ground cover and organic matter on the forest floor would expose the upper soil layers to nutrient loss from accelerated surface erosion. Leached and eroded soil nutrients would likely be transported offsite by rainwater runoff to downslope streams and reservoirs. The loss of topsoil and organic matter would interrupt the soil nutrient cycling process and slow soil productivity. It could take decades to restore the post-fire soil nutrient and productivity status.

Alternative 2

Hydrology and Water Quality

Water quality effects expected under this alternative would be minimal and short term in nature. Potential effects could occur during construction/reconstruction of roads, trails, and landings, as well as during log skidding (removal) activities and disturbed site rehabilitation activities. However, effects to water quality would be limited to those adjacent to stream channels. Mitigation measures prohibit those activities within 40 feet of any of the intermittent stream channels in the project area (no perennial streams occur in the area).

The localized sites where water quality may be affected are where roads cross stream channels or are within 100 feet of stream channels. This alternative would reconstruct or rehabilitate stream crossings to minimize the amount of sediment entering stream channels. Stream crossings would

be rocked and graveled within the stream channel influence area (approximately 100 feet on either side of road crossings). Those crossings that are scheduled for decommissioning would be treated and revegetated to stabilize the stream channel area. Also, road relocation and reconstruction/construction activities would greatly improve the poor road alignment and condition of some existing roads and trails.

The 5.5 miles of roads that would remain for future management use as closed (storage) roads would make a negligible contribution to sediment delivery. This is due to the improved road segment alignments and drainage features just described, the reduction in total road density after project completion, and closing those roads to public vehicle traffic. In addition, the 8.5 miles of roads that would be decommissioned after project completion would be reclaimed and returned to vegetative productivity, as described in chapter 2. After project implementation and reclamation work, there would be more acres in the project area with vegetative ground cover than the pre-existing condition.

Water quality would not be adversely impacted in Grindstone Reservoir and Mescalero Lake, or in the perennial streams that occur downstream and just outside the project area. There would be a very slight, first-year increase in sediment delivery to the low gradient, intermittent/ephemeral stream channels during road construction and road improvement work and other project activities. Some of the sediment may flow into waterbodies outside the project area during heavy rainstorms, but the amount, frequency and duration of those sediment effects would be insignificant. Table 32 shows the predicted amount of sediment delivery into stream channels as a result of all proposed activities, for each alternative based on WEPP model results.

Table 32. Predicted sedimentation rates (in tons per year delivered) for each alternative by watershed based on WEPP model results

Watershed	WEPP Modeling Scenarios				
	Alt. 1 No Action	Alt. 1 With Crown Fire		Alternatives 2 & 3	
	Average Annual Tons	1st Year Tons	Average Annual Tons	1st Year Tons	Average Annual Tons
Upper Rio Ruidoso	1,632	128,496	4,800	3,132	1,728
Carrizo	1,200	64,632	2,784	1,947	1,251

Improvements in stream crossings would reduce current sediment rates at those crossings. Sites where soil is disturbed or exposed by project activities would be rapidly rehabilitated after project activities in that part of the project area. The only exposed soil areas that would remain after project completion would be 5.5 miles of roads that would be retained as closed roads, and the drainage features of those roads would be improved over current conditions. Effective ground cover would be restored throughout treated areas. All treated areas would continue to have abundant tree cover, an increase in grasses and other plant cover, and at least 5 to 20 tons per acre of down woody debris. Due to the harvest methods selected and mitigation measures applied to those methods as described in chapter 2, only light to moderate soil disturbance would be

expected, with less than 10 percent of the area having exposed bare soil. Thinning methods such as those proposed for this project, with mitigation measures that include using scattered slash and other techniques to minimize the acreage of exposed bare soil, have been found to not significantly increase soil compaction, erosion, runoff or sedimentation over background rates, even on steeper slopes (Cram et al. 2007). Sediment contributions would be minimized within a year after project completion and rehabilitation of disturbed sites. The overall hydrologic condition would be improved over pre-treatment conditions due to reducing total road miles, removing roads from stream channels, and stabilizing places where roads cross stream channels.

Thus, the WEPP-model based predictions show a short-term rate of sediment delivery that would be a small, incremental addition to the background rate. Actual erosion and sediment delivery rates would be expected to be lower than those figures reflect. This is because the WEPP model does not account for the mitigation measures to control erosion and sedimentation that the Forest Service would implement, as described in chapter 2. Forest Service soil and water conservation practices have been found to greatly reduce impacts to water quality and soil resources (Seyedbagheri 1996). It also does not account for the improvements in road and trail drainage and design features to reduce erosion and sedimentation from the transportation system. It also does not account for reclaiming all the landings, skid trails, and most of the roads used for this alternative. Thus, this alternative would be expected to produce even less sediment delivery than is predicted by the model.

Soil Quality

Soil hydrology and infiltration rates would not be measurably affected by this alternative. The proposed ground-based thinning activities, which would have the most influence over soil porosity, compaction, and bulk density, would occur on less than 25 percent of the treatment areas (approximately 1,183 acres). Further, these ground-based activities would follow Forest Service soil and water conservation practices to minimize the potential for long-term effects (see “Mitigation Measures” in chapter 2). The season of use, location of skid trails and skid trail design, and proximity to critical soil areas would all be managed through soil and water conservation practices to minimize any impacts to soils. In addition, thinning and burning treatments would encourage the growth of grasses that aids infiltration. Higher infiltration rates result in reduced surface flows of rainwater, and less erosion and sedimentation.

Soil erosion would be within acceptable soil loss tolerance rates based on evaluating WEPP modeled erosion rates for each alternative against the current and tolerance rates listed for each soil map unit in the terrestrial ecosystem survey. There would be a modest increase in the amount of newly exposed bare soil that would be subject to accelerated soil erosion for 1 to 3 years until the exposed soil areas are reclaimed, as required by mitigation measures in chapter 2. These would be from the 0.5 mile of new roads (not on pre-existing roads or trails), widening of some existing roads or trails, and creating turnouts, log landings, and skid trails. These sites that become temporarily devoid of vegetation would be restored to vegetative ground cover quickly afterward, thereby returning erosion rates to background levels. Road stabilization at stream channel crossings and other erosion control measures, along with the reduction in total road density after road decommissioning, would further reduce erosion rates. Requirements for retaining large down logs and 5 to 20 tons per acre of woody material would further reduce soil erosion.

Ground disturbance from heavy equipment operations would also be minimal. First of all, ground-based logging operations would only occur on about 25 percent of the total treatment acreage, and only on slopes of less than 40 percent grade. Skid trails would be designed to minimize the amount of bare soil exposure. Scattered slash on the ground and retention of larger down logs would further minimize bare soil exposure and reduce erosion and runoff. Ground-based logging operations in the adjacent Cedar Creek area and other tractor thinning units on the Lincoln National Forest have not caused unacceptable levels of soil compaction or erosion. When the equipment runs over the slash, as would occur in proposed ground-based thinning units, it would further minimize soil compaction and aid soil stabilization. Some of the soil disturbance that results from thinning operations would improve seedbed preparation, promote grass and forb production, and increase water infiltration (Cram et al. 2007). Under this alternative, soil erosion control practices would be expected to keep soil disturbance and movement to a minimum.

For the same reasons described under “Water Quality,” erosion rates after project implementation and rehabilitation of disturbed sites would return to background rates. Table 33 shows the maximum predicted soil erosion rate for each alternative. As previously mentioned, the predicted rates in the table are overestimates that do not account for all the erosion control measures that would be used, including road decommissioning actions. Thus, the more realistic predicted erosion rates would be lower. Either way, they are within acceptable soil loss tolerance limits.

Table 33. Predicted soil erosion rates for each alternative based on WEPP model results

Watershed	WEPP Modeling Scenarios				
	Alt. 1 No Action	Alt. 1 With Crown Fire		Alternatives 2 & 3	
	Average Annual Tons Per Acre	1st Year Tons Per Acre	Average Annual Tons Per Acre	1st Year Tons Per Acre	Average Annual Tons Per Acre
Upper Rio Ruidoso	1	12.6	3.4	1	1
Carrizo	1	16.3	3.7	1	1

Soil nutrient cycling would be expected to improve under this alternative. Thinning would add a large amount of organic material to the ground. The low to moderate intensity surface burning would release the nutrients from the fine fuels and organic material less than 4 inches in diameter to be carried into the soil. The prescribed surface burning over most of the treatment area would also release some of the nutrients held in the current accumulation of organic matter on the forest floor. Thinning and burning treatments would increase the amount of sunlight and moisture reaching the soil surface, and would promote production of grasses, forbs and shrubs in the more open understory areas. These elements would further enhance soil nutrient status and productivity. Long-term site productivity would be maintained or improved under this alternative, due to the factors just mentioned and the fact that soil erosion and compaction would likely remain within acceptable levels.

Alternative 3

The WEPP modeling results indicate that alternative 3 is identical to alternative 2 in terms of erosion rate and sediment delivery. The difference in effects to soil and water resources under this alternative would be indiscernible.

The difference in thinning and burning treatments under this alternative is the additional 74-acre "burn-only" treatment unit. This alternative also would involve 6 miles of additional road construction or reconstruction compared to alternative 2, of which 3.9 miles would be new construction outside existing roadways. There is also a difference in thinning equipment to be used. Like alternative 2, this alternative uses a combination of manual tree felling together with ground-based, skyline, and cable methods. The main difference is that this alternative would not use helicopters to remove wood products, resulting in a high level of slash retention on the steeper slopes. Alternative 3 would use a masticator or hand crews on the steeper or less accessible slopes, leaving all the thinned wood onsite rather than removing it (refer to chapter 2 for details). The total amount of bare soil exposure in alternative 3 would be approximately the same as in alternative 2. This is because while the amount of bare soil exposure would be reduced by the mastication and manual thinning units that do not need skid trails, large helicopter landings, or haul roads, the additional road construction to access skyline and ground-based units would increase the amount of exposed soil. Refer to chapter 2 for specific miles of roads and number of landings for each alternative. Similar to alternative 2, vegetative ground cover would be rapidly restored to the skid trails, landings and roads to be decommissioned, thereby minimizing the magnitude and duration in which accelerated erosion or runoff would occur.

The woody material left on mastication units and other thinning units would provide ground cover that would minimize soil erosion, compaction and sediment runoff. In tree mastication units, a layer of shredded wood pieces would be left, averaging 1- to 3-inches thick, along with some large, down logs as needed to meet down log retention requirements. Studies of mastication equipment used in thinning operations found it to have no significant adverse effects on soil quality, infiltration rate, or sediment runoff (Hatchett et al. 2006). Most mastication equipment exerts very low ground pressure, 5 to 8 pounds per square inch, and masticators with self-levelers are specially designed to operate on steep slopes with minimal impacts to soil properties (Rummer 2004). Post-treatment reviews of mastication thinning units on slopes of up to 50 percent in Santa Fe's municipal watershed found no noticeable detrimental impacts to soil or watershed conditions (Wagner 2007). Overall, no significant adverse impacts to soil or water quality would be expected from this alternative, for the same reasons described for alternative 2.

Cumulative Effects

The cumulative effects analysis boundary for soil and water resources is considered to be the extent of the two 6th code watersheds that overlap this project area: Upper Rio Ruidoso and Carrizo Creek watersheds. All known past, present, and reasonably foreseeable future projects that could contribute to a cumulative effect were considered. Most of these two watersheds lie in the Sierra Blanca (White Mountains) range within the Sacramento Mountains. The majority of the two watersheds, including the headwaters portions of each watershed, cover undeveloped forest lands on the Mescalero-Apache Reservation and on national forest land in and around the White Mountain Wilderness. The bottom of the two watersheds overlaps the Village of Ruidoso. There are no in the watersheds, and no commercial or residential developments in these watersheds outside of Ruidoso. The activities that occur within the wildland-urban interface area surrounding

the project area—which are described in appendix A—are the same activities that occur throughout the two watersheds. In addition, livestock grazing occurs on the reservation land.

Thus, nearly 90 percent of the Upper Rio Ruidoso and Carrizo watersheds remain in a fairly natural, forested condition. Past crown fires have occurred in these watersheds and resulted in detrimental soil and water quality impacts lasting for several years, similar to those described for the no action “with crown fire” alternative. Other low to moderate intensity fires have also modified the forest vegetation to some extent, but have not noticeably affected soil erosion or sedimentation rates. Large fires that have occurred in the surrounding area are described in appendix A.

The area encompassing the two watersheds is used primarily for recreation. Recreational use includes hunting, fishing, hiking, mountain biking, horseback riding and other activities. There have been and continue to be many other fuel reduction activities occurring in these two watersheds, as described in appendix A. In addition, livestock grazing occurs on some of the Mescalero-Apache Reservation lands and national forest lands outside the project area boundary. The recreational activities, thinning projects, and livestock grazing that would continue to occur at the same time as project activities in the watershed would continue to be of limited extent, duration and magnitude. Cumulatively, they would not measurably impact infiltration, runoff, erosion, or nutrient cycling capabilities of the watersheds.

The Village of Ruidoso is experiencing considerable population growth. Housing construction, and road and highway developments or improvements are all contributing to decreases in infiltration capacity and increases in runoff, erosion, and sedimentation. The water quality limitations in Rio Ruidoso and Carrizo Creek are a result of human activities including roads, residential developments, commercial developments, and streamside recreational activities within the Village of Ruidoso. Nutrient cycling capacities are also being disrupted or drastically changed with the associated removal of natural vegetation and increases in nutrients associated with urban runoff. Activities in Ruidoso occur mostly within the Upper Rio Ruidoso watershed.

Cumulative effects from all the other activities in the two affected watersheds, combined with the small, short-term increases in erosion and sedimentation from proposed project activities, would be insignificant. The current soil and water quality conditions in these two watersheds would not be measurably degraded or impacted by the addition of erosion or sediment inputs from the proposed project. The proposed project would not result in any soil quality or water quality impairment or limitation that did not previously exist. As previously described, effects from the action alternatives would be small, short-term increases in soil erosion and sediment delivery potential, within acceptable limits. Even combined with other ongoing and future activities, they would still likely remain within acceptable limits. Overall, the cumulative effect would be no major change in soil or water quality conditions over pre-existing conditions.

Air Quality

Methodology: For this analysis, emissions were determined using forest and Rangeland Emission Factors (Hardy et al. 2001). The standard algorithm used for estimating emissions is:

(acres) x (tons per acre) x (percent consumption) x (pound per ton) = pounds of pollutant

Where:

- Acres = the area of the burn project
- Tons per acre = the fuel loading of the burn project
- Percent consumption = the amount of vegetation actually consumed
- Pound per ton = the emission factor
- Pounds of pollutant = emissions produced

The acres were determined for the project area. The tons per acre of fuel loading were determined using silvicultural reports. The percent consumption of burned material was determined using local knowledge of burning prescriptions. The ponderosa pine (long needle) emission factor was used for all vegetation types because it produced the highest pounds of particulate matter per volume of vegetation burned.

To calculate potential smoke production for this analysis, an estimate was made for the number of acres that could be burned and number of days it would take to complete that burning to implement this proposed project. These estimates made by fire specialists are based on past experience with similar projects on the Lincoln National Forest and Smokey Bear Ranger District. Under optimum weather conditions and availability of qualified personnel, assuming burning would not occur during the dry, windy fire season or summer monsoon rain periods, or on days with poor ventilation or other weather constraints, the following days would be available for burning in any given year: 150 days for pile burning and 80 days for broadcast burning.

Based on the same optimum conditions, the following acres could be burned in a single year: 1,000 acres of pile burning and 1,000 acres of broadcast burning.

Affected Environment

Airshed and Class 1 Areas

The project area is located within the Pecos River Airshed (NM Environment Department 2005). All airsheds in New Mexico are based on watershed boundaries developed by the New Mexico Water Quality Control Commission. Although the Pecos River basin covers many counties, the project area lies completely within Lincoln County. The north and east boundaries of the project area are adjacent to the Village of Ruidoso. The project area is bordered on the south and west by the Mescalero-Apache Reservation.

The only Class 1 area within 50 or less miles of the project area is the White Mountain Wilderness, which lies within 5 miles northwest of the project area. A Class 1 airshed applies to large wilderness areas and national parks that require the highest level of protection under the Clean Air Act.

Air Quality

The Clean Air Act and its amendments require the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment (Public Laws 88-206, 90-148, 91-604, 95-95, and 101-549). The act also allows states to adopt additional ambient air quality standards.

The NAAQS were established to set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly, as well as to protect against decreased visibility, damage to animals, crops, vegetation, and buildings. The Environmental Protection Agency (EPA) set NAAQS for six principal pollutants referred to as "criteria" pollutants. These pollutants are lead, sulfur dioxide, nitrogen dioxide, ozone, particulate matter less than 10 microns in diameter (PM_{10}), and carbon monoxide. The EPA has also issued standards for 2.5 micron-size particulate matter ($PM_{2.5}$) which is the largest component of smoke from wildland burning. In addition to the National air quality standards set by EPA, the State of New Mexico Environmental Improvement Board established additional standards for specific air quality pollutants. Air quality in a given location is defined by pollutant concentrations in the atmosphere and is generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The NAAQS represent maximum acceptable concentrations. The state air quality standards are at least as restrictive as the national standards (NAAQS) and include standards for total suspended particulate matter (TSP) for which there are no Federal standards. Table 34 presents both the National and State air quality standards that must be met to comply with the Clean Air Act.

The affected environment within and surrounding the project area meets air quality standards for the six criteria pollutants, so is not listed as a "non-attainment" area (NM Environment Department 2005). As defined by the Clean Air Act, a non-attainment area is one that does not meet the standards for one or more of the six criteria pollutants. The area within and surrounding the project area typically has excellent air quality conditions.

Table 34. Criteria pollutants allowable increments and averaging times (ug/m^3 = micrograms per cubic meter of air; ppm = parts per million)

Pollutant	National Standard	State Standard
Carbon Monoxide (CO)	8-hour average: 10 mg/m^3, 8.7 ppm	1-hour average: 40 mg/m^3, 13.1 ppm
Nitrogen Dioxide (NO_2)	24-hour average: 0.10 ppm	Annual mean**: 100 ug/m^3 0.05 ppm
Ozone (O_3)	1-hour average***: 235 ug/m^3	8-hour average (DRAFT): 157 ug/m^3
Lead (Pb)	Quarterly average: 1.5 ug/m^3	Quarterly average: 1.5 ug/m^3
Particulate PM_{10}	Annual mean**: 50 ug/m^3	24-hour average: 150 ug/m^3
Particulate $PM_{2.5}$	Annual mean**: 15 ug/m^3	24-hour average: 35 ug/m^3
Sulfur Dioxide (SO_2)	Annual mean**: 80 ug/m^3 0.02 ppm	24-hour average: 365 ug/m^3 0.10 ppm

Pollutant	National Standard	State Standard
Total Suspended Particulate	24-hour average: 150 ug/m^3	7-day average: 110 ug/m^3

Units of measure are parts per million (ppm) per milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air at 25º C (ug/m^3).

* The $PM_{2.5}$ standards have not been finalized.

** This is the Annual Arithmetic Mean for the averaging period.

*** The ozone 1-hour standard applies only to non-attainment areas as of July 1997, to allow for a smooth, transition to the 8-hour standard.

Topography, Winds and Receptors

The project is located in the Sierra Blanca (White Mountain) range of the Sacramento Mountains of southeastern New Mexico. Elevations range from about 6,800 feet near the Village of Ruidoso to 8,200 feet on the higher peaks. The canyon drainages direct rainfall waters in a generally easterly direction into the Ruidoso River within the Village of Ruidoso.

In mountainous terrain, winds are often influenced by the differential heating of slopes. In general, upslope and up-canyon winds can be expected on sunny afternoons with downslope and down-canyon winds developing overnight and continuing until around sunrise. Monthly average wind patterns have been determined by using the Ventilation Climate Information System (Ferguson et al. 2003). Prevailing winds typically blow from southwest to northeast (southwesterly winds), especially during the spring fire season, April through early July. They become more southeasterly during the hot summer months.

In conducting the effects analysis, smoke sensitive receptors or resources within the potentially affected area that may be sensitive to smoke impacts were identified. Sensitive receptors include populations or specific places, views, hospitals, airports, schools, highways, or businesses that would likely be impacted by smoke coming from the project area. The following specific sensitive receptors were identified and considered: the Village of Ruidoso, including all residences, schools, and businesses; the Village of Alto: the community of Ruidoso Downs: Sierra Blanca Regional Airport: U.S. Highway 70; and New Mexico Highways 37 and 48. There are few, if any, sensitive receptors to the south and west of the project area, which is also opposite the direction of prevailing winds during the wildfire season. However, White Mountain Wilderness is within 5 miles to the north and the town of Mescalero is within 12 miles to the south of the project area.

Environmental Consequences

Alternative 1 - No Action

If no wildfire occurred, existing air quality conditions would continue for the local area. No measurable impacts would be associated with this alternative. There would be no burning and, therefore, no smoke emissions from this alternative.

No Action with a Crown Fire

If a large crown fire occurred similar to the past five large wildfires that occurred near the project area since 2000, hundreds to thousands of acres of vegetation would burn within a few days and produce a large amount of smoke (see appendix A). The amount and dispersal of smoke could not be controlled. The amount of smoke generated by such a wildfire would be much greater than that produced from a prescribed burn in which smoke management techniques are employed. The smoke would contain large amounts of pollutants that would exceed both State and National air quality standards for particulate emissions.

Such a fire would be expected to distribute a great amount of smoke over a large geographic area. The primary pollutants produced during combustion of organic material, such as would be found in smoke from a wildfire, include carbon dioxide (CO_2), particulate matter (PM), nitrogen oxides (NO_X), and hydrocarbons. However the pollutant most likely to travel far enough from a fire to pose a threat to human health is PM, especially $PM_{2.5}$ which has an aerodynamic diameter of 2.5 micro meters or less and can become imbedded deep in the lungs.

Lead, ozone and SO_2 could be byproducts but in insignificant amounts. Wood smoke consists of dispersed airborne solids and liquid particles (particulates), which can remain suspended in the atmosphere anywhere from a few seconds to several months. Table 35 presents a summary of emission factors for some of these constituents expressed in pounds of emissions per ton of fuel consumed. Knowing the emission factor and applying it to the measured amount of fuel to be burned is an indication of how much pollutant would be produced. There are no emission factors for some of the other byproducts.

Table 35. Emission factors for certain wildfire byproducts

Emission Factor	Combustion (pounds of emission per product ton of fuel consumed)
Carbon Dioxide (CO_2)	2,000 to 3,500
Carbon Monoxide (CO)	20 to 500
Water Vapor (H_2O)	500 to 1,500
Particulate Matter (PM)	20 to 180
Wildfire Average PM_{10}	30
Wildfire Average $PM_{2.5}$	27
Hydrocarbons	10 to 40
Nitrogen Oxides (NO_X)	1 to 9

Of the criteria pollutants, $PM_{2.5}$ is of greatest health concern. Carbon monoxide is another major product of wildfire smoke, but as a gas, it is quickly diluted in the atmosphere. Carbon monoxide can be of concern to firefighters and those conducting prescribed burns as a result of working quite close to the source of the smoke, but in general has little impact away from the fireline.

Particulate matter has the potential to impair human health and visibility. PM_{10} causes eye, nose, and throat irritation. Because of its relatively larger size, it remains in the upper respiratory tract. $PM_{2.5}$, due to its smaller size, travels to the lungs and can cause more serious health impairments such as chronic respiratory disease, emphysema, or lung cancer.

Volatile organic compounds are also produced, but these are not considered criteria pollutants by EPA. The combustion of organic material also produces organic hydrocarbons that can affect human health. The two most important classes of compounds associated with organic hydrocarbons are polynuclear aromatic hydrocarbons and aldehydes. Some of these substances (e.g. benzo-c-phenanthrene and formaldehyde) are carcinogens. Emissions containing these substances solely from fire pose a negligible risk of cancer for the general public because generally they are produced in very small amounts (Sandberg and Dost 1993).

Daily particulate loads from a wildfire likely would be three to five times more than those for prescribed burning, and smoke could last as long as it takes to suppress the fire. The Smoke Impact Spreadsheet (Air Sciences, 2003) was used to model a 5,000-acre wildfire on a dry summer day with heavy fuel loading and a 20 percent crown fire. The results indicated 719 tons of $PM_{2.5}$ would be released over a relatively short period of time with concentrations exceeding the NAAQS as far away as 13 miles from the fire.

Figure 32. Large amount of smoke from a crown fire

In addition to health concerns associated with particulates and other emissions, high levels of particulate matter in smoke can impair visibility. Significant visibility impairment can lead to highway accidents or problems with planes landing at airports. If an intensive wildfire would occur, visibility along roads in the Ruidoso area could be reduced to less than ¼ mile. This could result in a high risk of traffic accidents, road closures, or other impacts to motorists along portions of New Mexico Highways 37 and 48, U.S. Highway 70, and local private and forest roads. There could also be major impairments to visibility in portions of the White Mountain Wilderness.

Alternatives 2 and 3

Emissions on the Lincoln National Forest are regulated by the New Mexico Environment Department, Air Quality Bureau. Prescribed burning would be restricted on days with less than good ventilation conditions and, therefore, the airshed would remain in attainment status. Emissions would be spread out over the life of the project, about 5 to 10 years, rather than all at once as would happen in the case of a wildfire.

No smoke would be generated from thinning or wood and slash removal; however, there would be other minor impacts to air quality by these activities, such as fugitive dust and exhaust from vehicles, heavy equipment, and chain saws. The levels of exhaust are anticipated to fall well below EPA emission standards. Road dust would be higher than current conditions during these activities unless they are conducted while the ground is frozen or the road is moist. Constructing,

maintaining, and decommissioning roads would also stir up dust; however, this kind of dust settles fairly quickly, can be mitigated with dust abatement techniques, and is limited spatially.

Most of the smoke would likely dissipate up through the air and to the northeast when burning slash or broadcast burning during the day. During daytime burns, the amount of smoke generated would tend to be greatest for a few hours in the late afternoon when the fire is hottest. Smoke dispersal is usually quite good and smoke accumulations are typically light, based on past experience with similar prescribed burns conducted by agencies throughout the greater Ruidoso area. However, people in Ruidoso would likely smell and see smoke in the air.

In the evenings, residual smoke would settle into canyons and stream valleys and would likely drain down the Ruidoso and Hondo River valleys. Thus, smoke would be most noticeable in the late evening and early morning hours. Smoke would be noticeable for 1 to 7 days, several hours a day.

Smoke would usually move toward the northeast and be most noticeable in Ruidoso, Alto, and Ruidoso Downs. It possibly could also be noticeable from the more distant communities of Capitan, Lincoln, Fort Stanton and Glencoe (averaging approximately 23 miles away) and on New Mexico Highways 37 and 48, and U.S. Highway 70 (as far as 30 miles from project area).

Because slash piles will be burned during favorable conditions which could include the late fall or winter when temperatures are cooler and humidity is high (often with snow on the ground), there would be an increased potential for the smoke to linger during these times due to temperature inversions. Early morning inversions often lift after about 10:00 a.m., after which time smoke would rise and disperse.

Emission reduction techniques would be used to reduce the actual amount of emissions produced from fire, where appropriate, to aid in the maintenance of air quality. For broadcast burning, the following techniques would be used:

- Ignition will generally cease by 2 p.m. to allow for ventilation and clearing of smoke.
- Large, down woody material would be protected, where appropriate, to reduce smoldering.
- Ignition may occur in small blocks to limit smoke impacts.
- Ignition techniques will be employed to alleviate long-term impacts to sensitive receptors such as private lands and road systems.

For pile burning, techniques would include:

- Firewood would be removed where appropriate.
- Piles would be kept free of dirt, as much as possible, to reduce smoldering.

Under both alternatives, mechanical treatments would be used to reduce the amount of fuels burned, which would replace the use of fire for more than 3 years. Non-burning alternatives would achieve fuels treatments while mimicking prescribed burning efforts. The following methods would be used to achieve this goal for both alternatives:

- Cut material would be piled to allow for most complete consumption of particulate matter.
- Material would be hauled offsite and utilized for woody products to reduce the total volume of material burned.

In addition, alternative 3 would use mastication processing of standing or downed woody biomass that would allow for a delay in prescribed burning.

Table 36 shows the particulate matter produced under alternatives 2 and 3 for all of the broadcast burning and piling burning proposed, based on burning estimates previously described. The estimated PM emissions from pile burning per year would be the same as total PM emissions from pile burning because it is possible to burn all the piles (about 300 acres) within the same year.

Table 36. Predicted annual and total particulate emissions of PM_{10} and $PM_{2.5}$ for alternatives 2 and 3 expressed in tons

	Alternative 2				Alternative 3			
	Broadcast Burn		Pile Burn		Broadcast Burn		Pile Burn	
	Annual	Total	Annual	Total	Annual	Total	Annual	Total
PM_{10} (tons)	49	218	14	14	32	132	14	23
$PM_{2.5}$ (tons)	43	192	13	13	28	116	13	21

Cumulative Effects

The analysis area for considering cumulative smoke related effects is the portion of the Pecos River airshed within the wildland-urban interface boundary defined in the community wildfire protection plan (see appendix A for details). It would not be necessary to analyze all the activites within the entire Pecos River airshed, which covers a large portion of the state of New Mexico spanning several counties. The relatively minor contribution of smoke emissions from this project and the fact that during expected smoke dispersal conditions the smoke would not be expected to be noticeable at any great distance, this cumulative effects area seems appropriate.

Cumulative effects include those from past, ongoing and reasonably foreseeable future activities that combine with effects of the proposed project in contributing to the total particulate matter or carbon monoxide load in the same airshed. Generally, the cumulative effects analysis area lacks large industry capable of contributing significant PM or carbon monoxide. While the other potential sources of these pollutants cannot be accurately quantified, they are as follows:

- Operation of combustion engines like vehicles or lawn mowers; contributes CO.
- Use of fireplaces and wood stoves contributes PM and CO mostly from November-April.
- Dust from unpaved roads does not typically travel very far or contribute large amounts of PM.
- Industry emissions are a negligible contribution.

- Prescribed burning by agencies and private landowners are a common contribution of PM and CO.
- Wildfires usually occur annually and contribute relatively large amount of PM and CO .

Thus, emissions from prescribed burning activities proposed with alternatives 2 or 3 together with emissions from the various other sources, and the existing PM and CO in the air from past activities, would increase the amount of pollutants that would be distributed to areas downwind. Of these sources of PM and CO, prescribed burning and fireplace smoke are the most common and would be the primary contributors to cumulative air quality effects. Fall and winter burning of slash piles in the project area and in the surrounding forests would contribute incrementally to the cumulative smoke effects from residential use of wood stoves and fireplaces.

Fine particulate emissions from the proposed action combined with other sources would add to the regional haze that results when there are multiple sources of emissions during the same time period. During temperature inversions, the haze becomes concentrated near the surface. Proposed actions would contribute an insignificant amount to the regional haze and overall air pollution load within this airshed, in part due to the timing, coordination and monitoring, low emissions concentrations, and other mitigation measures described in chapter 2. Although burning could occur any time throughout the year, a higher percentage of the broadcast prescribed burning (over 90 percent) would likely occur in the spring or fall rather than during the winter when residents use wood-burning stoves/fireplaces and there are more air inversions. Piles burned during the winter months would involve timing restrictions to allow for adequate smoke dispersal. To further reduce cumulative effects to air quality, prescribed burning would be coordinated between Federal land managers and the State regulatory agency so as not to overwhelm the air resource. The State would regulate and decide if and when burn permits are issued to the Forest Service and others in order to avoid cumulative effects that might exceed air quality standards. Thus overall, the cumulative increase in emissions from this project is not expected to be significant enough to approach concentrations that would exceed State or Federal air quality standards.

Scenery

Affected Environment

The project area lies within Management Area 1I, Upper Ruidoso, as described in the forest plan for the Lincoln National Forest (U.S. Forest Service 1986: 78-80). The primary emphasis of this management area is developed recreation. The project area is only a small part of this larger management area and contains no developed recreation facilities, although the Cedar Creek day-use site lies adjacent to the northeast side of the area. The project area is managed more as an undeveloped recreation area for hiking, biking and equestrian use. Refer to the “Recreation” section for more information on the recreation environment.

Visual quality objectives (VQOs) must be met in designing and implementing land management projects, based on the forest plan and Visual Quality Management Handbook. The VQOs were created during forest plan development in the mid-1980s and a VQO map is on file in the project record. The VQOs and percent of the project area they encompass are as follows:

- Retention (51 percent): management activities are not evident to a forest visitor. This VQO occurs mostly in the Perk block of the project area.

- Partial Retention (41 percent): management activities may be evident, but must be subordinate to the characteristic landscape. This VQO occurs mostly in the Grindstone block of the project area.
- Modification (8 percent): management activities may dominate the characteristic landscape but must use naturally established form, line, color, and texture. Activities should appear as natural occurrences when viewed as middle ground or background. This VQO occurs in the southwest corner adjacent to Mescalero-Apache tribal lands.
- Within each VQO, distance zones are generally defined based on the distance of a particular landscape from the viewer: foreground (0 to ¼-½ mile), middle ground (¼-½ to 3-5 miles) and background (3-5 miles to infinity) (U.S. Forest Service 1974: 30-35, 44-45).

The existing landscape character of the project area is steep, rugged mountainous terrain; slopes are heavily forested with a few scattered openings. The understory component of seedlings, saplings, and shrubby oak is particularly thick in much of the project area, creating an almost tunnel-like effect along some roads and trails, and limiting views into the area. As noted in chapter 1, years of fire suppression have contributed to increased stand densities, insect and disease infestations, and tree mortality. As a result, numerous large stands of grey and red dead and dying trees dot the landscape, creating a marked contrast to the overall dense green cover.

The dominant land feature of the Ruidoso area is Sierra Blanca Peak. Rising just under 12,000 feet and located outside the Perk-Grindstone project area on Mescalero-Apache Reservation lands, Sierra Blanca Peak provides the focus for viewers' attention and is the visual backdrop for the rounded ridgetops and steep slopes of the project area. Popular scenery based activities include driving for pleasure, mountain biking, picnicking, camping, and hiking.

There are about 6 to 7 miles of system and unauthorized (non-system) roads within the project area, along with some trails that were formerly roads (like Grindstone Mesa Trail 91). Many of these roads are primitive; none were designed by the Agency as standard Forest Service roads. They are mostly closed roads and receive light traffic volumes and little to no routine maintenance. Some are located in or along stream channels and they are generally in poor condition. The roads tend to detract from the natural appearance of the area.

Environmental Consequences

Alternative 1—No Action

The VQO requirements for retention, partial retention and modification would be met under the no action alternative. The area would continue to show a low level of scenic diversity in terms of forest structure, as there is a nearly continuous tree canopy and very dense understories that limit views through the trees. The landscape character would continue to change gradually over time by natural processes. Based on the vegetation analysis, there would be an increase in numbers of dead standing trees, creating even more contrast to the adjacent live trees. In addition, the poor condition of the roads would continue to worsen. The result would be a general decline in the overall scenic quality of the project area. Under this alternative there would be no opportunities to enhance and improve scenic resources or achieve the desired condition described in chapter 1 since there would be no thinning or other treatments.

No Action with Crown Fire

At least 60 percent of the landscape has a high to extreme crown fire hazard. A large size stand replacement fire in the project area is a major public concern and would certainly affect scenic resources.

In the event of a high-severity wildfire, the existing landscape character would be suddenly altered with little opportunity to slow or control the change. The VQO requirements do not apply to wildfires because they are not considered land management activities. A high-intensity, large-scale wildfire would redefine and reshape the existing landscape character. The appearance and character of the area would shift from densely forested to patchy and open. The overstory component and green canopy would be absent or drastically reduced, depending on the severity of the fire. For several years the landscape would be dominated by blackened, dead standing trees. If allowed to come down on their own, the trees would likely fall down in a dense, jack-straw pattern. For one to two growing seasons, the blackened, exposed ground surfaces would be highly visible due to lack of vegetation. Eventually these areas could be covered with scattered invasive plants (weeds) until native plants became established. These changes would be visible throughout the project area in the foreground of forest roads and trails, and as middle ground and background views from Sierra Blanca Peak, Grindstone Reservoir, the Village of Ruidoso, and developed recreation sites.

Initial public reaction to a large-scale fire tends to be negative, as many people do not consider extensive, blackened landscapes to be natural or beneficial. These effects are often perceived by local residents as devastating to their community and way of life; non-local forest visitors may regard the effects of a catastrophic fire as interesting and something “to be seen” but also as a degradation nonetheless of the scenic quality. In addition, emergency fire suppression actions such as fire lines and emergency post-fire rehabilitation treatments could result in scars on the landscape. Impacts of the suppression and emergency treatments, such as bulldozed fire lines, should not be evident to the casual forest visitor within 2 to 3 years of completion if the area were rehabilitated and as grasses, wildflowers, shrubs and forbs moved in, although effects from the fire itself would remain visible much longer. Within 5 years, the effects of the fire would begin to be viewed in a somewhat more positive light as the shrubby understory, seedlings and saplings become more abundant. However, the presence of dead standing trees would remain a dominant and somewhat negative visual reminder for many years.

Alternatives 2 and 3

The “seen areas” or those from which project activities would be somewhat to very noticeable include the Village of Ruidoso’s Grindstone Reservoir, Sierra Blanca Peak (on Mescalero-Apache tribal lands), the Cedar Creek recreation area, and from the roads and trails within and directly adjacent to the area. Direct and prolonged views from the Village of Ruidoso into the project area would be obscured by the undulating character of the existing terrain with its numerous ridges and steep slopes and relatively dense stands of trees on private land adjacent to homes. For the most part, residential areas are located within view of Sierra Blanca Peak, in the forested canyon bottoms, or on moderate to steep mountain side slopes. The resulting views of the project area from the Village of Ruidoso and its surrounds would be mostly interrupted and of short duration. Activities related to this project would primarily be viewed as middle ground and background, with limited areas viewed as foreground from National Forest System roads and trails.

The VQOs of retention and partial retention would probably not be met immediately or within 1 year of project completion. Approximately 91 percent of the project area landscapes are within retention or partial retention VQOs, which requires little or no evidence of human activities immediately after project completion. Evidence of some skid trails, landings, slash, tree paint, and other project activities may still be seen from some viewpoints within the first year after project completion. Once grasses and other ground cover are restored as required on skid trails, landings and other exposed soils, and slash is burned, the VQOs of retention and partial retention would likely be met. This may take only 1 year to complete in some parts of the project area and longer in other parts of the project area. It could take as long as 5 years to meet the VQOs throughout this project area after project completion. The VQO of modification located in the Grindstone block would be met because project activities would appear as natural occurrences when viewed in middle ground and background.

The presence of skid trails, landings, and piled or scattered slash in the foreground of forest roads and trails, private lands, and developed and dispersed recreation areas would detract from scenic quality. The disturbed soils in skid trails, landings and road cuts would appear much lighter in color and be more visible than the adjacent, unmodified vegetated land until they are re-covered with vegetation. Even though relatively level and open sites would be selected for landings, additional grading and clearing would be needed in order to create openings that were ¼ acre to 1 acre in size to accommodate log stockpiling and removal. These landings would introduce a very visible contrast to the natural color, line and texture of the area that would remain until they were rehabilitated. As noted in “Mitigations” in chapter 2, landings and skid trails would be rehabilitated and activity generated slash would be removed from the foreground within 1 year of project completion, or as soon as practical. The effects of skid trails and landings would likely last for a few years as each portion of the project area would be reclaimed once operations cease in that part of the area. Slash piles could be noticeable for a few years after the slash is piled in those areas, based on slash pile burning which will occur after piles are allowed to dry (approximately 6 months) and then allowing for appropriate weather parameters.

Scenic quality would improve under this alternative, due to the treatments and implementation of many specific mitigation measures to reduce visual quality impacts as described in chapter 2. The desired vegetation and fuel conditions described in chapter 1 would also be desirable scenic conditions. Diversity of tree species, age, and class size would increase; spatial distribution of trees would be more varied with an emphasis on clumpy, irregular groupings interspersed with openings. In addition, grasses, wildflowers, forbs and shrubs, which are currently sparse due to lack of openings in the canopy, would become abundant and diverse, creating a more dominant understory component. The landscape would still appear forested but would contain fewer mid-sized and small diameter trees; the larger trees would appear more dominant.

Thinning treatments would alter the existing character of forests in the area but the forests would still be mostly natural appearing. Viewers who are familiar with forested areas that appear full of dense, dog-hair thickets would be able to discern the difference after thinning because thinned areas would appear brighter, more open and less shaded. There would be more opportunities to view farther distances into and across the project area, particularly along the entire community boundary which would be thinned to achieve more open forest conditions. Regardless of the treatment type, emphasis would be placed on an uneven spacing of trees of varying age, size and species. These clumpy, irregular patches would more closely reflect the natural, fire-adapted forest conditions. In general the scenic quality would be improved, particularly in sanitation thinning units from which dead and dying trees would be removed.

Prescribed burning activities would not result in any visually dominant, long-term effects on scenic quality, unless residual standing trees were damaged or killed. The prescribed burns would be low to moderate intensity ground fires and slash pile burning would only occur along the community boundary. The ground would appear black or grey in some areas immediately following the burns, particularly under slash piles. In some areas, fire scorching on tree boles and additional burn-related tree mortality would occur and present a contrast to the otherwise green surroundings. These contrasts would soften and become less noticeable within two or three growing seasons after project completion as the understory component (i.e. grass, oak seedlings, etc.) moved in, as singed but not dead trees recovered and greened up, and as dead standing trees fell down.

Skyline and cable logging would only occur on about 8 and 18 percent of the project area for alternatives 2 and 3 respectively. The visual impacts from skyline logging corridors would be minimal and of short duration. With skyline logging, logs to be removed are partially or entirely suspended above the ground, resulting in little disturbance to the ground (U.S. Forest Service 1980: 199, 204-207). Mitigation measures described in chapter 2 would require skyline corridors to be designed to blend in with the surrounding landscape by varying corridor widths from 12 to 14 feet and leaving irregular, non-linear, feathered edges. Some corridors under these alternatives would be viewed as middle ground from the Village of Ruidoso, while others would be viewed in the foreground of the road and recreation sites along Cedar Creek. However, the natural undulating terrain and mitigation measures would minimize the visual effects and screen direct views into the corridors to the point that the corridors would not be evident to forest visitors. This mitigation measure was shown to be effective in reducing visual impacts in a similar skyline treatment unit that can be viewed along U.S. Highway 70 near Apache Summit on the Mescalero-Apache Reservation.

Proposed road construction and reconstruction activities would create some additional ground disturbance. The effects would be limited and of relatively short duration, as a result of project roads primarily following roads and trails that currently exist. A total of 0.5 and 3.9 miles of new road would be constructed under alternatives 2 and 3 respectively. Of the 14 miles of road to be constructed or reconstructed under alternative 2, 5.5 miles would be decommissioned and 8.5 miles would be closed after project completion. Under alternative 3, 20 miles of road would be constructed or reconstructed. After project completion, 9 miles would be decommissioned and 11 would be closed. Decommissioning would essentially eliminate most visible evidence of the road through reseeding, reshaping the road edges, and otherwise restoring the terrain to its natural, pre-project conditions. Through road closure, the road is retained for possible future administrative use and is closed with gates or natural barriers such as berms, slash, and boulders. Scenic quality would be enhanced through road reconstruction because scars and contrasts caused by the erosion, ruts and gullies of the current road condition would be eliminated. Methods used to close roads would be visible at least for a short distance adjacent to and around the closure device. However, since most of the roads to be closed already exist, additional visual impacts related to road construction would be minimal.

Additional reductions to road impacts on visual quality will be achieved by utilizing pockets of trees and shrubs that will be left along roads to help screen and break up the long line of the road into shorter segments of varying length, which will aid in reducing negative impacts to scenic quality. Cut and fill slopes and landings that will be reseeded will provide additional screening. Once the grasses sprouted, the contrast between the lighter brown of the road surfaces and the greener regenerated understory component will be reduced. With implementation of the

mitigation measures that were developed to specifically address segments of road described in chapter 2, the long-term effects on visual quality should be minimal.

Differences to note in the effects to scenic quality under alternative 3 are related to the use of mastication and manual thinning methods on 48 percent of the project area. These two methods do not include wood product removal (described in chapter 2). This retention of woody biomass will result in different visual qualities than could be expected under woody product removal.

Cumulative Effects

The boundary for determining cumulative effects for scenic quality is the project area and adjacent Village of Ruidoso. Past, present and reasonably foreseeable future actions that may affect scenic quality include old wildfires, reconstruction of developed recreation sites along Cedar Creek, urban development, and fuels reduction projects in and around Ruidoso conducted by the Mescalero-Apache Tribe, Forest Service, Village of Ruidoso and other Federal and State agencies (see appendix A for details).

The short-term visual effects described for the proposed activities under alternative 2 or 3 would not have a measurable cumulative effect when combined with other past, present, and reasonably foreseeable future actions. Other fuels reduction projects would have generally the same or slightly more pronounced effects as described for alternatives 2 and 3 on non-Forest Service lands that do not incorporate visual quality mitigation measures. As a substantial amount of forest thinning has occurred and continues to occur throughout the Ruidoso area, the changed forest conditions in the Perk-Grindstone area would be less noticeable and blend with the surrounding mountain landscapes. Effects of alternatives 2 and 3 would add to the same effects that are occurring in surrounding forested areas. The long-term effects of the project combined with similar projects would be beneficial to vegetative diversity and scenic quality. There would be cumulative short-term negative effects to scenic quality, similar to those described for the proposed project, with the added impacts from other fuel reduction projects. If similar mitigation measures developed for the Perk-Grindstone Project are implemented on other fuel reduction projects to rehabilitate disturbed areas, then overall scenic quality would be enhanced.

Recreation

Affected Environment

The Perk-Grindstone project area is included in Management Area Il, Upper Ruidoso as described in the forest plan for the Lincoln National Forest (U.S. Forest Service 1986; X). The emphasis for this management area is on developed recreation opportunities, and while there are a few developed recreation sites adjacent to the project area along Cedar Creek, there are none within the project boundary itself.

The goal of the Forest Service recreation manager is to provide the opportunities for visitors to realize satisfying experiences in the national forest. The recreation management approach used by the Forest Service is called the “Recreation Opportunity Spectrum” (ROS). The ROS provides a framework for defining the types of outdoor recreation environment, activities, and opportunities along a continuum or spectrum (Clark and Stankey 1979). Opportunities for experiences along the spectrum represent a range from very high probability of solitude, self-reliance, risk, and

challenge (such as in primitive or semiprimitive ROS settings), to a very social experience where self-reliance, challenge and risk are relatively unimportant.

The ROS settings and percent coverage within the project area are as follows:

- Roaded Natural (92 percent): a mostly natural appearing environment with moderate evidences of the sights and sounds of people.
- Urban (8 percent): areas characterized by a substantially urbanized environment with natural appearing background elements. These areas are located adjacent to the Village of Ruidoso.

The project area is generally managed for dispersed recreation and is viewed by residents of Ruidoso as their backyard play land. Numerous system and unauthorized (non-system) roads and trails provide access for turkey and big game hunting (bear, mule deer, and elk), non-motorized uses such as horseback riding, hiking, and mountain biking, and some off-highway-vehicle use such as occurs in Sawmill Canyon. A few popular dispersed (undeveloped) camping areas also occur in the project area.

Roads and trails in the project area are generally in poor condition and roads are passable only by high-clearance vehicles. Some roads and trails are deeply rutted with steep, rocky pitches. Road and trail conditions further deteriorate where roads and trails are located in stream channels. The surface of the roads and trails are native soils.

Environmental Consequences

Alternative 1—No Action Alternative

Under the current stand density conditions described in the “Vegetation” section, there would be an increase in the number of dead and dying trees. Eventually the dead trees would fall down and some would fall across roads and trails, which are mostly used for hiking and other non-motorized activities as most of the roads are closed to public vehicles. More road and trail maintenance and clearing would be needed. There would also be an increase in the hazard of trees or branches falling on people recreating in the area.

Road and trail conditions would continue to decline, which may impact motorized access on the roads that are open. The ROS classes would not be affected.

No Action with Crown Fire

A large high-severity wildfire would result in at least a temporary decrease of recreation opportunities for dispersed camping and use of roads and trails. Some roads and trails may have to be abandoned indefinitely because they become totally unuseable. Trails and dispersed camping areas may be closed due to severe erosion and presence of hazard trees. Hunting opportunities would decrease for about one season after a fire because game would have left the area or been killed by the fire. Over the long term, hunting opportunities would increase because game, such as elk, would be attracted to any native grasses and forbs that could sprout as a food source. Technically, the landscape after a wildfire would be consistent with the ROS classes of urban and roaded natural because most of the landscape changes would be “naturally” caused, although access to and the availability of recreation opportunities would be affected for 1 to 2 years or more, depending on fire severity. The expected post-fire effects to Grindstone Reservoir

as described in the water and soil section of this EIS would likely eliminate recreational opportunities like fishing and canoeing in the reservoir for at least a year or longer. Fishing opportunities in the nearby Rio Ruidoso would also be indirectly impacted by post-fire water quality impacts that flow downslope from the project area.

Alternatives 2 and 3

Recreational access to the roads, trails and areas where equipment is operating would likely be temporarily prohibited or restricted during those operations to protect public safety. This would result in some short-term user displacement and dissatisfaction. However, the entire treatment area would not be closed at the same time, as the project would be implemented in phases across the landscape. Thus, when one area, road or trail is identified as off limits to public use, recreationists would be able to find other roads, trails or back-country areas they could access and use within the project area. The Fitness Trail near the Smokey Bear Ranger District office would not be used for skidding operations. However, because it is located in a unit marked for ground-based thinning equipment, short-term and periodic trail and trail area closures may be necessary when heavy equipment is in the area and logs are being moved to landings near Cedar Creek Road.

A popular dispersed camping area located at the end of Forest Road 88 would be used as a landing for log stockpiling and removal under alternative 2. As a result, it would be closed to public use while activities were being conducted in this area. Recreationists who enjoy using this area would be displaced during project operations; if closure of this area occurred during the height of the camping season, then this recreation opportunity would be negatively impacted and public dissatisfaction would be high. However, after work was completed in this area and the landing restored by seeding, recreation use and access would be enhanced with a slightly enlarged and better graded parking area.

Temporary damage to trail treads may occur during project implementation, but would be minimized by the mitigation measures described in chapter 2, and trails would be restored as needed to their original condition.

Unauthorized motorized access by all-terrain vehicles, motorbikes or other motorized vehicles may increase in the project area as a result of the forest being more open, especially along the community interface. However, by the time project implementation begins or is in progress, the Lincoln National Forest would have completed its travel management planning and decisionmaking process and issued motor vehicle use maps that designate the travel routes open to motorized use. Routes not on the map would be prohibited from motorized use. The decision about which routes, if any, would be open to motorized use after project implementation is not part of this fuel reduction project decision.

Road management activities described for this project in chapter 2 would result in some minor, short-term effects to the recreation environment. Some recreationists seeking a challenging and risk-filled adventure may likely be dissatisfied with the road improvements. Some recreationists may feel access to their backyard was being restricted with the decommissioning of roads. Other recreationists would view these activities in a positive light and would appreciate the improved road and trail conditions and improved ecological and watershed conditions associated with the road work.

The total miles of trails and closed roads that can be used as trails would be increased over current conditions after the project is fully implemented. For example, existing road 988G in the northeast corner of the project area would be converted to a trail after project use.

Cumulative Effects

The spatial extent of analysis for cumulative effects is the boundary of Perk-Grindstone project area along with the adjacent Cedar Creek recreation area and Village of Ruidoso. Past, present and reasonably foreseeable future actions that may affect recreation resources include the recent reconstruction of developed recreation sites along Cedar Creek, similar fuels reduction projects conducted in the Village of Ruidoso area, expected travel management decision and motor vehicle use designations, and future plans by the Lincoln National Forest to develop additional bike trails in the Perk block (see other actions for cumulative effects analysis in appendix A).

Because there would be only very minor, short-term changes in recreational settings and opportunities anticipated under the two action alternatives, they would not measurably add up to a significant cumulative effect even when combined with effects of the other actions mentioned. There could be an incremental net benefit to non-motorized recreation opportunities in the general area from the combination of the activities both within and outside the project area that increase the abundance and quality of trails including mountain bike trails, and improve recreation area facilities and access roads.

Heritage Resources

Affected Environment

The planning for this project included completing the required surveys, reports, and assessments of effects on heritage resources, along with consultation with the State Historic Preservation Office (SHPO) and Native American tribes, in accordance with the forest plan and National Historic Preservation Act regulations (U.S. Forest Service: 19, 60-61, and 36 CFR 800). The Forest Service received concurrence from the New Mexico SHPO on the Perk-Grindstone Fuel Reduction Project inventory report and proposed heritage resource site protection measures (NM SHPO 2005). The SHPO concurrence and inventory report for this project supplement other survey reports and SHPO consultations covering similar past activities in the project area: Ruidoso Urban Interface concurrence in Oct-Nov 1997; Grindstone Urban Interface concurrence in July 1998; Perk Grindstone Thinning concurrence in Dec. 1999; Cedar Perk Wildland-Urban Interface concurrence in Feb. 2000; and Ruidoso Wildland-Urban Interface concurrence in Sept. 2000.

The treatment acreage within the project area contains four historic properties deemed eligible for the National Register of Historic Places and two historic properties whose eligibility is undetermined. A total of six historic properties have been previously recorded in the project area. These include remains of Native American temporary encampments containing lithic and artifact scatters and a pithouse village. During consultation, no traditional cultural properties used by surrounding communities were identified. However, the locations of traditional cultural properties are often culturally sensitive and confidential. It is expected that protection measures contained in the programmatic agreement will be sufficient to protect historic properties from adverse effects (U.S. Forest Service 2003b).

Environmental Consequences

Alternative 1—No Action

None of the ground-disturbing or burning activities proposed for this project would take place; therefore, this action would have no effect on heritage resources.

No Action with Crown Fire

Without thinning or burning treatments, there is a high risk of a large intense crown fire in the project area. Such an event would pose a great risk to heritage resources. All heritage sites in and surrounding the area could be damaged or destroyed by a large, high-severity crown fire and its aftereffects. Combustible portions of archeological remains and historic structures could be partially or completely consumed by a high-intensity fire (Haecker 2001; Romme et al. 1993). Noncombustible materials, such as the remains of stone tools, masonry architecture and metal artifacts, could become blackened or glazed; these materials can also spall, melt, and experience irreversible physical or chemical changes to their composition (Buenger 2003; Deal 2002; Haecker 2001).

The removal of vegetation by high-severity wildfire can result in the exposure of bare surfaces and accelerate erosion, particularly from water. This erosion taking place following a wildfire could damage or destroy heritage resources. Archeological deposits could be displaced or completely removed by erosion. Historic structures such as road related features could be inundated, buried and structurally undermined by increased sediment loads carried in streams and intermittent drainages. Flooding and other large erosion events could damage or destroy access trails to the traditional cultural property, creating a short-term or long-term loss of access to the property by members of the community. The falling of trees killed by fire could also result in blocking access to traditional cultural property.

Impacts to heritage sites would also likely occur from typical wildfire suppression activities. The use of bulldozers and hand tools to construct fire containment lines can damage or destroy the subsurface deposits of an archeological site, and the surface features of archeological sites and in-use historic sites (Traylor et al. 1990). The use of water and fire retardant spread from engines and aircraft may also cause damage, particularly to in use historic structures such as recreation residences and other domestic buildings (Floyd et al. 2004).

Alternatives 2 and 3

With employment of appropriate mitigation measures as described in chapter 2, the activities proposed would not affect heritage resources. Thus, there are no differences in effects to heritage resources between the two alternatives. All requirements of National Historic Preservation Act have been met for this project, including survey, consultation and development of appropriate mitigation measures.

In addition, some activities proposed in this alternative would improve conditions for many of the heritage resource sites located within the project area. All potential damage to heritage resource sites from thinning and skidding logs with tracked or rubber-tired mechanical vehicles, hand piling of thinning slash, pile burning, low-to-moderate intensity broadcast burning, and the various road management activities would be prevented because heritage resource sites would be completely avoided. As such, these activities would have no effect on heritage resources.

This alternative provides more protection from high-severity wildfire to heritage resources compared to the no action alternative.

None of the proposed activities have potential to affect traditional cultural property that may occur within the areas to be treated by this alternative, or indirectly affect portions of the traditional cultural property that lie outside of these areas. Project activities would have no affect on the traditional cultural property provided that the trails are left open and kept clear of thinning slash and all other debris during all project activities (See the “Mitigation Measures” section in chapter 2).

Cumulative Effects

This analysis considered the past, present and foreseeable future projects that could affect heritage resources in the community wildfire protection plan’s wildland-urban interface (CWPP-WUI) area around Ruidoso, as described in appendix A. The main activities that would potentially impact heritage resources include the historic logging, historic creation of roads, and high-severity wildfires, along with ongoing recreational activities such as camping outside developed or designated areas and off-road motor vehicle uses. Authorized Federal activities typically provide sufficient protection of heritage resources in accordance with National Historic Preservation Act (NHPA) requirements.

The action alternatives for the Perk-Grindstone project would meet requirements for preservation (avoidance) of heritage resources and would not be expected to result in any adverse impacts. Therefore, there would be no potential for adverse cumulative effects.

By treating the area to reduce the chance of a high-severity wildfire and its aftereffects, the action alternatives would cumulatively add to the beneficial effects of other fuel reduction projects in the CWPP-WUI area around Ruidoso. Together these projects cumulatively contribute to long-term protection of heritage resources and the cultural and scientific value they provide to society.

Human Health and Safety

Affected Environment

Currently, there are no major human health and safety concerns existing within the project area that are different from the many similar national forest lands throughout the United States. People visiting or working in the forest are at some risk of hazards from weather conditions, rough terrain, encounters with wildlife, and other factors that naturally occur in a wildland environment. However, the project area has a high level of insect and disease infestation, with increasing incidence of tree mortality. Increasingly, there are dead trees occurring along roads and trails, so dead branches or trees may fall onto people recreating or working in the area.

Environmental Consequences

Alternative 1—No Action

Under this alternative there would be no change from existing conditions described in the “Affected Environment,” and no major increase in safety hazards to workers or the public. However, the number of dead trees would likely continue to increase as an indirect result from

stand density and insect/disease infestations (see “Vegetation, Fuels and Fire” section). This heightens the potential for dead trees and large dead branches to fall and injure people recreating in the area, especially during windy conditions.

No Action with Crown Fire

A large crown fire event would pose severe health and safety risks to the public and to firefighters. Nearly all of the major wildfires in New Mexico that occurred over the past decade resulted in injuries, and some resulted in fatalities associated with fire fighting operations. The narrow Upper Canyon Road residential area that intersects the Perk and Grindstone blocks of the project area is perhaps the most vulnerable to incurring impacts from a crown fire. There is only one road available to exit that canyon, which could become blocked by wildfire or fallen trees, making evacuation very difficult. Other residential subdivisions lie directly along the project area’s north and east boundary, which is the probable direction of wildfire spread based on prevailing winds during the wildfire season in southern New Mexico and Arizona. While the Scott Able Fire of 2000 burned away from population centers, sparing Cloudcroft, 64 homes were destroyed and the fire took two lives of firefighters. That fire spread across 5.5 miles within the first 6 hours, as reported by Forest Service news releases in May 2000. If such a crown fire starts anywhere in the project area—even on the farthest southwest corner—it would only need to travel a maximum of 2 to 3 miles across the heavily forested project area to enter Ruidoso. This would be predicted to occur within the first few hours, given the current density of forests in the area and fire behavior modeling results. Fire suppression crews would have little chance in stopping a high-intensity crown fire from spreading into Ruidoso, as well as to the municipal water supply at Grindstone Reservoir. The Cerro Grande Fire of 2000 consumed 43,000 acres, caused the emergency evacuation of 18,000 residents, and destroyed the homes of 400 families in Los Alamos (Hill 2000). Fires like the Cerro Grande and many others that occurred in New Mexico, threaten human health, safety and lives.

Post-fire flooding would be another public safety hazard that would reasonably be anticipated to occur under this alternative. The Rio Ruidoso in particular has a likelihood of flooding based on experience with similar fire-related flood events and the magnitude of water runoff that would possibly flow downslope from the project area after a severe fire and heavy monsoon rains.

In addition, smoke impacts from crown fires would be likely to adversely impact the health of some people in the Ruidoso area, as described in the “Air Quality/Smoke” section.

Alternatives 2 and 3

Under these alternatives, the most significant risk to the public and firefighter safety and lives—the risk related to a catastrophic crown fire event—would be substantially reduced. This would primarily be attributable to the activity treatments designed for both alternatives 2 and 3 that are predicted to yield a 40 percent reduction in the acreage having high, very high and extreme crown fire hazard conditions.

Smoke emissions from proposed prescribed burning can adversely affect human health for smoke sensitive people, such as those with respiratory illnesses. Differences among the two action alternatives and no action alternative in terms of anticipated smoke emissions were previously described in the “Air Quality/Smoke” section. Therefore, it will not be discussed further in this section.

There is a low probability of an “escape fire” resulting from prescribed burning activities that would impact human health and safety for nearby residents or visitors. This is because of the many mitigation measures described in chapter 2, including conducting burns under very specific weather and fuel moisture conditions to help prevent hazardous situations. Although prescribed burns and pile burning may result in the fire creeping or sparking outside the burn perimeter or burn piles, they would not be expected to pose a public safety hazard. All burning would be closely monitored and controlled.

Proposed actions would pose some hazardous situations for forest workers, typical of all thinning or timber harvest projects. The logging industry is known to have relatively high accident and injury rates compared to many other industries in the United States (citation). Forestry statistics that compare injury rates among different thinning/logging methods, manual tree falling and cutting logs was found to have the highest injury rates, followed by helicopter logging and skyline/cable logging, and ground-based logging rates were the lowest (BC Forest Safety Council 2007). Tree cutting methods where the operator is in a covered or protected cab would be expected to have a lower risk of worker injury. Under alternative 2, at least 65 percent of the treated acres would require manually felling, mostly in helicopter logging units. Under alternative 3, only 30 percent would require manual felling with no helicopter use on those acres. Thus, alternative 3 would be considered to have lower safety hazards than alternative 2.

The most prevalent worker safety hazard in this particular project area, due to the relatively high numbers of dead standing trees in some stands, would be the hazard of dead trees or large dead branches falling and injuring or killing workers underneath. This risk would be higher under alternative 2 due to the helicopters that would hover over the trees, pick up the logs, and fly the logs to the landings. Helicopters would increase the potential for dead trees and large dead limbs to fall onto the thinning crews that need to work under those trees and helicopters. The operational safety risks would be expected to be adequately addressed and minimized through following standard forestry safety procedures and Occupational Safety and Health Administration (OSHA) requirements.

Log trucks and other trucks used to implement these two alternatives could potentially increase traffic safety hazards, especially where they drive through some narrow residential areas in Ruidoso as they immediately exit the project area. There are four primary exit routes where logging trucks would leave the project area and enter Ruidoso, which can be seen on the alternatives maps in chapter 2. One is Cedar Canyon Road that is a high-standard, paved road that currently experiences daily truck traffic. The others, in the Grindstone area, are mostly light duty gravel roads that could support log truck traffic and are often currently used by trucks (including gravel trucks). One Village of Ruidoso road just north of Grindstone Reservoir would need to be upgraded to support log trucks coming from this project area. Because there are already many large trucks that drive throughout the Village of Ruidoso, especially over the past several years of mandatory thinning throughout the village, this type of log truck traffic is considered fairly common. Thus, the additional truck traffic that would result from these alternatives would not substantially raise the traffic safety hazard above background levels.

Public safety for people hiking, mountain biking, riding horses or otherwise visiting the area would be at risk if they are doing those activities within active work zones. For example, under alternative 3, mastication equipment can throw shredded wood pieces 200 feet or more at a force that could easily injure someone. Under alternative 2, suspended logs carried by helicopters could potentially come loose and fall on someone. There are numerous public safety hazards that would

potentially occur if people were recreating in the area of ongoing thinning or burning treatments. Thus, the Forest Service would notify the public of the dangers of recreating within operational areas, and sign roads and trails that need to be closed to avoid this potential hazard. The Forest Service may also issue temporary area closures on portions of the project area during those operations if deemed necessary.

Cumulative Effects

Other fuel reduction projects, recreational activities and nearly all the daily activities of people, within the project area and surrounding Ruidoso area were considered. Cumulatively, other human activities would pose some similar potential safety hazards as those described for the two action alternatives. For example, other fuel reduction projects occurring around the project area would result in similar (minor) increases in worker safety hazards, which would combine with slight increases in worker safety hazards associated with the action alternatives. Those kinds of safety hazards would be minimized through standard safety mitigation measures and the additive effect from the project would not be cumulatively significant. Hazards associated with outdoor recreational activities and truck traffic would continue to occur in and around the Ruidoso area. Overall, the slight increase in numbers of hazard trees, smoke, log truck traffic, and other potential hazards mentioned for this proposed project would not be expected to result in a significantly greater cumulative impact to human health and safety when combined with effects of other human activities.

Noise

Affected Environment

The project area receives noise from a variety of sources both within and outside of the national forest boundary. Current noise sources (sounds) originating within the project area is attributable to: (1) machinery and vehicle operations (such as currently occurring in the adjacent Cedar Creek area); (2) human voices during recreation activities; (3) wildlife and domestic animals; and (4) natural environmental sounds (e.g. water, wind). Noise sources from outside the area are essentially the same, along with road traffic and residential construction activities. Machinery creates the loudest sounds, along with noise from some vehicles.

The noise level within the project area is very low and intermittent, as would be expected in a national forest environment. However, due to the area’s adjacency with the Village of Ruidoso, noise emanating from outside the project area can be heard in portions of the project area along the community boundary.

Mechanical noise within the project area is primarily from these sources:

- All-terrain vehicles (ATVs) occur although use is considered light and concentrated in Sawmill Canyon.
- Forest Service pickup trucks are used for general patrols and pre-project analysis work.
- Airplanes, helicopters and other aircraft that periodically fly over the area.

The National Forest System roads in the area are currently closed to public motor vehicle traffic, other than small ATVs in Sawmill Canyon. The lack of machine noise can be attributed to no

projects using mechanical equipment in the area. Thus, there are few mechanical noise sources. Human activities in the area are primarily hiking, mountain biking and horseback riding.

Environmental Consequences

Alternative 1—No Action

Under this alternative there would be no noticeable change in the noise level within the project area that would impact people recreating in or living next to the area.

No Action with Crown Fire

The noise from fire engines, light trucks, helicopters, and airplanes would become quite loud during the suppression of a large crown fire. The noise from this equipment would sound about as loud as a road construction site. The noise from bulldozers creating firelines, chain saws and other fire-fighting equipment would be limited to the immediate area in which it is located, while that from aircraft would be heard over a broad area, depending on the size of the aircraft and the distance it flies. Based on similar large fires in the area, suppression efforts could last for months. Post-fire rehabilitation activities, including operation of large machinery, chain saws and other equipment would also increase the noise level in the project area. The noise during fire suppression and post-fire rehabilitation work would indirectly reduce recreational use of the area for people seeking a quiet forest environment.

Alternatives 2 and 3

Implementation of either alternative would entail several actions that would result in a short-term increase in noise levels in the area. Actions that would directly create noise are: (1) operating vehicles and equipment on roads in or around the project area or, in the case of helicopters, in the air above the project area; (2) operating equipment used to construct roads, helicopter landing pads, skid trails, and log landings; (3) operating equipment to remove forest vegetation (e.g. thinning trees and hauling wood); and (4) human voices (e.g. workers). Alternative 2 would result in noise being noticed over a larger geographic extent, due to the helicopters flying in and out of the area and landing locations. Noise from ground-based equipment would be more localized. People living adjacent to the area would likely notice an intermittent increase in noise from these various sources, especially when the sites near their homes are being treated. People on the Fitness Trail and in Cedar Creek Recreation Area would also likely notice an increase in noise from this area during treatment activities in the Perk block.

In addition, removal of thick understory vegetation would result in long-term increases in noise levels in the project area. Currently, dense stands of vegetation in the project area buffer sound from adjacent roads, residential areas, recreation trails, and other sources. This is because when noise travels through dense vegetation, energy is scattered and noise attenuation increases. Removal of the understory would remove this buffering effect permanently, unless dense understory vegetation is allowed to become re-established.

Cumulative Effects

Other activities in the Ruidoso wildland-urban interface area that contribute to the noise in the area were discussed in the “Affected Environment” section. There are other ongoing and planned fuel reduction treatments in the greater Ruidoso area immediately surrounding the project area.

These include the ongoing project in the Cedar Creek area, projects on Mescalero-Apache Reservation land, and those on private lands. In addition, Ruidoso continues to grow in population, resulting in more housing developments and traffic noise sources. The increase in noise over background levels resulting from this project, added to the increased noise from residential housing construction, more traffic, and other existing sources in Ruidoso, would cumulatively raise the noise for people living in Ruidoso close to the project area boundary. This would have a more pronounced effect on noise-sensitive people living within about 1 mile of the project area who would have intermittent bursts of mechanical noise coming from both directions. The southwesterly prevailing winds would further exacerbate the cumulative noise levels coming from activities in the project area toward Ruidoso residential areas.

Other Social and Economic Values

This section briefly describes the social and economic setting and analyzes some social and economic topics that were not previously analyzed in this EIS. Many social topics were already addressed in this EIS, including scenic quality, recreation, noise, human health and safety, and the community water supply (in the “Water and Soil” section).

Thus, this section describes any other social effects that would result from the proposed project, including disclosure of any environmental justice concerns. The environmental justice discussion discloses whether there would be any disproportionately high and adverse human health or environmental effects of the proposed project activities on minority and low-income populations, as directed by Executive Order 12898 regarding environmental justice.

This section also briefly summarizes the economic costs associated with the proposed project. Economic cost of the project was raised as an issue early in the planning process, as described in chapter 1. The economic issue raised was related to the high cost of the proposed helicopter logging (alternative 2). If the cost of helicopter logging were to exceed the funds available to implement the project, project implementation could be delayed and not satisfy the urgent need to reduce the crown fire hazard in this wildland-urban interface, as described in chapter 1.

The economic benefits discussion briefly estimates the jobs and income expected from each alternative, based on a widely-used economic analysis computer application called IMPLAN (Impact Analysis for Planning). The IMPLAN application along with 2003 IMPLAN data were used to determine changes in income and employment in the affected area economy. A multiplier is used to estimate cumulative economic changes, considering primary and secondary (direct or indirect) sources of jobs and income. This is because increases in jobs or income in one sector of the economy typically induces increases in jobs or income in another economic sector. Running the IMPLAN model for this project utilized primarily 2003 economic data for Lincoln County.

Affected Environment

Social Setting

The Village of Ruidoso is a small but thriving mountain community that has historic roots in tourism and natural resource extraction (Village of Ruidoso 2004). The Ruidoso area provides a variety of recreation and vacation activities during both summer and winter, including skiing, golfing, horse racing, camping, hiking, horseback riding, and casino gambling. Ruidoso also has a growing art community that supports several dozen galleries. Ruidoso is a full-service community

with police, fire, and emergency services, a community hospital, a public school system (grades K-12), and a branch of Eastern New Mexico University. The primary activity in the forests around Ruidoso is recreation (Village of Ruidoso 2004).

No private land inclusions occur within the project area. However, there is a residential area called Upper Canyon located between the Perk and Grindstone blocks of national forest lands included in this project area. Upper Canyon is informally known as a historic district with many historic cabins from the early 1900s, along with contemporary mountain cabins. Subdivisions that border the north and east boundaries of the project area include: Ponderosa Heights/Brady Canyon, Upper Canyon, Black Forest/Grindstone, Carrizo Canyon, Town and Country/Forest Heights (Village of Ruidoso 2004). Homes in those residential areas are particularly at risk if a catastrophic wildfire should occur.

The Mescalero-Apache Reservation, adjacent to the western and southern boundaries of the Perk-Grindstone project area, is home to about 3,156 residents (U.S. Census Bureau, 2007a). The town of Mescalero lies about 10 miles south of the project area boundary. Land uses on the 460,384-acre reservation include agriculture, grazing, timber production, and tourism.

Grindstone Reservoir, located adjacent to the east side of the project area is a water supply source for the Village of Ruidoso. The reservoir supplies approximately 30 percent of the municipal water for local residents (Carlos Salas, Village of Ruidoso Water Department, 15 October 2007, pers. comm.).

The permanent resident population of Ruidoso was 7,598 at the time of the 2000 Census (U.S. Census Bureau, 2007a); a 2006 population estimate was almost 9,400 (U.S. Census Bureau, 2007b). During the busy tourist season, the population of Ruidoso increases to approximately 25,000, peaking at 40,000 during special event weekends (Ruidoso Valley Chamber of Commerce, 2007a).

The project area lies within portions of Lincoln County census tract 9806, block group 4 (Grindstone area) and census tract 9808, block group 1 (Perk area). The demographic statistics indicate a relatively narrow range of diversity in the population of the greater Ruidoso area. As shown in table 37, these populations are largely white (more than 80 percent) and not of Hispanic origin (74 to 82 percent). This contrasts with New Mexico’s state population distribution of less than 67 percent white and nearly 60 percent of Hispanic origin (U.S. Census Bureau 2007c). Although Otero County lies adjacent to the south and west sides of the project area boundary, the adjacent land consists of undeveloped Mescalero-Apache Reservation land. There are no incorporated towns in Otero County in the vicinity of the project area that would be impacted by the proposed project or by the potential crown fire that is predicted under the no action alternative.

Table 37. Race, ethnicity, age and income data for the State of New Mexico, Lincoln County, Village of Ruidoso, and the two census block groups that include the project area. Note that percentages do not always equal 100 due to rounding.

	New Mexico	Lincoln County	Census Tract 9806, Block Group 4	Census Tract 9808, Block Group 1	Mescalero Apache Reservation	Village of Ruidoso
Total Population	1,829,146	19,411	2,012	1,503	3,156	7,698
Race (percent of total population)						
White	66.8%	83.6%	87.2%	85.7%	4.8%	87.5%
Black	1.9%	0.4%	0.5%	0.1%	0.2%	0.3%
American Indian	9.5%	2.0%	1.9%	3.1%	91.5%	2.4%
Asian	1.1%	0.3%	0.2%	0.2%	0.0%	0.3%
Hawaiian or Pacific Islander	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Other Race	17.0%	11.3%	7.5%	8.6%	1.2%	7.4%
Two or More	3.6%	2.5%	2.6%	2.3%	2.2%	2.1%
Hispanic Origin (percent of total population)						
Hispanic or Latino (of any race)	42.1%	25.6%	18.5%	21.6%	11.2%	18.2%
Age						
Median Age (years)	34.6	43.8	44.6	41.7	22.6	46.2
65+ Years (% of total pop.)	11.7%	18.0%	16.9%	21.1%	2.4%	21.8%
Income						
Per Capita Income (dollars)	$17,261	$19,338	$20,442	$18,929	$8,118	$22,721
Persons Below Poverty Level	18.4%	14.9%	9.0%	11.8%	35.7%	11.9%

Source: Census 2000 (U.S. Census Bureau, 2007a, 2007c, 2007d, 2007e, 2007f)

Economic Setting

Tourism is a major source of income in the greater Ruidoso area as well as on the Mescalero-Apache Reservation. As shown in table 38, as of the 2000 U.S. Census, four combined employment sectors in both Ruidoso and Lincoln County made up about 60 percent of all

employment. These four industries were: (1) retail trade; (2) arts, entertainment, recreation, and hospitality; (3) education, health, and social services; and (4) construction (U.S. Census Bureau, 2007g).

Table 38. Employment by industry sector in Lincoln County and in the Village of Ruidoso based on Census 2000 sampling data.

Employment Sectors (Industries)	Lincoln County		Ruidoso	
	No.	Percent	No.	Percent
Agriculture, forestry, fishing, hunting, mining	382	4.5%	53	1.6%
Construction	1,000	11.7%	368	11.0%
Manufacturing	218	2.5%	64	1.9%
Wholesale trade	161	1.9%	74	2.2%
Retail trade	1,298	15.2%	584	17.4%
Transportation, warehousing, utilities	363	4.3%	104	3.1%
Information	164	1.9%	84	2.5%
Finance, insurance, real estate	655	7.7%	333	9.9%
Professional, scientific, management	525	6.1%	272	8.1%
Educational, health, social services	1,423	16.7%	541	16.1%
Arts, entertainment, recreation, hospitality	1,392	16.3%	549	16.4%
Other services	487	5.7%	222	6.6%
Public administration	471	5.5%	107	3.2%
Total	8,539	100%	3,355	100%

(U.S. Census Bureau, 2007g)

There is one lumber products sawmill in Mescalero that is operated by the Mescalero-Apache Tribe. The tribe's second lumber mill in Alamogordo closed in early October 2007. According to the mill manager, the Mescalero mill is operating at full capacity with approximately 60 to 70 employees (J. Bridge, pers. comm., 12 October 2007). They process about 21,000,000 board feet per year from reservation lands and expect to be able to sustain this for at least the next 8 years. While there are a few small wood product operations in Ruidoso that utilize small diameter wood, this area lacks sufficient businesses (markets) for utilizing large quantities of wood biomass from small trees and species such as white fir. Ranger district personnel have knowledge of a local commercial market for piñon and juniper firewood.

Local companies have conducted fuel reduction thinning work throughout the greater Ruidoso area, including those with mastication equipment, tractor skidders, skyline equipment, and other

logging equipment. There is no helicopter logging business that operates within the local area. One local operator recently completed a 500-acre fuel reduction project on the national forest land adjacent to the proposed project area, under a Community Forest Restoration Program grant.

The purpose of the proposed project is to reduce the potential for crown fire and its associated impacts to the environment and community. The project is not designed to provide regulated commercial timber production, although the forest plan classifies this area as tentatively suitable for timber production. However, as a byproduct of this project, it has the potential to provide marketable timber and other raw forest products that could benefit the forest products economies of nearby communities. The proposed project has no special features to ensure timber production or salability, or to avoid potential adverse effects on the forest products industry.

Environmental Consequences

Alternative 1—No Action

Social Effects Including Environmental Justice

The no action alternative would not affect the community services or employment in Ruidoso. This alternative may result in increased property insurance rates or possibly the inability to obtain property insurance for those residents with homes located in at-risk areas (Richard Silva Lincoln County Assessor, pers. comm., 13 September 2007).

Under no action there would be no potential for the proposed activities to create a disproportionate effect on low-income or minority populations.

Economic Benefits and Costs

Under no action, there would be no increase in jobs or income associated with the project because the project would not be implemented. There would also be no change in existing land management costs for managing this project area.

No Action with Crown Fire

Social Effects Including Environmental Justice

During a wildfire, community services such as police, medical, fire, and water supply (including people and equipment) would likely be diverted directly and indirectly to fire suppression efforts. This may result in limited services available for “regular” purposes. After a wildfire, there could be a temporary loss of community services if disrupted by fire damage (e.g. loss of buildings or equipment). Of particular concern would be the potential for damage to the local water supply system should Grindstone Reservoir be damaged as a result of a wildfire.

Over the short term, nearby communities would bear the effects of smoke and suppression tactics, such as having fire retardant dropped on their property or losing personal property to wildfire. As the project area and adjacent areas most likely to experience these effects are not primarily populated by low-income or minority groups, there would be no disproportionate effect on these special populations.

No Action with Crown Fire

Economic Benefits and Costs

Only a small fraction of workers in Lincoln County would receive an economic benefit as a direct result of a crown fire. There would be an increase in temporary, short-term (few weeks) employment and income for firefighting and post-fire rehabilitation crews, as well as local restaurant and lodging businesses that support those crews during fire suppression and rehabilitation efforts. Fire suppression related employment from the Scott Abel Fire near Cloudcroft included over 450 firefighters, 21 engines, 14 bulldozers, 7 air tankers and 1 helicopter to suppress the fire. Additional equipment and crews were employed to control erosion and help rehabilitate the damaged area after the fire. While there would be a short-term surge of firefighting forces needed under this alternative, the Forest Service, State Forestry Department, and local firefighting units would not likely create additional permanent positions as a result of a crown fire event. Thus, no new permanent jobs or income would likely be generated. Overall, the annual increase in the county's employment and income from occurrence of a high-severity crown fire would be short term and, thus, relatively low.

Suppressing a large, high-severity wildfire would be very costly. Costs for fire suppression vary, depending on the resources and values at risk. Suppression costs alone would average over $1 million for a wildfire over 300 acres in size, based on a 4-year average for wildfires over 300 acres each in the Southwestern Region of the Forest Service (fire database 2001-2004). Total fire suppression costs for the Forest Service in 2006 were $1.5 billion for over 2 million acres burned, of which nearly $500 million was spent on 20 of the largest fires (Clevette et al. 2007). These figures do not include rehabilitation costs and cost of lost property, which typically exceed fire suppression costs. The Scott Able and Cree Fires that burned in southern New Mexico in 2000 did not burn through any large communities, but were estimated to cost $12 million and $7 million respectively, including suppression and rehabilitation costs (Dancker 2001a, Dancker 2001b). The Angora Fire that recently burned 3,100 acres in a small mountain community near Lake Tahoe, California, cost a total of $11.7 million. A large crown fire event in the Ruidoso area could cost at least $10 to $30 million, based on the costs of other severe crown fires that burned through mountain communities.

Tourism, the number one industry in Ruidoso, would be expected to suffer as a result of such a fire event. An indirect impact of a crown fire would be the loss of local business revenue as a result of tourism cancellations. Cancellations or shortening of visits to the Ruidoso area may occur: (1) during a wildfire due to smoke and/or forest closures and also from perceived danger; and (2) post-fire due to habitat/aesthetic loss or forest use restrictions (e.g. no hunting) as needed for fire rehabilitation activities. A loss of gross receipts taxes from reduced tourism would reduce both the portion of the tax that goes to the State of New Mexico as well as that portion returned to local city and county governments, thereby reducing their annual budgets.

After the heavy fire season of 2000, Lemhi County, Idaho, surveyed its local businesses to attempt to determine economic impacts (Board of Lemhi County Commissioners 2006). Of the 55 businesses that responded to the survey, about 65 percent reported an average of 35 percent reduction in sales, 15 percent had similar sales levels, and about 20 percent had an average increase of 20 percent in sales over 1999. The reduction in sales was primarily attributed to the loss of tourism associated with smoke conditions, closure of highways, rivers and media impacts (Board of Lemhi County Commissioners 2006).

The Village of Ruidoso would experience additional costs, and the community and an important water supply source (Grindstone Reservoir) lie immediately adjacent to the project area, and directly in the path of prevailing winds and associated wildfire spreads. A running crown fire starting anywhere in the project area could quickly spread through both the national forest land in the project area and at least half of the village within the first 6 hours of ignition before firefighting crews would likely be able to suppress it, based on the average rates of spread of large fires in the western United States. Numerous homes, forested properties, businesses, vehicles, and other infrastructure would likely be damaged or lost. Evacuation from some of the residential areas and Ruidoso itself could be very difficult and time consuming. The Village of Ruidoso may incur high costs associated with rehabilitating stream and reservoir conditions if post-fire heavy flooding and debris accumulations impact Rio Ruidoso and Grindstone Reservoir. From the aftermath of the Cerro Grande Fire in 2000, Los Alamos had to dredge and rebuild the entire Los Alamos Reservoir. Large accumulations of sediment, ash and woody debris in the reservoir could result in a relatively long duration shutdown (loss) of that municipal water source.

Private landowners may lose structures and personal property (e.g. vehicles, household goods, clothing) which would either result in insurance losses or personal financial losses. As a result of the Kokopelli Fire in 2002, 28 homes and 1 outbuilding were destroyed (Richard Silva, Lincoln County Assessor, pers. comm., September 13, 2007). The Lincoln County Assessor estimated property losses at $4.8 million. The loss of this property cost the county $29,600 in lost property taxes. The assessor also reported an estimate of $20 million in losses to insurance companies (Richard Silva, Lincoln County Assessor, pers. comm., 13 September 2007). Property values after a fire can further decline due to loss of aesthetics and recreation opportunities. After the Cerro Grande Fire that burned 48,000 acres near Los Alamos, New Mexico, the Federal Emergency Management Administration received 18,000 claims for property losses (U.S. General Accounting Office 2003). The Cerro Grande Fire resulted in a cost of $1 billion in damages (Hill 2000). The Angora Fire near Lake Tahoe spread 4 miles in 3 hours, and destroyed over 250 residences and 75 other structures, including over 80 percent of the residential lots in the small mountain community. Fortunately, the 405 acres that had been previously thinned and slash-burned allowed the crown fire to drop down to the ground and burn as a surface fire (California Department of Forestry and Fire 2007).

Alternatives 2 and 3

Social Effects Including Environmental Justice

Implementation of fuel reduction treatments under alternative 2 or 3 would have no direct effects on homes, businesses, or community services in the Ruidoso area. Indirectly, implementing either alternative would add to community cohesion. The community and elected local, State and Federal government officials have expressed their strong desire to see that this proposed project is implemented to help protect the community, its water supply and other forest land values. An increase in community cohesion has already developed around implementing the community wildfire protection plan (CWPP) that was collaboratively developed for the greater Ruidoso area. Many agencies, organizations and citizen group representatives on the CWPP Working Group have continued to collaboratively plan and implement fuel reduction treatments on the Ruidoso area properties they manage or own. Appendix A contains the maps of those other fuel reduction treatments. The working group unanimously agrees that the entire Perk-Grindstone landscape requires this additional fuel reduction work in order to satisfactorily reduce the chance of severe impacts from a high-intensity crown fire.

The demographic data indicate any project effects from implementation of either alternative 2 or alternative 3 would not disproportionately affect minorities or low-income groups. Therefore, these alternatives are in compliance with E.O. 12898.

Economic Benefits and Costs

Under alternatives 2 and 3, economic benefits would be derived from the potential timber volume that could be extracted from the thinning treatments. Table 39 shows the maximum estimated timber volume yield by alternative.

Table 39. Estimated Timber Volume Output by Alternative

Alternative	Volume CCF* (saw timber)	Volume CCF* (chips, pulp, biomass, fuelwood)
No Action	0	0
Alternative 2	7,640	10,189
Alternative 3	6,550	4,054

*CCF = hundreds of cubic feet

The employment and income benefits are associated with the direct, indirect and induced labor and wages. Tables 40 and 41 display the average annual job and income increases from baseline conditions associated with alternatives 2 and 3. The figures include the direct, indirect, and induced jobs and wages, as generated by the IMPLAN model previously described. All dollar values are in 2007 dollars.

Table 40. Employment and income (direct, indirect & induced) for alternative 2

Alternative 2	Employment (Jobs)	Employee Compensation ($-thousands)	Employee Comp/Job ($)	Labor Income ($-thousands)	Total Income ($-thousands)
Fuels projects and road construction/re construction	52	$1,193	$23,026	$1,549	$1,381
Timber	88	$1,559	$17,692	$2,472	$3,936
Totals	140	$2,752		$4,021	$5,317

Table 41. Employment and income (direct, indirect and induced) for alternative 3

Alternative 3	Employment (Jobs)	Employee Compensation ($ thousands)	Employee Comp/Job ($)	Labor Income ($ thousands)	Total Income ($ thousands)
Fuels projects and road construction/re construction	96	$2,216	$23,091	$2,877	$2,554
Timber	76	$1,337	$17,692	$2,220	$3,375
Totals	172	$3,553		$4,997	$5,929

-- Employment is the total number of wage, salaried, and self-employment jobs, including full-time and part-time workers.

-- Employee compensation includes the wages and salaries of workers who are paid by employers, as well as benefits such as health and life insurance, retirement payments, and non-cash compensation.

-- Labor income is the sum of employee compensation and proprietary income.

-- Total income is the sum of personal income and other property type income, such as rents, royalties, and dividends.

Under either action alternative, economic benefits would be associated with the gain of approximately $5.3 to 5.9 million in income from 140 to172 jobs. Under either alternative, the regional economy, assumed to be based primarily in Lincoln County, would experience a short-term expansion as a result of the proposed activities. Approximately 10,500 to 17,800 CCF of sawtimber and wood biomass would be offered, as well as several service contracts for slash treatment and other fuels reduction activities. Alternative 3 would yield slightly less wood volume but would provide slightly more jobs to complete the proposed treatment activities. It is likely that the timber would be purchased by local area logging contractors or wood products manufacturers. These local contractors would likely deliver products to local manufacturing facilities where it would be converted into building materials that are sold in the National market. Total jobs include those associated with road construction or reconstruction work and log hauling, in addition to thinning and other fuel treatment activities.

Of the $5.3 to 5.9 million in total income to the regional economy, approximately $2.8 to $3.6 million would accrue to wage earners (not including owners of businesses, i.e., proprietors) and $2.3 to $2.5 million to the owners of capital. Most commercial timber harvest and lumber processing jobs would be short term, over a 2- to 3-year period. The remaining fuel treatment activities to be conducted in the area, including processing or burning non-merchantable material, would occur for the duration of the project (up to 10 years).

Of the total number of direct and indirect jobs that would be generated by the proposed project, 65-70 percent would be non-manufacturing forest industry jobs, 12-16 percent would be forest product manufacturing jobs, and the remaining 14-23 percent would be in various retail and service industries. Income associated with those jobs would be distributed in those economic sectors in approximately the same proportions.

If some of the timber were processed outside the region, then some jobs and income would be shifted to areas outside Lincoln County. Also, some local wage earners may spend some of their

income on expensive items in larger cities outside Lincoln County, which would shift more of the income to other counties.

Estimates of timber and wood product volumes are considered maximum volumes that would be offered for utilization. Volumes may be lower due to the continuing amount of wood decay and tree mortality caused by ongoing insect and disease infestations in the project area. There is also a low demand for small diameter trees and white fir species that would make up the majority of the volume to be harvested from this area.

One of the greatest challenges to fuel reduction projects like this is the cost to treat and process a large number of small diameter trees. The least expensive treatment methods would be the burn-only treatments. However, only a small portion of the project area would be treated with the burn-only method due to the need to prevent crown fire behavior. The next, most cost-efficient methods would be those that mechanically cut trees and leave cut material in the forest, without attempting to utilize marginal volumes. Wood removal and transportation activities significantly increase per acre costs (U.S. Forest Service 2005).

The total estimated cost to implement alternatives 2 and 3 are: alternative 2 - $5.9 million and alternative 3 - $3.6 million.

Proposed thinning treatments have highly variable and complex costs, as there are many different activities associated with each alternative. Activities associated with each alternative are described in detail in chapter 2. Felling trees and harvesting logs under alternative 2 would cost a total of about $4.2 million, of which $2.8 million would be for the helicopter log removals. Alternative 3 would cost $1.9 million for the felling and harvesting actions, of which $ 0.5 million would be for manual and mastication methods that would generally replace the helicopter methods. The highest per acre cost in alternative 2 is the helicopter cost, averaging $289 per acre. The highest per acre cost in alternative 3 is the hand-thinning and mastication machine costs that would average $200 and $250 per acre respectively. For the two alternatives, road construction or reconstruction costs range from $140,000 to $238,000, and prescribed burning costs range from $857,000 to 991,000. There are numerous other treatment costs, including lopping and scattering slash, hand piling some slash, hauling logs and other wood material, creating landings, cleaning harvest equipment to remove potential invasive plants or seeds, rehabilitating skid trails and landings, closing and decommissioning roads, and other activities.

The $5.9 million cost of proposed activities under alternative 2 would exceed the funding anticipated to be available for this project, based on recent past, current and foreseeable future budget allocations for fuel reduction projects on the Lincoln National Forest. The forest would need to allocate over $1 million per year for the next 5 years to cover the cost of proposed activities, plus another $0.5 million per year to cover the Forest Service costs to implement either fuel reduction project alternative. The additional funds needed to cover Forest Service costs to implement the project include: funds for preparation, administration and monitoring activities, such as preparing contract packages; designing, surveying and marking the road locations, landing sites, skid trails, and treatment units; completing detailed silvicultural prescriptions; marking leave trees; completing burn plans and coordinating with the State; inspecting and administering commercial and service contracts; monitoring implementation and environmental effects; and other Agency activities. Other fuel reduction projects on the forest would also be utilizing portions of the total forest budget appropriation for fuel reduction projects. Therefore, funding would likely be limited during 1 or more years during the life of the project. If funding

limitations slow the progress of implementation, it would impede the Agency's ability to rapidly reduce the risk of a severe crown fire within this wildland-urban interface area. This situation is less likely to occur under alternative 3, which would require substantially less funding to implement.

Cumulative Effects

The area of consideration for cumulative effects of the action alternatives is Lincoln County, including the greater Ruidoso community area, because most of the social and economic effects discussed for this project would be expected to occur within this county.

In terms of social and environmental justice effects, because there would be no measurable direct or indirect effects to community services, or disproportionate adverse effects to minority or low-income populations as a result of either alternative 2 or 3, there would be no significant cumulative impacts from either alternative.

The contributions to employment and income in the county from other activities were previously displayed and discussed under "Affected Environment." As previously mentioned, the most significant economic activities and contributions are those related to the tourism industry. Project activities under alternative 2 or 3 would not have a measurable effect on the tourism industry in the area. No major change in recreation opportunities in the project area would occur as a result of implementing the project, as described in the "Recreation" section of this EIS.

Recent past, ongoing and planned fuel reduction projects would continue to occur on adjacent Mescalero-Apache Reservation lands and other Federal, State and private lands surrounding the project area. These are described and shown on maps in appendix A. These would cumulatively add to the employment and jobs expected in the forest industry sector of the economy. Cumulatively, these other actions would further add to the supply of wood products in the local area. It is possible that the large number of thinning projects and associated wood supply would result in diminishing the local demand for forest products by both harvest contractors and manufacturers over the next 10 years, based on the current local market. A lower demand for wood products in the local area would likely reduce the total jobs and income predicted to be generated by the proposed project.

Overall, the short-term increase in jobs and income would not have a significant effect on the local economy, even when considered cumulatively in addition to other forest products jobs and income. Tourism would continue to be the dominant industry in this economy. The other economic sectors would remain relatively unchanged regardless of the minor additive effects from this proposed fuel reduction project.

The action alternatives for this proposed project would not have any adverse economic impacts. Thus, there could be no cumulative adverse economic effects to the forest products economy. All direct, indirect and cumulative effects to the economy would be beneficial.

Other Effects Disclosures

Short-term Use and Long-term Productivity

All action alternatives would be consistent with mandates of the Multiple Use-Sustained Yield Act of 1960, which requires the Forest Service to manage National Forest System lands for

multiple uses including: timber, recreation, wildlife, range, and watershed. All renewable resources would continue to be available for use by future generations. Proposed thinning and prescribed burning to reduce stand densities would be a short-term use of a renewable resource with no long-term loss of site productivity.

The action alternatives would not have an adverse impact on long-term soil and vegetative productivity, through compliance with forest plan standards and guidelines and other required mitigation measures described in chapter 2. In fact, the analysis of effects on soil and vegetation indicates that long-term site productivity would be enhanced by proposed treatments, while protecting renewable resources from significant environmental damage. In the long term, ecosystem diversity and wildlife habitat diversity would also be maintained or improved, as described in the “Vegetation” and “Wildlife” sections. The analysis shows that the no action alternative “with crown fire” would likely result in a substantial amount of soil erosion and runoff, with an associated loss of long-term soil productivity.

Unavoidable Adverse Effects

Implementation of either of the action alternatives would result in some adverse environmental effects which cannot be entirely mitigated or avoided. The interdisciplinary team of resource specialists designed treatments to avoid or lessen any significant adverse impacts. In addition, best management practices, forest plan standards and guidelines, mitigation measures, and monitoring would be applied to further limit the extent, severity, and duration of any effects which were deemed unavoidable.

Unavoidable adverse effects from action alternatives would be of limited geographic extent and relatively short duration, generally within the project area, and for 2 to 5 years during the life of the project. In all cases, the effects would be within environmental standards established by law and regulation. Specific environmental effects were discussed earlier in this chapter, and are summarized as follows:

- There would be an increase in invasive plant species where soil is disturbed and exposed, although prevention measures, monitoring and control treatments would avoid any long-term increase in invasive plant populations.
- There would be wildlife disturbance effects from increased activity within the area, although effects would be short term and localized, and seasonal operating restrictions that cover nearly 50 percent of the project area would protect important breeding habitat.
- There would be a reduction in stand density and canopy cover in nesting/roosting habitat for Mexican spotted owl or northern goshawk. However, the increase in forest structure complexity, movement toward mature and old growth attributes, and mosaic of suitable nesting and foraging habitat would retain habitat quality for these species in the long term.
- There would be a slight increase in soil erosion and sediment production, although Agency standards and Clean Water Act standards would be met.
- There would be smoke production from prescribed burns that would be noticeable in the project area and Village of Ruidoso, although Agency and Clean Air Act standards would be met.

- There would be an altered scenic appearance of the landscape in the short term, due to evidence of tree stumps, scorched trees, blackened vegetation, and wider roads. In the long term, those effects would diminish and the area would appear more diverse, with an abundance of mature trees, ground vegetation, and improved views through the forested landscape.
- There would be a temporary reduction in recreation opportunities in the portions of the project area where thinning and burning activities occur, in order to protect public safety.
- There would be an increase in noise effects from thinning and road construction activities within portions of the project area, including those directly adjacent to residential properties.
- There would be some safety hazards to workers associated with activities such as tree cutting, harvesting, and log hauling, minimized by adherence to standard safety practices.

As described in the previous environmental consequences sections, unavoidable adverse impacts under the no action alternative “with crown fire” would be of much greater magnitude and duration. These include significant increases in all of the effects mentioned: invasive plant populations, wildlife disturbance impacts, losses of wildlife nesting and roosting habitat, soil erosion and sediment production, smoke production, scenic quality impacts, declines in recreation opportunities, noise effects from fire suppression and rehabilitation activities, and safety hazards to firefighters and the public. The amount of sediment production and smoke accumulation would likely exceed State and Federal standards for water quality and air quality.

Irreversible and Irretrievable Commitment of Resources

Irreversible commitments of resources are actions that would result in a permanent or long-term loss of non-renewable resources such as soil, water, or heritage resource sites. Irretrievable commitments are actions that would result in a long-term loss of productivity, or loss of an opportunity to use a resource.

The environmental consequences previously described indicate there would be no irreversible or irretrievable commitments of resources under the action alternatives. The amount of soil erosion expected would not result in a loss of long-term site productivity. Water quality in perennial streams or the reservoir that occur outside the project area would not be significantly degraded by proposed activities. Heritage resources would not be expected to be lost or damaged by proposed activities. The unavoidable adverse effects previously listed would not cause any major long-term loss of resource productivity, use or opportunity. Adherence to forest plan standards and guidelines and additional mitigation measures specified in chapter 2 provide reasonable assurances that there would be no irreversible or irretrievable commitments of resources from the action alternatives.

Under the no action alternative, without implementing fuel reduction treatments, the opportunity to restore fire-adapted ecosystems and a frequent, surface fire regime would be irretrievably lost. The forest structure, composition and fire-adapted ecological processes would continue to decline, as previously described in the analysis. Eventually, an uncharacteristically large and severe crown fire would burn through this area. There would also be an irretrievable loss of opportunity to produce merchantable wood products as a byproduct of the fuel reduction treatments.