United States Department of Agriculture

Environmental Assessment

Sulphur Forest Restoration Project

Sandia Ranger District, Cibola National Forest and National Grasslands, Bernalillo County, New Mexico

Forest Service

Southwestern Region

June 2014

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Chapter 1 – Purpose and Need

Document Structure

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four parts:

- Introduction: The section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- Alternatives, including the Proposed Action: This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes possible mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- Environmental Consequences: This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area. Within each section, the affected environment is described first, followed by the effects of the alternatives.
- Agencies and Persons Consulted: This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- Appendices: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Sandia Ranger District Office in Tijeras, New Mexico.

Background and Project Area

The Sulphur Forest Restoration Project area, located in Bernalillo County, begins directly south of Sandia Crest Highway (State Highway 536) and extends south to the Forest Boundary for approximately 3 miles in portions of Township 11 North, Range 5 East, sections 14, 15, 22, 23, 26 and 27 New Mexico Principal Meridian. The entire project area is approximately 1700 acres, but the total treatment area only 760 acres. The proposed location falls within the Sandia Ranger District of the Cibola National Forest, Management Area 2; it is located outside of the Sandia Mountain Wilderness and T'uf Shur Bien Preservation Trust area (see Figure 1 for project location). This is a forest restoration project.

Portions of the Sulphur Project area fall within a Wildland Urban Interface (WUI) (Figure 1). The WUI is commonly defined as the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels (Community Wildfire Protection Plan, pg.8). Experience has proven that losses of life, property, and infrastructure do not occur as readily in areas within the WUI where wildfire fuels are managed. The Forest Leadership Team and Sandia Ranger District recognize the need for restoration in the WUI. The East Mountain Community Wildfire Protection Plan (CWPP) identifies one Community Zone (Community Zone 2) that falls within the project boundary and describes Community Suggestions for Risk Reduction and Mitigations for this zone. Community suggestions for risk reduction and mitigation include chipping, thinning, and slash disposal (CWPP pg. 29). It was

determined that fuel reduction is a critical activity for reducing the risk of wildfire throughout the East Mountain area. The goal of fuel management is to preemptively modify wildfire behavior by altering the fuel complex (CWPP pg. 37).

High tree densities in the area have an ongoing potential for insect and disease outbreaks and increases in potential for uncharacteristic wildfire. On a majority of the project area fire no longer plays its natural role in maintaining ecosystem structure and function within the project area. The Sandia Mountains have been identified as high wildfire potential within the East Mountain Community Wildfire Protection Plan (CWPP). This can have a negative impact on the use and demand for recreation activities, fuel wood collection, and scenic quality within the Sandia RD and surrounding communities.

In addition to the land managed by the Sandia RD, numerous small communities adjacent to the project area are rated as moderate or high risk in the *2011 NM Communities at Risk Assessment Plan* (New Mexico Energy, Minerals and Natural Resources Department [NMEMNRD] 2011) and would benefit from the fuels reduction treatments being proposed. Two communities, Sandia Park and Canoncito, are within ½ mile of the Sulphur Project boundary and the community of San Antonito is 1 mile from the boundary (Figure 1).

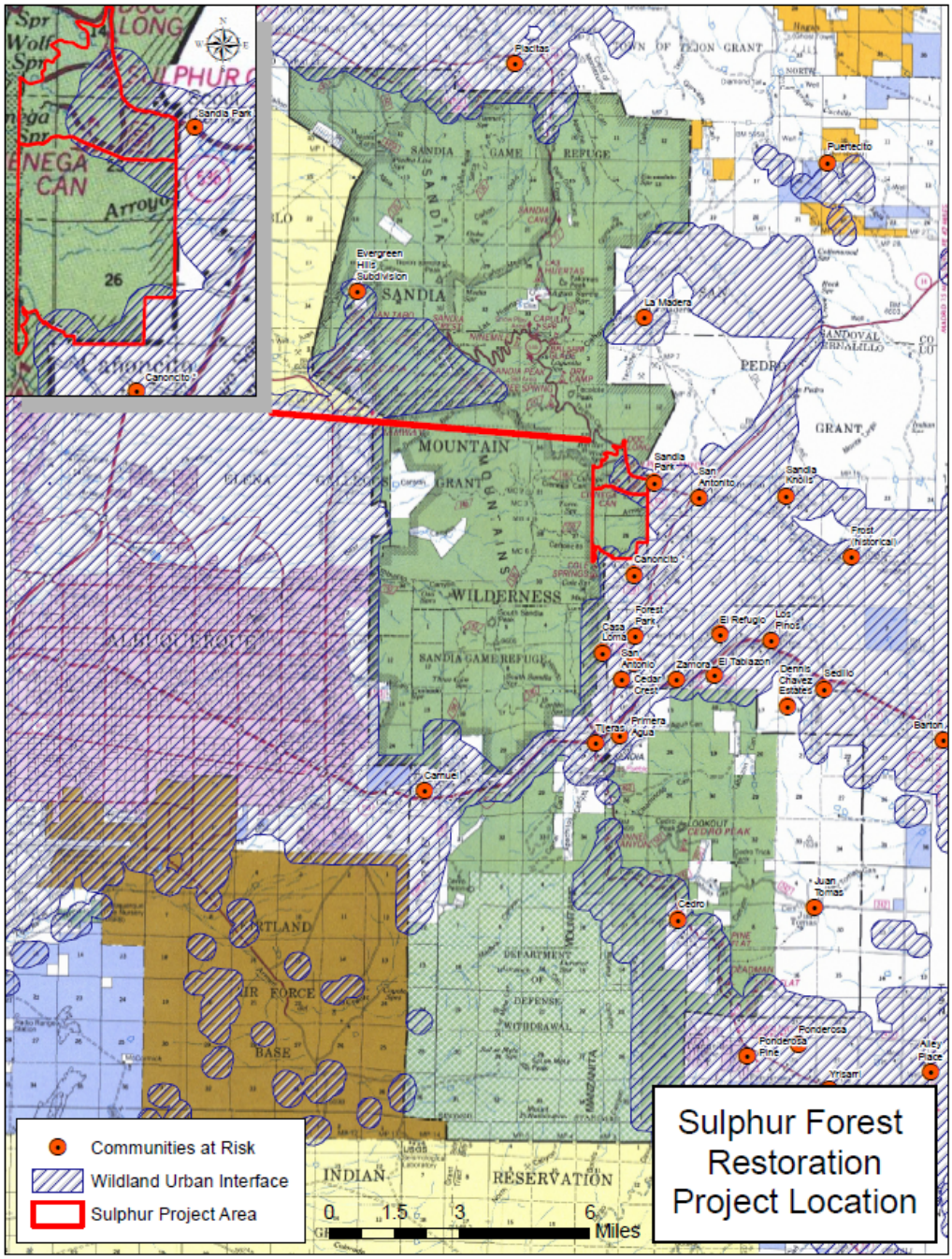

Figure 1 - Project Location Map

Purpose and Need For Action

The purpose of Sulphur Forest Restoration Project is to move the existing conditions in the project area towards the desired conditions outlined in the Cibola National Forest Land and Resource Management Plan (Forest Plan) of 1985.

The Sulphur project area consists of 1,677 non-wilderness acres along the eastern boundary of the Sandia Ranger District. According to the *1985 Amended Cibola National Forest Land and Resource*

Management Plan (Forest Plan), the entire project area lies within Management Area 2 - Sandia Ranger District, excluding Sandia Mountain wilderness and military withdrawals, "Management emphasis is on providing opportunities for a variety of year round recreational experiences consistent with guidelines established for maintaining viable wildlife populations and ecosystem health. Wildlife diversity and population viability will be maintained or improved through habitat management using such tools as prescribed fire, timber or firewood collection, or structural improvements to attain identified goals and objectives for the management area. Pinyon-juniper on slopes less than 15 percent will be managed for personal use firewood (page 84)." (Note: the slope refers to a sustained slope, not short, avoidable steeper pitches.)

This project is being planned and designed as a landscape restoration project. Existing conditions have been analyzed for all resource areas (vegetation, fire, wildlife, soils, hydrology, and recreation) and based on these conditions certain areas of the project have been determined to need restoration treatments. The objectives of the treatments are to restore forest health for resiliency to drought, insect and disease, and uncharacteristic wildfire. Treatments that promote an uneven-aged forest structure and mimic natural disturbance patterns will also increase wildlife and vegetation diversity and improve scenic quality. Improved forest health include an uneven aged stand structure for vegetation, properly functioning riparian areas in satisfactory conditions, a reduction of fuel ladders (vegetation that allows fire to climb into the tree canopy) to limit the severity of future fire events, enhanced watershed functions, and enhanced scenic quality e.g. enhancing views and spatial distribution of trees.

The Sulphur project originally developed out of the East Mountain Area Community Wildfire Protection Plan (CWPP) compiled in 2006 in response to the federal Healthy Forest Restoration Act (HFRA) of 2003. The CWPP states the following on pg. i:

"Wildland fire is a natural part of the environment in the East Mountain area near Albuquerque, New Mexico. It has assisted in developing the forests, woodlands, and grasslands valued by residents and visitors alike. These vegetative communities have been significantly altered by drought, infestation, suppression protocols, and encroachment, resulting in increased fuels and greater risk to humans and infrastructure. In addition, contemporary population growth has led to increased development close to the wildland urban interface and increased the number of residents and structures at risk from wildfire. To address these issues, a group of multijurisdictional agencies (federal, state, and local), organizations, and residents have completed an arduous and awarding process to develop the East Mountain Area Community Wildfire Protection Plan (CWPP).

The purpose of the East Mountain CWPP is to assist in protecting human life and reducing property loss due to wildfire in the communities of the East Mountains and the surrounding areas. Although reducing the risk of wildfire is the principal motivation behind the development of this CWPP, managing the lands for hazardous fuels and wildfire and the protection of individual homes by implementing Fire wise measures and defensible space are important components of the plan. Residents and visitors are interested in preserving the diversity and uniqueness of the forests and wildlands within the East Mountains to promote sustainability and maintain a valued way of life."

This project complies with Federal, State, and local laws or requirements for the protection of the environment.

The project will be implemented following a signed decision.

Existing Conditions

The project area is 1,677 acres. Due to differing wildlife restrictions across the project area and in order to ease impacts on recreation, the area is divided into Subunit A and Subunit B (see Figure 1). Subunit A is 504 acres and Subunit B is 1,173 acres. The project area does encompass one parcel of private land, but no treatments or other actions are being proposed on private land. The existing condition of each resource is described below:

Vegetation

The project area consists of Mixed Conifer, Pinyon and Juniper Woodland, and Ponderosa Pine vegetation types as well as riparian areas.

The following is a breakdown of existing condition by forest type in the project area (based on stand exam data):

Mixed Conifer - Subunit A consists of 179 acres and Subunit B consists of 502 acres of mixed conifer. Density of trees greater than 5" Diameter Breast Height (DBH) ranges from 180-640 trees per acre. In addition stands have an average of 3,261 trees less than 5" DBH per acre. Overall, canopy closure is 60%+. These areas are primarily even-aged lacking structural diversity.

Pinyon/Juniper Woodland - Subunit A consists of 221 acres and Subunit B consists of 322 acres of pinyon/juniper woodland. Total tree densities (trees greater than 5" diameter at root collar (DRC)) range from 128-485 trees per acre. In addition stands have an average 2,745 trees less than 5" DRC per acre. Overall, canopy closure is 60%+. Approximately half of this type is considered uneven-aged (three or more distinct age classes, either mixed or in groups). The remaining acreage is primarily even-aged lacking structural diversity.

Ponderosa Pine - Subunit A consists of 96 acres and Subunit B consists of 348 acres of ponderosa pine. Total tree densities (trees greater than 5" DBH) range from 183-396 trees per acre. In addition stands have an average of 2,614 trees less than 5" DBH per acre. Overall, canopy closure can be considered 60%+. These areas are primarily even-aged lacking structural diversity.

Riparian - Subunit A has approximately 7 acres of riparian area while Subunit B has no riparian. Total tree density is 440 trees per acre. Overall, canopy closure can be considered 48%. This area is primarily even-aged, dominated by native conifers and few riparian and native hardwood trees per acre.

Fire Management

Vegetation growth within the project area has been vigorous over the last several decades and has resulted in a dense overstory (i.e. high crown density). This dense overstory, combined with the exclusion of wildfire for over a century and dry climate conditions, has resulted in fuel conditions that favor high intensity wildfire with unpredictable behavior. Portions of the project area have been previously treated to reduce fuel loading and protect nearby property in the event of an uncharacteristic wildfire (1995 Cienega Picnic Area Fuel break and 2002 Armijo Fuel break). However, these projects were not maintained and their effectiveness has been compromised due to vigorous spouting of Gamble oak and juniper as well as needle cast. All of the fuel breaks are in need of maintenance.

There is the risk of fire moving into <u>or</u> out of the adjacent forested communities of Tejano Canyon, Mountain Ranch, San Antonito, Sandia Park, Quelles, Piñon Ridge, Cholla Crest, La Madera, Sandia Knolls, and Pine Top Acres.

Wildlife

Landscapes in the proposed project area are currently managed for either the northern Goshawk or the Mexican spotted owl, as described in the Cibola National Forest Land and Resource Management Plan (Forest Plan, as amended in 1996). For the Northern goshawk, landscapes are either inside or outside Post Fledgling Areas (PFA's), which also include six goshawk nest areas. Mexican Spotted Owl (MSO) habitat in the proposed project area include Recovery Habitat (formerly known as Restricted Habitat) consisting of mixed conifer and minor amounts of riparian habitat.

Approximately 700 acres of Subunit B are managed Goshawk PFA's, while all of Subunit A's 504 acres lie outside goshawk PFA's. Six Goshawk nesting sites, totaling approximately 180 acres, most with recent activity, are located within Subunit A. There are approximately 680 acres of MSO Recovery habitat scattered in patches throughout the entire project area.

Watershed

The project area covers portions of two watersheds, the Headwaters San Pedro Creek and the Upper Tijeras Arroyo watersheds. Both of these watersheds have a risk rating of 2 as determined by the Watershed Condition Framework (WCF) (FS-977). Watershed condition is the state of the physical and biological characteristics and processes within the watershed that affect the soil and hydrologic functions supporting aquatic ecosystems. A rating of 2 indicates that these watersheds are functioning at risk, as opposed to functioning properly or impaired. Watershed condition reflects a range of variability from natural pristine (functioning properly) to degraded (severely altered state or impaired). In general, the greater the departure from the natural pristine state, the more impaired the watershed condition is likely to be. A fully functioning watershed receives a rating of 1, or healthy, while a severely impaired watershed receives a rating of 3, or poor.

Three developed recreation sites, developed trails, and multiple user created trails have contributed to the degradation of the watershed condition. There is a major riparian (streamside) area along Cienega Canyon and minor areas in Arroyo Armijo and Canoncito. Much of the Canoncito riparian area is a heavily used summer day-use recreation site with trail heads. The other riparian areas have trail-based dispersed-recreation use. Erosion into the riparian areas is present due to portions of the Armijo Trail being located inside Armijo Canyon, as well as multiple user-created trails in the area. Erosion into the riparian areas of Canoncito is also being caused by the location of the Canoncito Trail within the arroyo (see images on pg. 93).

Recreation

Cienega's trailheads provide the only immediate general-public access to the trails. Many adjacent landowners have private access through gates in the Forest boundary fence. In the event of a wildfire, there is only limited access provided for public and emergency personnel safety to and from the project area. There is currently nothing in place (aka. a gate) that will allow the Forest to completely close off the Cienega/Sulphur Picnic Areas for fire activity. The areas immediately surrounding the recreation sites are heavily wooded with fuel material.

Desired Condition

Vegetation

Overall, the objectives of individual tree selection will be for wildlife habitat improvements, fuels reduction, and visual resource enhancement, with secondary benefits of providing firewood to the Albuquerque Metropolitan area (Forest Plan, pg. 88).

Ponderosa Pine and Pinyon/Juniper

Within the Ponderosa Pine and Pinyon/Juniper (P/J) forest types, the desired condition is Goshawk habitat that is consistent with the Northern Goshawk guidelines (Forest Plan, page 71-5; Management Recommendations for the Northern Goshawk in the Southwestern United States, General Technical Report RM-217. 1992).

Overall, the desired conditions include:

- managing for uneven-age stand conditions for live trees to include tree groups and openings
- retaining live reserve trees, snags (2/acre), large downed logs (3/acre), and woody debris levels (5-7 tons/acre) throughout woodland, ponderosa pine, mixed conifer and spruce-fir forest cover types
- managing for old age trees such that as much old forest structure as possible is sustained over time across the landscape
- sustaining a mosaic of vegetation densities, age classes, canopy gaps and species composition across the landscape
- maintaining a range of Vegetation Structural Stages ("VSS", or growth stages of living trees) - treatments will strive to achieve, over time, a VSS distribution of 10% VSS 1 (grasses, forbs, and shrubs); 10% VSS 2 (seedlings and saplings); 20% VSS 3 (young forest); 20% VSS 4 (mid-aged forest); 20% VSS 5 (mature forest); and 20% VSS 6 (old forest) across the landscape.
- within Goshawk Post Fledgling Family areas (PFAs) and dispersal PFAs residual trees per acre (TPA) and canopy cover will be slightly higher due to habitat needs compared to Foraging areas (lands outside PFAs).
- Nest areas will consist of a minimum 30-40 TPA in a size class distribution of VSS 5 and/or 6.
- On 20% of the 3,900 ponderosa pine acres (approximately 780 acres) and 20% of 2,600 P/J acres (approximately 520 acres) the desired condition will be to develop and maintain old growth conditions as defined in the Forest Plan, Forest Wide Standards and Guidelines, pg. 66, Table "The Minimum Criteria for the Structural Attribute Used to Determine Old Growth" These areas will be designated during the environmental analysis process.
- Temporary openings, for regeneration purposes, up to four acres with a maximum width of 200 feet exist on approximately 10% of the area. Three to five reserve trees per acre are maintained in these openings. Two large snags and three large logs per acre exist. Five to seven tons of woody debris is retained.

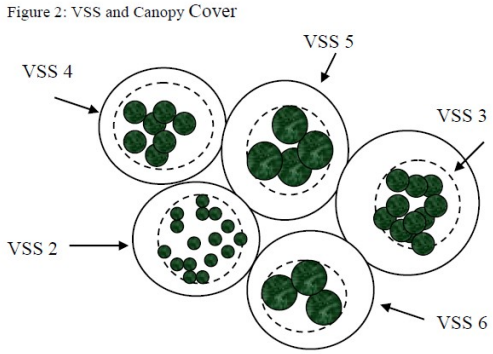

Figure 2 – Vegetation Structural Stage & Canopy Cover

The above diagram, from Center for Biological Diversity, shows different VSS class groups and general numbers of trees per group required to meet canopy cover requirements. Generally, smaller VSS size class groups should contain more trees per 1/10th acre equivalent.

(Please note: this desired condition is not in compliance with the Forest Plan in all areas, so the Proposed Action and resulting implementation do NOT follow this prescription completely.)

Mixed Conifer

The desired condition of the Mixed Conifer forest type is consistent with requirements set forth for Management Area 2 in the Forest Plan, with twenty percent (20%) maintained as threshold conditions for Mexican Spotted Owl restricted habitat as stated in the Forest Plan on page 71-2 and 71-3.

Densities within the mixed conifer forest type will be approximately 90-115 trees per acre. Approximately 10% of this forest type exists as temporary openings for recruitment of the VSS 1 and 2 structural stages. Canopy cover within this forest type will remain intact except for the temporary openings. 132 acres (20%) will be maintained for MSO threshold conditions. (See Figure 3)

Riparian

Aquatic Resource:

- Shade: Shading over perennial and intermittent water surfaces that are at least 80 percent of natural levels.
- Bank Cover: Natural bank protection of at least 80 percent of natural levels. Stream bank stability provided by woody plant roots, particularly on outside bends of stream channel meanders.
- Streambed Sedimentation: Composition of sand, silt, and clays within streambeds should not exceed 20 percent of natural levels.
- Habitat: Aquatic pools are wet for longer periods of time to provide persistent habitat for aquatic species
- Riparian areas will be in properly functioning condition

Vegetation Resource (where site is capable of supporting woody plants):

- Species Composition: 60 percent of woody plant composition in three or more riparian species or as appropriate for the site.
- Plant Structure: Three age classes of riparian woody plants with at least 10 percent of the woody plant cover in the sprout seedling and sapling stages and 10 percent in the mature and over-mature.
- Crown Cover: Both trees and shrubs that is at least 60 percent of natural levels

Fire Management

According to the Forest Plan of 1986, the goal of Fire Management is to provide a fire management program in cooperation with other agencies that allows a reasonable level of fire protection to reduce fire hazards and risks, prevent loss of life and property, minimize resource losses, and support other resource objectives (pg. 34). Over time, multiple treatments are needed to create conditions for safely reintroducing fire into the National Forest. This is due to the nearly total exclusion of fire for a century or more. A return to the more natural fire regime will reduce the potential for high intensity stand-replacement fire inside or outside of the Forest. In turn, this will allow continued protection of the habitat of any threatened, endangered, and sensitive wildlife species in the Forest.

Wildlife

The desired condition of Mexican Spotted Owl (MSO) habitat is consistent with the Forest Plan, to provide three levels of habitat management – protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (Forest Plan, pg. 71). The project area

includes MSO Restricted areas, which are all mixed-conifer and riparian forest outside of delineated protected areas. In these areas, forest direction is to manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species (Forest Plan, pg. 71-2). A minimal percentage (10%) of restricted area should be managed to have nest/roost characteristics. The western portion of the project area (Treatment 7) has been designated to meet the MSO threshold conditions and will not be treated.

The desired condition of northern goshawk habitat is consistent with the Forest Plan (Forest Plan, pg. 71-5). "Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer and spruce-fir forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Sustain a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape. Provide foods and cover for goshawk prey. Limit human activity in nesting areas during the breeding season. Manage the ground surface layer to maintain satisfactory soil conditions i.e. to maintain soil compaction; and to maintain hydrologic and nutrient cycles."

Watershed

The overall goal of watershed management on the forest is to manage roads to obliterate poorly located or constructed roadways to improve watershed condition and reduce soil loss (Forest Plan, pg. 92).

The specific desired condition of the two affected watersheds is a WCF score of 1, Functioning Properly (Watershed Condition Framework, FS-977). Watersheds that are functioning properly have terrestrial, riparian, and aquatic ecosystems that capture, store, and release water, sediment, wood, and nutrients within their range of natural variability for these processes. When watersheds are functioning properly, they create and sustain functional terrestrial, riparian, aquatic, and wetland habitats that are capable of supporting diverse populations of native aquatic- and riparian-dependent species.

The desired conditions of the riparian areas are consistent with the Forest Plan. Riparian areas in moderately high and high condition will be maintained or improved. Areas in low and moderately low condition will be treated. The Forest Plan includes direction to emphasize protection and improvement projects for riparian areas (pg. 33).

Recreation and Scenery Management

The desired conditions for recreation and scenery management are consistent with the Forest Plan (pgs. 33, 58-61 and 85-88):

- Provide high quality picnic grounds with adjacent trail opportunities, sufficient screening, reduced overhead hazards, and a vibrant uneven-aged forest canopy.
- Provide outstanding opportunities to drive for pleasure specifically along designated Scenic Byways.
- Provide non-motorized trail system that includes a broad spectrum of opportunities while also enhancing resource protection through improved trail design and location while discouraging use and creation of unauthorized trails.
- Provide the highest possible quality wilderness experience given the challenges of providing such an opportunity in close proximity to an urban environment.
- Provide for a variety of visual quality objectives (VQOs) across the Sulphur project landscape.

Proposed Action

This project proposes to apply treatments to five different resource areas (vegetation, fire management, wildlife, watershed, and recreation) in order to accomplish forest restoration. The main points of the proposed action are listed below (see Chapter 2 for a detailed description of the proposed actions).

Vegetation

- Existing condition for both Ponderosa pine and P/J woodland is deficient of trees greater than 16" at breast height and diameter at root collar
- Will not cut any trees over this diameter

P/J Woodland

- Management will be to create or maintain uneven aged stands while maintaining large trees consistent with uneven aged stand conditions.

Ponderosa Pine

- A "Group Selection" treatment (where trees are removed and new age classes are established in small groups; also, where regeneration, growth and yield are regulated in an aggregation of groups) will be implemented.

Mixed Conifer

- Treatment will promote an uneven-aged forest structure with native species diversity and natural variation retaining all age classes and sizes based on the Cibola Forest Plan (pg. 71-2).

Riparian

- Designated native conifers and nonnative (invasive) species will be thinned.
- Treatments will create and/or enhance riparian features such as downed logs and bank stability.

Subunit B

- Only mastication, hand individual tree selection, and prescribed burning will be carried out on the P/J in this area.
- All other habitat types will not be treated.
- 7 different implementation methods will be applied within each habitat type (see Table 1)
- Attributes such as stand location, soil condition, and slope went into the selection of Methods.

Fire Management

- Vegetation treatments described above are needed to reduce the severity of future wildland fires by reducing fuel ladders.
- Portions of the Faulty Trail that are located within project area will be used as an additional fuel break.
- Additional hand line construction that will vary in width from 1-5 feet.

Wildlife

- The vegetation treatments described above take into account wildlife needs and standards.
- Cutting prescriptions for each stand will follow the Forest Plan.
- An uneven-aged management technique will be applied, consisting of individual tree selection in the nesting areas, and will continue for another 100-200 years with cutting every 20 years.
- Individual tree selection activities will be avoided during the Goshawk nesting season, March 1st – September 30th, when they occur within the PFA.
- 20% (136 acres) of the project area will not be treated and maintained for threshold conditions for Mexican Spotted Owl restricted habitat.

Watershed

- A portion of the Canoncito Trail is poorly located and is significantly contributing to sediment in the drainage, as well as damage to the limestone terraces.
- This section of trail will be relocated approximately 50-100 feet up the hillside (Figure 3).
- Former cross country travel corridors will be rehabilitated
- A number of unauthorized (non-system) trails will be decommissioned.

Recreation

- Treatments in recreation areas will maintain or enhance scenic quality and retain a variety of age classes in addition to fuel treatments.
- Thinning prescriptions will consider maintaining shade and screening around picnic tables
- An additional gate will be constructed at the front of Cienega/Sulphur Picnic Area in order to allow closure of the entire area in case of wildland fire.
- Portions of the Faulty Trail and Canoncito Trail will be rerouted in order to bring them out of the Wilderness land and to mitigate current resource damage.

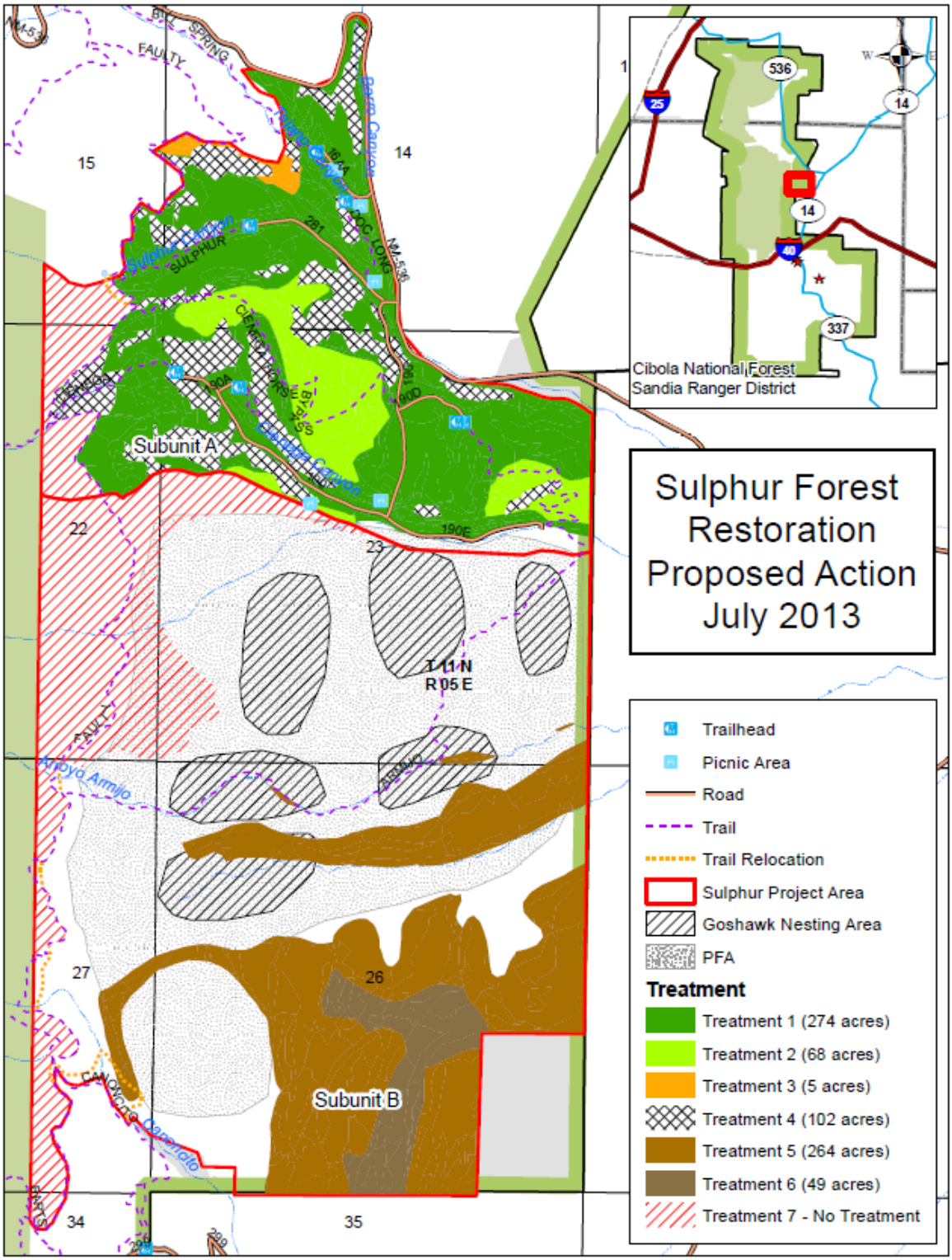

Figure 3 - Proposed Action

Decision Framework

Given the purpose and need, the deciding official reviews the environmental consequences of the proposed action and the other alternatives in order to make the following decisions:

- Whether to implement the proposed action
- Whether to implement an alternative to the proposed action
- Whether to take no action

Public Involvement

Public Scoping

The proposal was first listed in the Schedule of Proposed Actions on January 18, 2013. The proposal was provided to the public and other agencies for comment during scoping between the dates of January 18, 2013 to February 20, 2013. Comments received during scoping were used to develop a list of issues and these issues helped guide the development of alternatives.

Contemporary American Indian Uses

The Cibola National Forest routinely consults with fourteen American Indian tribes that may have used or may continue to use the Sandia Ranger District lands for traditional cultural or religious activities, and that might attach religious or cultural significance to properties within the Sandia Mountains.

The Sandia Mountains hold considerable cultural significance for many of the area tribes, including the Navajo Nation, the western Pueblos of Acoma, Laguna, and Zuni, many of the Rio Grande and northern Tewa Pueblos, and the Jicarilla Apache Nation. These mountains have long standing and ongoing historical, cultural, religious importance for these tribes. All consider the mountains to be sacred, and some acknowledge and have identified specific sites of traditional cultural and religious significance in the mountains.

The Sandia Mountains are a place where tribes continue to perform ceremonial activities in accordance with traditional cultural practices that are essential in maintaining their cultural identity and the continuity of their culture. The mountains are used by many of the area tribes for a variety of traditional cultural and religious activities such as hunting, traditional plant and mineral gathering, religious pilgrimages, accessing springs, and as a place for special offerings.

Tribal Consultation

Consultation pursuant to Section 106 of the National Historic Preservation Act was initiated in 2010 when the Forest included the Sulphur Fuels Reduction project in its list of proposed projects that was sent to the tribes in February 2010. Scoping pursuant to NEPA was also initiated in 2010.While the name of the proposed project has been changed, and the intent has evolved from fuels reduction to forest restoration, the elements of the project are the same as was shared with the tribes in 2010. Follow up consultation meetings were held from May through September of 2010 with the Pueblos of Isleta, Sandia, Santo Domingo, Zia, Santa Ana, Jemez, and Zuni, as well as the Navajo Nation and the Jicarilla Apache. None expressed concern about the proposed project. Scoping was done again in 2013 for the current project and no tribal comments were received. To date, no historic properties of religious and cultural significance to an Indian tribe have been identified within or near the proposed project area.

Issues

Through scoping, the Interdisciplinary Team identified the following issues:

- The construction of temporary roads causes some watershed concerns. Portions of the proposed temporary roads are located on soils with moderate to severe erosion hazard ratings or impaired or unsatisfactory soil conditions. In addition, new water crossings associated with the temporary road will be areas of disturbance and may affect the stream conditions.
- No substantive issues were raised by the public. Scoping comments were received but no issues were raised.

Chapter 2 – Alternatives

This section describes the alternatives that have been considered in the development of this EA. The No Action alternative must always be considered in the EA process. An EA often addresses one or more "action" alternatives; in this case, one action alternative is presented.

Alterative A – No Action

Under the No Action alternative, the current level of management would continue to guide management of the project area. No treatments would be implemented to address existing vegetation, fuels, wildlife, watershed, or recreation concerns. Suppression of wildfire would continue. Previously created fuel breaks would not be maintained and no new fuel breaks would be created. Closer compliance with Goshawk Guidelines would not be accomplished. Riparian habitat types would not be enhanced. Trails would not be relocated or decommissioned, inviting mountain bike trespass into the wilderness area via the Faulty Trail. Additionally, no watershed enhancement would occur.

The No Action alternative would fail to address purpose and need of the project, to move the existing conditions in the project area towards the desired conditions outlined in the *1985 Amended Cibola National Forest Land and Resource Management Plan* (Forest Plan).

Alternative B – Proposed Action

Due to issues identified during internal and external scoping, the Proposed Action has been changed since USFS public scoping. The following are the changes:

- The location of Subunits A and B have been reversed.
- Treatments have been limited within Subunit B and these altered treatment descriptions have been added to the table.
- Treatments within Pinyon-Juniper areas will be to create or maintain uneven aged stands, not group selection.
- Within the piñon-juniper woodland and ponderosa pine forest types, permanent openings <u>would not</u> be created.
- Within the mixed conifer forest type, retain 10-15 tons (instead of 5-7) of downed woody material per acre.
- Maintenance treatments to the two Fuel breaks in the project area will not be carried out.
- The Canoncito Trail reroute has been adjusted for further resource protection.
- The Armijo Trail will not be obliterated or rerouted.
- Temporary roads will not be constructed for this project.

This project proposes to apply treatments to five different resource areas (vegetation, fire management, wildlife, watershed, and recreation) in order to accomplish forest restoration.

Vegetation

Specific vegetation treatments have been proposed for each habitat type in the project area in order to move the condition of the area towards the desired condition.

The existing condition for both ponderosa pine and P/J woodland is deficient of trees greater than 16" diameter at breast height (DBH) and diameter at root collar (DRC). This project proposes to not cut any trees over this diameter to assist in moving the area to desired condition.

To move these stands toward the desired condition as described above; an uneven-aged (where trees are found in three or more distinct age classes, either intimately mixed or in small groups) silvicultural system will be used. All treatment areas may be entered multiple times to meet the desired conditions described above. Prescribed fire would be the primary maintenance tool used to reduce tree densities and undesirable tree regeneration and promote grasses and forbs.

Pinyon-Juniper Treatments

Management will be to create or maintain uneven aged stands while maintaining large trees consistent with uneven aged stand conditions.

Designated trees will be thinned from below to a residual of 55 - 92 trees per acre (TPA) on lands outside PFAs, 119-138 TPA in PFAs and in Nesting Areas. All large alligator juniper is preferred for retention. Maintain the relative abundance of P/J within the groups so that one species is not favored above another for removal. For example if the area originally had 70% pinyon pine and 30% juniper, after thinning the same ratio will exist.

Ponderosa pine, white fir, and Douglas fir occurring in pinyon-juniper woodlands will be maintained as groups or stringers as appropriate to meet wildlife habitat improvement objectives.

On average at least two snags and 5-7 tons of down woody debris per acre (including large downed logs) will be retained.

Individual tree selection will be accomplished by hand, with mechanized equipment, and/or mastication. Personal-use fuel wood permits and Stewardship Project contracts will be offered to remove the wood. The only product that will be available for removal is firewood, small diameter poles, and woodchips. There is no corporate industry or large scale sawmills in the area. All products will be low value and the removal of said product is secondary to the purpose and need of the project.

Ponderosa Pine Treatments

Establish groups of trees with interlocking crowns, typically 0.25 to 0.75 acres in size but ranging from a few trees to 2 acres. Create temporary openings for regeneration purposes, up to four acres with a maximum width of 200 feet on approximately 10% of the area. Three to five reserve trees per acre are maintained in these openings. Locate temporary openings away from roads and system trails to maintain visual corridors and provide wildlife security.

Within groups designated trees will be thinned from below to a residual of 73-110 trees per acre (TPA) on lands outside PFAs, and 119-138 TPA in PFAs and in Nesting Areas. All large alligator juniper is preferred for retention. On average at least two snags and 5-7 tons of downed woody debris per acre (including 3 large logs per acre) will be retained.

Individual tree selection will be accomplished by mechanized harvesting equipment, by hand, and/or mastication.

Personal-use fuel wood permits and Stewardship Project contracts will be offered to remove the wood. The only product that will be available for removal is firewood, small diameter poles, and woodchips. There is no corporate industry or large scale sawmills in the area. All products will be low value and the removal of said product is secondary to the purpose and need of the project.

Mixed Conifer

Promote an uneven-aged forest structure with native species diversity and natural variation by retaining all age classes and sizes (Forest Plan page 71-2). All large trees over 16” DBH or DRC will be retained.

Individually select trees up to 15.9” DBH or DRC and retain trees to a residual of 90-115 TPA, including up to 10% of trees with dead tops, decadence, and/or irregular crowns to provide habitat for a variety of prey species. Retain all large oaks and native deciduous hardwoods (10” DRC and greater) and promote natural regeneration by removing competing conifers. Existing patches of snags will not be treated unless determined to be hazard trees. Mimic natural disturbance patterns on up to 10% of 149 acres to provide spatial heterogeneity and horizontal variation by creating temporary openings that range from 1/10th of an acre to ¼ of an acre in size. Retain key habitat components such as on average at least 2 snags and 10-15 tons of downed woody debris per acre.

Riparian

Individual tree selection of designated native conifers and non-native invasive plant species would occur on seven acres around the intersection of National Forest System Road 190 and 190A. Trees would be removed by hand; no motorized equipment would be allowed within 300 feet of the stream channel. Treatments would create and/or enhance riparian features such as downed logs and bank stability to provide for wildlife habitat and a functioning riparian area. Key habitat components would be retained, including at least 2 snags per acre and 10-15 tons of downed woody debris per acre.

Subunit B

As there is no motorized access to Subunit B, other than cross-country travel, only mastication, hand individual tree selection, and prescribed burning will be carried out in this area. All of the Pinyon-Juniper will be masticated, hand thinned, and/or burned, following the same silvicultural prescription as described above. An area of P/J and Ponderosa Pine transition zone will also be treated (see Figure 3). The P/J portions (the midstory of the Ponderosa) will be treated with mastication, hand individual tree selection, and/or prescribed burning. The other habitat types will not be treated. Fuel wood removal will not be permitted in this area.

Project Implementation Methods

Seven different project implementation methods will be applied within each habitat type (see Table 1). The Forest Silviculturist has delineated “stands” on aerial photographs to help determine treatment methods. (Stands are a collection of trees of similar size, species, and health and at least 10 acres but usually less than 100 acres in this Area.) Many attributes went into the selection of these methods, including: stand location, soil condition, and slope.

Table 1 – Proposed Vegetation Treatment Methods to meet the Desired Condition for each Forest Type (see Figure 3 for locations)

Treatment Type	Cutting Methods How will excess trees be cut or otherwise handled?	Tree Removal Will cut trees be removed from the areas?	Slash Treatment What happens to tree tops and other material that remains on the site after cutting?
1 – satisfactory soils, less than 40% slope (274 acres)	Mechanical mastication	None where mastication occurs	Masticated material would be spread on site to a depth of 0”-4”, other cut material lopped and scattered to a depth of 18” max. Hand piles may be created where needed and piles will not exceed 10’x10’ Broadcast burning and/or pile burning when management prescription conditions are met.
	Chainsaws – contract or Forest Service Mechanized feller	Where good access exists, material removed under permits for personal use firewood and Stewardship Project contracts. No cross country travel permitted where erosion hazard is severe.	
2 - impaired soils with less than 40% slope (68 acres)	Mechanical mastication	None where mastication occurs	Masticated material would be spread on site to a depth of 0”-4”, other cut material lopped and scattered to a depth of 18” max. Hand piles may be created where needed and piles will not exceed 10’x10’ Broadcast burning and/or pile burning when management prescription conditions are met.
	Chainsaws – contract or Forest Service Mechanized feller	Personal use firewood permits and Stewardship Project contracts.	
3 - unsatisfactory soils with less than 40% slope (5 acres)	Treatments based on the needs to enhance or maintain the soil condition – mechanized feller, hand felling, or no cutting	None	Cut material will be lopped and scattered to a depth of 18” max. Hand piles may be created where needed and piles will not exceed 10’x10’ Broadcast burning and/or pile burning when management prescription conditions are met.
4 – all soils with greater than 40% slope (102 acres)	Only hand cutting with chainsaws. Some areas will not be cut.	None	Cut material will be lopped and scattered to a depth of 18” max. Hand piles may be created where needed and piles will not exceed 10’x10’ Broadcast burning and/or pile burning when management prescription conditions are met.
5 – P/J habitat type in Subunit B (264 acres)	Mechanical mastication or hand cutting	None	Masticated material would be spread on site to a depth of 0”-4”. Broadcast burning when management prescription conditions are met.
6 – P/J and Ponderosa Pine transition zone in Subunit B (49 acres)	Mechanical mastication or hand cutting	None	Masticated material would be spread on site to a depth of 0”-4”. Broadcast burning when management prescription conditions are met.

7 – no treatment areas – mixed conifer set aside for Mexican Spotted Owl restricted habitat (215 acres)	None	None	None

For location of treatment types as described in the table, refer to Sulphur Forest Restoration Proposed Action Map (Figure 3).

Slash Disposal

Activity fuel such as bole wood, slash, hand piles, and mastication grindings would be treated as needed to meet fuels reduction and scenic quality objectives through prescribed burning and/or pile burning when conditions allow for safe and effective burning. All prescribed burning would comply with Bernalillo County air quality regulations and will be approved through appropriate permitting processes.

Receipts from Firewood Sales

Dollars generated from the sale of the collected material and fuel wood permits will be retained by the Forest Service under authority in the Knutson-Vandenberg Act of 1930 (KV) for rehabilitation activities. The rehabilitation activities could include: 1) decommissioning of unauthorized roads within the project area by ripping compacted soils, installing erosion control features, seeding the impacted areas with native grasses and using slash to cover impacted corridors to 80% coverage, 2) rehabilitating cross country travel corridors by ripping compacted soils, installing erosion control features, seeding the impacted areas with native grasses and using slash to cover impacted corridors to 80% coverage, 3) hand piling slash where needed to provide for manageable prescribed fire conditions, 4) lopping and scattering slash not collected through fuel wood gathering to 18”maximum height, 5) non-chemical treatment of noxious weeds that may have been introduced as a result of restoration activities, and 6) conducting individual tree selection within the project area.

Fire Management

The vegetation treatments described above are needed to reduce the severity of future wildland fires in the area by reducing “fuel ladders” (brush or small “understory” trees that allow surface fire to climb into the foliage of larger “overstory” trees). Additional treatments are also needed to create or maintain an environment for safer fire suppression.

The portions of the Faulty Trail that are located within the project area will also be used as a fuel break (See Figure 3). No treatments will be applied to and no product removal will occur in the irregular (0-1200’) strip of land between the Faulty Trail and the Wilderness boundary. Removal of forest product east of Faulty will not involve crossing the trail.

Some additional hand line construction will also be necessary. These hand lines will vary in width from 1 foot to 5 feet, depending on the surrounding vegetation and topography, and will be dug down to unburnable soil. Hand dug control lines will not be intended for Forest visitor use, and will be rehabilitated once the unit was burned. Rehabilitation work on these hand lines could include seeding, water barring, or piling woody material on the hand line.

Wildlife

The vegetation treatments described above take into account wildlife needs and standards. Cutting prescriptions for each stand will follow the Forest Plan and allow for closer compliance with Northern Goshawk guidelines. Nesting areas will be “thinned from below,” i.e., taking smaller or damaged trees, to improve vigor and size of the remaining trees. This is an “uneven-aged management” technique which will continue for another 100 to 200 years, with cutting about every 20 years.

Twenty percent (136 acres) of the mixed conifer in the project area will not be treated and maintained for threshold conditions for Mexican Spotted Owl restricted habitat. The Goshawk nesting season is March 1 to September 30th each year and individual tree selection activities will be avoided during that time period when they occur in the PFA.

Watershed

Rehabilitation activities will be carried out in the project area in order to move the two associated watersheds towards the desired condition of Functioning Properly.

A portion of the Canoncito Trail is poorly located and significantly contributing to sediment in the drainage as well as damage to the limestone terraces. This section of trail will be relocated approximately 50-100 feet up the hillside (see Figure 3). The new location is a much more sustainable location.

Until recently, cross-country travel has been allowed on all parts of the Forest. The recent Travel Management Rule (36 CFR 212, Subpart B) limits this method of travel. Former cross-country travel corridors will be rehabilitated by ripping compacted soils, installing erosion control features, seeding the impacted areas with native grasses, and using slash to cover impacted corridors to 80% coverage.

A number of unauthorized trails exist within subunit B of the project area and are causing resource damage. Unauthorized trails will be obliterated through ripping compacted soils, installing erosion control features, seeding the impacted areas with native grasses, and using slash to cover impacted corridors.

Recreation

Treatments in recreation areas will maintain or enhance scenic quality and retain a variety of age classes in addition to fuels treatments. When developing prescriptions, maintaining shade and screening around picnic tables will be considered. Mitigation will include keeping stump heights to below six inches, and considering options to reduce slash such as chipping and scattering.

The area in and around Cienega Picnic Area will be treated first. 63 acres (1/4 mile around the picnic area) will be thinned and most wood will be removed from the site. An additional gate will be constructed at the front of Cienega/Sulphur Picnic Area. This gate will be utilized during burns to close off the entire area.

Portions of the Faulty Trail and Canoncito Trail will be rerouted (See Figure 3). Two sections of the Faulty Trail run through the Wilderness. These sections will be rerouted to run along the Wilderness boundary, adhering to USFS specifications ((trail class II-pack & saddle) FSH 2309.18, sec. 14.2, ex. 01)). Three sections of the Faulty Trail are poorly located and are causing resource damage. These sections will be rerouted. A section of the Canoncito trail is also causing resource damage and will be rerouted as described above in the Watershed section. The old trail sections will be decommissioned through ripping compacted soils, installing erosion control features, seeding the impacted areas with native grasses, and using slash to cover impacted corridors.

Additional Project Design Features

Mitigation measures were developed to ease some of the potential impacts the action alternative may cause. Monitoring would be conducted for all resources to ensure that mitigation measures are effective.

Soils/watershed

- Utilize Best Management Practices (BMP's) outlined in the Forest Service Soil and Water Conservation Practices Handbook (FSH 2509.22) and further described in the BMP appendix to the Soil and Watershed specialist report to limit impacts on watershed, soil, and riparian resources.
- Do not allow pile placement or jackpot burning (igniting concentrations of fuels on the forest floor, whether they are natural fuels or fuels resulting from treatment) in ephemeral, intermittent,

or perennial channels. Soils/watershed specialists will determine appropriate buffers for these actions outside the stream channel.

- Down woody material would be retained or returned to the sites after proposed activities to ensure appropriate levels to maintain soil quality are present.
- The areas where soil condition is less than satisfactory or where erosion hazard is severe would not be open to personal fuel wood collecting to limit the amount of soil disturbance. This measure is built into the treatment types (see Table 1).
- Stream channels and riparian areas will have a 300 foot buffer established around them where mechanized and motorized activities would not be allowed. Springs will be protected by a 500 foot buffer.
- Stream channels and riparian areas will have a 300 foot buffer established around them where mechanized and motorized activities would not be allowed.
- Springs will be protected by a 500 foot buffer.

Recreation/scenic resources

- To meet visual quality objectives within the immediate foreground areas (up to 300 feet) adjacent to area system trails (actively managed by the Forest Service) and of the three recreation day use sites within the project boundary, slash treatments would be as follows:
    - Stumps would be cut flush to the ground if possible or kept to a maximum 6-inch height above ground level/obstacles and the face cut of stumps would be directed away from the trail, where possible.
    - Approximately 70% or more of the activity generated slash smaller than three inches in diameter would be hand piled and burned, to meet visual quality objectives.
    - Piles created would be burned to achieve 95% or more consumption, and following burning, unconsumed slash would be scattered and the ground would be seeded with the approved seed mixture for this area.
        - Piles created between June and September would be burned in September-November of the same year unless fuel or weather conditions are not conducive to attainment of the 95% consumption objective. These piles would be burned the following spring as soon as conditions permit.
        - Piles created during a winter cutting operation would not be burned until the following September-November period.
- Consider options to reduce slash such as chipping and scattering.
    - The chipped material in the recreation sites will be spread at a depth of 0”-2”.
- Leave smaller trees between picnic sites to create a screen giving users privacy while enjoying the facilities.
    - Collaborate with recreation staff and/or landscape architect staff to identify and mark these trees.
- Provide for public health and safety by coordinating activities with adjacent land owners and placing warning signs along official system trails and other access points to the National Forest.
- Treatments within the recreation sites would not be performed during peak use periods such as May 15-September 1 and during the Albuquerque International Balloon Fiesta in October.
- Minimize temporary closures to trails by coordinating implementation and staggering treatments.

Burning/air quality

- Coordinate with and obtain required burn permits from Bernalillo County.
- Burn on days with a ventilation category that would facilitate good smoke dispersion.
- Monitor the fuel moisture of the piles and burn when the moistures are conducive to having good consumption.
- Break the overall unit into smaller subunits and burn these when appropriate.

- Adjust the ignition pattern within the unit in order to draw the smoke away from the private residences and notify the affected public prior to any ignitions occurring.
- Activity slash created June to September would be burned November-March of the same year; activity slash created during the winter would not be burned till the following November-March period unless the fuels meet appropriate fuel moisture levels.
    - There may also be opportunities for prescribed burns during the monsoon season, July – September.
    - No prescribed burns would occur during fire restrictions.
- Some archeological sites are located within the proposed project area and mitigation measures would need to be in place before burning. Fire and fuels personnel would coordinate with the district archeologist prior to broadcast burning and prior to the development of piles so mitigation measures can be taken.
- The analysis area consists of wildlife habitat that restricts burning, has timing restrictions, or has burning parameters associated. These mitigations are summarized below and are listed in more detail in the Wildlife Specialist Report (in the Project Record). These actions would leave certain areas untreated and increase the potential for high intensity fire; however, these burn restrictions on a landscape level would not be significant. The actions will increase the cost of burning and complicate burning efforts.
    - Snags greater than 18 inches and logs over 12 inches in diameter and longer/taller than 8 feet and hardwood species are recognized as habitat for several wildlife species, including the MSO. The Proposed Action would remove some snags and logs within fuel breaks and adjacent areas to control lines for burning. Snags and logs adjacent to these areas can create holding issues for firefighters and compromise firefighter safety. Snags and logs that do not compromise firefighter safety are to be left. Lighting techniques that allow for the retention of large logs and snags should be used.
    - No burning would be permitted in northern goshawk PFAs from March 1 to September 30.
    - Northern goshawk PFAs would be lightly burned to retain habitat. Prescription parameters are listed in the wildlife specialist report.

Wildlife

- The implementation of any of the proposed activities within northern goshawk PFAs and nest sites would occur from October 1 to February 28.
    - Avoid all activities that would involve cutting, in PFA's from March 1 – September 30.
    - Low intensity ground fires are allowed at any time, but high intensity fires need to be limited in the PFA's March 1 – September 30.
- Maintain two Abert's squirrel sites per 100 acres except where basal area of trees over eight inches d.b.h. is between 150 and 200 square feet per acre then maintain one Abert's squirrel site per 100 acres. Abert's squirrel sites consist of at least six trees 11 to 16 inches d.b.h. in a 1/20 acre group, with interlocking crowns.
- Seed intensely disturbed areas with native grass/forb/shrub seed mix.
- Retain large, downed woody materials (12" diameter midpoint and greater) and snags within riparian areas.

Vegetation

Ips Beetles

- Create activity slash only between July through December unless woody material 3"+ in diameter can be removed within 30 days of being created; or unless the potential for *Ips* infestation is determined to be low. Avoid creating activity slash in the same area multiple years. Remove as much woody material 3"+ in diameter from the site as possible. Promptly

treat slash through lop/scatter, chipping, hand pile burning or prescribed burning. Accomplish chipping or masticating in the fall (after August) and early winter when beetles are not actively flying. Don't allow concentrations of chipped/masticated material to accumulate over 4" in depth or lie immediately adjacent to live standing trees. Distribute chipped/masticated materials on slopes where they would dry quickly. Don't consider burning of woody material to be an effective treatment for Pinyon *Ips* unless accomplished before beetles emerge from the woody material. Avoid mechanical damage to residual trees and their root systems to reduce risk of attracting bark beetles. Monitor slash during and after treatment for *Ips* beetle infestation. If found, contact Forest Silviculturist.

Noxious Weeds

- Monitor potential sources of introduction of noxious weeds into the project area; included are rehabilitation of trails through grass establishment. Minimize the introduction of weeds into the project area. Require inspection and cleaning of equipment and vehicles involved in implementation of the project to the extent possible. Remove populations, by non-chemical methods, which are a result of activities within 1-2 years.

Cultural Resources

- Mitigation measures for mechanical individual tree selection treatments
  - All eligible and unevaluated sites should be flagged for avoidance prior to the implementation of mechanical treatments. It is further recommended that all sites should be hand-thinned following mechanical treatments. At the completion of vegetative treatment (particularly prescriptions that involve removal of large quantities of trees, such as grassland restoration projects), archaeological sites remain easily identifiable, "islands" of trees that are vulnerable to impacts from increased visitor traffic, looting and grazing. It is therefore, highly desirable that these sites receive hand-individual tree selection treatment following the mitigation measures described below.
- Mitigation measures for fire sensitive sites during prescribed burn treatments
  - To ensure the protection of fire sensitive sites, various combinations of the following protection measures may be approved by the Forest Archaeologist to protect sites for projects listed in Appendix J of the *First Amended Programmatic Agreement, for Large-Scale Fuels Reduction, Vegetation Treatment, and Habitat Improvement Projects*. The protection measures do not require additional consultation with the New Mexico SHPO.
    - Protect fire-sensitive sites:
      - Exclude from project area
      - Hand line
      - Black line
      - Wet line
      - Foam retardant
      - Structural fire shelter
      - Remove heavy fuels from site by hand
      - Prevent in-situ heavy fuels that cannot be removed from ignition (e.g., flush-cut & bury stumps)
      - Implement same protective measures for future maintenance burns.
    - Protect selected other sites from burning (optional).
    - Allow burning over non fire-sensitive sites provided:
      - No ignition points within site boundaries
      - No staging of equipment within site boundaries
      - No slash piles within site boundaries.

        - Allow construction of safety zones and additional lines in 100% surveyed areas, with archaeological monitoring as appropriate to assure historic properties are avoided.
    - In addition to these standard mitigation measures, other precautions should be taken to ensure that the archaeological sites which may be fire sensitive are monitored before the onset of the proposed prescribe burns. Several of the possibly fire sensitive sites are located in areas with high fuel loads. In order to ensure that these sites are not subjected to damage from higher temperatures and prolonged exposure to heat, it is recommended that all possibly fire sensitive sites are monitored by a professional archaeologist prior to fire treatment plans. Depending upon the estimated fuel load and previous fire exposure, fuel loads and types that would adversely impact cultural material should be removed from sites prior to prescribed burns. It is essential that this effort is coordinated with the district or forest archaeologist. An archaeological monitor may be necessary to ensure that removal of fuels does not result in damage to sites.
- Mitigation measures for hand-individual tree selection treatments
    - Treatments can be allowed within site boundaries provided:
        - Cutting is accomplished using hand tools only
        - Large diameter trees are felled away from all features
        - Materials removed from the site are removed by hand
        - No dragging of logs, trees, or thinned material across or within site boundaries.
        - No use of vehicles or other mechanized equipment within site boundaries.
        - No staging of equipment within site boundaries.
        - No slash piles within site boundaries.
    - It is recommended that an archaeological monitor is present during the individual tree selection of sites with visible architecture.
- Mitigation measures for road/trail decommissioning
    - Standard protection measures have been developed to protect sites for projects listed in Appendix E of the First Amended Programmatic Agreement, for Routine Road Maintenance, Road Closure and Road Decommissioning Projects on National Forests in New Mexico. The protection measures do not require additional consultation with the New Mexico SHPO.
        - No earth-disturbing decommissioning and closure activities within the boundaries of eligible or unevaluated sites
        - No use or staging of heavy mechanized equipment within site boundaries
        - Allow road decommissioning activities within the boundaries of eligible or unevaluated sites if the Forest and the SHPO agree that the activities will have no effect or no adverse effect on the identified historic properties.

Summary of Timing Restrictions

- The implementation of any of the proposed activities within northern goshawk PFAs and nest sites would occur from October 1 to February 28.
    - Avoid all activities that would involve cutting, including temporary road construction, in PFA's from March 1 – September 30.
    - Low intensity ground fires are allowed at any time, but high intensity fires need to be limited in the PFA's March 1 – September 30.
- Create activity slash only between July through December, unless woody material 3"+ in diameter can be removed within 30 days of being created; or unless the potential for *Ips* infestation is determined to be low

  - Activity created June to September would be burned November-March of the same year; activity slash created during the winter would not be burned till the following November-March period.
  - There may also be opportunities for prescribed burns during the monsoon season, July – September.
  - No prescribed burns would occur during fire restrictions.
- Accomplish chipping or masticating in the fall (after August) and early winter when beetles are not actively flying
- Treatments within the recreation sites and trails would be staggered so that not all rec areas would be treated at the same time.

General Schedule
There are no wildlife timing restrictions in Subunit B, but activities in Subunit A, which is almost entirely within a PFA, will take place mostly during the winter season.

- Cutting and individual tree selection of trees in Subunit A and non-PFA areas of Subunit B- Anytime, but stagger treatments March to May and mid-August to mid-December as peak recreational use periods - May take several seasons to complete
- Cutting and individual tree selection of trees within the PFA area of Subunit B - October to February - May take several seasons to complete
- Chipping and mastication of material in Subunit A and non-PFA areas of Subunit B – September to December
- Chipping and mastication of material in PFA areas of Subunit B – October to December
- Prescribed burning in Subunit A and non-PFA areas of Subunit B - November to March
  - May take several seasons to complete
  - Additional prescribed burning may occur during Monsoon season - July to September
- Prescribed burning within the PFA area of Subunit B - November to February - May take several seasons to complete
- Trail rehabilitation in Subunit A and non-PFA areas of Subunit B - Anytime, but avoid March to May and mid-August to mid-December as peak recreational use periods
- Trail rehabilitation in PFA areas of Subunit B - October to February
- Fuel wood Collection – Generally from May to December, but dependent on snowmelt and snowfall

New Mexico Forest Restoration Principles
The Sulphur Forest Restoration Project analysis considered all of the guidelines associated with the New Mexico Forest Restoration Principles.

Collaborate.
Landscape scale assessment, and project design, analysis, implementation and monitoring should be carried out collaboratively by actively engaging a balanced and diverse group of stakeholders. *Collaboration has occurred during all phases of the analysis and continues with a varied group of stake holders including known interested individuals and organizations, environmental and tribal groups, and governmental agencies at local, state and federal levels (EA - Chapter ,1 Public Involvement Section; Chapter 4; Project Record).*

Reduce the threat of unnatural crown fire.
A key restoration priority must be moving stands toward a more natural restored condition and the reduction of the risk of unnatural crown fires both within stands and across landscapes. Specific restoration strategies should vary based upon forest vegetation type, fire regime, local conditions, and local management objectives. Forests and woodlands characterized by infrequent and mixed-severity fire

should be managed toward a stand structure consistent with their historical ranges of variation—including, in some cases, high-density, continuous stands. Discontinuous stand structure may be appropriate to meet community protection objectives in areas such as the wildland urban interface for these forest and woodland types. *Reducing the threat of unnatural crown fire is part of the Purpose and Need of this analysis (EA - Chapter 1; Fuels Specialist Report).*

Prioritize and strategically target treatment areas.
Key considerations for prioritizing restoration treatment areas are: degree of unnatural crown fire risk, proximity to human developments and important watersheds, protection of old-growth forests and habitats of federally threatened, endangered, or listed sensitive species, and strategic positioning to break up landscape-scale continuity of hazardous fuels. Treatments should be done at a landscape scale to decrease forest vulnerability to unnatural stand-replacing fire. This priority-setting should take place during fire management planning, land management planning, and community wildfire protection planning. *See discussion in Background and Purpose and Need sections; Proposed Action; Treatment Types; Allocated old growth for Ponderosa Pine and woodland veg types (EA, Fire/Fuels Specialist Report, Project Record).*

Develop site-specific reference conditions.
Site-specific historical ecological data can provide information on the natural range of variability for key forest attributes, such as tree age structure and fire regimes that furnish local "reference conditions" for restoration design. A variety of constraints, however, prevent the development of historical information on every hectare of land needing restoration. General goals should be to restore ecological integrity and function. *The varied specialist reports and analyses are based on site specific inventory information and were used as a basis to restore ecological integrity and function such as soil conditions, potential natural vegetation (PNV) and fire regime for Ponderosa Pine and woodland vegetation types (EA - Chapter 3).*

Use low-impact techniques.
Restoration treatments should strive to use the least disruptive techniques, and balance intensity and extensiveness of treatments. In many areas, conservative initial treatments would be the minimum necessary to adequately reduce the threat of unnatural crown fire. Wildland fire use or management ignited fires may be sufficient to reestablish natural conditions in many locations. In the extensive areas where fire alone cannot safely reduce tree densities and hazardous ladder fuels, mechanical individual tree selection of trees may be needed before the introduction of prescribed fire. Patient, effective treatments would provide more options for the future than aggressive attempts to restore 120 years of change at once. In certain areas, however, such as some urban-wildland interfaces, trade-offs with imminent crown fire risks require considerations of rapid, heavy thinning of mostly small diameter trees. *A variety of tools, ranging from hand thinning to mechanical thinning to prescribed fire, and mitigations would be used to meet treatment objectives. Mechanical treatments are strategically placed so prescribed fire can be used at a landscape scale as the primary restoration tool. (EA - Chapter 2).*

Utilize existing forest structure.
Restoration efforts should incorporate and build upon valuable existing forest structures, such as large trees, and groups of trees of any size with interlocking crowns excluding aspen. These features are important for some wildlife species, such as Abert's squirrels and goshawks, and should not be removed completely just to recreate specific historical tree locations. Since evidence of long-term stability of precise tree locations is lacking, especially for pinyon and juniper, the selection of "leave" trees and tree clusters in restoration treatments can be based on the contemporary spatial distribution of trees, rather than pre-1900 tree positions. Maximizing use of existing forest structure can restore historical forest structure conditions more quickly. Leaving some relatively dense within-stand patches of trees need not compromise efforts to reduce landscape-scale crown fire risk. The underlying successional processes of

natural tree regeneration and mortality should be incorporated into restoration design. Southwestern conifer regeneration occurs in episodic, often region-wide pulses, linked to wet-warm climate conditions and reduced fire occurrence. Periods with major regeneration pulses in the Southwest occurred in the 1910s–1920 and in 1978–1998. Some of this regeneration would have survived under natural conditions. Restoration efforts should retain a proportion of these cohorts. *Working with and retaining, to the extent possible commensurate with project objectives, existing forest structure (including large trees) is an integral part of the design of this project (EA - Chapter 2- Proposed Action and Desired Condition).*

Restore ecosystem composition.
Missing or diminished compositional elements, such as herbaceous understories, or extirpated species also require restoration attention. The forest understory, including shrubs, grasses, forbs, snags, and down logs, is an important ecosystem component that directly affects tree regeneration patterns, fire behavior, watershed functioning, wildlife habitat, and overall patterns of biodiversity. Similarly, soil organisms, such as mycorrhizal fungi, are vital elements that can influence community composition and dynamics. A robust understory provides a restraint on tree regeneration and is essential for carrying surface fires. The establishment and maintenance of more natural patterns of understory vegetation diversity and abundance are integral to ecological restoration. Restoration planning should include the conservation of habitats for diminished or extirpated wildlife species. Comprehensive forest ecosystem restoration requires balancing fire risk reduction with retention of forest structures necessary for canopy dependent species. Recovery plans and conservation plans for threatened, endangered, and sensitive species should be incorporated to the fullest extent possible in planning for comprehensive forest restoration *(EA - Chapters 2 and 3).*

Protect and maintain watershed and soil integrity.
Low impact treatments would minimize sedimentation, disruption of surface runoff, and other detrimental ecosystem effects. Equipment and techniques should be managed according to soil and water conservation “best management practices” applicable to site-specific soil types, physiography and hydrological functions.

Reconstruction, maintenance, or decommissioning of existing roads to correct for poor hydrologic alignment and drainage condition can greatly reduce soil loss and sedimentation rates. Projects should strive for no net increase in road density.

Managing forest density and fuels to avoid uncharacteristically intense wildfire events would reduce the likelihood of catastrophic post-fire soil erosion and nutrient depletion from forested landscapes. Soil productivity should be protected and maintained by avoiding soil loss and compaction, and managing for on-site nutrient retention. Avoid repeated whole tree biomass removal from the forest to maximize nutrient retention. Whenever feasible, green foliage should be recycled by scattering on site followed by prescribed burning to release stored nutrients *(EA - Chapters 2 and 3; and Soil and Water Resources Specialist Report).*

Preserve old or large trees while maintaining structural diversity and resilience.
Large and old trees, especially those established before ecosystem disruption by Euro-American settlement, are important forest components and critical to functionality of ecosystem processes. Their size and structural complexity provide critical wildlife habitat by broadly contributing crown cover, influencing understory vegetation patterns, and providing future snags. Ecological restoration should manage to ensure the continuing presence of large and old trees, both at the stand and landscape levels. This includes preserving the largest and oldest trees from cutting and crown fires, focusing treatments on excess numbers of small young trees.

Develop "desired" forest condition objectives that favor the presence of both abundant large diameter trees and an appropriate distribution of age classes on the landscape, with a wide distribution of older trees. It is generally advisable to maintain ponderosa pines larger than 41 cm (16 inches) diameter at breast height (dbh) and other trees with old-growth morphology regardless of size (e.g. yellow-barked ponderosa pine or any species with large drooping limbs, twisted trunks or flattened tops).

Treatments should also focus on achievement of spatial forest diversity by managing for variable densities. Overall, forest densities should be managed to maintain tree vigor and stand resiliency to natural disturbances. Disease conditions are managed to retain some presence of native forest pathogens on the landscape, but constrained so that forest sustainability is not jeopardized. Guidelines must provide opportunities to apply differing site-specific management strategies to work towards attainment of these goals, and recognize that achievement may sometimes require more than one entry.

Stand level even-aged management may be appropriate for some objectives, including disease management, post wildfire tree regeneration, accelerating development of old growth characteristics, or for, forest types for which even-aged stands are characteristic, such as spruce or aspen. Treatments should be identified through collaboration with key stakeholders. Some ponderosa pine forests contain extremely old trees and dead wood remnants that may be small but are important because they contain unique and rare scientific information in their growth rings. Such trees have become increasingly rare in the late 20th century, and the initial reintroduction of fire often consumes these tree-ring resources. Restoration programs should preserve them where possible. *The existing condition for both ponderosa pine and piñon-juniper woodland is deficient of trees greater than 16 DBH and DRC. This project proposes to not cut any trees over this diameter to assist in moving the area to desired condition (EA - Chapters 2 and 3).*

Manage to restore historic tree species composition.
Forest density levels and the presence of fire in the ecosystem are key regulators of tree species composition. Where fire suppression has allowed fire-sensitive trees like junipers or shade-tolerant white fir or spruce to become abundant in historical ponderosa pine forests, treatments should restore dominance of more fire-resistant ponderosa pines. However, fire intolerant species sometimes make up the only remaining large tree component in a stand. Retention of these large trees is important to canopy dependent wildlife species. In mixed conifer forests, landscapes should be managed for composition and structure that approximates the natural range of variability *(EA - Chapters 2 and 3; and Vegetation Specialist report).*

Integrate process and structure.
Ecological sustainability requires the restoration of process as well as structure. Natural disturbance processes, including fire, insect outbreaks, and droughts, are irreplaceable shapers of the forest. In particular, fire regimes and stand structures interact and must be restored in an integrated way; mechanical thinning alone would not reestablish necessary natural disturbance regimes. At the same time, fire alone may be too imprecise or unsafe in many settings, so a combination of treatments may often be the safest and most certain restoration approach.

The single best indicator of whether a proposed approach should be considered as "ecological restoration" is to evaluate if the treatment would help successfully restore the fire regime that is natural for that forest type. Approaches that do not restore natural fire regimes will not achieve full ecological restoration *(EA - Chapter 3; and Vegetation and Fuels Specialist Reports).*

Control and avoid using exotic species.
Seeding of exotic grasses and forbs should be prohibited as ecologically incompatible with good restoration. Once established, exotic species can be extremely difficult or impossible to remove. Seeding

should be conducted with certified or weed free seeds to reduce the risk of contamination by non-native species or varieties. In general, it is ecologically desirable to allow native herbaceous vegetation to recover incrementally unless there is potential for serious soil erosion or the potential for establishment of non-native invasive plants. If enhancement of herbaceous vegetation is needed, especially for road closures and recovery, using locally sourced native seeds or transplanting individuals from nearby areas into treatments is ecologically desirable. Restoration treatments should also routinely incorporate early actions to control the establishment and spread of aggressive exotics that can be expected from restoration-related site disturbance (*EA – Proposed Action; and Vegetation Specialist Report)*

Foster regional heterogeneity.

Biological communities vary at local, landscape, and regional scales, and so should restoration efforts. Ecological restoration should also incorporate the natural variability of disturbance regimes across heterogeneous landscapes. Heterogeneity should be fostered in planning and implementing ecological restoration and all spatial scales, including within and between stands, and across landscape and regional scales *(EA - Chapter 3; Vegetation and Wildlife Specialist reports—specifically the analysis at the Ecosystem Management Area scale and associated Cibola National Forest and Grassland Land Management Plan direction).*

Protect sensitive communities.

Certain ecological communities embedded within ponderosa pine or other types of forests and some riparian areas, could be adversely affected by on-site prescribed burning or mechanical thinning. Restoration efforts should protect these and other rare or sensitive habitats, which are often hotspots of biological diversity, particularly those that are declining in abundance and quality in the region *(EA - Chapter 3; and Wildlife Specialist report).*

Plan for restoration using a landscape perspective that recognizes cumulative effects.

Forest restoration projects should be linked to landscape assessments that identify historical range of variation (reference condition), current condition, restoration targets, and cumulative effects of management. Ecosystems are hierarchical; changing conditions at one level arise from processes occurring at lower levels, and are constrained, in turn, by higher levels. The landscape perspective captures these complex relationships by linking resources and processes to the larger forest ecosystem. Forest restoration projects should incorporate plans for long-term maintenance of ecological processes *(EA - Chapter 2 and 3, specifically the Purpose and Need and Proposed Action which includes maintenance as monitoring data show that desired conditions are surpassing thresholds).*

Manage grazing.

Grass, forbs, and shrub understories are essential to plant and animal diversity and soil stability. Robust understories are also necessary to restore natural fire regimes and to limit excessive tree seedling establishment. Where possible, defer livestock grazing after treatment until the herbaceous layer has established its current potential structure, composition, and function. *Sandia RD has not permitted grazing since the 1950's.*

Establish monitoring and research programs and implement adaptive management.

Well-designed monitoring, research, and documentation are essential to evaluate and adapt ongoing restoration efforts. Monitoring programs must be in place prior to treatment, and must evaluate responses of key ecosystem components and processes at multiple scales. Use research and monitoring results from a variety of sources to adjust and develop future restoration treatments. When possible, restoration projects should be set up as experiments with replicates and controls to test alternative hypotheses. The locations and prescriptions for all restoration treatments should be archived in a geographic information system, so that land managers and researchers have access to site-specific records of restoration

treatments. *Monitoring would occur during all phases of project implementation (EA – Proposed Action). In addition, the Cibola NF&G will actively seek out partners with an interest in restoration to assist with monitoring.*

Exercise caution and use site-specific knowledge in restoring or managing pinyon- juniper ecosystems and other woodlands and savannas.
These systems are diverse and complex. Knowledge of local reference structure, composition, processes and disturbance regimes is lacking or uncertain for many pinyon–juniper ecosystem types. Given the diversity, variability, and complexity of pinyon–juniper systems, identification of local reference conditions is critical to the development of restoration objectives. Exercise caution and use best available science and site-specific knowledge in planning and implementing ecological restoration projects. Active management may be appropriate to mitigate soil erosion, community wildland fire hazard, or degraded hydrologic function in cases where historical ecological dynamics are insufficiently understood to justify ecological restoration. Pinyon–juniper sites may be particularly susceptible to ecological damage from treatments, for example, soil erosion and invasion by non-native plants. *The varied specialist reports and analyses are based on site specific inventory information and were used as a basis to restore ecological integrity and function (EA - Desired Condition, Proposed Action, and Chapter 3).*

Comparison of Alternatives

Table 2 serves as an executive summary of the effects of implementing each alternative and references the detailed information included in Chapters 1, 2, and 3. Information in the table is focused on the main resources that would be affected by project activities

Table 2 - Comparison of Alternatives

Topic	Alternative A (No Action)	Alternative B (Proposed Action)
Effects to Resources - Fire and Fuel	Fuel conditions (quantities and distribution) would remain relatively unchanged across the landscape. This, plus high tree densities, continuous canopy cover and ladder fuels would favor active crown fire and catastrophic fire events that would adversely affect forest vegetation. Stand structure (the horizontal and vertical distribution of forest components including the height, diameter, crown layers, and numbers of trees, shrubs, snags and down woody debris) would remain relatively unchanged. Ladder fuels would remain favoring movement of surface fires into tree canopies. The dramatic increases in stand density and BA over the last 80-90 years represent an increased susceptibility for bark beetle epidemics and stand-replacing wildfire. Stand diversity would remain low and competition for water, nutrients and space would remain high. All developments and resource values in this project area could be lost in a single burning period.	The forest would have fewer trees, especially small diameter trees that act as ladder fuels and increase the risk of torching, and an open canopy with lower crown bulk density which reduces the risk of sustained crown fire The ecosystem should be resilient to natural disturbance events including fire, drought, disease, and insect infestations. A desired future condition would allow fire to play its natural role in the environment, and be maintained in a manner to alleviate resistance to control. Desired future conditions would mimic natural ecosystem traits, having a diverse mosaic of fuels that are arranged in a fashion not subject to catastrophic wildfire. Treatments such as prescribed burning will be used to maintain the desired conditions. Coupled together these guides and tools will help alleviate undesirable conditions that are present in the Sulphur area currently. This alternative would be expected to help protect important values such as Wilderness and private land. Firefighters can more safely extinguish a fire if it stays small, has lower intensities, low spotting potential, and low resistance to control. This alternative will reduce the canopy and ladder fuels effectively reducing the potential for crown fires creating a safer area for firefighters.

Effects to Resources - Vegetation	The No Action alternative would result in continuing management (no treatment) of existing forest vegetation conditions. The forest ecosystem would remain susceptible to the adverse effects of uncharacteristic wildfire and insect/disease outbreak. Conditions related to high Stand Density Index values (full site occupancy by trees; severe competition between trees; active competition induced mortality; minimum individual tree diameter and volume growth; stagnation) would continue unless affected by natural events (wildfire, insect/disease outbreaks, etc.) Forest vegetation would continue to grow but at reduced rates due to high tree densities, overcrowding and competition for limited nutrients, water and sunlight. Trees, both on an individual and landscape basis, would continue to be stressed and more susceptible to drought and insect/disease attack. Higher rates of mortality resulting from these causes could be expected. Average stem diameters would remain low. The grass/forb/shrub component would continue to lack in diversity, vigor and abundance. Recruitment and enhancement of old growth at all scales would continue to occur, although at the current, slower pace; in addition, such areas would be susceptible to uncharacteristic wildfire and/or insect/disease outbreaks. Green House Gases (GHG) emissions and carbon sequestration levels would continue at current levels.	The forest would move towards a more sustainable and resilient forest condition. Key wildlife habitat objectives (enhancement and protection of Northern Goshawk foraging, PFA and nesting sites; MSO Restricted Habitat; as well as old growth) would be more readily met. Old growth recruitment/development at the project scale would be enhanced through reduction of tree densities and resultant improvement in tree vigor and growth. Allocated old growth areas would be better protected from catastrophic wildfire and insect/disease outbreaks. Desired Vegetative Structural Stand (VSS) class distribution would be enhanced through the recruitment of seedlings and saplings over approximately 10% of the pinyon-juniper and ponderosa forest types; and further development of the mature and old forest classes in all forest types. Stand structure would provide for more open forest conditions, increased tree growth/vigor and recruitment of understory grasses, forbs and shrubs The potential for insect/disease outbreaks would be reduced. The proposal to burn natural and activity created woody material, either through prescribed or pile burning, within the project area would directly release CO2 during the burning operations. This would contribute to increasing the atmospheric greenhouse gas concentration. However, restoration (or maintenance) of the desired conditions would result in a lower risk of uncharacteristically severe wildfire for those treated acres and resultant emissions of much lower amounts of CO2.

Effects to Resources - Wildlife	Threatened/Endangered and Sensitive Species Alternative A would not reduce the tree densities in the Sulphur Forest Restoration project area; density and canopy cover of all forest types would continue to increase throughout the project area. Existing small openings and forb/shrub/grassland areas would continue to decrease in size. Fuels build-up would continue, leading to increased potential for a crown fire if wildfire occurs in the area. Disturbance to wildlife species and loss of habitat from use of existing trails in riparian areas would continue. Management Indicator Species – No reduction in tree densities; density and canopy cover would continue to increase. Existing small openings and forb/ shrub/grass areas would continue to decrease in size. Wildlife would continue to be subject to disturbance due to existing roads, and trails. High Priority Migratory Birds - Fuels build-up would continue, leading to a crown fire if a wildfire occurs in the area. This would substantially reduce nesting and foraging habitat. Woodpeckers can benefit in the short term from wildfire, as the dead and dying trees provide insect habitat; sapsuckers prefer live trees for their excavations. Disturbance due to vehicle use and human activity related to trails use in riparian habitat would continue. Unintentional take of migratory birds due to tree cutting and prescribed fire would not occur.	Threatened/Endangered and Sensitive Species In general the proposed action provides reduced potential of stand replacing wildfire since fuels would be reduced throughout the area. The proposed action incorporates designs to lessen effects to threatened, endangered and sensitive species. Implementation of the proposed actions would provide essential habitat components such as snags, downed logs, residual basal area, and canopy cover necessary for potential occupancy of threatened, endangered, or sensitive species. Management Indicator Species – In general there would be no change in the population or habitat trend of MIS species at the Forest level. Implementation of the proposed action would result in short-term displacement due to treatment activity (noise and human presence). Snags used by cavity nesting MIS birds would be retained. In the long term, forage condition and availability would improve for all species due to reduced canopy cover and retention of oaks and other shrubs. The risk of stand replacing wildfire would be reduced. Treatment activities would result in increased displacement of elk, deer, and turkey from preferred habitat. Trail reroutes would lessen the effect to riparian dependent species in the long term and would improve riparian habitat. High Priority Migratory Birds –In all project areas, habitat features important to high-priority migratory birds will be retained. Large trees would be retained and a more natural spacing (similar to what occurs in fire-adapted ecosystems where small trees and overly dense stands are usually removed by natural fire) would result. <u>Short term</u> – Slight decreases to habitat condition. <u>Long term</u> – Improved habitat condition.

Effects to Resources – Soils and Watershed	Soil Resources Direct Effects – No changes in current conditions. Erosion will continue to contribute to soil loss. Indirect effects – Continued risk of uncharacteristic wildfire would have an adverse effect on soils in the project area, should a large intense fire occur. Uncharacteristic wildfire would result in adverse effects in soil hydrophobicity, altered infiltration, increased runoff, sedimentation/erosion and nutrient cycling. Water Resources Direct effects – No changes. Indirect effects – Uncharacteristic wildfire would result in increased erosion, sedimentation and runoff. Riparian Resources Direct effects – In not rerouting sections of trails, there would be continued negative effects to the riparian areas. Indirect effects – Uncharacteristic wildfire would decrease watershed stability and increase debris flows and soil movement. Recovery of vegetation would vary by fire intensity, but most effects would be undetectable within 10 years. Spring flows could increase for up to five years. This alternative provides the least direct impact to water resources, but provides the greatest potential indirect effects due to risk to wildfire.	Soil Resources Direct effects – Could be soil disturbance from mechanized equipment, removal of trees, mastication, and prescribed fire. Driving on soils and the use and maintenance of roads related to the proposed action would cause compaction and increased sediment yields in these areas. Over time, mastication may negatively affect nitrogen dynamics. When pile burning is necessary, soils below the piles may be negatively impacted. Indirect effects –Improving controllability of uncharacteristic wildfire is a benefit to soil resources. Trail re-routes would result in an improvement in soil condition on the closed sections of trail and reduce soil condition on the new sections of trail. Water Resources Direct effects – Long term there will be little detectable change. All water features will be protected through the use of project design features and mitigation, but it is expected there will be some short term impacts to these features. Indirect effects – Little detectable change. Riparian Resources Direct effects – None due to utilization of buffers. Indirect effects – Protection of riparian areas by reducing the risk of wildfire.

Effects to Resources – Recreation	Current recreation opportunities would not be altered. Poorly located trails would continue erosion and negative effects on soil and water resources. No effects on the wilderness characteristics.	Recreation Opportunity Spectrum (ROS) No effect to current ROS classifications Closures Will require complete temporary closure of Sulphur, Cienega, and Doc Long picnic areas during active operation. Some trails may need to be temporarily closed to public at various times. Operations will be timed to minimize the impact of closures to the public. Vegetation Management Will provide an opportunity to remove trees with evidence that they may become an overhead hazard in the near future. A reduction in screening could lead to a reduced feeling of privacy within the picnic areas. Wilderness No long term effects expected. A short-term increase in air pollutants would be expected due to exhaust from trucks, and harvesting equipment. Noise Individual tree selection activities may increase the noise levels within 1–2 miles of units and have short-term effect on the opportunity for solitude. All of the management activity would not occur at one time, rather over the duration of the entire project timeframe. Trails Reroutes on the Canoncito and Faulty trails will allow for better location and design limiting further degradation of resources. Removal of segments of the Faulty trail within the wilderness will eliminate incursion of bicycles improving the primitive quality of the area. Removal of unauthorized trails helps limit degradation of resources and reduce confusion by reducing the number of unidentified trail junctions. Planned Ignition Impacts to Recreation Smoke produced has the potential to negatively impact the recreation experience. This impact will be temporary and only occur during active burning and shortly thereafter.

Effects to Resources – Scenic Resources	No impacts to the scenic resources associated with, burning, and mechanical treatments since these actions would not be implemented. Overall scenic quality would decline over time due to the existing trend of even-aged stand management. Risk of stand replacement fire would continue. In the event of an uncharacteristic high severity wildfire, the existing landscape character would be suddenly altered with little opportunity to slow or control the change. The changes would contrast with the natural appearance of the landscape and degrade the scenic quality.	Reduced vegetation density, arrangement, and temporary openings (overall, a more open and natural forest appearance) would be visible from Highway 14, Highway 536, and area subdivisions. The difference between treated (project area) and untreated (Wilderness/residential areas/MSO) would provide a linear contrast between those areas. Stumps slash, and ground disturbance would dominate the view in the immediate foreground of area trails. Viewers may perceive loss of scenic beauty until ground cover has been reestablished. A decrease in the sense of solitude and diminished scenic quality might occur. The landscape would exhibit a managed appearance at least in the short term (up to 10 years). The scenic attractiveness rating is not expected to change as a result of this project; however for people who prefer the appearance of an unmanaged landscape this will decrease the scenic quality. While at recreation sites or on trails, viewing thinned areas, including slash and downed trees, burned slash piles, and hearing chain saws during recreation activities will likely reduce the recreation experience and sense of natural surroundings. The ground disturbance resulting from using machines to pile slash would be noticeable for up to 1 year after project completion. Prescribed burns have been found to negatively impact scenic beauty in the short term, but with ground vegetation recovery, can enhance scenic beauty within five years. The Visual Quality Objectives (VQOs) of Retention and Partial Retention would be met under this alternative. Scenic quality would be enhanced to a greater extent and for a longer period as the diversity of tree species, size, and spatial distribution increased.

Chapter 3 – Environmental Consequences

This section summarizes the physical, biological, and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. Complete specialist reports are available in the Project Record.

Fire and Fuels

Affected Environment

Effects on fuel and fire conditions will be assessed for the area based on the referenced regulatory framework and the best available science.

In order to determine the affected environment, the best available information was used, which included vegetation and fuels data taken from a variety of sources. They included stand examinations, fuels inventories, scientific research literature and field reconnaissance by professional foresters and fuel specialists. We also used fuels and fire modeling programs such as: BehavePlus, FVS, FSVEG, and Fire Family Plus. In cases where the district did not have field data, the data from stands that were similar in nature were used to predict existing condition.

Fuels and Fire management is a continuous process of predicting potential fire hazards that could lead to an uncharacteristic fire event. The project area will be managed for firefighter and public safety and to a level where cost effective resource protection is possible. Of all the elements influencing fire behavior, only fuels can be manipulated.

Historical Condition

Management activities such as fire suppression, timber harvesting and sheep grazing programs have all had significant effects on vegetation and fire regimes within the project area. Historically, natural fire burned throughout the project area relatively frequently, usually within a six year mean fire return interval (Baisan, 1997). High frequency and low intensity fires served to minimize regeneration of tree and shrub species, leaving a mosaic pattern of tree densities in the pinion/juniper (P/J) woodlands while in the ponderosa stands an open grassy park-like landscape with large fire resistant trees. These frequent fires also removed young, encroaching trees and maintained a low stocking of stems per acre.

Stands were altered by three practices around the end of the 18th century. First, the Spanish settlements grazed large flocks of sheep and goats throughout the 18th century. This practice intensified toward the latter part of this century and essentially removed the fine fuel grasses which served as the primary carrier for fire. Second, fire suppression became national policy near the turn of the century and grazing continued reducing fire frequency. The 10 am Fire Policy enacted following the devastating 1910 wildfire season put the goal of having all wildfires contained by 10 am the next day. This action proved very effective at limiting wildfires but also allowed forests to become unnaturally dense in stocking and dead fuels to accumulate. Third, large diameter trees were harvested from the forest to be used as railroad ties and fuel wood (Baisan and Swetnam, 1995).

Condition Class

Condition Class 1 areas are generally within or near the historical range and do not attribute to loss of key ecosystem components. Vegetation groups are intact and functioning within the natural range of variability.

Condition Class 2 areas develop as one or more fire return intervals are interrupted resulting in denser stands with an increased fuel load Vegetation composition and structure have moderately departed from a formal natural range which increases the risk or loss of key ecosystem components. Fires burn with a greater intensity altering biodiversity, soil productivity, and water quality.

Condition Class 3 is a significant departure from a historical range of variability exposing the system to risk of losing key ecosystem components. Large scale insect damage and disease may be present attributing to an increase in available fuels. Extreme fire behavior is typical with this departure state, and usually will result in a complete stand replacement occurrence.

Fire Regime

Fire regime is a description of the role fire plays in an ecosystem without the presence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee, 1993). Five primary fire regime groups have been developed by Hardy et al. (2001) and Schmidt et al. (2002). These are coarse scale and simplified categories that help in understanding the ecological fundamentals of the biotic systems that occur on this landscape, and its previous relationship with fire as a process which acted on them at different frequencies and resulting severities for thousands of years.

Fire Regime I - This system includes the lower and mid-elevation forested plant associations, Ponderosa Pine, and Douglas-Fir. These regimes historically had a high fire return interval (0-35 years) preventing high fuel loadings and produced limited layers within the system. The Dry Mixed Conifer Forest group including ponderosa pine sites and lower elevation conifer is most closely represented by Fire Regime I. The net result was more frequent and less severe fire occurrence.

Fire Regime II - This system is also in the lower to mid elevation range; however it includes grassland plant associations. These regimes have a high fire return interval (0-35 years) with a mix of low and high severity fires. This system includes P/J, mountain mahogany, and other dry mountain shrub species. Fire Regime II is tied to the Hot Dry Shrub-lands and Woodlands including P/J.

Fire Regime III -This system consists of forest plant associations located at mid elevation. Species found there are consistent with higher moisture availability such as Douglas fir, higher elevation bunch type grasses and forbs. The fire return interval is 35 to 100+ years with a mix in fire severity. Stand replacement fire may occur but are usually rare events. This regime is typically a heterogeneous landscape. The mid elevation Mixed Conifer group is best represented by Fire Regime III.

Fire Regime IV - This system is characterized by forested species at mid to high elevation. Spruce, and sub-alpine fir plant associations are included within this group. This regime is generally considered as having a fire free period of 100+ years. This usually results in a stand replacement, high intensity fire occurrence. The mid to high elevation spruce-fir vegetative group is represented by Fire Regime IV.

Fire Regime V - This is a high elevation system, and the plant associations depend upon high local moisture availability. Due to the very long fire return interval in excess of 200 years, this regime is generally considered fire free. Rock, lack of fuels and other combinations of the physiographic setting typically inhibit propagation of fire. The high elevation shrub group including Gamble oak is represented by Fire Regime V.

Table 3 - Existing Fire Regimes/Condition Class Percentages in Project Area

Fire Regime Group	Historic Fire Return Interval	Condition Class	Approx. Percentage within project area
I	0 - 35 years	2	5%
I	0 - 35 years	3	15%
II	0-35 years	2	15%
II	0 - 35 years	3	45%
III	35 - 100+ years	3	20%
IV	100+ years	3	0%
V	200+ years	3	0%

The Sulphur project has three primary stand types: P/J, ponderosa pine and mixed conifer. The P/J woodlands occupy approximately 544 acres. The pattern of tree patches in the P/J woodlands is influenced by soil depth, nutrients, microbes, drought, plant competition, fire, grazing and insect-pathogen attack (Klopatek et al. 1990). Some of these woodlands are sufficiently open to subdue a running crown fire but dense patches do exist which may sustain this type of fire behavior. Of the three stand types 80% of the project area is in a condition class three with 20% being in a condition class two. 80% of the project is in a fire regime two and three meaning that 100% of the project area is, at different degrees, removed from a historic state (Table 3).

Figure 4 - Pinion and Juniper Woodlands, Note High Tree Density and Continuous Vegetation Cover

The Ponderosa pine forest covers approximately 445 acres of the Sulphur project. Historically, ponderosa pine in the Southwest experienced low-intensity fires every 5 to 20 years (Covington and Moore 1994). This fire regime generally created and maintained open, park-like ponderosa pine forest with grasses in the under story (Pollet and Omi 2000). The mature pine was able to withstand low to moderate intensity fires due to their thick bark (Pollet and Omi 2000). These frequent fires also removed young, encroaching trees and maintained a low stocking of stems per acre. This created openings which allowed dense seedling establishment during wet years and no frequent fires to limit the stocking numbers increasing the stand density. This condition threatens any remaining legacy trees through competition and

by fueling increasingly extensive crown fires due to vertical continuity of the stand (Covington and Moore 1994, Omi and Martinson 2002). There is very little under story vegetation but plenty of dead pine needles which are a recipe for a stand replacement wildfire under high risk weather conditions. Crown fires in the ponderosa pine type are absent in the historic local and regional fire scar records (Touchan and Swetnam 1991), indicating that current stand conditions are an aberration attributable to the three practices mentioned.

Figure 5 - Even-Aged Ponderosa Pine Stand, Note Dense Tree Stocking and Lack of Herbaceous Understory

The third stand type is mixed conifer which occupies approximately 681 acres of the Sulphur project. Douglas Fir, White Fir, Ponderosa Pine, Engelmann Spruce, and Subalpine Fir constitute the mixed conifer forest type. The natural fire regime, which created a mosaic of age classes across the landscape, has not been allowed to burn in this type since the early 1900's. This forest type, therefore, is becoming dense and homogenous across the landscape. Down woody fuel loadings are unnaturally high. Current conditions are such that susceptibility to insects and diseases is increasing. The probability of an uncharacteristic, stand-replacing fire in the mixed conifer forest type is high.

Figure 6 - Mixed Conifer Stand, Note Abundant Regeneration Creating Ladder Fuels

Fuel Loading

Fuel loading is the accumulation of dead woody debris in different states of decomposition. The fuel load which is dead responds primarily to relative humidity in the surrounding area and no longer is supplied

moisture through other means. With hotter summer months relative humidity decreases decreasing the dead fuel allowing it to be more susceptible to burn. The lower the RH values in the fuel the hotter and faster it will burn. Increased intensity of the burning fuel lowers the RH of living woody material in the area allowing them to be susceptible to burn. The amount of fuel loading in the forest is important to managers because it gives an idea of what resources are at risk. Higher fuel loadings generate more intense fires resulting in bigger changes to resources such as vegetation, water sheds, and wild life habitat. District personnel and contractors conducted fuel transects throughout the project area to gather an overall baseline of existing fuel loads for this reason. The existing dead and down fuel loading in the project area has an average of 3.1 tons/acre in the Pinion-juniper 1.6 tons/acre in the ponderosa pine, and 2.5 tons/acre in the mixed conifer. Some mortality is occurring due to trees stressed from competition and drought therefore, they are more susceptible to loss from insects and disease. As trees die and fall over, surface fuel loads increase. In these semi-arid systems where rates of biotic accumulation exceed the normal rate of decay fire plays a critical role in recycling biomass (Baisan and Swetnam 1995).

Due to the late-seral state of the existing vegetation, increased fuel loadings, and grossly overdue fire return interval, the majority of the project area is at risk of loss of key ecosystem components. A significant and long duration departure from the natural regime has occurred across the project area. With the increase in fuel availability and loading, it can be determined that the inherent probability of an ignition of wild land fires also increases.

Crown Base Height & Crown Bulk Density

Crown base height (CBH) and crown bulk density (CBD) influence fire behavior, and can be directly managed by thinning or similar forest treatments (Graham and others 1999). Crown base height is the measurement in feet from the ground to the base of the crown. The lower the crown base height the more likely the surface fire would reach the crowns and torch individual trees and initiate a crown fire. Thinning from below and prescribed burning often results in higher crown base heights thus lessening the potential for crown fire initiation.

Ladder fuels are vegetation arrangements that allow fire to climb up vegetation into the crowns of the over story. Often thinning from below and prescribed burning eliminates some of the ladder fuels. CBH is directly related to ladder fuels. When an abundance of ladder fuels exist the average height to the crown ratio is lowered and a lower surface fire flame length is needed to initiate torching and crowning of over story species. The Sulphur project has numerous pole size trees and areas with abundant regeneration that contributes to heavy concentrations of ladder fuels, thus the risk of a crown fire is high (Table 4).

Table 4 - Crown Base Height by Stand Type in Feet

Treatment	Pinion Juniper	Ponderosa Pine	Mixed Conifer
Pre-Treatment	6.1	7.2	9.5
Post-Treatmet	14.1	15.6	18.8

Crown Bulk Density is the primary controlling factor of crown fire behavior and it depends on both species composition and stand density (Graham and others 1999). CBD is measured in kilograms per meter cubed and is the amount of mass in the canopy of a stand. CBD is an indicator of the incidence of interlocking crowns which can tells us how a crown fire can spread. In general, the lower the CBD, the higher the wind speed has to be to sustain a crown fire. CBD's of 0.08 kg/mˆ3 and above are considered high (Table 5).

Table 5 - CBD of Project Broken Down into Stand Types

Treatment	Pinion Juniper	Ponderosa Pine	Mixed Conifer
PreTreatment	0.0499	0.0586	0.0706
PostTreatmet	0.0155	0.0234	0.0270

Stand Density Index

Stand density index (SDI) is defined as a comparison of stand density in relation to tree size that better reflects stand characteristics rather than looking at trees per acre or basal area alone. SDI is a measure that is used to compare density of the forest. At 35% of maximum SDI, trees fully occupy the site. At higher densities competition among trees either results in reduced growth and vigor on individual trees, or may result in competitive stress and tree mortality (Page 2006). Present average SDI for the project area is 70%, ranging from 18% to 123%. 98% of the Sulphur analysis area currently has a SDI greater than 35%. In terms of fire behavior this condition is not desirable. After treatment in some stands opening the canopy through tree removal will allow seedlings such as Ponderosa Pine, Gamble Oak, and other non-merchantable species access to more resources such as light and moisture that was taken up by larger over story trees. This will sometimes be a higher SDI than there was previously on the site. The increase of productivity in these types of forests is good because they allow more diversity increasing the resiliency of the stand. Other stands may not exhibit this type of change; they may show a reduction in SDI. A reduction in SDI will also increase the vitality of the forest by reducing the severity of a fire.

Risk

Components of fire risk are weather, fuels, and human influences. Fire risk is the potential for a fire to ignite given certain parameters and conditions. Fires start as the result of human activity or naturally by lighting. Sulphur, Doc Long, and Cienega recreation area as well as Sandia Peak Ski are areas have high use by the public. The district is visited by 2 million people annually. The increase of human activity in the forest increases the likelihood of intentional/unintentional fire starts. Lightning is another proponent of fire starts on the Sandia District. The onset of monsoon season in July through August each year increases the chance of lightning caused fires. The monsoon is at a time of year of high temperatures and sometimes low humidity which caters to large growth fires.

Fire Behavior

Fire behavior is a function of fuels, weather, and topography. Throughout much of the Southwest, the fine fuels such as grasses and forbs are important fuels that allow fire to spread. In most areas, human impacts have had significant effects on the availability of these fuels**.** Example, in the mid elevations (above 6850ft msl) a long needle complement is traditionally the carrier of fire while at the higher elevations (above 7900 msl), dead conifer needles are the primary carrier of fire. Since the early 1900s, wildfire activity has increased in the Southwest and recent fires have burned at intensities and sizes rarely seen in the past. This is evident in the fire behavior exhibited by the Big Springs, Trigo, and Ojo Peak, all on the CIF, and the Los Conchas, north of CIF. In each of these circumstances, fire behavior was considered extreme and the size of the areas burned exceeded 300,000 acres combined, crossing several watersheds.

Fire season in New Mexico usually occurs from early April to late July in most years. It is characterized by low humidity, strong winds and unstable atmosphere. Dry lightning storms are a common occurrence on hot afternoons. Predominate winds are normally from the west-southwest but can change to almost any direction with passing weather cells. A Remote Automated Weather Station (RAWS) identified as the Oak Flat RAWS station is located approximately 15 miles southeast of the project area. Weather records indicate that winds ranging from 8 to 30 mph are typical during the spring and early summer. Based on data over a 6-year period (2004 thru 2010) and over the 6 months when fire weather is most extreme (March 1st thru August 31st), winds blew predominantly from the south and southwest. Winds of this speed coupled with low relative humidity and the current fuel conditions can create an environment that supports extreme fire behavior. Traditionally 60% to 75% percent of the rainfall on the districts occurs July through April when monsoonal moisture generated in the Gulf of Mexico follows a thermal trough into the Southwest. The least amount of rainfall occurs from May into early-July when a drier continental air mass resides over the Southwest. This is also the time-frame in which the project area

receives its highest visitation. Weather data was collected from the Oak Flat RAWS then assimilated in Fire Family Plus (Table 6). The out puts show fuel moisture as well as weather at three different percentiles. The 97th percentile is close to extreme fire conditions or conditions that attribute to large fire growth. The 90th and 50th was also run in the models to give a representative of more normal conditions.

Table 6 - Weather Data Taken from Oak Flat RAWS Station

Attribute	50th Percentile	90th Percentile	97th Percentile
	Normal Conditions	Severe Conditions	Extreme Conditions
1-hour fuel moisture %	5.2	2.5	1.6
10-hour fuel moisture %	6.6	3.4	2.3
100-hour fuel moisture %	11.5	6.4	4.9
Herbaceous fuel moisture %	30	3.2	1.9
Live Woody fuel moisture %	69.4	60	60
20-foot wind speed (mph)	7	10	12
Temperature-max (degrees)	78	84	87

Slope affects fire spread and intensity. Fire normally burns faster and hotter upslope than down slope or on level ground. Slopes within the Sulphur project area represent a wide range of conditions, ranging between 0 (flat) and 55 percent.

Aspect affects fire spread and intensity based on the direction the slope is facing and the overall vegetation and soil moisture. A south-facing slope is hotter and dryer than a north-facing slope. On a south-facing slope fuels tend to be small and drier and the average relative humidity tends to be lower. Since the project area lies on the east side of the Sandia Mountain, the east aspect has a strong influence; however, due to sub drainages and intersecting ridges, all aspects are present.

Behave Plus Outputs

The Behave Plus program was used to simulate and model potential fire effects in the project area. Several fuel models were selected to best represent stand characteristics. Stands were characterized by species types which were PJ, Ponderosa Pine, and Mixed conifer (Table 7). Fuel models were selected for each of the stands that best represented the existing conditions. For mixed conifer a fuel model TL 5 or timber litter 5 is a model representing high loads of conifer litter. Ponderosa pine was modeled with a fuel model 9 or long needle pine needle stand which is represented with a heavy needle cast with some down woody component. The last stand type Pinion Juniper is modeled with a SH 7 or very high load dry climate shrub. This model is a shrub model but best represents the characteristics of Pinion Juniper in size and continuity. All three stands where run with weather data collected at the Oak Flat RAWS. Pretreatment and post treatment were run for the stand types and compared. Post treatment fuel models were selected that differ from the pretreatment models. These models were in the same classes as the other models but with a reduced fuel loading. A reduction in all categories that were run can be seen, with the biggest decrease being in the rate of spread. This will help in suppression efforts as fire severity is decreased. Although it is not shown in Pinion Juniper due to the amount of fuel loading the other stands show a decrease in BTUs which correlates to the intensity and duration of a fire. With a decrease in BTUs severity will decrease as the exposure time for vegetation, soil, and wildlife decreases

Table 7 - Behave Outputs for Sulphur Project Broken into Three Stand Types

Pretreatment	97 Percentile				90 Percentile				50 Percentile			
Forest Type	Rate of Spread ch/h	Heat per Unit Area Btu/f2	Fire Line Intensity Btu/ft/s	Flame Length ft	Rate of Spread ch/h	Heat per Unit Area Btu/ft2	Fire Line Intensity Btu/ft/s	Flame Length ft	Rate of Spread ch/h	Heat per Unit Area Btu/ft2	Fire Line Intensity Btu/ft/s	Flame Length ft
Mixed Conifer	2.5	472	21	1.8	1.9	434	15	1.6	1.2	357	8	1.2
Ponderosa Pine	5.1	506	47	2.6	3.8	467	33	2.2	2.2	386	16	1.6
Pinion Juniper	23.1	2816	1194	11.7	18.5	2624	891	10.2	11.1	2249	456	7.5
Postreatment	97 Percentile				90 Percentile				50 Percentile			
Forest Type	Rate of Spread ch/h	Heat per Unit Area Btu/ft2	Fire Line Intensity Btu/ft/s	Flame Length ft	Rate of Spread ch/h	Heat per Unit Area Btu/ft2	Fire Line Intensity Btu/ft/s	Flame Length ft	Rate of Spread ch/h	Heat per Unit Area Btu/ft2	Fire Line Intensity Btu/ft/s	Flame Length ft
Mixed Conifer	0.5	1.9	1	0.5	0.4	129	1	0.5	0.3	108	1	0.3
Ponderosa Pine	0.7	139	2	0.6	0.5	129	1	0.5	0.3	108	1	0.4
Pinion Juniper	19.6	2816	1194	11.7	15.6	2624	891	10.2	9.4	2249	456	7.5

Smoke Management and Air Quality

Local area fire weather forecasts will be monitored daily before and during the implementation of any prescribed burn. Spot weather forecasts will be obtained daily for the operational periods of the burn. On-site weather readings will be monitored during operational periods as directed by the burn boss using a belt weather kit. The weather data that is recorded from the belt weather kit will be the primary weather readings that will be the determination factor for the go-no-go and for the prescription parameters.

The Burn Boss will ensure that the project complies with all local, county, state, and federal air quality regulations. The project will be registered with the Albuquerque-Bernalillo County Air Quality Control Board /Air Quality Bureau at least 2 weeks prior to implementation. Notification will be given 24 - 48 hours prior to ignition and a copy of the spot weather forecast will be faxed to the Sandia Ranger District. A copy of our smoke monitoring report will also be faxed. Coordination between the Albuquerque zone dispatch center, Albuquerque-Bernalillo County Air Quality Control Board, and neighboring agencies will be established. Burn will be terminated if Albuquerque-Bernalillo County Air Quality Control Board or the National Weather Service issues an air stagnation alert.

Smoke conditions must be monitored carefully to assess potential impacts to highway traffic and populated areas. Monitoring should be visual and also may include instrument monitoring. Adequate ventilation or winds that carry smoke away from traffic or populated areas may be required to minimize impacts. The Burn Boss will determine if conditions are favorable at time of ignition.

Environmental Consequences

It is important to note that fire is boundary-less by nature. There are many elements, some of them discussed within this report, that drive fire growth and spread potential. It is therefore understood that cumulative effects, on site-land management practices, and off-site land management practices are all co-related and overall risk is shared.

Alternative A - No Action

The No Action alternative would result in no treatment of the existing unhealthy forest vegetation conditions. The forest ecosystem would remain susceptible to the adverse effects of uncharacteristic wildfires consistent with increased population, public use, and fuel loading also vulnerable to insect/disease outbreaks.

Forest vegetation would continue to grow but at reduced rates due to high tree densities, overcrowding and competition for limited nutrients, water and sunlight. Trees, both on an individual and landscape basis, would continue to be stressed and more susceptible to drought and insect and disease attack. Higher rates of mortality resulting from these causes could be expected. The dramatic increases in stand density and BA over the last 80-90 years represent an increased susceptibility for bark beetle epidemics and stand-replacing wildfire (Margaret M. Moore, et al. 2004, pg. 1).

Stand structure (the horizontal and vertical distribution of forest components including the height, diameter, crown layers, and stems of trees, shrubs, snags and down woody debris) would remain homogenous or uniform.

Recruitment and enhancement of old growth at all scales would continue to occur, although at the current, slower pace; in addition, such areas would be susceptible to uncharacteristic wildfire and/or insect/disease outbreaks.

Stand diversity would remain low and competition for water, nutrients and space would remain high. All developments and resource values in this project area could be lost in a single burning period. From fire/fuels prospective this alternative is the least desirable.

Alternative B

Based on the fuels reduction prescriptions, Alternative B would have fewer trees especially small diameter trees that act as ladder fuels and increase the risk of torching (Table 4), and an open canopy with lower crown bulk density which reduces the risk of sustained crown fire (Table 5). The ecosystem should be resilient to natural disturbance events including fire, drought, disease, and insect infestations. A desired future condition would allow fire to play its natural role in the environment, and be maintained in a manner to alleviate resistance to control. Desired future conditions would mimic natural ecosystem traits, having a diverse mosaic of fuels that are arranged in a fashion not subject to catastrophic wildfire. Measurements such as SDI, CBH, CBD, and tons per acre will be used to monitor future conditions of the stands. Taken together as a whole this would move the project area much closer to a condition class 1 across the entire project area. Some areas would remain slightly departed, condition class 2, from the historic range of variability after the first entry. Treatments such as prescribed burning will be used to maintain the desired conditions based on the measurements pre mentioned. Coupled together these guides and tools will help alleviate undesirable conditions that are present in the Sulphur area currently.

Cumulative Effects

There have been multiple ecosystem restoration/fuels reduction projects conducted over the years in the Sulphur project area. Between 1994 and 1998 the Sandia Ranger District implemented thinning, chipping, and prescribed burning in the Cienega and Armijo project areas. The Cienega project was a 150 acre low intensity, broadcast style, prescribed burn just to the South of the Cienega picnic grounds. The Armijo fuels reduction project was a 200 foot wide shaded fuel break that ran from Canoncito up to Sandia Park. This project was extensively thinned, piled, and then prescribe burned. These entries of thinning and prescribed fire have definitely helped to reduce the subsequent fuel loading in all size classes in the current Sulphur project area. It has also greatly reduced the stand density index, increased the crown base height, and lowered the crown bulk density in the treated areas. Another project that will have an effect on

the Sulphur project is the Hondo fuels reduction project. Hondo is a 406 acre thin from below project that lies just to the South of the Sulphur project. The Southern 200 acres of Hondo has been thinned and brush was lopped and scattered. And the bottom 100 acres of that has been prescribed burned. The remaining 100 acres of South Hondo is slated to be burned in the winter of 2013/2014. The North Hondo section, 206 acres, is slated for a similar treatment once the implementation of the Sulphur project begins. The Hondo project is an important piece of the overall effectiveness of the Sulphur project. It adds a significant buffer to the South, greatly reducing the risk of an uncharacteristic wildfire entering the Sulphur project area.

Implementation of fuels reduction projects need to consider the intended recreation usage of the area. A symbiotic relationship exists regarding road and trails. One of the unintended results of fire-line construction or creation of fuel-breaks often result in increased traffic and user created routes that require mitigation or obliteration. An example is NFRS 9 which was simply an access route created by fuel wood permit holders during the Heatherland Hills Fuels Reduction & Wildlife Habitat / Forest Health Improvement project. It quickly became a high use area and because of the recreational value is now designated as a system route. Consideration of increased risk could be managed under the Cibola Fire Management Plan which would restrict or close these areas under extreme fire conditions. Public access into areas currently prohibited or limited under previous decisions would continue as designated.

Conversely, valued and managed recreational routes are usually located geographically and topographically so that they allow easy compartmentalization of areas without having to construct new fire-line. An example of this is the implementation of the David Canyon Forest Health Project (1998) in which entire trail systems made up the compartments for implementation of landscape prescribed fire. After the fuels reduction project was completed the trail was improved with erosion barriers, minor re-routing, and thus became more ecologically sustainable. David Canyon is the location of the Sandia Ranger District Isleta CFRP.

Action alternatives would be expected to help protect important values such as Wilderness and private land. In order to protect these values, firefighters must be able to remove the fuel and contain the fire. The shorter the fires duration, the less potential exists for adverse weather changes or extreme fire behavior that makes conditions less safe for firefighters. There is less exposure to elements such as smoke and terrain. Firefighters can more safely extinguish a fire if it stays small, has lower intensities, low spotting potential, and low resistance to control. Action alternatives will reduce the canopy and ladder fuels effectively reducing the potential for crown fires creating a safer area for firefighters.

Vegetation

Vegetation mapping, diagnosis and analysis were accomplished using 2000 and 2006 vegetation data. Modeling was accomplished using the Forest Vegetation Simulator.

Affected Environment

Pinyon-Juniper Woodland (Persistent)
Approximately 544 acres of the analysis area consists of the “persistent” Pinyon-Juniper Woodland where trees are a major component of the vegetation unless recently disturbed by fire, clearing, etc. (Romme, 2008). This forest type is typically a mix of pinyon pine and one-seed/Rocky Mountain juniper with scattered Ponderosa pine, Alligator juniper, Douglas and White fir, Wavyleaf oak and Gambel oak. Average stem diameter is 3.6 inches; tree densities range from approximately 320 to 9,100 trees (0”+ diameter) per acre; stand structure distribution is approximately 38% uneven-aged and the remainder even-aged. The dominant habitat type is Pinyon Pine/Gambel Oak (Pied/Quga). Stand density index is

approximately 347, or 75% of maximum. This value describes full site occupancy by trees; severe competition between trees; active competition induced mortality; minimum individual tree diameter and volume growth; stagnation; and declining whole stand volume growth due to mortality. The grass/forb/shrub component is lacking in both diversity and abundance. Soils are classified as impaired due to excessive bare soil, lack of vegetative litter and low percent of ground cover.

Dwarf mistletoe infection is non-existent or light (less than 20% of the trees infected) across approximately 97% of the area and moderate on the remaining 3% (5032/19,32).

Note: In the Pinyon-Juniper Woodland as a whole (both savanna and persistent), there is a high confidence that tree density and canopy coverage have increased in many or most persistent woodlands during the 20th century although the precise magnitude of increase, causes, and geographic applicability are not adequately known. In addition, there is a high confidence that an important consequence of this process is that formerly heterogeneous landscape mosaics – intermingled patches of woodland, shrub land, and grassland – are becoming more homogeneous as trees become established within former shrub land and grassland patches. There is evidence that expansion of pinyon and/or juniper into previously non-wooded areas (especially shrub lands and grasslands) is occurring extensively…in parts of Arizona and New Mexico (Romme, 2008).

Ponderosa Pine
Approximately 445 acres of the analysis area consists of Ponderosa pine dominated forest. Pinyon pine, Juniper, Gambel oak, Douglas and White-fir are found in the understory and can compromise up to 55% of the species composition. Average tree diameters approximate 3.8 inches; tree densities range from 1,830 to 5,701 trees (0”+ diameter) per acre; stand structure distribution is approximately 31% uneven-aged and the remainder is even-aged. Stand density index is approximately 368 or 82% of maximum. This value defines full site occupancy by trees; severe competition between trees; active competition induced mortality; minimum individual tree diameter and volume growth; stagnation; and declining whole stand volume growth due to mortality. The grass/forb/shrub component is lacking in both diversity and abundance.

The predominant habitat type is Ponderosa pine/Gambel Oak (PIPO/QUGA).

Dwarf mistletoe infections is non-existent or light (less than 20% of the trees infected) and localized across approximately 95% of the project area and moderate on the remaining 5%.

Mixed Conifer
Approximately 681 acres of the analysis area consists of dry Mixed Conifer forest (at least 40% composition of Douglas and/or White fir). Average tree diameters approximate 4.0 inches; tree densities range from 774 to 7,906 (0”+ diameter) trees per acre; stand structure distribution is approximately 21% uneven-aged and the remainder even-aged. Stand density index is approximately 476, or 68% of maximum. This value defines full site occupancy by trees; severe competition between trees; active competition induced mortality; minimum individual tree diameter and volume growth; stagnation; and declining whole stand volume growth due to mortality. The grass/forb/shrub component is lacking in both diversity and abundance.

The predominant habitat type is White fir/Gambel Oak (ABCO/QUGA).

Dwarf mistletletoe is non-existent or light (less than 20% of the trees infected) and localized across approximately 89% of the project area and moderate on the remaining 11%.

Required calculations of percentages and allocation of restricted area to be managed for nest/roost characteristics (pages 71-2 and 71-3 of the Cibola FLMP) have been calculated and are on file.

Gambel Oak
Gambel oak occurs primarily as an understory species within the previously described forest types. The species occasionally reaches large diameters (10”+ drc) in drainages or otherwise moist sites but is most commonly found in the 2”-9” size classes. Oak can be expected to readily respond to any disturbance.

Aspen
Within the project area, aspen is best described as a seral component of the mixed conifer and ponderosa pine forest types. It rarely occurs as a pure stand but is most often co-dominant, intermediate, and declining component of these forest types. The most contiguous area of aspen is found in drainages such as Cienega and Sulphur Canyons.

Riparian
Approximately seven acres are classified as riparian within the Sulphur project area. Riparian vegetation is closely associated with existing springs and seeps as well in moist drainages such as Cienega and Sulphur Canyons. The most notable area would be within the confines of the Cienega Picnic Area (location/site 005032/05) (CEEM Hondo-Sulphur Landscape Assessment, 2007).

Tree Diameters
Overall (all forest types), trees larger than 16 inches in diameter (at either diameter breast height or diameter root collar) are deficient.

Northern Goshawk Post Fledgling Family Area (PFA)
A Northern Goshawk PFA has been established in the general area south of Cienega Canyon and extending further south almost to the southern boundary of the project area. Six nest sites are included within this PFA.

Insects and Disease
Dwarf Mistletoe – As noted in the individual forest type narratives, mistletoe occurs at overall non-existent to low infection levels. Moderate or higher levels of infection are found in levels ranging from 3% (pinyon-juniper woodland) to 11% (mixed conifer).

Douglas-fir Tussock Moth – First detected in 2005, but determined to be building for at least two years prior to that time, Tussock Moth has caused extensive mortality in the mixed conifer (white and Douglas-fir) on the Sandia Mountains. While having reached its peak in 2007-2009, activity is still evident though at reduced levels (Personal observation, Terry Rogers). Within the Sulphur project area, an estimated 5-8% of the mixed conifer has died, in localized patches, due to this insect. These areas of mortality have responded by increased understory vegetation (grasses, forbs and shrubs). (Personal observation, Paul Tidwell)

As evidenced by high tree densities and Stand Density Index values, all forest types remain susceptible to insect/disease outbreak and reduced resiliency.

Susceptibility to Catastrophic Wildfire
The high occurrence of ladder fuels, high tree densities and continuous canopy across the landscape provides conditions that promote active crown fire and catastrophic wildfire across the landscape.

Invasive plants
Invasive tree species do occur in the project area. Species such as Siberian elm and Russian olive are concentrated along travel ways and near developed recreation sites; however, isolated invasive tree species are found throughout the analysis area.

Old Growth
Old growth resources were analyzed at multiple scales, the first being the midscale "Sandia Ecosystem Management Area" (EMA) which includes National Forest lands north of Interstate 40 and outside the Sandia Wilderness; one scale above, which includes the Sandia ecosystem management area plus the Sandia Wilderness; and, at one scale below, at the Sulphur Fuels Reduction Project level (analysis maps are available in project record).

GIS analysis was used to incorporate a variety of resource information including forest inventory data, soils data, local knowledge and a review of past disturbances relating to management, insect/disease and fire activity.

Fully developed old growth structural conditions, as defined on page 65-66 of the Forest Plan, are not yet present in any of the scales being analyzed.

Allocation of at least 20%, by forested ecosystem management area, of old growth has been completed (Forest Plan, page 65). Sites with the most potential to reach old growth status in the earliest timeframe have been allocated for each representative forest type in the project area.

Midscale - The Sandia EMA is characterized by historical, but relatively localized, disturbance mostly from wood harvesting and grazing at the lower elevation ponderosa pine and pinyon-juniper woodland forest types over the last 300-400 years. Lack of access to the higher elevation ponderosa pine and mixed species forests has minimized impacts to those areas. Fire activity, with the exception of the late 1990-1991 Cooper fire (approximately 175 acres) on the northern portion of the area, has been minimal.

Table 8 shows the allocation of the forest types included in this project to be managed for old growth characteristics within the Sandia EMA. Included are "de facto" old growth areas (The Plan, page 55) such as the Bernalillo Watershed Research Natural Area and goshawk nesting areas.

These acreages have been updated with the recently signed Hondo project decision.

Table 8 – Old Growth Allocation within the Sandia EMA

Forest Type	Gross Acres	Old Growth Allocation (acres)
Pinyon-juniper woodland	10,160	2,032 (20%)
Ponderosa pine	2,025	4705 (20%)
Mixed conifer	4,971	995 (20%)

One scale above - The Sandia Wilderness area supplements the Sandia EMA described above to comprise a scale above that initial area. Historic disturbances within the Wilderness area are more limited than in the Sandia ecosystem area due to lack of access, legislative withdrawal of the area as a Wilderness, and lack of historic fire activity.

All forested areas within the Sandia Wilderness are considered "de facto" old growth (Forest Plan, page 65).

Table 9 displays the combined old growth allocated acres by forest type for both the Sandia ecosystem management area and the Sandia Wilderness.

Table 9 – Old growth Allocation within the Combined Sandia EMA and Sandia Wilderness

Forest Type	Gross Acres	Old Growth Allocation (acres)
Pinyon-juniper woodland	11,727	2,345 (20%)
Ponderosa pine	2,963	593 (20%)
Mixed conifer	11,121	2,224 (20%)

One scale below - The Sulphur Project area comprises the scale below the initially described Sandia ecosystem management area. This project area represents that lower elevation portion of the Sandia ecosystem management area that was typically most accessible for wood harvest resulting in disturbance related changes to stand structure over time. Table 10 shows those areas selected for allocation towards old growth by forest type.

Table 10 – Old Growth Allocation within the Sulphur Analysis Area

Forest Type	Gross Acres	Old Growth Allocation (acres)
Pinyon-juniper woodland	650	138 (21%)
Ponderosa pine	400	130 (33%)
Mixed conifer	635	200 (31%)

Northern Goshawk Habitat

Distribution of habitat structures (Forest Plan, page 71-7.1985) for the Northern Goshawk are analyzed at the Sandia ecosystem area scale, the Sulphur Fuels Reduction Project scale and site (stand) scale.

Data supporting this analysis is from 2000 and 2006 forest inventories; also, existing GIS coverage involving insect/disease activity, past management, fire activity and vegetation.

Vegetation Structural Stage (VSS)

Tables 11, 12 and 13 show the distribution, at each scale, for each of the forest types.

Table 11 - Vegetation Structural Stage analysis – Pinyon Juniper woodland

Scale	VSS 1&2 (0”-2.9” drc)	VSS 3 (3”-4.9” drc)	VSS 4 (5”-10.9” drc)	VSS 5 (11”+ drc)	Uneven-aged
Sandia EMA	<1%	9%	14%	42%	34%
Sulphur Project Area	<1%	<1%	25%	36%	38%
Stand (site)	4%	4%	22%	44%	26%

Table 12 - Vegetative Structural Stage analysis – Ponderosa pine forest type

Scale	VSS 1&2 (0-4.9” dbh)	VSS 3 (5”-11.9” dbh)	VSS 4 (12”-17.9” dbh)	VSS 5 (18”-23.9” dbh)	VSS 6 (24”+ dbh)	Uneven-aged
Sandia EMA	4%	14%	26%	9%	6%	41%
Sulphur Project Area	<1%	23%	23%	22%	0%	31%
Stand (site)	10%	39%	16%	7%	2%	26%

Table 13 - Vegetative Structural Stage analysis – Mixed conifer forest type

Scale	VSS 1&2 (0-4.9” dbh)	VSS 3 (5”-11.9” dbh)	VSS 4 (12”-17.9” dbh)	VSS 5 (18”-23.9” dbh)	VSS 6 (24”+ dbh)	Uneven-aged
Sandia EMA	3%	16%	27%	17%	5%	32%
Sulphur Project Area	<1%	46%	21%	11%	0%	21%
Stand (site)	15%	37%	22%	11%	<1%	14%

Tree densities

Average tree densities (trees per acre 0”+ diameter) by forest type at the different scales are shown in Table 14. Relatively high, and consistent, tree densities at all scales reflect the lack of disturbance, either natural or through management, over time.

Table 14 - Average Tree Densities (trees per act 0”+ diameter) by Forest Type at the Different Scales

Forest Type	*Sandia Ecosystem Mgt Area*	Sulphur Project Area	Site
Pinyon-Juniper Woodland	3,119	2,702	Range of 320 – 9,100
Ponderosa pine	2,625	2,135	Range of 1,830 – 5,701
Mixed conifer	3,559	3,483	Range of 774 – 7,906

Snags (standing dead trees)

Snag deficits in the Pinyon-Juniper and Ponderosa pine forest types at the site and project area levels reflect historical use and limited management (prescribed fire, etc.) (Table 15). Higher snag levels, at all scales, in the mixed conifer forest type reflect lack of disturbance and insect/disease related mortality over the years.

Table 15 - Average Number of Snags (standing dead trees >9” dbh/15’ height and >12” drc/10’ height) Per Acre at the Different Scales

Forest Type	Sandia EMA	Sulphur Project Area	Site
Pinyon-Juniper Woodland	1-3	<2	<1
Ponderosa pine	4-6	<2	<1
Mixed conifer	10+	5-7	5-7

Downed logs

Relatively low levels of downed logs in the Pinyon-Juniper and Ponderosa pine forest types at the site and project area levels reflect historical use and limited management due to better accessibility. Downed logs at all scales are typically at higher stages of decay.

In the mixed conifer forest type, downed logs occur at higher levels and reflect the full spectrum of decay. Higher levels in this forest type also reflect lack of disturbance (again due to limited accessibility) and insect/disease related mortality over the years.

Table 16 displays downed log distribution at all scales.

Table 16 - Average Number of Downed Logs (12"+ Midpoint/8' length) per Acre at the Different Scales

Forest Type	Sandia EMA	Sulphur Project Area	Site
Pinyon-Juniper Woodland	1-3	1-2	<1
Ponderosa pine	1-3	1-2	<1
Mixed species	8-10	3-5	3-5

Canopy cover

Canopy cover, for all forest types, tends to be consistently high at the EMA scale due to lack of disturbance and typically dense canopies in the upper elevation forest types. This remains mostly true at the Sulphur Fuels Reduction Project area and site scales although somewhat reduced in the Ponderosa pine and Pinyon-Juniper forest types.

Table 17 displays canopy cover at different scales.

Table 17- Average Canopy Cover per Acre at the Different Scales

Forest Type	Sandia EMA	Sulphur Project Area	Site
Pinyon-Juniper Woodland	35-50%	35-50%	Range from 30-50%
Ponderosa pine	50-60+%	40-60%+	Range from 39-60%+
Mixed conifer	60+%	60%+	60%+

Green House Gases

Green House Gases (GHG) emissions and carbon sequestration are a consideration in any vegetation manipulation project. Forests play a major role in the carbon cycle. The carbon stored in live biomass, dead plant material, and soil represents the balance between CO2 absorbed from the atmosphere and its release through respiration, decomposition, and burning.

Environmental Consequences

Alternative A - No Action

Alternative A would result in continuing management (no treatment) of existing forest vegetation conditions. The forest ecosystem would remain susceptible to the adverse effects of uncharacteristic wildfire and insect/disease outbreak.

Fuel conditions (quantities and distribution) would remain relatively unchanged across the landscape. This, plus high tree densities, continuous canopy cover and ladder fuels would favor active crown fire and catastrophic fire events that would adversely affect forest vegetation.

Stand structure (the horizontal and vertical distribution of forest components including the height, diameter, crown layers, and numbers of trees, shrubs, snags and down woody debris) would remain relatively unchanged. Ladder fuels would remain favoring movement of surface fires into tree canopies.

Conditions related to high Stand Density Index values (full site occupancy by trees; severe competition between trees; active competition induced mortality; minimum individual tree diameter and volume growth; stagnation) would continue unless affected by natural events (wildfire, insect/disease outbreaks, etc.). In a 50 year time frame, modeling indicates that the percent of maximum SDI values would average 75% in the Mixed Conifer forest type and 90-100% in the Pinyon-Juniper and Ponderosa pine forest types. In all cases, the SDI related conditions described in the Affected Environment section would continue to worsen.

Forest vegetation would continue to grow but at reduced rates due to current high tree densities which favor overcrowding and competition for limited nutrients, water and sunlight. Trees, both on an individual and landscape basis, would continue to be stressed and more susceptible to drought and insect and disease attack. Higher rates of mortality, as a result, resulting from these causes could be expected.

Average stem diameters would remain low. Modeling indicates the average stem diameter in the included forest types would not exceed 6”-6.5” over a fifty year time frame.

Currently undesirable structural conditions within Northern Goshawk foraging, PFA and nesting habitats and MSO Restricted Habitats would remain essentially unchanged and would remain so for an extended period of time until disturbed by natural factors (wildfire or insect/disease outbreak). In the event of such disturbances, such key habitat would be at risk.

The dramatic increases in stand density and basal area over the last 80-90 years…represent an increased susceptibility for bark beetle epidemics and stand-replacing wildfire (Margaret M. Moore, et al. 2004). Research indicates that risk of Mountain Pine beetle attack in Ponderosa pine increases from a level of low to moderate when residual basal areas exceed 100 sq. ft/ac (Munson and Anhold. 2000). Modeling indicates basal areas within the Ponderosa pine forest type will increase from already high current levels of 203 sq. ft/ac to 235 sq. ft/ac in a fifty year time period. The same concept would apply in the Pinyon-Juniper woodland in relation to the Pinyon Ips beetle.

Invasive plant species would continue to be identified and mapped through random surveys in the area. Appropriate treatment strategies would have to be developed based on these random findings.

The grass/forb/shrub component would continue to lack in diversity, vigor and abundance.

Recruitment and enhancement of old growth at all scales would continue to occur, although at the current, slower pace; in addition, such areas would be susceptible to uncharacteristic wildfire and/or insect/disease outbreaks.

Green House Gases (GHG) emissions and carbon sequestration levels would continue at current levels.

Alternative B

Alternative B effectively provides for a more sustainable and resilient forest condition from the perspective of reducing the likelihood of both catastrophic wildfire and insect/disease outbreak. Reducing tree densities, ladder fuels, fuel loadings as well as improving both vertical and horizontal structural diversity will lessen the likelihood of catastrophic wildfire.

Key wildlife habitat objectives (enhancement and protection of Northern Goshawk foraging, PFA and nesting sites; MSO Restricted Habitat; as well as old growth) would be more readily met. Old growth recruitment/development at the project scale would be enhanced through reduction of tree densities and resultant improvement in tree vigor and growth. Allocated old growth areas would be better protected from catastrophic wildfire and insect/disease outbreaks.

Management objectives, including the implementation of uneven-aged management, as provided in the Cibola FLMP are implemented. This alternative treats only a minor portion of the total landscape in need of treatment; however, from a smaller scale, effective vegetation treatments would be implemented that meet Forest Plan goals on a site specific (localized) basis and in a strategic portion of the Sandia RD.

Desired Vegetative Structural Stand (VSS) class distribution would be enhanced, and brought more into desired balances, through the recruitment of VSS classes 1 and 2 (seedlings and saplings) over

approximately 10% of the each of the forest types Increased development of the mature and old forest classes through reduced competition and increased tree vigor would occur. These structural conditions would not be completely achieved in this initial entry but would be placed on a trajectory towards meeting those conditions in the future.

The percent of maximum Stand Density Index levels would initially be decreased to 15-25 percent in the Pinyon-Juniper and Ponderosa pine forest types providing for more open forest conditions, increased tree growth/vigor and recruitment of understory grasses, forbs and shrubs. Subsequent levels would vary by forest type would generally provide for limited completion between trees and increased tree vigor and resiliency. Within the Mixed Conifer forest type, percent of maximum SDI levels would be higher but would still meet Cibola FLMP direction for MSO Restricted Habitat and provide for enhanced forest health conditions.

Average stem diameters can be expected to increase 3-5 times, over the next 50 years, as compared to the No Action alternative.

FVS modeling of the proposed treatments indicates that project level canopy cover would range between 33 and 50 percent in the Ponderosa pine forest type over time and be maintained at higher levels in the Mixed Conifer forest type. At the group level, canopy cover would meet the Cibola FLMP requirements within the VSS 4 through VSS 6 groups. Outside the analysis area, canopy cover levels would remain at current levels and continue to increase over time.

The risk of Pinyon Ips (Pinyon-Juniper woodland) and Mountain Pine Beetle (Ponderosa pine) attack would be minimized through lower tree densities and increased tree vigor.

The Gambel oak component can be expected to respond vigorously though the proposed treatments. In habitat types where Gambel oak is a significant component, “Gambel oak…can resprout prolifically” (Plant Associations of AZ and NM, Volume 1: Forests, pg. 229).

Native tree species composition would be maintained across the landscape and treatment of inventoried invasive tree species would occur.

The proposal to burn natural and activity created woody material, either through prescribed or pile burning, within the project area would directly release CO2 during the burning operations. This would contribute to increasing the atmospheric greenhouse gas concentration. However, restoration (or maintenance) of the desired conditions would result in a lower risk of uncharacteristically severe wildfire for those treated acres. This reduced risk has a two-fold effect on GHG emissions or the carbon cycle:

1) There is a direct beneficial effect on climate change of decreased GHG emissions from these acres because the risk of acres being burned by uncharacteristically severe wildfires would be reduced, and

2) There is an indirect beneficial effect by treating these acres because live stands of trees would retain higher capacity to sequester carbon dioxide compared to stands killed by uncharacteristically severe wildfires, especially if not immediately reforested.

It would be difficult to determine the significance of effects of one project on greenhouse gases directly, and therefore climate change indirectly, as there are currently no Federal statutes, regulatory standards, or policy direction on the significance of such effects. Until meaningful, accepted thresholds are adopted against which to weigh any project-related GHG emissions, it would not be possible to determine whether a specific project would have a significant effect under this factor.

Forest Vegetation Simulator depictions of resultant structural conditions in the Pinyon-Juniper Woodland/Ponderosa pine and Mixed Conifer forest types are shown in Figures 2 and 3 of the Vegetation Specialist Report.

Cumulative Effects

Current vegetation conditions (the affected environment) in the Sandia EMA are a reflection of past and present treatments.

Past activities

Intensive grazing occurred in the late 1700's to early 1900's. Intensified tree harvest coincided with the arrival of the Atchison, Topeka and Santa Fe railroad in the late 1800's; however, tree harvest has typically been limited to the lower elevations due to poor access to the remainder of the EMA. Most of these harvests were for fuel wood, railroad ties, etc.

Approximately 40-90 acres, located in the higher elevations of the Sandia Mountains, were clearcut in association with the Crest Aspen projects in the mid-late 1990's for aspen regeneration purposes.

Wildfire has been of low occurrence within the EMA with the 1990-1991 Cooper fire (approximately 175 acres) in the northern portion of the District being the most significant fire event in recent times.

The Hondo Fuels Reduction Project was approved for thinning and regeneration activities in 2010. This 400 acre project lies immediately south of the proposed Sulphur fuels reduction project. Implementation is expected in late 2011.

The District has a program of removing "danger trees" in areas of high recreational use. Approximately 200 such trees are removed each year and sold as fuel wood.

Reasonably foreseeable activities

While several projects, involving vegetation management, are being contemplated, none are currently within the formal NEPA analysis process.

There is uncertainty and unknown risks associated with global climate change and the ultimate effects on climate change are indeed the results of incremental cumulative effects of many actions, most of which are outside the Agency's control. We cannot discern significant climate change effects from the proposed Sulphur Fuels Reduction project, given the context of projects and plans and the lack of effects that can be meaningfully evaluated under current science, modeling, and policies.

In summary, no adverse cumulative effects on vegetation resources would be sustained from past, present, or reasonably foreseeable future actions in combination with the effects of the proposed action.

Wildlife

The proposed Sulphur Forest Restoration Project (the project) is located on the east side of the Sandia Mountains. The project area includes 544 acres of pinyon-juniper woodland, 445 acres of ponderosa pine forest, 681 acres of mixed conifer forest, and 7 acres of riparian habitat. There is a direct connection between vegetation types and wildlife use of sites in the project analysis area. Wildlife analyzed in this report includes Threatened and Endangered species, Forest Service Sensitive species, Management Indicator Species (MIS), and Migratory Birds. This Wildlife Specialist Report incorporates the Vegetation, Watershed and Fire / Fuels Specialist Reports by reference.

Affected Environment (Habitat Existing Conditions)
Reduction of natural processes such as low fire intervals in the pinyon-juniper type have resulted in a tightly closed woodland canopy, and a reduced grass, shrub, and forb understory. Wildlife species dependent on diverse habitat within the woodland system are limited due to lack of understory vegetation. Pinyon-juniper woodlands are important to wildlife because they provide pinyon nuts and juniper berries that are readily available forage for many wildlife species. Other habitat features include important winter range for game mammals and birds, travel corridors, thermal cover, dead and down woody materials used for nesting and resting, and snags used by cavity nesting species.

Ponderosa pine forests provide forage and cover for many species of wildlife. Habitat features common in ponderosa pine forest include roost and nest trees, snags and large downed logs, abundant needle litter, thermal cover, travel corridors, grassy forest openings, fawning areas for deer, and natural water sources. Much of this habitat type within the project boundary is vegetated by even-aged stands. These ponderosa pine stands lack the understory vegetation necessary for wildlife species diversity. There are very few older age class ponderosa pine stands with large diameter trees, snags and large downed logs. Management of habitat for the northern goshawk is an important consideration in this habitat type.

In the mixed conifer forest, much of the habitat in the project area is in canyon bottoms and north facing slopes. Old growth trees with associated downed logs and woody debris are important habitat features. Springs, seeps, and other water sources are more common in the mixed conifer habitat type, as are rock outcrops and snags. Management of habitat for the Mexican spotted owl is an important consideration in this habitat type.

Wildlife use riparian habitat types disproportionately more than the availability of these areas across the landscape. These areas provide essential components such as water and forage for many wildlife species. Some riparian areas have been degraded due to non-native plant species invasion and conifer encroachment, as well as shading and crowding out of riparian vegetation, as a result of past management practices such as the exclusion of fire. In these areas, there is little shrub or herbaceous understory and bank stability has been reduced allowing accelerated channel degradation and increases in sediment. Riparian areas are located near Canoncito Spring, Armijo Spring and in the developed picnic areas at Doc Long, Sulphur and Cienega. There is a complete overlap of recreation trails and picnic areas with riparian habitat causing degradation of habitat and displacement of wildlife.

Due to fire suppression, a gradual yet continual buildup of coniferous trees has increased tree density of all species in the project area, resulting in high potential for ladder fuels (smaller, dense stands of trees that allow wildfires to reach the canopy) to accumulate. This dense accumulation also shades the understory, reducing grass/forb and shrub components essential as wildlife forage and cover.

<u>Threatened and Endangered Species</u>
The U.S. Fish and Wildlife Service list of threatened, endangered, and proposed species which may occur in Bernalillo County was reviewed to determine potential wildlife and plant species which may occur in the analysis area. The New Mexico Department of Game and Fish's 2012 Biennial Review of the list of Threatened and Endangered species of New Mexico was also consulted. The website "New Mexico Rare Plants" (http://nmrareplants.unm.edu/) was reviewed but there are no known populations of rare or endangered plants in the analysis area. Refer to the project level Biological Evaluation report in the project. There is no Critical Habitat for listed species in the analysis area.

Threatened, endangered, or proposed wildlife species which may occur or have potential habitat in the project area include the Mexican spotted owl (MSO, Table 18). No known Protected Activity Centers (PACs) or Designated Critical Habitat occur within the project boundary; potential Recovery habitat

exists in the 681 acres of mixed conifer forest and the 7 acres of riparian habitat. Species whose habitats do not occur in the project area were not considered further. Table 18 displays species considered and whether they are likely to occur in the analysis area. Only highlighted species will be considered further.

Table 18 - Potential Threatened and Endangered Species

Common Name	Scientific Name	Group	Status	Habitat Type
Black-footed ferret	*Mustela nigripes*	Mammal	Endangered	Plains grassland- Occurs only in association with prairie dog towns. There are no prairie dog towns in the project area.
Rio Grande silvery minnow	*Hybognathus amarus*	Fish	Endangered	Aquatic- There is no link or association between the project area and the Rio Grande where the species occurs.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Bird	Endangered	Riparian- Occurs in lower elevation boggy riparian areas with an overstory of cottonwood and willows. This habitat type does not occur within the analysis area.
Mexican spotted owl	*Strix occidentalis lucida*	Bird	Threatened	Mixed conifer- Occurs in Mixed conifer and montane riparian habitat. There are 681 acres of mixed conifer and 7 acres of riparian (Recovery habitat) in the analysis area. There are no known territories or designated Critical Habitat in the project area. The area was surveyed to protocol with no MSO found. This species will be considered further.
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Mammal	Proposed, Endangered	Riparian- Occurs in areas with saturated soils and tall dense patches of sedges.

MSO habitat existing condition: Mixed conifer forest types in the project area are experiencing competition which is causing mortality, declining health, and increased susceptibility to insect and disease activity, as well as wildfire. An ecosystem assessment was conducted at the project scale as well as at the district-wide scale, and identified and designated areas exceeding 25% of the total mixed conifer area.

MSO habitat desired condition: The CIF Forest Plan describes standards and guidelines for management prescriptions for Mexican spotted owl habitat, as detailed in the Recovery Plan.

Provide three levels of habitat management - protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape.

Protected areas include delineated protected activity centers (PACs; none in the project area); mixed conifer forests with slopes greater than 40 percent where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. Restricted areas include all mixed-conifer and riparian forests outside of protected areas. While pine-oak is included in certain recovery units, this is not the case for the project area which is in the Basin and Range – East Recovery Unit. Other forest and woodland types include all ponderosa pine, spruce-fir, woodland, and aspen forests outside protected and restricted areas. Limit human activity in protected activity centers during the breeding season, which is March 1 to August 31.

Mixed Conifer Forests: Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species.

The minimum mixed conifer restricted area includes 10 percent at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10 percent in BR-E and +15 percent in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area across simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus.

Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions. Maintain all species of native trees in the landscape including early seral species. Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure. Emphasize uneven-aged management systems. However, both even-aged and uneven aged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Existing stand conditions will determine which system is appropriate. Extend rotation ages for even-aged stands to greater than 200 years. Silvicultural prescriptions should explicitly state when vegetative manipulation will cease until rotation age is reached. Save all trees greater than 18 inches DBH. Encourage prescribed and prescribed natural fire to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire.

Retain substantive amounts of key habitat components:

- Snags 18 inches in diameter and larger
- Down logs over 12 inches midpoint diameter
- Hardwoods for retention, recruitment, and replacement of large hardwoods
- Riparian Areas

Riparian Areas: Emphasize maintenance and restoration of healthy riparian ecosystems through conformance with forest plan riparian standards and guidelines. Management strategies should move degraded riparian vegetation toward good condition as soon as possible. Damage to riparian vegetation, stream banks, and channels should be prevented.

Other forest and woodland types - Apply ecosystem approaches to manage for landscape diversity mimicking natural disturbance patterns, incorporating natural variation in stand conditions and retaining special features such as snags and large trees, utilizing appropriate fires, and retention of existing old growth in accordance with forest plan old growth standards and guidelines.

Sensitive Species

The Regional Forester's Sensitive species list for the Southwestern Region was reviewed to determine potential wildlife or plant species which may occur in the analysis area. Refer to the project level Biological Evaluation report in the project record. The following Forest Service Regional Forester's sensitive species were considered but not evaluated due to the absence of suitable or potential habitat in the analysis area (Table 19).

Table 19 - Sensitive Species Considered but not Evaluated

Common Name	Scientific Name	Group	Condition in Project Area
Western burrowing owl[1]	*Athene curnicularia hypugaea*	Bird	Associated with prairie dog towns, which are not found in the project area.
Peregrine falcon[1]	*Falco peregrinus anatum*	Bird	No preferred or available cliff nest sites affected; no direct link to prey.
Gray vireo	*Vireo vicinior*	Bird	This species inhabits dry-shrub dominated landscapes mingled with networks of shallow arroyos. Elevations where it nests range from 5,000 to 6,500 ft. There is no suitable habitat for this species in the project area.
Sandia alumroot	*Heuchera pulchella*	Plant	Populations currently recorded from Sandia Mountain near the crest, outside of the project area.
Loggerhead shrike	*Lanius ludovicianus*	Bird	Has not been located along breeding bird surveys conducted in Armijo and Bill Spring Canyons.
Plains leopard frog	*Rana blaira*	Amphibian	Require dense aquatic emergent vegetation for breeding, larger streams for overwintering; no habitat in project area.
Bald eagle	*Haliaetus leucocephalus*	Bird	Occurs only as a rare transient in the project area.
Yellow-billed cuckoo[2]	*Coccyzus americanus occidentalis*	Bird	Occurs in lower elevation cottonwood and willow riparian woodland habitat outside the analysis area.
Rocky Mountain bighorn sheep	*Ovis canadensis canadensis*	Mammal	Found adjacent to cliff habitat; no longer occurs on the Sandia Ranger District.

[1]U.S. Fish and Wildlife Service Species of Concern for planning purposes.
[2]U.S. Fish and Wildlife Service Candidate Species.

Sensitive wildlife species which may occur or have potential habitat in the project area include: northern goshawk, loggerhead shrike, Merriam's shrew, dwarf shrew, spotted bat, and pale Townsend's big-eared bat (Table 20). A northern goshawk territory is located in the project area. A Post-Fledging Family Area (PFA) and associated nest areas were established within the project area and the territory is monitored annually.

Table 20 - Potential Sensitive Species

Common Name	Scientific Name	Group	Habitat Type
Northern goshawk[1]	*Accipiter gentilis*	Bird	Ponderosa pine-and oak habitat with open areas, woody debris to support abundant prey. There is one known territory in the project area and the ponderosa pine habitat is considered suitable for future occupancy. Surveys were conducted to protocol in the project area, but no other territories were located. "Management Recommendations for the Northern Goshawk in the Southwestern United States" (USFS General Technical Report RM-217) outlines desired forest conditions for the 6,000 acre home range used by a breeding pair of goshawks including the viability of 14 important prey species.
Merriam's shrew	*Sorex merriami leucogenys*	Mammal	This species is generally associated with dry habitats, usually near water. No surveys have been conducted for this species in the project area, but potential habitat is present.
Dwarf shrew	*Sorex nanus*	Mammal	The preferred habitat is talus and other rocky areas primarily in mixed conifer forest. No surveys have been conducted for this species in the project area, but potential habitat is present.
Spotted bat	*Euderma maculatum*	Mammal	This species is a cliff dweller that roosts in cracks and crevices in rock in forested areas near open water. No surveys have been conducted for this species in the project area.
Pale Townsend's big-eared bat[1]	*Corynorhinus townsendii pallescens*	Mammal	Conifer forests strongly associated with the availability of caves or cave-like roosting habitat (mines, buildings, etc.) provide habitat for the Townsend's big-eared bat. No surveys have been conducted for this species in the project area.

[1]U.S. Fish and Wildlife Service Species of Concern for planning purposes

Northern Goshawk habitat existing condition: Management Scale - Distribution of habitat structures (tree size and age classes, tree groups of different densities, snags, dead and down woody material, etc.) was evaluated at the ecosystem management area level, at the mid-scale such as drainage, and at the small scale of site. The following tables were produced for the vegetation specialist report and are reprinted below. Refer to the vegetation specialist report in the project record.

Table 21 - Distribution by VSS Class and Forest Type (percentage) for Forested Areas within the Sandia Ecosystem Management Area

Forest Type	VSS 1/2	VSS 3	VSS 4	VSS 5	VSS 6	Uneven-Age
Pinyon-Juniper Woodland	<1%	9%	14%	42%	--	34%
Ponderosa Pine	4%	14%	26%	9%	6%	41%
Mixed Conifer	3%	16%	27%	17%	5%	32%

Table 22 - Distribution by VSS Class and Forest Type (percentage) for Forested Areas within the Sulphur Project Area

Forest Type	VSS 1/2	VSS 3	VSS 4	VSS 5	VSS 6	Uneven Age
Pinyon-Juniper Woodland	<1%	<1%	25%	36%	--	38%
Ponderosa Pine	<1%	23%	23%	22%	0%	31%
Mixed Conifer	<1%	46%	21%	11%	0%	21%

Table 23 - Distribution by VSS Diameter Groups (By Site) at the Site Level

Forest Type	VSS 1/2	VSS 3	VSS 4	VSS 5	VSS 6	Uneven Age
Pinyon-Juniper Woodland	4%	4%	22%	44%	--	26%
Ponderosa Pine	10%	39%	16%	7%	2%	26%
Mixed Conifer	15%	37%	22%	11%	<1%	14%

Across the Ecosystem Management Scale, there is a surplus of VSS 4 in ponderosa pine and mixed conifer forests, which are lacking trees in the mature VSS classes, especially 6. Ponderosa pine forests in the project area show a similar age class distribution as that reflected in the EMA scale, while there is a relatively small amount of mixed conifer in the project area exclusively in VSS 1/2 and 5/6. Ponderosa pine and mixed conifer forests in the project area are lacking trees in VSS 6. Pinyon juniper woodlands in the EMA and project area are primarily older trees, lacking middle and younger age classes. Management activities will help push stands toward a more desirable age class distribution.

Table 24 - Average Tree Densities (trees per acre) by Forest Type at the Different Scales

Forest Type	*Sandia EMA*	Sulphur Project Area	Site Level
Pinyon-Juniper Woodland	3,119	2,702	320-9,100
Ponderosa Pine	2,625	2,135	1,830-5,701
Mixed Conifer	3,559	3,483	774-7,906

Average tree densities (trees per acre) by forest type at the different scales are shown in Table 24. Relatively high and consistent tree densities, at all scales, reflect the lack of disturbance, either natural or through management, over time.

Table 25 - Average Number of Snags (standing dead trees) Per Acre at the Different Scales (pinyon-juniper at least 12-inchdrc/10-foot height; ponderosa pine 9-inch dbh/15-foot height)

Forest Type	*Sandia EMA*	Sulphur Project Area	Site Level
Pinyon-Juniper Woodland	1-3	<2	<1
Ponderosa Pine	4-6	<2	<1
Mixed Conifer	10+	5-7	5-7

Snag deficits in the pinyon-juniper and ponderosa pine forest types at the site and Sulphur Forest Restoration analysis area levels reflect historical use and limited management (prescribed fire, etc.) due to limited accessibility (Table 25). Higher snag levels, at the Sandia Ecosystem level, are a result of recent insect and disease activity across the landscape.

Table 26 - Average Number of Downed Logs 12”+ Midpoint per Acre at the Different Scales

Forest Type	*Sandia EMA*	Sulphur Project Area	Site Level
Pinyon-Juniper Woodland	1-3	1-2	<1
Ponderosa Pine	1-3	1-2	<1
Mixed Conifer	8-10	3-5	3-5

Relatively low levels of downed logs in the Pinyon-Juniper and Ponderosa pine forest types at the site and project area levels reflect historical use and limited management due to accessibility. Downed logs at all scales are typically at higher stages of decay.

In the mixed conifer forest type, downed logs occur at higher levels and reflect the full spectrum of decay. Higher levels in this forest type also reflect lack of disturbance (again due to limited accessibility) and insect/disease related mortality over the years.

Northern Goshawk habitat desired condition: The CIF Forest Plan describes standards and guidelines for ecosystem management in Northern goshawk habitat, as detailed in the General Technical Report RM-217 (Reynolds et al 1992).

Establish a post-fledging family area that includes six nesting areas per pair of nesting goshawks. Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer and spruce-fir forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Sustain a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape. Provide foods and cover for goshawk prey. Limit human activity in nesting areas during the breeding season.

HOME RANGE ESTABLISHMENT
Post-fledging family areas (PFA) will be approximately 600 acres in size. Post-fledging family areas will include the nest sites and consist of the habitat most likely to be used by the fledglings during their early development. Establish a minimum of three nest areas and three replacement nest areas per Post-fledging family area. The nest areas and replacement nest areas should be approximately 30 acres in size. A minimum total of 180 acres of nest areas should be identified within each post-fledging family area. Manage for nest replacement sites to attain sufficient quality and size to replace the three suitable nest sites.

VEGETATION MANAGEMENT
Landscapes outside (Goshawk post-fledging family area's)
The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10 percent grass/forb/shrub (VSS1), 10 percent seedling-sapling (VSS2), 20 percent young forest (VSS3), 20 percent mid-aged forest (VSS4), 20 percent mature forest (VSS5), 20 percent old forest (VSS6). Identify and manage dispersal PFA and nest habitat at 2-2.5 mile spacing across the landscape.

Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+ percent and 2/3 40+ percent, mature forest (VSS 5) should average 50+ percent, and old forest (VSS 6) should average 60+ percent. Maximum opening size is up to four acres with a maximum width of up to 200 feet. Retain one group of reserve trees per acre of 6 trees per group for openings greater than one acre in size. Leave at least three snags, five downed logs, and 10-15 tons of woody debris per acre.

Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+ percent, mature forest (VSS 5) should average 40+ percent, and old forest (VSS 6) should average 40+ percent. Opening size is up to four acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size. Leave at least two snags per acre, three downed logs per acre, and 5-7 tons of woody debris per acre.

Woodland: Manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris.

Within post-fledging family area's
Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family

area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area.

Ponderosa Pine: Canopy Cover for middle aged forest (VSS 4) should average 1/3 60+ percent and 2/3 5O+ percent. Mature VSS 5) and old forest {VSS 6) should average 50+ percent.

Woodland: Maintain existing canopy cover levels.

Within Nesting Areas
Provide unique nesting habitat conditions for goshawks. Important features include trees of mature to old age with high canopy cover. The structure of the vegetation within nest areas is associated with the forest type, and tree age, size, and density, and the developmental history of the stand. Preferred treatments to maintain the desired structure are too thin from below with non-uniform spacing and use of hand tools and fire to reduce fuel loads. Lopping and scattering of thinning debris is preferred if prescribed fire cannot be used. Piling of debris should be limited. When necessary, hand piling should be used to minimize compaction within piles and to minimize displacement and destruction of the forest floor and the herbaceous layer. Do not grapple or dozer-pile debris. Manage road densities at the lowest level possible to minimize disturbance in the nest area. Use small, permanent skid trails in lieu of roads for timber harvesting.

Mixed Conifer and Ponderosa Pine Cover Types: The nesting area contains only mature to old forest (VSS 5 & 6) having a canopy cover (measured vertically) between 50-70 percent with mid-aged VSS 6 trees 200-300 years old. Non-uniform spacing of trees and clumpiness is desirable.

Woodland: Maintain existing canopy cover levels.

HUMAN DISTURBANCE
Limit human activities in or near nest sites and post-fledging family area's during the breeding season so that goshawk reproductive success is not affected by human activities.

The breeding season extends from March 1 through September 30. Low intensity ground fires are allowed at any time in all forested cover types, but high intensity crown fires are not acceptable in the post-fledging family area or nest areas. Avoid burning the entire home range of a goshawk pair in a single year. For fires planned in the occupied nest area, a fire management plan should be prepared. The fire management plan should minimize the risk of goshawk abandonment while low intensity ground fire burns in the nesting area. Prescribed fire within nesting areas should be planned to move with prevailing winds away from the nest tree to minimize smoke and risk of crown fire developing and driving the adults off or consuming the nest tree.

Management Indicator Species
The Forest Plan identified 13 forest-wide Management Indicator Species (MIS) to estimate the effects planned activities may have on wildlife forest-wide and project level habitat and populations. All 13 MIS species were considered for this analysis, but only those species whose habitat occurs in the project area were considered further.

Based on the habitat types that exist in the analysis area the following MIS were selected for analysis: elk, mule deer, juniper titmouse, black bear, pygmy nuthatch, hairy woodpecker, Merriam’s turkey, and house wren. Only those MIS likely to occur in the project area were analyzed. Table 27 describes the habitat type, existing habitat trends, management indicator species, and existing MIS population trends. Refer to the Forest-wide MIS report in the project (USDA Forest Service 2005).

Table 27 - Habitat Types, MIS, and Existing Forest-wide Habitat and Population Trends

Habitat Type	Acres in Project Area	Existing Forest-wide Habitat Trend	Management Indicator Species	Existing Forest-wide Population Trend
Pinyon-juniper	544	Stable	Mule deer	Downward
			Juniper titmouse	Downward
Ponderosa pine	445	Stable	Pygmy nuthatch	Stable
			Merriam's turkey	Upward
Mixed conifer	681	Stable	Hairy woodpecker	Upward
			Black bear	Stable
			Elk	Upward
Riparian	7	Upward	House wren	Stable

MIS for the pinyon-juniper woodland are mule deer and juniper titmouse. Mule deer can be found in the area yearlong. Mule deer numbers in general have decreased over the past decade and mid-successional habitats used by deer are being reduced due to a lack of disturbance from fire or restoration treatments. The juniper titmouse is a woodland species that nests in cavities. Older age class pinyon and juniper trees in open canopy stands are the primary nesting habitat. Existing population trend for the species is downward statewide in New Mexico due to conversion of woodland habitat to rangeland, removal of mature and senescent trees in pinyon-juniper habitat, and overall decline of this habitat due to drought and beetle infestation.

MIS for the ponderosa pine forest are pygmy nuthatch and Merriam's turkey. The pygmy nuthatch is a cavity nester and prefers old-growth ponderosa pine. The Merriam's turkey is a habitat generalist that occurs in ponderosa pine, pine-oak and pinyon-juniper woodlands. It was reestablished in the Sandia Mountains in the early 2000's and has continued to expand its range in the area.

MIS for mixed conifer are black bear, elk, and hairy woodpecker. Black bear are found throughout the project area where they require woodland cover and food producing shrubs and trees such as oak, pinyon, current, sumac, cactus fruit, and bear corn which are all abundant in the project area. Bear populations appear to cycle in relationship to mast (acorn and pinyon nut) crops, which are dependent on precipitation and absence of late freezes. Hairy woodpeckers are a primary cavity excavator found in several habitat types with larger diameter snags. Elk are not common in the Sandia Mountains, but may be found in the project area. Elk prefer open grassy meadows located less than ½ mile from water. Sedges are most often selected as forage. Many of the grassy openings on the analysis area are being encroached upon by conifer trees. Hiding cover for elk occurs in stands 30 to 60 acres in size with 70 percent canopy cover. Road density is also an important habitat consideration with optimum road spacing at less than ¼ mile of primary road per section of land (640 acres).

MIS for riparian habitat is the house wren. The house wren feeds on insects in the understory of riparian vegetation primarily at elevations from approximately 7,500 feet to 8,500 feet. It is a summer resident of the project area and a Neotropical migrant. Limiting factors for house wrens appear to be suitable snags and cavities in proximity to riparian areas.

Migratory Birds

On January 10, 2001, Executive Order 13186 was signed placing emphasis on conservation of migratory birds. The Executive Order supplements the Migratory Bird Treaty Act which has been in effect since the early 1900's. Effects to migratory birds are analyzed in the following manner: (1) effects to Highest Priority Birds listed by Partners in Flight (Partners in Flight 2007); (2) effects to Important Bird Areas (IBAs); (3) effects to important over-wintering areas.

On the Cibola National Forest, populations of birds are monitored through the use of breeding bird surveys (BBS) on geographic areas to detect population and trend during the breeding period. There are two types of BBS survey done on the Cibola National Forest: The U.S. Geological Survey monitoring routes, which are 24.5 miles in length, and Cibola NF BBS routes. These latter surveys are from one to two miles in length with either six to eleven points, respectively. Each point is surveyed for 10 minutes. There are two Cibola NF BBS routes in the project area. The Armijo Canyon and Bill Springs routes are located in various habitat types representative of all habitats in the project area. Refer to the Cibola National Forest Breeding Bird report for 2010 and supplement for 2012 for additional details (USDA Forest Service 2010).

Priority Birds identified for the Southern Rockies/Colorado Plateau Conservation Region were reviewed for potential occurrence in the project area. The loggerhead shrike and gray vireo were considered as sensitive species. Year-round residents were excluded from the Migratory Bird analysis (juniper titmouse, scaled quail, pinyon jay, and Crissal thrasher). Priority bird habitat in the project area is: pinyon-juniper, ponderosa pine, mixed conifer, and riparian. Different vegetation types provide habitat for a variety of migratory birds. There are no IBAs within the project area. The nearest IBA is located on the south end of the Sandia's at the HawkWatch raptor count site. There are no over-wintering areas identified in the project area. Migratory bird species evaluated are summarized in Table 28. Population trends were determined according to Partner's In Flight assessments (New Mexico Partners in Flight 2007).

Table 28 - Migratory Bird Species Evaluated In the Vegetation Types in the Analysis Area

Habitat Type	Species	Population Trend	Comments
Pinyon-juniper: 544 acres	Virginia's warbler	Stable	The species is common when Gamble oak understory is available from May through July and during dispersal and migration.
	Black-throated gray warbler	Downward	The location of this species is generally in elevations lower than the project area, but it may occur uncommonly from May to September in mesic woodlands with a high canopy cover interspersed with shrubs.
Ponderosa Pine: 445 acres	Flammulated owl	Unknown	This cavity nesting species occurs commonly from May to September where large, old ponderosa pine trees exist.
	Grace's warbler	Downward	The area contains suitable habitat, where it nests in the upper canopy of contiguous ponderosa pine stands. It is relatively common from May to September.
Mixed Conifer: 681 acres	Band-tailed pigeon	Downward	This species is probably not common within the project area, but occurs when there is an abundant mast crop from May to September.
	Broad-tailed hummingbird	Stable	There is suitable habitat that occurs from about 7,000 feet upwards for this species where it occurs from May to September.
Riparian: 7 acres	Red-naped sapsucker	Stable	This species feeds primarily in deciduous forest along riparian areas and requires hard snags for nesting cavities.

Environmental Consequences

Threatened and Endangered Species

Alternative A - No Action

Alternative A would not reduce the tree densities in the Sulphur Forest Restoration project area; density and canopy cover of all forest types would continue to increase throughout the project area. Existing small openings and forb/shrub/grassland areas would continue to decrease in size. Fuels build-up would continue, leading to increased potential for a crown fire if wildfire occurs in the area.

Alternative B

In general Alternative B provides reduced potential of stand replacing wildfire since fuels would be reduced throughout the area. An uneven-aged forest structure with native species diversity and natural variation would be created by retaining all age classes and sizes. All large trees over 16” DBH or DRC will be retained.

In mixed conifer habitat, thinning up to 15.9” DBH or DRC would be conducted by retaining trees to a residual of 90-115 TPA, including up to 10% of trees with dead tops, decadence, and/or irregular crowns to provide habitat for a variety of prey species. All large oaks and native deciduous hardwoods (10” DRC and greater) would be retained. Natural regeneration of hardwoods would be promoted by removing competing conifers. Existing patches of snags will not be treated unless determined to be hazard trees. Natural disturbance patterns will be mimicked on up to 10% of project acres to provide spatial heterogeneity and horizontal variation by creating temporary openings that range from 1/10th of an acre to ¼ of an acre in size in mixed conifer. Key habitat components such as on average at least 2 snags and 5-7 tons of downed woody debris per acre would be retained. Twenty percent (67 acres) of the project area will not be treated and maintained for threshold conditions for Mexican Spotted Owl restricted habitat.

The Canoncito Trail is poorly located and significantly contributing to sediment in the drainage as well as damage to the limestone terraces and riparian habitat. Relocation of this trail will improve riparian habitat.

The proposed action incorporate designs to lessen effects to threatened and endangered species. Implementation of Alternative B would provide essential habitat components such as snags, downed logs, residual basal area, and canopy cover necessary for potential occupancy of threatened and endangered species (Forest Plan page 71-2).

Table 29 - Summary of Effects Determinations to TE Species by Alternative

Species	Alternative A	Alternative B
Mexican spotted owl	Continuation of fuels build-up and small diameter (ladder) trees, leading to a potential crown fire if wildfire occurs in the area. Important habitat features such as snags, and large down logs could be burned. Riparian habitat would not be improved. No effect in the short term. In the long term disease, insects and drought may create some natural variation in the mixed conifer habitat.	This alternative would reduce ladder fuels; maintain snags, downed logs and residual basal area for potential MSO occupancy on 681 acres of mixed conifer habitat. Tree cutting would occur in unoccupied mixed conifer habitat, with methods and results being consistent with the Forest Plan. Trail reroutes are generally located outside of MSO habitat. Existing trail rerouting is in riparian habitat causing short-term effects due to rehabilitation efforts. In the long term, riparian habitat will be improved. May affect species, not likely to adversely affect species or its habitat.

<u>Sensitive Species</u>

Alternative A

Alternative A would not reduce the tree densities in the Sulphur Forest Restoration project area; density and canopy cover of all forest types would continue to increase throughout the area. Existing small openings and forb/shrub/grassland areas would continue to decrease in size. Fuels build-up would continue, leading to a crown fire if wildfire occurs in the area. Disturbance to wildlife species and loss of habitat from use of existing trails in riparian areas would continue.

Alternative B

In general Alternative B provides reduced potential of stand replacing wildfire since fuels would be reduced throughout the area. Alternative B would incorporate mitigation measures designed to lessen effects to sensitive species. No adverse management activities will occur within the Post-Fledging Family Area from March 1 to September 30. Vehicle related disturbance would increase in the short term due to project activities. Trail rerouting out of riparian areas would decrease disturbance to wildlife and loss of habitat in the long term, but rerouting activities would displace wildlife in the short term.

Implementation of the project would result in mosaics of small, highly interspersed groups of different VSS, where grass, forb, and shrub habitat is interspersed around the VSS groups to provide habitat for rabbits, ground squirrels, and birds. These groups of trees interspaced within a grass/forb/shrub mosaic would also provide an irregular and discontinuous forest canopy with variable tree densities and discontinuous arrangement of fuels which minimizes the potential for crown fire and facilitates the use of low intensity prescribed fire. Implementation of Alternative B would provide essential habitat components such as snags, downed logs, residual basal area, and canopy cover necessary for potential occupancy of sensitive species.

Table 30 - Summary of Effects Determinations to Sensitive Species by Alternative

Species	Alternative A	Alternative B
Northern Goshawk	This alternative would allow fuels to build-up, leading to a potential crown fire if a wildfire occurs in the area. No impact to the species in the short term. In the long term habitat could become so densely stocked with trees that prey species habitat would be reduced. Continued inaction would not meet the Forest Plan guidelines.	Implementation of this alternative would improve habitat conditions for the goshawk's prey species, and reduce potential for a crown fire if wildfire occurs in the area. This alternative would treat the dense, overstocked stands of ponderosa pine in the project boundary to the standards set forth in the Management Recommendations for the Northern Goshawk (GTR RM-217) and CIF Forest Plan. Treatment activities in PFAs would occur outside of the nesting season (March 1 to September 31). Prescribed burns would be conducted to retain habitat components important to northern goshawk including large trees, large snags and downed logs. Trail reroutes are generally not located in goshawk habitat but could cause short-term effects due to use and/or rehabilitation efforts. In the long term, trails will be rerouted, improving habitat condition. May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Spotted Bat	This species is not likely to be affected through implementation of Alternative A since they roost in rocky cliffs and outcrops rather than trees. Continuation of fuels build-up leading to a potential crown fire may improve prey species availability in the short term.	There would be slight direct impact to the species but large trees would remain except in permanent openings. Riparian areas would be improved benefitting the species. May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Pale Townsend's big-eared bat	Continuation of fuels build-up could lead to a potential crown fire if wildfire occurs in the area thus increasing the species' prey population in the short term. Roost habitat would likely be lost in the event of a landscape scale wildfire.	Snags and larger diameter trees would be retained except in permanent openings improving roosting habitat somewhat, but overall impacts (if any) are expected to be insignificant. May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Dwarf Shrew	Continuation of fuels build-up could lead to a potential crown fire if wildfire occurs in the area thus reducing hiding cover of the species and its prey. No impact on the species in the short term.	The species has the potential to occur in the project area. The tree removal may have a minor impact to the species, as this activity would remove the tree understory cover of seedlings/saplings/pole sized trees. May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.
Merriam's Shrew	Continuation of fuels build-up could lead to a potential crown fire if wildfire occurs in the area thus reducing hiding cover of the species and its prey. No impact on the species in the short term.	The species has the potential to occur in the area. Tree removal may have a minimal impact on the species. May impact individuals, but is not likely to result in a trend toward federal listing or loss of viability.

Management Indicator Species

Alternative A

Alternative A would not reduce the tree densities in the Sulphur Forest Restoration project area; density and canopy cover of all forest types would continue to increase throughout the project area. Existing small openings and forb/shrub/grassland areas would continue to decrease in size. Wildlife would continue to be subject to disturbance due to existing roads, and trails.

Alternative B

In general there would be no change in the population or habitat trend of MIS species at the Forest level. Implementation of Alternative B would result in short term displacement due to treatment activity (noise and human presence). Snags used by cavity nesting MIS birds would be retained. In the long term, forage condition and availability would improve for all species due to reduced canopy cover and retention of oaks and other shrubs. Other habitat features common in ponderosa pine forests such as roost and nest trees and downed logs would be retained except in permanent openings. The risk of stand replacing wildfire would be reduced. Treatment activities would result in increased displacement of elk, deer, and turkey from preferred habitat. Trail reroutes would lessen the effect to riparian dependent species in the long term and would improve riparian habitat.

Table 31 - Summary of Alternative A Effects for MIS

Management Indicator Species	Direct and Indirect Effects	Forest-wide Population / Habitat Effects
Elk	Habitat would not be improved as stands would remain in an overstocked condition with a dense canopy that has reduced the availability of understory forage. In the event of a stand replacing wildfire, elk foraging habitat would be improved once the area recovers, but cover conditions would no longer be met. Project level populations of elk would remain stable. It is unlikely there would be any long or short term increase or decrease in elk populations unless habitat was lost due to wildfire.	No Change
Mule deer	There would be no change in the woodland canopy cover, thus there would be a continued lack of browse forage availability. Winter range cover would be retained and displacement due to human presence would not occur. In the event of a stand-replacing wildfire mule deer browse forage would increase once the area recovers, but cover requirements would not be met, making foraging areas generally unavailable except along unburned edges. This alternative would not affect mule deer populations in the project area.	No Change
Juniper titmouse	Habitat features such as old-growth and snags would not be protected from wildfire under this alternative. The titmouse would not be displaced given that no disturbance would occur. Project level populations of juniper titmouse are expected to continue to decline due to factors other than Alternative A.	No Change
Black bear	There would be less mast and herbaceous forage available to black bear due to continued dense canopy growth reducing understory forage. Cover requirements would continue to be met without the temporary displacement due to human presence described in the Alternative B. Project level populations of black bear are expected to remain stable.	No Change
Pygmy nuthatch	Ponderosa pine snags used for nesting would not be affected in the short term, but if landscape scale wildfire occurred, snags could be created. There would be no displacement due to human presence during treatments. Project level populations of pygmy nuthatch are expected to remain stable. In the long term not taking any action would not affect pygmy nuthatch unless local habitat was completely lost to landscape-scale fire.	No Change
Merriam's turkey	Habitat would not be improved since there would be no change to tree age and class structure, and the existing dense forest would not provide understory forage. Roost trees would not be protected from drought and fire effects. Trails would continue to cause habitat loss and displacement, but to a lesser degree in the short term than as described in the Alternative B. Project level populations of wild turkey are expected to remain upward for reasons unrelated to implementation of this alternative. In the long term, not taking any action would not affect the forest level population or habitat trend of wild turkey unless cover and forage habitat were completely removed as a result of a landscape-scale wildfire.	No Change
Hairy woodpecker	Habitat needs would continue to be met under this alternative unless there was a stand replacing wildfire. There would be no displacement due to human presence during treatments. Project level populations of hairy woodpecker are expected to remain upward.	No Change
House wren	Habitat needs would continue to be met unless there was a stand replacing wildfire. There would be no displacement due to human presence during treatments. Riparian habitat would not be improved with trail reroutes. Project level populations are expected to remain stable.	No Change

No Change = Negligible impact to population or habitat (Forest-wide) since the amount of untreated acres represent a very small percentage of the total habitat available on the Forest.

Table 32 - Summary of Alternative B Affects for MIS

Management Indicator Species (Habitat)	Short term project level species direct effects	Long term project level habitat indirect effects	Forest wide Population Effect
Elk (Mixed conifer)	Short-term displacement due to human activity likely.	IC - Improves foraging habitat; may compromise security cover (patches ≥ 250 acres in size); no change in habitat quantity.	N
Mule deer (Pinyon-juniper and mountain shrub/oak woodland)	Short term displacement due to human activity likely.	IC - Improves browse forage availability and quality; no change in habitat quantity. Tree cutting would not occur during the fawning season benefitting the species. Most patches would be too small for thermal cover requirements (2 – 5 acres).	N
Juniper titmouse (Pinyon-juniper)	Short term displacement due to human activity likely affecting foraging habitat.	IC - Improves foraging habitat. Treatment retains snags. There would be no change in habitat quantity.	N
Black bear (Mixed conifer)	Short term displacement due to human activity likely.	IC - Improves mast crop and forage availability and retains oaks; no change in habitat quantity.	N
Pygmy nuthatch (Ponderosa pine)	Short term displacement due to human activity likely affecting foraging habitat.	NC - Snags and large diameter trees would be retained.	N
Merriam's turkey (Ponderosa pine)	Short term displacement due to human activity.	NC - Openings would provide improved forage conditions for poults.	N
Hairy woodpecker (Mixed conifer)	Short term displacement due to human activity likely.	NC - Large snags would be retained benefitting the species.	N
House wren (Riparian)	Short term displacement due to human activity likely.	NC - Snags would be retained and riparian habitat would be improved benefitting the species.	N

IC = improves habitat condition, DC = decreases habitat condition, NC = no change in habitat condition since the amount of treated acres represents a very small percentage of the total habitat available on the Forest. N = No change in population trend at the Forest level.

Migratory Birds

Alternative A

Under Alternative A, fuels build-up would continue, leading to a crown fire if a wildfire occurs in the area. This would substantially reduce nesting and foraging habitat. Woodpeckers can benefit in the short term from wildfire, as the dead and dying trees provide insect habitat; sapsuckers prefer live trees for their excavations. Disturbance due to vehicle use and human activity related to trails use in riparian habitat would continue. Under Alternative A, unintentional take of migratory birds due to tree cutting and prescribed fire would not occur.

Alternative B

The recommended Cibola NF migratory bird timing restriction is April 1 to July 31. Implementation of the project is not practicable if timber and fuels activities are limited during this timeframe. Project activities will negatively impact all populations of species of concern occurring within the project area. Reproduction will be compromised due to direct impacts to nesting sites as well as indirect impacts such as nest abandonment. Unintentional take will occur as a result of these impacts. Some incidental take can also result from nest abandonment due to human activity such as trail reroutes, and rehabilitation of trails.

In all project areas, habitat features important to high-priority migratory birds will be retained. Large trees would be retained and a more natural spacing (similar to what occurs in fire-adapted ecosystems where small trees and overly dense stands are usually removed by natural fire) would result. The short term impacts would be a reduction in both vertical and horizontal diversity within stands. Since trees would be removed to create groups and openings and to reduce the “ladder fuels” (trees that allow a fire to easily reach the canopy or “crowns”) this would increase the lower understory layers and eventually result in increased diversity within the stands. Most bird species do not utilize these smaller diameter trees as nesting substrate; however, trees in the 9” class (particularly in pinyon-juniper stands) may occasionally be used as nesting substrates. The vertical stand diversity (due to the removal of smaller, understory trees) would be the component most affected by Alternative B. Horizontal tree diversity (looking at the stand from directly above) would be impacted as trees between groups would be removed except for one or two of the larger diameter trees that are retained between groups. For the most part, areas with extant small diameter trees (where a larger over-story does not occur) may be removed, thus creating openings in the canopy where none existed. Some slight impacts could be expected in the short term to nesting habitat; but as noted, these small trees are generally not the preferred nest substrates. In the short term, vehicle use and associated disturbance would increase in the project area. Populations of migratory birds dependent on pinyon-juniper woodlands, ponderosa pine, mixed conifer forests, and riparian areas would be maintained in the long term as a result of implementation of Alternative B.

In the long term, after the thinning occurs and the stands retain a more natural spacing, populations of birds of conservation concern are expected to show slight to moderate increase, as opening the understory to increase light to the forest floor would allow for an increased shrub and forb component, potentially increasing species utilized as food by granivorous birds (seed and berry eaters), as well as creating a greater mix of understory plant species utilized by insects, which are preyed upon by insectivorous bird species. Retaining the larger trees, as well as dead and dying trees with cavities present, would retain the important nesting substrates used by most of the species. Cavity trees may be reduced somewhat over time since removing the smaller trees would “release” larger trees (removing root competition allows the remaining trees to increase in size); thus, trees that may have succumbed earlier due to the dense stocking rates would probably not be as prevalent.

Table 33 summarizes the impacts (both short and long-term) of the different action alternatives.

Table 33 - Summary of Effects to Migratory Birds

Species	Alternative A	Alternative B
Band-tailed pigeon	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to loss of openings and berry producing shrubs.	DC – Decreases habitat condition in the short term due to disturbance; IC – Improves habitat condition in the long term due to increased foraging potential in mature pine/oak stands, maintenance of forest openings for berry-producing shrubs, maintenance of tall snags for roosting, and decreased wildfire risk.
Broad-tailed hummingbird	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to loss of openings, and deciduous shrubs as canopies continue to close.	DC – Decreases habitat condition in the short term due to loss of structural diversity and disturbance; IC – Improves habitat condition in the long term due to an increase in grassy areas and higher forb production associated especially with prescribed burns.
Grace's warbler	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to continuing habitat loss associated with fire suppression and the potential catastrophic fires. Also due to fire suppression or lack of mechanical treatments, trees are smaller and form a more closed canopy than in the more park-like stands favored by this species.	DC – Decreases habitat condition in the short term due to disturbance; IC – Improves habitat condition in the long term due to increased foraging potential and decreased disturbance due to wildfire risk.
Flammulated owl	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term because fire suppression and lack of vegetation treatments have created large areas of dense, "doghair" ponderosa stands unsuitable for nesting or foraging. Immediate threats include the loss of remaining areas of open, mature forest habitat to catastrophic fire.	DC – Decreases habitat condition in the short term due to loss of structural diversity and disturbance; IC – Improves habitat condition in the long term due to increased foraging potential and decreased wildfire risk. Existing areas of mature or old-growth forest will be protected and maintained.
Red-naped sapsucker	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to fire suppression and loss of areas with deciduous trees like aspen.	DC – Decreases habitat condition in the short term due to loss of structural diversity and disturbance; IC – Improves habitat condition in the long term due to increased foraging potential and decreased wildfire risk. Medium- to large-diameter dead snags will be left intact.
Virginia's warbler	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to loss of open forests with shrub cover.	DC – Decreases habitat condition in the short term when prescribed fires are used which removes suitable nests sites and foraging opportunities, as well as project related disturbance. IC – Improves habitat condition in the long term due to increased foraging potential, decreased disturbance and wildfire risk, and the reinstitution of a natural disturbance regime.
Black-chinned sparrow	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term.	DC – Decreases habitat condition in the short term due to loss of structural diversity and disturbance; IC – Improves habitat condition in the long term due to increased foraging potential, and decreased wildfire risk since this species prefers open canopy habitat and shrubs which will increase following the proposed vegetation treatments.

Black-throated gray warbler	NC – No change in habitat condition in the short term; DC – Decreases habitat condition in the long term due to potential loss of large stands of mature piñon-juniper woodland due to insects, disease and wildfire.	DC – Decreases habitat condition in the short term due to loss of structural diversity, increased habitat fragmentation in dense woodland habitat, and disturbance; IC – Improves habitat condition in the long term due to increased foraging potential. Vegetation treatments will reduce the risk of stand replacing wildfire.

IC= improves habitat condition; DC=decreases habitat condition; NC=no change in habitat condition

Important Bird Areas (IBAs): There are no designated IBAs affected by the project. The nearest IBA is the HawkWatch site on the south end of the Sandia Mountains. There is no direct link between the project area and the HawkWatch IBA.

Overwintering Areas: Important over wintering areas have not yet been designated on the Forest, thus, none would be impacted by project implementation.

Cumulative Effects

The cumulative effect analysis area for wildlife includes habitat types similar to the project area (pinyon-juniper woodlands, ponderosa pine forests, mixed conifer forests, and riparian areas) along the wildland urban interface on the east side of the Sandia Mountains. Past activities in the analysis area that have led to current conditions include livestock grazing in the early to mid-1900's, subsequent removal of livestock from the Forest, exclusion of unplanned fires, human settlement, and recreational development and use of trails and trailheads. More recent activities considered as cumulative effects include Forest Service and private lands fuels reduction treatments in the vicinity of the Sulphur Forest Restoration project area and along the urban interface zone. Some of those treatments have occurred in the past 30 years and trees are becoming reestablished reducing the effectiveness of the treatments. New fuels reduction and forest health restoration projects on Forest Service managed lands are being proposed in the vicinity of the project area. Immediately south of the project area, the Hondo project is being implemented along the Wildland Urban Interface. The Isleta project is being implemented along the DOD boundary in David Canyon. The Talking Talons project is also in the implementation phase to the south of I-40, and the adjacent Tablazon project will provide fuel wood opportunity. Projects being proposed which are in various stages of analysis include the Cedro project, a landscape scale project to the south of I-40, and the La Madera project which is similar to the north of I-40. Riparian restoration is being proposed in the Las Huertas project area of the Sandias, and trail and watershed improvements are being considered in the Placitas area. Fuel hazard reduction treatments presently occurring on private lands are also likely to continue.

Cumulative effects under Alternative A would result in a continuation of existing habitat conditions for wildlife in the wildland urban interface since much of this area has not yet been treated for fuels reduction. Wildlife species composition and populations on National Forest system lands would continue to be similar to what is there now except in the event of a stand replacement wildfire. Fuel hazard reduction presently occurring on private lands is likely to continue and may result in heavier treatments with less emphasis on leaving untreated patches, snags, downed woody debris and providing for stand diversity. Existing development and expansion of subdivisions along the urban interface would continue to fragment and isolate woodland and forested habitats in this area reducing its habitat value for wildlife on Forest Service managed lands.

Cumulative effects related to Alternative B would result in the continued treatment of the wildland urban interface resulting in some reduction in the threat of stand replacing wildfire. Without reducing the danger from wildfire by some combination of thinning and burning along the entire wildland urban interface and beyond, fuels treatments in the Sulphur Forest Restoration project area are likely to reduce the fire severity only within or near the project boundaries. Past, present and future treatments on Forest Service lands would provide for more sustainable conditions to maintain vegetation structural and compositional diversity. Expected improvement of forage habitat on National Forest system lands would tend to reduce wildlife use of housing areas in the wildland urban interface. The cumulative effects of past and future fuels reduction to wildlife species dependent on these woodland and forest habitats would be overall beneficial.

Soils and Water Resources

The project area is located on the east slope of the Sandia Mountains and is approximately 1100 acres. Vegetation type ranges from piñon-juniper woodlands at lower elevations to ponderosa pine, Douglas fir and white fir at the higher elevations. Oak hardwoods are found throughout the project area.

Affected Environment

Climate

In the area covered by this analysis, precipitation seasonality varies due to the influence of the Arizona monsoon (a.k.a., the southwest monsoon). Areas affected by the southwest monsoon receive greater amounts of summer precipitation from moist air masses derived from the Gulf of Mexico and Gulf of California. Most of the annual precipitation comes in the form of rain originating from convective thunderstorms during the months of July through September. Higher elevations of the analysis area may also receive some cool season moisture in the form of snow. In addition to temporal variability of precipitation, spatial variability of precipitation is also a characteristic within the analysis area. Topography and storm type are two factors that control the spatial variability of precipitation. At the local scale, precipitation tends to increase with elevation due to the effects of orographic lifting. Summer precipitation tends to have more spatial variability than winter frontal storms.

Within the analysis area, average annual precipitation is generally less than 14 inches per year. Precipitation intensity (amount of water/unit of time) tends to be very high in this part of the state due to the convective nature of the storms. For example, the intensity of precipitation at the nearby Sandia Park weather stations (35.2167 N 106.45W 10459 feet) shows that the 2 year, 1-hour storm can produce upwards of 0.85 inches of water. Antecedent soil and vegetation conditions can help determine whether this amount of precipitation results in beneficial infiltration or erosion generating runoff.

Droughts are common in New Mexico due to the overall low amount of annual precipitation and the previously described spatial and temporal variability of that precipitation. Regional precipitation patterns are regulated by global scale fluctuations in ocean surface temperatures. Over the long term, the Pacific Decadal Oscillation (PDO) tends to influence the precipitation regime in this part of New Mexico. Studies of 20th century precipitation patterns show that there have been three distinct precipitation regimes. The first was a relatively wet period from 1905 to 1941. Next was a period of dry from 1942 through 1977. This was followed by a period of wet from 1978 through 1998. The years since 1998 have marked a shift back to a dry period and suggest that we could be in for another 1-3 decades of drier than average conditions. This information has important implications on ecosystem management due to the influence of precipitation on disturbance regimes and the capacity of ecosystems to resist or recover from those disturbances.

Soils and Terrestrial Ecosystem Units (TEUs)

Soil conditions in the project area were assessed using the Cibola Terrestrial Ecological Unit Inventory (TEUI) (Strenger et al. 2007) and field observations. The survey consisted of mapping and interpreting ecosystems through a systematic examination, description, classification and integration (gradient analysis) of the primary ecosystem components (soil/vegetation/climate). Terrestrial Ecological Unit Inventory information provided the initial ecological base for developing ecosystem management plans at the Forest or project level. Terrestrial Ecological Unit Inventory information was used to evaluate and adjust land uses to the limitations and potentials of natural resources. Field observations occurred in 2009, 2010, 2011 and 2013.

Soil condition consists of three components – hydrologic, nutrient cycling, and stability (USDA 2013). Soils in satisfactory condition are functioning properly and can maintain resource values. Impaired soils have a reduction in soil functions and/or an increased risk of degradation. Unsatisfactory soils have lost soil function and are unable to sustain resource values. Soil hydrology refers to properties which effect how water percolates into or flows over the ground. Soil compaction is one hydrologic property of soil and is evidenced through changes in porosity, surface structure, bulk density, infiltration, or penetration resistance. Nutrient cycling relates to soil organic matter and sustaining long term soil productivity and

plant growth. Woody material, soil crusts, litter, roots, and vegetation are all indicators of nutrient cycling. Stability of soils refers to the erosion, transport, and deposition of soil particles by water, wind or gravity (USDA 2013).

The condition of the soils in the analysis area varies widely according to geology, vegetation, slope, and disturbance history. The ecological legacies of past climatic events, centuries of historic grazing management, fuel wood collecting, recreation, and fire history are still observable throughout the analysis area.

TE Units in the Treatment Area
Table 34 summarizes TES map units in the vegetation treatment areas and their related soil condition. Figure 9 is a map of the TES map units in the project area. The photos shown are of map units within the project area.

Map Unit 24
This map unit makes up a little over 4% of the treatment area. This map unit is found in bottom of stream channels in the project area, including Cienega, Armijo, an unnamed drainage south of Armijo, and Cañoncito Canyons. There are two components in this TEU. The main difference between them is that component 1 has a higher slope (8%) and is drier with an overstory of conifer species (~80%), while component 2 is less steep (3%) and has a riparian overstory (~50%). Both components exist in the project, often within the same drainage bottom. Generally, soil condition is impaired with a moderate erosion hazard rating. On the east side of the project area, these drainage bottoms are often lacking woody material and expected canopy cover. It is likely due to past activities, some of which predate NFS management.

Figure 7 - Map Unit 24

Map Unit 87
This map unit is found in 4.2% of the treatment area. This map unit is found in the drier valleys at the north end of the project area such as Sulphur Canyon and the lower ends of Tejano and Barro Canyons. The potential condition for this unit is less than 10% canopy cover, mostly comprised of ponderosa pine with smaller amounts of piñon pine and juniper species – a dry meadow with scattered trees. Soil condition is currently satisfactory with a slight erosion hazard rating.

Map Unit 178
This unit comprises 3.3% of the treatment area. This map unit is found on west facing slopes of ephemeral drainages on the southern end of the project area. The slopes are steep, over 40%. Piñon and juniper are the dominant trees in the 25-35% canopy cover. Vegetative ground cover is lacking in this unit, which contributes to the unsatisfactory soil condition. The erosion hazard rating is moderate to severe.

Map Unit 191
This map unit comprises almost 20% of the treatment area. This unit is located on the moderately steep to steep slopes on the north end of the project area between Sulphur and Tejano Canyons. On the southern portion of the project area, this unit occurs on the south side of the unnamed drainage which drains into Armijo Arroyo. This site can support an average of 70% canopy cover comprised of mostly ponderosa pine with oak in the understory. Currently, soil condition of satisfactory but there is accelerated erosion processes and lack of large woody material, especially on the southern end of the project area as shown in Figure 8. Unauthorized trails and previous management activities have contributed to this condition. Erosion hazard rating is severe to moderate in this unit.

Figure 8 - Map Unit 191

Map Unit 192
This map unit makes just over 14% of the treatment area. This map unit occurs on very steep slopes. It is mostly found in the northern part of the project area between Sulphur and Cienega Canyons, on the slopes above the Cienega picnic area. This site can support an average of 70-75% canopy cover comprised of mostly Douglas fir with lesser amounts of ponderosa pine and oak in the understory. Currently, soil condition is satisfactory but localized areas exhibit accelerated erosion and/or lack sufficient large woody material. Recreational activities are likely the cause of these impacts due to the proximity to the picnic area. The erosion hazard rating is severe to moderate.

Map Unit 194
This map unit makes up 24.3% of the treatment area. This map unit occurs on slopes which average 30%. It is mostly found in the across the project area on the upper slopes above the canyons. This site can

support an average of 35-55% canopy cover comprised of mostly ponderosa pine, lesser amounts of piñon and juniper with oak in the understory. Currently, soil condition is impaired due to bare soils and lack of ground cover. Large woody material is also lacking in this area. The erosion hazard rating is slight.

Map Unit 270
This map unit is found on 19.3% of treatment area. This map unit is located on slopes with an average of 25%, mostly on north aspects in the southeast side of the project area. The potential canopy cover in this unit is 50-60%, mostly composed of piñon and juniper. While this map unit has an overall satisfactory rating for soil condition, numerous unauthorized trails on the southern end of the project area have resulted in an impaired to unsatisfactory soil condition. The severe erosion hazard rating makes this impact difficult to prevent and restore.

Map Unit 282
This map unit makes up 5% of the treatment area. This map unit is found on 25-30% slopes in the upper drainage bottoms and on the northern end of the project area. The canopy cover has the potential to be 70-75%, largely composed of Douglas fir, ponderosa pine with oak in the understory. Map unit 282 has a current soil condition of satisfactory with a low potential for revegetation due to alkaline conditions and severe timber harvest limitations due to low subsoil strength. The unit has a moderate to severe erosion hazard rating.

Map Unit 284
This map unit is almost 2.6% of the treatment area. This unit consists of moderately steep slopes (22-26%) in higher elevation side drainages. The canopy cover is mixed conifer with potential for 60-85% canopy cover. Map unit 284 has a current soil condition of satisfactory with moderate to severe erosion hazard rating.

Map Unit 287
This map unit is 3.6 acres, about .5% of the treatment area. This small area is located in the northwest side of the project area. This unit is moderately steep in the upper elevations of drainage bottoms. The vegetation is largely mixed conifer species but includes quaking aspen as a component of the potential 60-75% canopy cover. The soil condition is satisfactory with a severe erosion hazard rating.

Map Unit 288
This map unit occurs on 2.1% of the treatment area on the south side of Cienega Canyon on the west end of the project area on very steep slopes (~66%). The vegetation is largely mixed comfier species with a trace of quaking aspen. The soil condition is satisfactory. The erosion hazard rating is slight.

Table 34 - TES Soils and Related Information

Map Unit	Percent of Project Area	Percent of Treatment Area	Erosion Hazard	Soil condition
24	7.7	4.3	slight - moderate	satisfactory
87	2.3	4.2	slight	satisfactory
178	4.7	3.3	moderate - severe	unsatisfactory
191	19.1	19.9	moderate - severe	satisfactory localized unsatisfactory/impaired
192	11.2	14.3	moderate - severe	satisfactory localized unsatisfactory/impaired
194	27.4	24.3	slight	impaired
270	9.8	19.3	severe	satisfactory localized impaired
282	4.9	5.0	moderate - severe	satisfactory
284	9.4	2.6	moderate - severe	satisfactory
287	2.1	.5	severe	satisfactory
288	1.3	2.1	slight	satisfactory

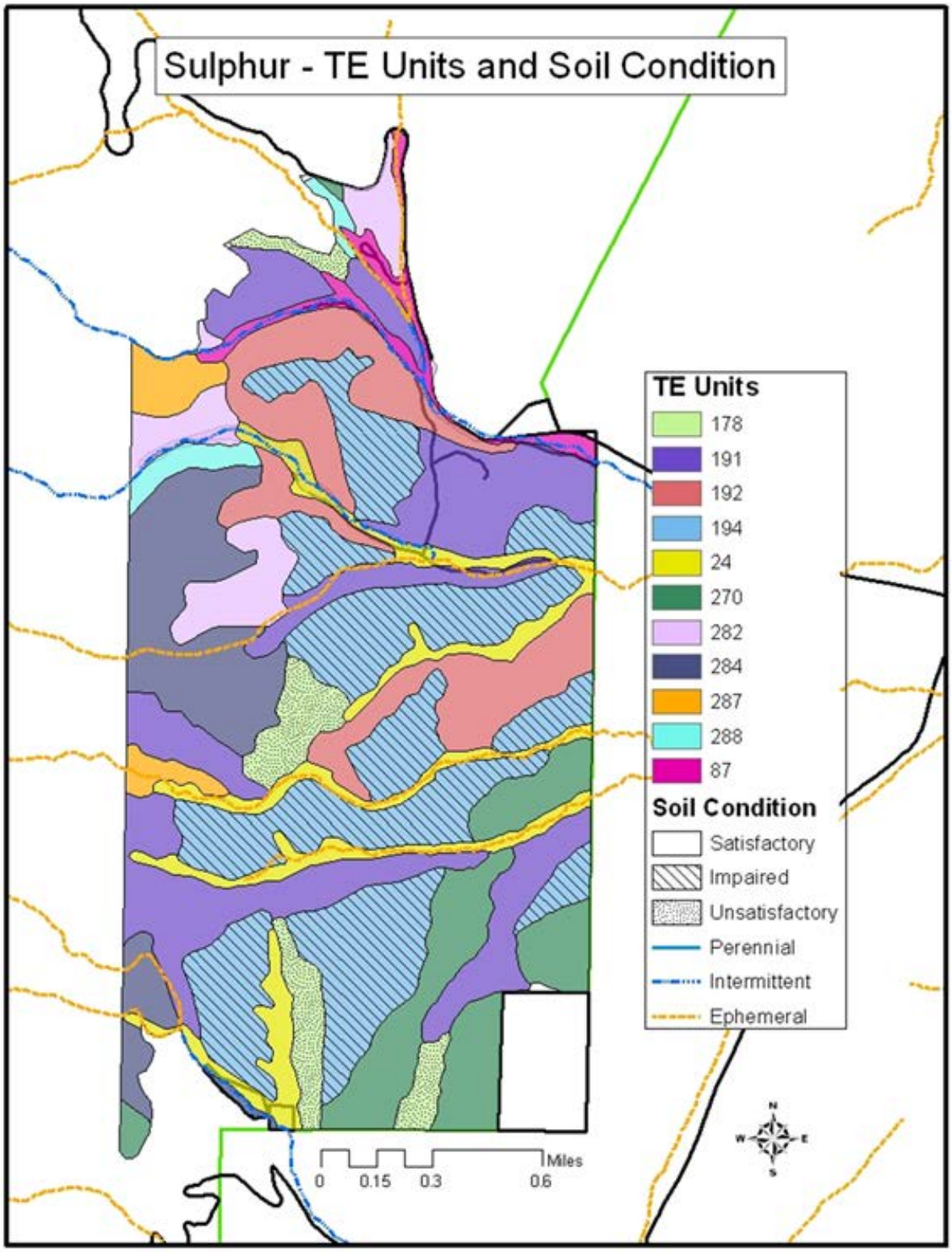

Figure 9 - TE Map Units and Soil Condition in the Sulphur Project Area

Soil Condition ratings are tied to a given soil type found within the Terrestrial Ecological Units (Strenger, et. al. 2007)). Table 35 summarizes soil condition within the project area. Figure 9 is a map of soil condition classes within the project area. Soils were classified into three condition groups; Satisfactory, Impaired, and Unsatisfactory.

- **Satisfactory** – Soil function is being maintained and is operating as expected.
- **Impaired** – Ability of the soil to function properly has been limited or it has less resistance to the forces of degradation. Changes in management or mitigation measures may be appropriate.
- **Unsatisfactory** – Loss or degradation of vital soil functions have occurred resulting in the inability to maintain resource values, sustain outputs and recover from impacts. Soils rated in this category are candidates for improved management or active restoration designed to recover soil functions.

Soil condition is an evaluation of soil quality based on the interrelationship between soil hydrology, soil stability, and nutrient cycling. Soil hydrology is assessed using compaction. Compaction occurs on and adjacent to roads, trails, and recreation areas in the project area. Compaction reduces the ability of the soil to absorb, store, and transmit water. Soil stability is assessed through the erosion hazard rating and existing conditions on the ground. Nutrient cycling is assessed through levels of woody material which exist since wood is an important factor in maintaining soil organic matter. Soil condition integrates these three factors categories to come up with a soil condition rating. Soil condition ratings for this project area were determined using guidelines found in the Technical Guidance document (USDA 2013).

Table 35 lists the soil condition ratings in the project area and treatment area. Figure 9 is a map showing locations. Much of the project area is in satisfactory soil condition. Impaired and unsatisfactory soil conditions occur on about 1/3 of the area.

Table 35 - Summary of Soil Condition

Soil condition	% of Project Area	% of Treatment Area
Satisfactory	67.8	72.4
Impaired	27.4	24.3
Unsatisfactory	4.8	3.3

Where soils are currently impaired or unsatisfactory, high erosion rates and lack of woody material on the ground are the main causes. High erosion rates are related to the lack of ground cover and litter as noted in the TEU descriptions. In the pinyon- juniper forest type, the loss of biotic crusts is widespread. The lack of woody material is largely the result of past management practices. In particular, large woody material greater than 16 inches in diameter is lacking in many areas, including wood that is in an advanced state of decay. This type of wood provides nutrients to the soil and habitat for soil biota.

There is woody material data within the project area. This data was collected two ways – during stand exams and fuel transects. Table 36 shows the woody material information for the project area. From the stand data, the ponderosa pine vegetation type is lacking woody material in 43% of the area where it is located in the project area. In the piñon-juniper vegetation type, 11% of these acres do not have enough woody material on the ground. In the mixed conifer vegetation, there is enough woody material to sustain a good soil condition. The fuels transect data shows that woody material is lacking in the ponderosa pine and mixed conifer sites while the PJ type has enough woody material. Figure 11 shows the location of areas that are lacking adequate levels of woody material as indicated by the stand data. It should be noted that there are areas within the project which could also be lacking woody material but these areas are localized and do not show up at this scale.

Figure 10 - Large Woody Material – south end of project area

Table 36 - Available Woody Material Information for Project Area

Vegetation Type	Range of woody material for satisfactory soils	% with satisfactory levels (stand data)	Stand Data woody material (tons/acre)	Fuels Transect woody material (tons/acre)
Ponderosa Pine	5-10 tons/acre[1]	57	6.1	1.6
Piñon - Juniper	2-8 tons/acre[2]	89	4.8	3.1
Mixed Conifer	8-16 tons/acre[1]	100	11.6	2.5

[1]USDA (2013), [2] Ernest, et al (1993)

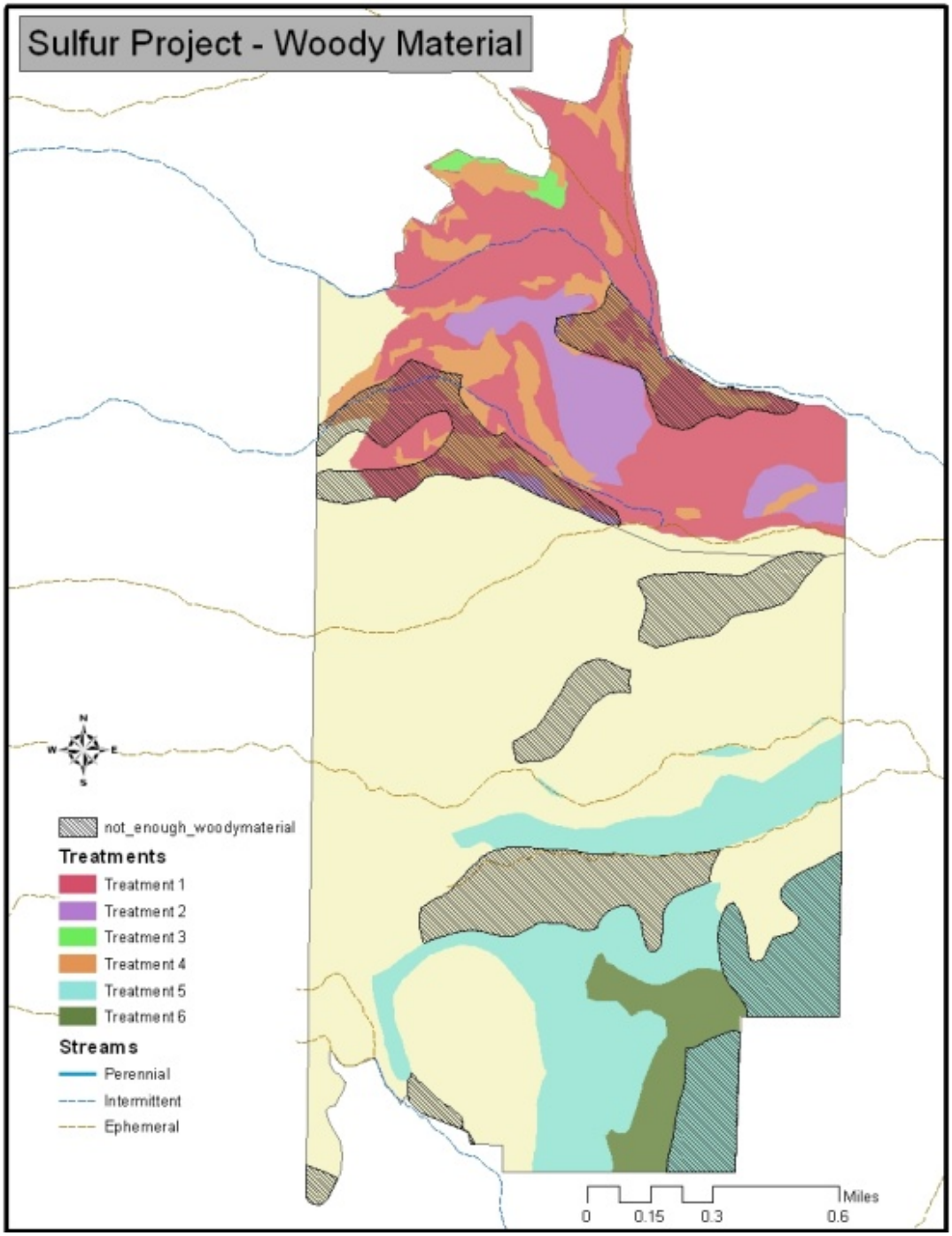

Figure 11 - Areas where woody material is lacking on the ground as indicated by stand data

The erosion hazard interpretation determined from the TE data provides important information that helps determine the treatment methods that consider soil stability. Erosion hazard is based on the potential for soil loss from complete removal of vegetation and litter (USDA 1986). A severe rating indicates areas where mitigations are unlikely to prevent losses in soil productivity. Soils rated as moderate must be mitigated to prevent losses in soil productivity. Soils rated with a slight rating usually stabilize under natural conditions once the disturbance is removed. Figure 12 is map of the location of erosion hazard categories in the project area.

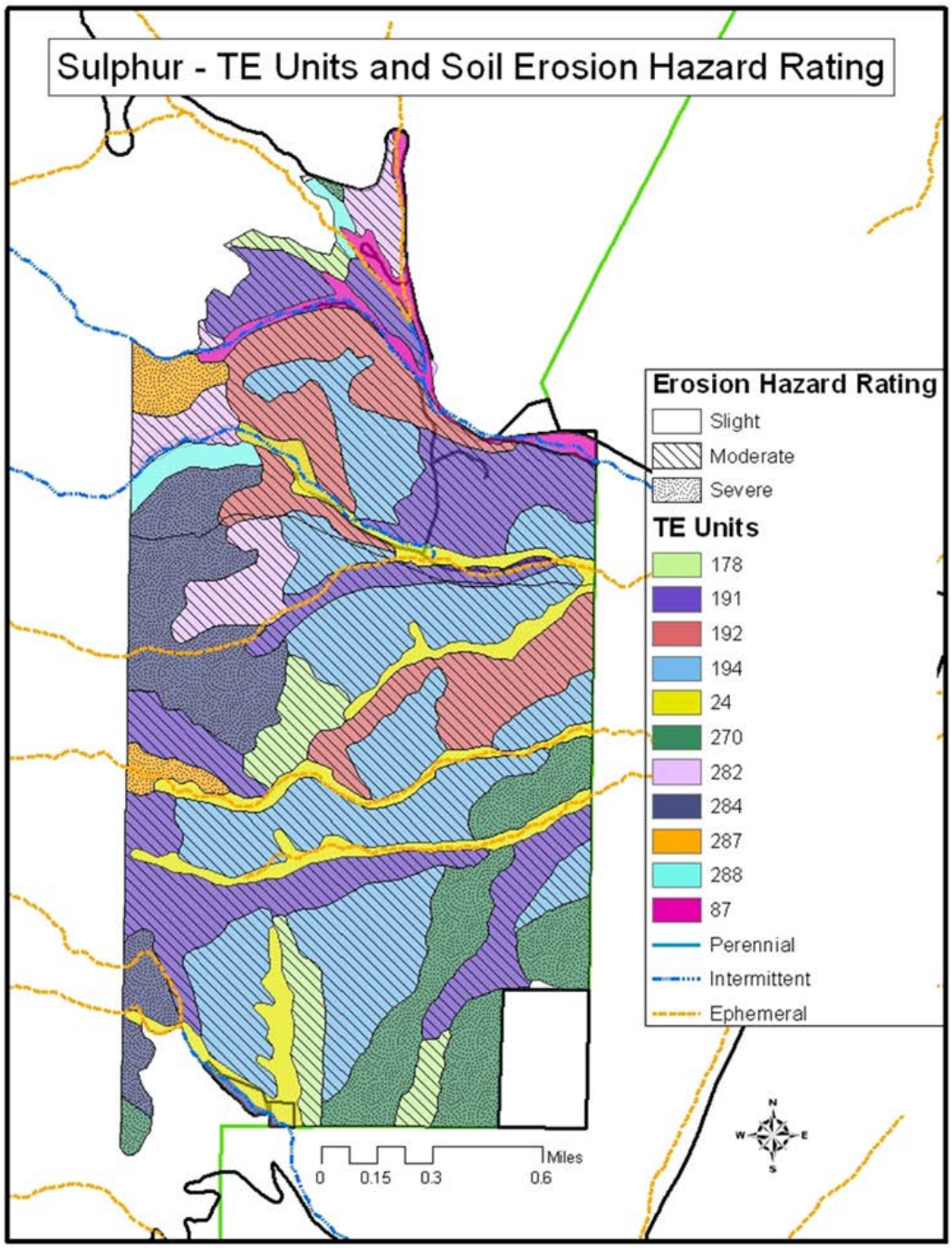

Figure 12 - Erosion Hazard Rating in the Sulphur Project Area

<u>Watershed Resources (Watersheds, Soil, and Water)</u>
Watersheds are areas drained by streams to a single location. These drainage areas are defined by the highest elevations surrounding a selected location on a stream so that a drop of water falling inside the boundary will drain to the stream while a drop of rain falling outside of the boundary will drain to another watershed.

A systematic method of delineating watershed boundaries and giving them a number code was developed by the USGS (Seaber, Kapinos, & Knapp, 1987). The number code is called the hydrologic unit code (HUC). Each two digits refers to successively smaller watershed delineations within the previous two digits of the HUC. The project area is located within the Rio Grande Region (HUC = 13) in the smaller Rio Grande-Elephant Butte Subregion (HUC = 1302). The next level is the Basin scale, also called Rio Grande-Elephant Butte, whose HUC is indicated by 6 numbers, 130202. The northern part of the project area is in the 8 digit Sub-Basin, HUC= 13020201, called Rio Grande-Santa Fe. Within this larger Sub-Basin, the northern part of the project is located in the smaller 10-digit Watershed, Arroyo Tonque, HUC=1302020105 and the 12 digit Sub-Watershed, Headwaters San Pedro Creek, HUC=130202010501 (32298 acres). The southern part of the project area is located in the Sub-Basin, HUC=13020203, called Rio Grande-Albuquerque. Within this larger Sub-Basin, the southern end of the project is located in the Watershed, Tijeras Arroyo, HUC=1302020302 in the Sub-Watershed, Upper Tijeras Arroyo, HUC=130202030201, (38047 acres). Figure 13 is a map of the 12 digit Sub-Watersheds where the project area is located.

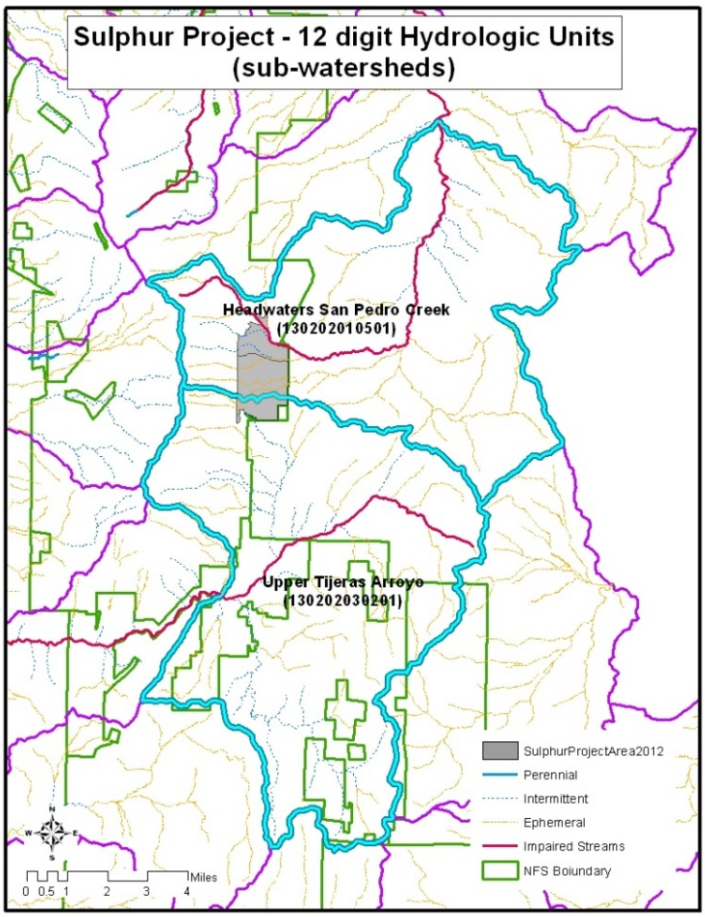

Figure 13 - 12 digit Sub-Watersheds in Project Area

Watershed condition was assessed at the 12 digit Sub-Watershed scale using the Watershed Condition Framework process (USDA 2011). Watershed condition is the state of a watershed based upon physical and biological characteristics affecting hydrologic and soil functions. Twelve indicators were used to assess watershed condition. Both of the 12 digit HUCs within the project area are rated as functioning at risk, or 'fair'. Figure 14 shows the ratings for each of these 12 indicators for the two 12 digit HUCs in

the project area. From this graphic, it can be seen that aquatic habitat and soil condition are rated as poor in both watersheds. The indicators, forest cover, forest health, and terrestrial invasive species are the only factors rated as good for both watersheds. Fire condition is rated as poor for the Headwaters of San Pedro Creek, in the northern portion of the project area. These indicators help to show which components of the watersheds could use restoration.

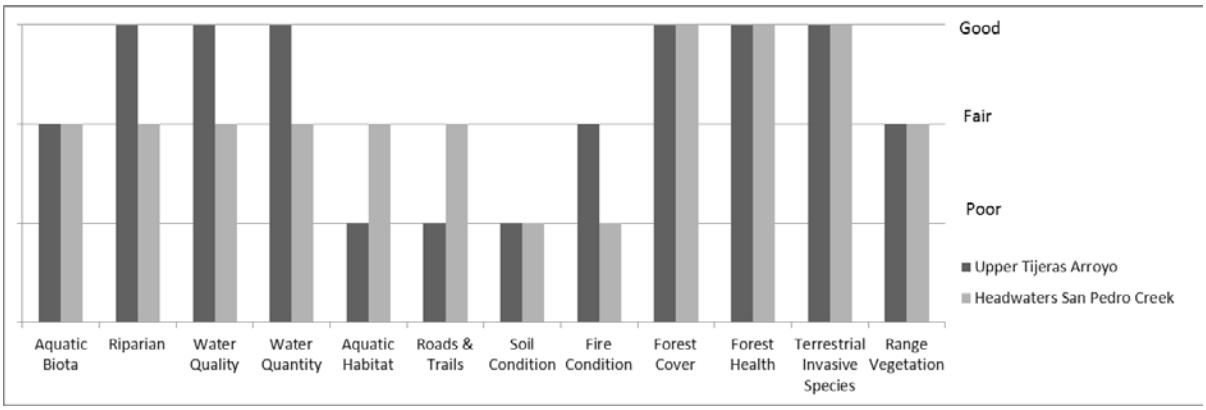

Figure 14 - Ratings for the 12 Indicators of Watershed Condition

For the purposes of this project, smaller watersheds were delineated to assess project effects. These smaller watersheds allow for the analysis of potential effects from the proposed activities. There is no HUC associated with these smaller watersheds which will be referred to as *project watersheds*. Figure 15 shows these smaller project watersheds in relation to the project area. Sulphur Canyon, Cienega Canyon, and upper Armijo are located within the larger 12 digit HUC, Headwaters San Pedro Creek (130303010501). Cañoncito and West Upper San Antonio Arroyo drain to the south into the 12 digit HUC, Upper Tijeras Arroyo (130202030201). The condition of these smaller watersheds is generalized from the larger scale watershed condition analysis. This means these project watersheds are also rated as 'fair' or 'functioning at risk'.

The highest parts of these project watersheds are located on the ridge of the escarpment of the Sandia Mountains. The drainages are mostly ephemeral and flow to the east. Topography is generally steep and rugged, although not as steep as the west side of the Sandia Mountains. The vegetation changes with rising elevation from piñon-juniper woodland to Ponderosa pine forest to mixed conifer forest in the higher, moister parts of the analysis area.

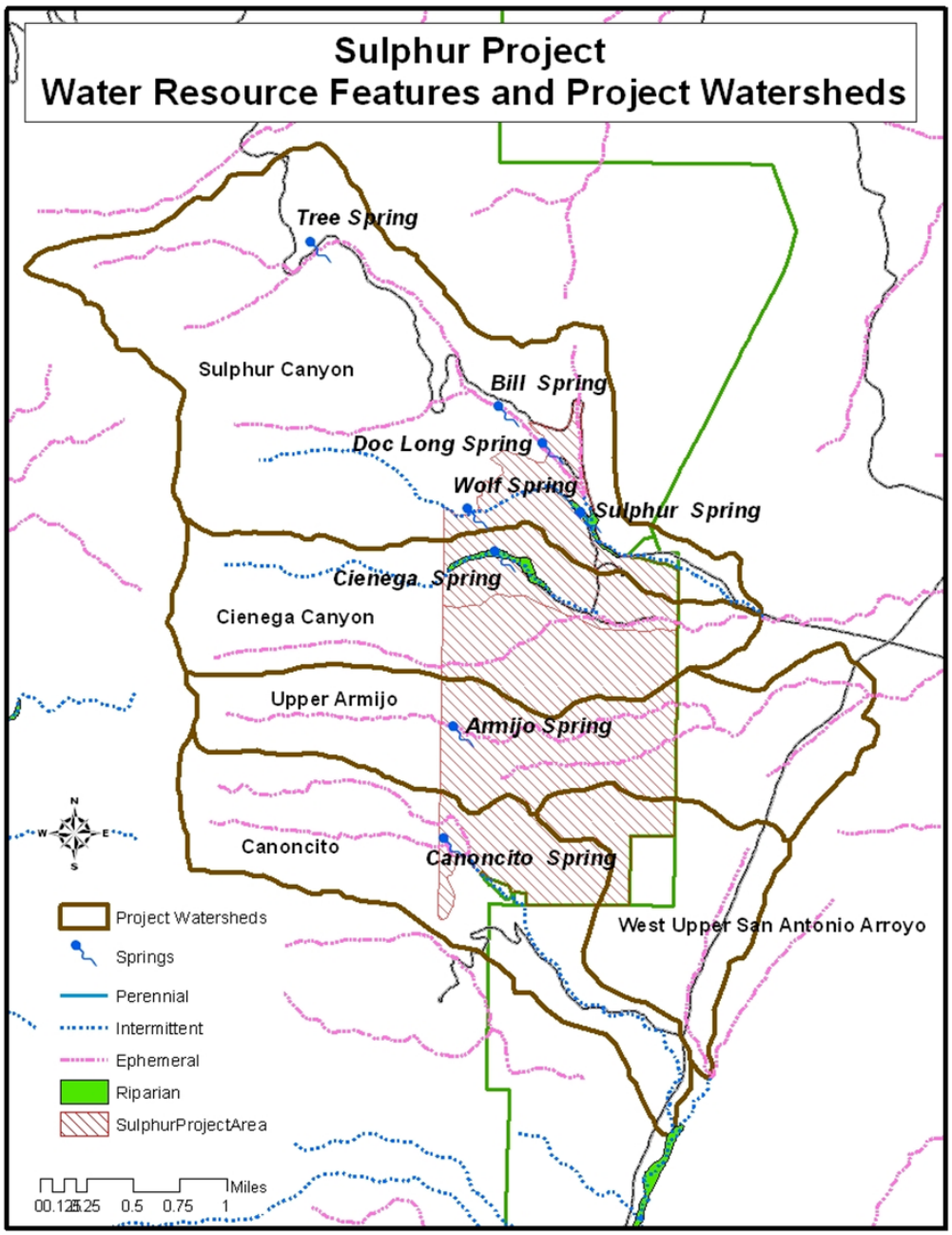

Figure 15 - Water Resource Features and Project Watersheds

<u>Water Resource Features</u>

Water resource features include the streams, springs, and riparian areas that occur within project area. Stream and spring information is from the National Hydrography Data (NHD) maintained by USGS. The riparian data is from the RMAP (Regional Riparian Mapping Project) data layer created by the Forest Service. The GIS datasets are still being ground truthed and updated as new information becomes available. Figure 15 shows the locations of the water resource features within the project watersheds. Wetlands in project area are comprised of the small perennial portions of streams, intermittent streams, springs, and riparian areas.

The project watersheds were delineated with the main drainage features as a guide. These include Sulphur Canyon, Cienega Canyon, Armijo Arroyo, Canoncito, and a side drainage on the west side of San Antonio Arroyo. There are no perennial reaches within the project watersheds except for small areas in the vicinity of the more reliable springs, such as Canoncito and Cienega Canyon. Perennial flow refers to stream where the water flows all of the time except possibly during periods of exceptional drought. Parts of the streams are intermittent which means they flow or awhile after the snowmelt or storm that supplied the moisture. These are shown on the map and are tend to be associated with riparian areas since the presence of water supports riparian vegetation. The majority of the streams are ephemeral which means they only flow in direct response to snow melt or rainfall. Ephemeral and intermittent streams have important values even though they do not flow continuously (Levick et al 2007).

Evaluations of riparian and aquatic ecosystem components were based on field observations collected within the project area. The collection and interpretation of the data was guided by the document titled, "Riparian Area Management-A Users Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas (USDI-BLM 1998). The method in this document is referred to as 'PFC' for Proper Functioning Condition. Riparian areas are geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems (Forest Service Manual 2526). Riparian Ecosystems are a transition area between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water. Springs support riparian areas and are evaluated using the PFC.

There are eight mapped springs with the project watersheds. Four of these springs are within the treatment area boundaries. There are three spring types as shown in Table 37. When springs discharge into stream channels, they are called rheocrene springs. Helocrene springs flow from wetlands which are fed by indistinct sources seeping from shallow unconfined aquifers. A hypocrene spring is a spring whose flow does not reach the surface due to low flow and/or evaporation. Springs in the project area were assessed for condition. When springs are developed at the source, the condition is considered non-functional. This is because developed spring no longer have the water needed to support diverse resource values and the development structure is located at or immediately adjacent to the spring source. Cienega Spring and Sulphur Spring are both developed spring sites. Canoncito and Armijo Springs are both located along hiking trails which cause erosion, sedimentation, and alteration of flow patterns resulting in an at risk condition.

Table 37 - Spring Information in the Sulphur Project Area

Name	Project Watershed	Wet/Dry at time of visit (date)	Type	In Project Area	Condition
Canoncito Spring	Canoncito	Wet (7-11-2012)	rheocrene	Yes	At risk
Armijo Spring	Armijo Arroyo	Wet (9-15-2009) Wet (4-23-2012)	rheocrene	Yes	At risk
Cienega Spring	Cienega Canyon	Wet (4-21-2012) Wet (7-5-2012)	rheocrene	Yes	developed
Sulphur Spring	Sulphur Canyon	Wet (5-21-2012)	rheocrene	Yes	developed
Wolf Spring	Sulphur Canyon	Not visited	unknown	No	unknown
Doc Long Spring	Sulphur Canyon	Wet (6-13-2012)	helocrene	No	unknown
Bill Spring	Sulphur Canyon	Dry (6-13-2012)	rheocrene	No	unknown
Tree Spring	Sulphur Canyon	Dry (4-19-2012)	hypocrene	No	unknown

There are 20.8 acres of mapped riparian areas in the project area shown on Figure 15. There are 3.5 acres of herbaceous riparian and 17.3 acres of the willow-thinleaf alder type. All of the mapped riparian areas are located within the proposed treatment areas. There are additional acres in the project area that were

not mapped because they are small and weren't mapped as part of the RMAP protocol. This includes areas near springs such as Armijo and Canoncito Springs. There has not been a formal assessment of the condition of these riparian areas but there are risk factors at each of the known sites. The riparian areas in the vicinity of Doc Long – Cienega recreation areas are at risk due to the recreational activity and related developments, in addition to the spring development at Cienega Springs. As mentioned previously, Armijo and Cañoncito Springs are at risk due to impacts related to hiking trails which are actively eroding.

Figures 16 and 17 - Canoncito and adjacent trail

Water Quality

A review of the 2012-2014 State of New Mexico's Integrated Clean Water Act §303(d)/§305(b) Report (NMED 2012) indicates that both 12 digit HUCs in the project area have streams listed as impaired. The project area is in the headwaters of both of these streams as shown in Figure 13. Both listed reaches are in category '5C' which means that available data and/or information indicate that at least one designated or existing use is not being supported but additional data are necessary to verify the listing before TMDLs are scheduled.

- The north end of the project area is in the headwaters of San Pedro Creek, assessment unit NM-9000.A_004. The designated use of coldwater aquatic life is not supported in this reach as indicated by a benthic-macroinvertrebate bioassessment in 2008. Possible sources of impairment include septic systems, rangeland grazing, land development, and unknown sources. The perennial portion of this San Pedro Creek starts about 5 miles downstream from the project area. There is no rangeland grazing in the project area. The recreation area in the project area has developed areas and contained septic system. It is unlikely that the impairment is related to activities in the project area.
- The southern end of the project area drains to Tijeras Arroyo (assessment unit NM-9000.A_001), about three miles downstream from the project area. The designated use of warm water aquatic life is not supported in this reach as assessed by benthic-macroinvertrebate bioassessment and nutrient/eutrophication biological indicators in 2008. Probable sources of impairment include

channelization, discharges from municipal storm sewer systems, drought related impacts, local septic systems, rangeland grazing, wastes from pets, and unknown sources. Forest management activities in the project area do not contribute to any of these causes so it is unlikely that the project area contributes to the listed impairment.

There is no water quality data available for the temporary ephemeral and intermittent streams in the smaller watersheds. Water quality criteria for ephemeral and intermittent waters in New Mexico are linked to the designated uses of livestock watering, wildlife habitat, aquatic life and secondary contact. Criteria for secondary contact in these waters are limited to an E.coli bacteria standard. It is unknown whether or not this standard is met in ephemeral and intermittent water in the analysis area. It is likely that on Forest Service lands, this criterion is met due to limited sources of bacteria in the watershed since there are no livestock grazing or septic systems. Recreation use in areas without sanitary facilities does have the potential to increase these levels locally and for short periods of time. The recreation areas in the Sulphur project area have sanitary facilities and camping activities are dispersed so it is unlikely there is a measurable effect from these uses. This includes potential effects to spring water as well.

There is information for the 4 springs in the project area. For the parameters measured, water quality at all springs meets New Mexico water quality standards. Table 38 lists some of the basic water chemistry data for the springs in the project area.

Table 38 - Water Quality Data at Springs

Name	pH	Conductivity ($\mu S/cm^3$)	Temperature (F)	SO_4 (mg/l)	Ca (mg/l)	Date
Canoncito Spring	6.91	495	51.3	15.61	107.65	7-11-2012
Armijo Spring	7.21	---	50.9	---	---	9-15-2009
	6.57	541	47.1	8.04	98.65	4-23-2012
Cienega Spring	6.63	564	50.0	13.08	109.16	4-19-20112
	6.71	612	46.6	10.26	98.55	7-5-2012
Sulphur Spring	---	---	---	25.4	43.99	5-21-2012

Environmental Consequences

The proposed activities include removal of trees by hand individual tree selection, mechanized equipment, and mastication. Slash (left over woody material) could be treated by lop and scatter, chipping, hand piling of slash, burning piles, and prescribed fire. Commercial contracts and person-use fuel wood permits will be offered to remove wood. In addition, a gate will be construction in the Cienega/Sulphur Picnic area and portions of the Faulty Trail and Canoncito Trail will be rerouted.

Potential Effects Related to Water and Soil Resources

The following issues related to the proposed actions were brought up during internal and external scoping of this project.

- *Soil condition* may be affected.
- *Watershed conditions* may be changed.
- *Water quality* may be impacted.
- *Spring flows* may be affected.
- The condition of *riparian areas* and *streams* may be affected.

Soil Resources

The analysis area for soil condition is the project area boundary. This is because it is the soils within the project area have the potential to be directly and indirectly affected by the proposed activities. The measures for soil condition are woody material on the ground, acres of disturbance, and the heat per unit

area, as modeled at the surface, listed in Table 39. The heat per unit area at the surface provides information about the heat the soil would be subject to during a wildfire under the modeled scenarios of the alternatives. The amount of woody material on the ground is a useful measure since lack of woody material has been observed and measured across the project area. Soil disturbance is an indicator where the soil is disturbed, resulting in soil loss and erosion. Soil disturbance is divided into two effects, area where compaction could occur from motorized vehicles and area under burn piles. The time period for analysis is 10 years since this time period allows time for changes to soil to be observed.

Table 39 - Measures Used to Assess Effects on Soil Resources

Resource	Effect	Measures
Soil condition	Loss of Woody material Compaction Erosion	Amount of woody material on the ground Acres disturbed by motorized vehicles Acres of hand piles Modeled heat per unit area

Alternative A – No Action

Under Alternative A, none of the proposed activities would occur. The greatest effect of this, an indirect effect, is the effects of uncharacteristic wildfire. As discussed in the Fuels Report, under this alternative, the forest ecosystem would remain susceptible to the adverse effects of uncharacteristic wildfires without improved control options as provided by the action alternatives. Wildfires would be harder to control and burn hotter as indicated by the heat per unit area at the surface. Currently, the modeled surface heating in the 97 percentile scenario varies from 472 Btu/ft^2 in the mixed conifer, 506 Btu/ft^{2}in the ponderosa pine type, and 2816 Btu/ft^2 in the PJ. These heating levels could lead to temperatures well above the values where organic matter is destroyed, amino acids are lost, and nitrogen is volatilized (Hungerford et al 1990). Fire related effects include soil hydrophobicity, altered infiltration, increased runoff, sedimentation and erosion. Nutrient cycling is also changed by heating of both organic and inorganic compounds. The effect would be dependent on fire behavior, but soils are likely to be heated changing the physical and biotic characteristics of the soil. With high burn severity, soils may also become water repellent which increases runoff during storm events because water is not able to infiltrate.

There would be no direct effects on soil resources, such as ground disturbance or loss of tree cover. Locations where erosion is occurring such as roads and trails, both designated and user-created, will continue to contribute to soil loss. Areas where soil condition is less than satisfactory due to lack of woody material will remain in this condition. Recruitment of woody material is likely to occur as trees die.

Alternative B

Under this alternative, the activities of removing trees, adding woody material to the ground, prescribed fire including the potential for pile burning and driving on soils to remove wood products, could lead to direct effects to soil resources. These direct effects lead to indirect effects. Creating the proposed openings could result in soil disturbance from mechanized equipment, removal of trees, mastication, and prescribed fire. Removing trees and soil disturbance exposes soil to precipitation events leading to erosion and sediment transport. Soil disturbance would be reduced or prevented in some areas through design features and best management practices (BMPs) as described in the BMP appendix. Erosion hazard and existing soil condition were used to design the treatment types such as the method of vegetation removal and slash treatment. Field observations reveal that motorized personal fuel wood collecting greatly disturbs soils. As a result, where soil condition is less than satisfactory and erosion hazard is severe, motorized personal use fuel wood collecting would not be used to remove wood (Table 40). This project design feature prevents this known impact to these sensitive soils. Changes in

microclimate occur when canopy cover is removed. However, leaving woody material on the ground improves soil condition where woody material is lacking and provides protection to soil during rainfall, making up for the loss of vegetative cover. Subsequent prescribed burning would remove masticated material, while vegetation grows back in. Masticated material is generally left in the openings and burned in later years. The depth of masticated material would not exceed 4 inches. Down woody material would be retained and/or appropriate levels would be restored after proposed activities to ensure appropriate levels to maintain soil quality are present.

Table 40 - Treatment Types and Associated TE Units, Erosion Hazard, and Soil Condition

TE Unit	Percent of Treatment Area	Erosion Hazard	Soil condition	Treatment Type - acres
24	4.3	slight - moderate	satisfactory	1- 20.6 4- 3.7 5- 8.8
87	4.2	slight	satisfactory	1- 28.7 4- 3.0
178	3.3	moderate - severe	unsatisfactory	3- 5.5 4- 4.1 5- 1.9 6- 13.6
191	19.9	moderate - severe	satisfactory	1- 108.1 4- 14.1 5- 15.3 6- 13.9
192	14.3	moderate - severe	satisfactory localized impaired	1- 58.4 4- 50.4
194	24.3	slight	impaired	2- 67.6 4- 5.4 5- 104.3 6- 8.0
270	19.3	severe	satisfactory localized impaired	1- 1.3 5- 132.4 6- 13.5
282	5.0	moderate - severe	satisfactory	1- 24.8 4- 13.5
284	2.6	moderate - severe	satisfactory	1- 17.6 4- 2.5
287	.5	severe	satisfactory	1- 3.0 4- .6
288	2.1	slight	satisfactory	1- 11.1 4- 5.0

Driving on soils and the use and maintenance of roads related to the proposed action would cause compaction and increased sediment yields in these areas. Existing roads are already compacted, however when masticators or other equipment is used off road to remove trees, compaction occurs quickly. Compaction quickly occurs during the first few passes across soil, and in the P-J zone cryptogamic crusts are destroyed. In treatment type 3, mechanized fellers could be used in addition to hand felling. In treatment types 1, 2, 5, and 6 mastication is also proposed. Mastication is done using large equipment. As a result, about 15% of these areas have visible tire tracks and compacted surfaces (Cline, et al 2010). Personal fuel wood use collection would not involve the use of motorized vehicles as these areas are close to the road, allowing for wood collection without off road motorized use. The existing road system would be utilized, with no new roads planned.

Therefore, tor the purposes of analysis, it is assumed that the 15% of treatment types 1,2,3,5, and 6 could be subject to ground disturbance when mastication or mechanized fellers are used. As a result, up to 100

acres could have motorized uses on them, including large equipment such as masticators, mechanized fellers, pickups, or ATVs.

Research suggests that thinning can increase nitrogen transformations into available nitrogen (Kaye and Hart 1998) but that repeated prescribed burning for maintenance may result in increased nitrogen mobility (Wright and Hart 1997), leading to nitrogen losses from soils. Results from research on mastication and soil suggest that masticated material can reduce soil temperatures and increase soil moisture (Owen et al 2009). Over time, mastication may negatively affect nitrogen dynamics (Gottfried and Overby 2011). The same study showed that pile burning increases soil temperatures, reduces soil moisture, changes soil structure, and causes nitrogen to be leached away.

Pile burning would only be used when wood loads are too great to be treated any other way. Piles are proposed as a possible treatment method for slash in treatment types 1, 2, 3, and 4. Piles would not exceed 10 feet by 10 feet and 5-10 piles per acre. This could result in 4.5 – 9.0 acres of soils impacted below these piles. If pile burning occurs several best management practices could be used to mitigate the effects to soil such as burning piles in the winter.

The indirect effect of improving controllability of uncharacteristic wildfire behavior as a result of the proposed vegetative treatment is a benefit to soil resources. Thinning activities are a preferable alternative to wildfire, resulting in less impact to watersheds (Ffolliott, et al 2011 and Dore et al 2010). The fuels report lists the results of fire behavior model, BEHAVE Plus, for this alternative. This model shows that when weather conditions are severe the model results for heat per unit area at the surface are reduced in the ponderosa pine and mixed conifer vegetation types. In the piñon-juniper type, the heat levels do not change regardless of the treatment method. This means the piñon-juniper type could still be subject to high heating levels during a wildfire, regardless of the alternative selected.

Trail re-routes would result in an improvement in soil condition on the closed sections of trail and reduce soil condition on the new sections of trail. About 1 mile of trail would be re-routed. Assuming a trail influence width of 10 feet, this is approximately 1.1 acres.

Table 41 - Measures of Effects for Soil Resources

Alternative	Potential Acres of disturbance - motorized use	Potential Acres of disturbance – acres of piles to be burned	Heat per Unit Area - Btu under severe weather[1] conditions /ft2			Average Woody material (tons per acre)		
			P-J	PP	MC	P-J	PP	MC
A – No Action	0	0	2816	506	472	3.1- 4.8	1.6 - 6.1	2.5 – 11.6
B - Proposed	100	4.5 – 9.0	2816	139	1.9	5-7	5-7	10-15

[1] Severe weather conditions as indicated by the 97% scenario in the Fuels report

Water Resources

The analysis area is the water resource features in the project area. This includes the springs, stream channels, riparian areas, and project watersheds within the project area. Measures to assess effects to water resources were developed for each topic. The measures for water resources are listed in Table 42. A discussion of these measures is listed below.

Table 42 - Measures Used to Assess Potential Effects to Water Resources

Resource	Effect	Measures
Water Resource condition	Changes to riparian condition Changes to stream channels	Water resources features within treatment area acres of riparian area number of springs miles of stream channel by type
Water quality	Sediment in water	Acres treated with mechanized/motorized methods within 300 feet of water resource features miles of trail re-routed away from Cañoncito
Water quantity	Changes in water yield at springs and in channels	Percent treatment areas within project watersheds
Watershed condition	Change in watershed condition rating	Watershed Condition Rating for project watersheds

The water resource features within the project area include stream channels, springs, and riparian areas. The condition of water resource features is assessed using the amount of these features within the treatment areas as shown in Table 42. While these features will be mostly be buffered from treatment activities, the effectiveness of mitigations and project design features is not 100%. As a result, some effects would occur in these areas within the analysis timeframe of 10 years.

The analysis area for water quality is the surface waters within the project area. This includes the springs and the seasonal waters in intermittent and ephemeral streams. The water quality components most likely to be affected by the proposed activities are sediment and dissolved nutrients such as nitrogen. Ecosystems accumulate and cycle large quantities of nutrients. Fire and loss of vegetation can disrupt this cycle and cause nutrient leaching, volatilization, and transformation (Elliot et al 2010). Wildfire release more nitrogen into surfaces waters than prescribed fire (Stednick 2000). If vegetation is quickly reestablished, nutrient exports are short-lived and usually do not represent a threat to water quality (Elliot et al 2010). Because of this, nitrogen effects are not carried through the analysis. Sediment is discussed in each alternative.

Sediment is the result of soil disturbance, increased erosion, and subsequent transport to a stream channel or other water resource feature. Stream channels adjust to increased sediment loads. Fine sediment in channel bottoms, can cause changes to micro-invertebrates and changes in stream type. Increased site disturbance will result in increased soil erosion and subsequent sediment production (Elliot et al 2010). The measures for the potential to change sediment are acres of ground disturbance. Roads are the source of much of the sediment related to harvest activities (Elliot et al 2010). Increased traffic on roads related to tree removal activities leads to increased erosion and sediment from these roads and adjacent areas. The measures for sediment are acres treated with mechanized and/or motorized methods within 300 feet of water resource features and miles of trail re-routed away from Cañoncito. Three hundred feet was chosen as the buffer to use for this project since several sources suggest that 100m (303 feet) is generally effective in controlling sediment (Belt et al 1992). Therefore, identifying those activities which are within 300 feet of riparian areas, streams, and springs is a way to identify areas which are could contribute to sediment to these features. The timeframe for analysis is ten years since effects could be observable.

Removing vegetation has the potential to increase water yields, change the timing of flow, and increase floods within a watershed (Elliot et al 2010). However, negligible water yield potential for piñon-juniper vegetation type has been reported (Zou, et al 2010). In the ponderosa pine vegetation type, there is the potential for some response, mostly from the redistribution of snow cover on north facing slopes (Baker, 1986). However, when precipitation is low as in the project area, water yield increases are less likely to

occur, even in the ponderosa pine zone (Hibbert 1983, Bosch and Hewlett 1982, Brown et al 2005, and Zou et al 2010). Hibbert (1983) found that when precipitation is less than 18 inches and evapotranspiration exceeds precipitation, it is unlikely to reduce transpiration and observe measureable increases in water yield from vegetation treatments. In the Rocky Mountain region, the mean of reported change in peak flows begins to be important when at least 20% of the watershed is harvested (Stednick 1996). It is expected that this threshold is much higher for the project area, since the area has a high proportion of piñon-juniper and is not located on many north facing aspects. Many factors combine to produce potential water yield increases. These changes in peak flow are most evident during times of high soil moisture and high snowfall. To assess this effect, smaller project watersheds were delineated (Figure 15) to assess how much of these smaller watersheds are proposed for treatment. The measure is percent of treatment areas within the project watershed. The timeframe for changes to annual water yield and small to moderate peak flows is 10 years since within this timeframe, most potential water resources effects become undetectable with natural variability.

The analysis area for watershed condition is the smaller project watersheds. This is because the larger 12 digit HUC watersheds are much larger than the treatment areas. In the Headwaters San Pedro Creek (130303010501), treatment areas comprise 1.6% of the acres while in Upper Tijeras Arroyo (130202030201), .6% of acres are proposed for treatment. At this scale, there would be no effect on watershed condition of these larger watersheds. Because of this, the smaller project watersheds are the analysis area for watershed condition with the timeframe of 10 years. This is because within 10 years, the effectiveness of vegetative treatment in reducing the risk of uncharacteristic wildlife is reduced.

Alternative A

There would be no direct effects on water resources or watersheds from the No Action Alternative. This is because there would be no activities occurring that would cause ground disturbance to water resource features or loss of vegetative cover. There would be indirect effects from the no action alternative, largely due to the continued risk of uncharacteristic wildfire and related effects. In addition, the sections of trail which are proposed for re-routing would not be re-routed, resulting in continued effects to the riparian area in Canoncito.

The condition of water resources features would remain as described in the affected environment section. This includes the springs and intermittent and ephemeral channels in the project area. As described in the Fire/Fuels report, under this alternative, existing forest conditions could lead to uncharacteristic wildfire with susceptibility to crown fire and high surface heating across large portions of the project area, as evidenced from recent wildfires in the area. Wildfire removes vegetation and causes bare soil, leading increased erosion, sedimentation, and runoff (USDA Forest Service 2010). As a result, channels adjust, water quality changes, depending on the severity and extent of the fire.

If a wildfire were to occur within the project area it could have adverse effects on the riparian areas. A wildfire affects riparian areas both directly and indirectly. The direct effects consist mainly of consumption (removal) of the vegetation that intercepts precipitation, and the partial consumption of the underlying litter layer. The indirect affect to riparian areas it decreases watershed stability, and in steep erodible topography, debris flows are likely (USDA, 2005). However, depending on the severity, recovery of vegetation can be rapid within a couple years to pre-fire conditions in some environments; it is dependent on the combined disturbance of both the fire and the flooding. Should this happen most of these effects would decrease to undetectable levels within 10 years as revegetation occurs and water resources features such as channels and spring recover.

Water quality in the project area would remain much the same, with the continued susceptibility to uncharacteristic wildfire and sediment yield related to roads and trails, especially the user created trails in

the south end of the project area and the actively eroding trails identified for re-routing. Under the no action alternative, no trails would be re-routed and eroding user created trails would not be addressed.

Change to water yields in the project watersheds as a result of the no action alternative depends on whether or not a wildfire occurs within the timeframe of analysis – 10 years. There would be no change in water yield due to the proposed vegetative treatments. However, as mentioned in the Fuels report, the susceptibility for high heat per unit area values is greatest under this no action alternative for ponderosa pine and mixed conifer vegetation types. Control opportunities for fighting wildfire would not be created under this alternative, leading to less control opportunities which could lead to extensive wildfire that burns large percentages of watersheds.

Wildfire removes vegetation and causes bare soil, leading increased erosion, sedimentation, and runoff (Elliot et al 2010). Runoff from wildfire areas would also increase depending on the amount of fire within each watershed. Indirect effects from a wildfire have to potential to increase spring flows for up to five years should a large percentage of the watershed be burned as the result of decreased evapotranspiration similar to what is currently observed in the area of the Trigo Fire on the Mountainair District. Should this happen most of these effects would decrease to undetectable levels within 10 years as revegetation occurs.

There would be no change in watershed condition in the smaller project watersheds should the no action alternative be selected. There are two reasons for this. First, there is a large percentage of piñon-juniper in the project watersheds which do not have reduced risks related to wildfire as shown in the Fuels report. The second reason is that the amount of treatment proposed is small compared to the landscape area which is at risk of uncharacteristic wildfire. As a result, the project watersheds would continue to function at risk with a ‘fair’ rating if the no action alternative is selected. This is because the risk of uncharacteristic wildfire would be unchanged from the current condition under the no action alternative.

This alternative provides the least direct impact to water resources, but provides the greatest potential indirect effects due to risk to wildfire.

Table 43 - Measures used to Assess Effects on Water Resources by Alternative

Resource	Measures		Alternative A No Action	Alternative B Proposed
Condition of Water Resource Features	number of springs within treatment area		0	2
	acres of riparian area within treatment area		0	21
	miles of stream channel within treatment area	Intermittent	0	2.0
		Ephemeral	0	1.4
Water Quality - sediment	treatment acres within 300 feet of water resource features		0	313
	miles of trail re-routed away from Cañoncito		0	.4
Water Quantity	Percent of treatment acres in project watershed	Cañoncito	0	7.8
		Cienega	0	16.3
		Sulphur	0	8.5
		Upper Armijo	0	6.1
		West Upper San Antonio	0	19.5
Watershed Condition	Watershed Condition Rating	Cañoncito	At risk	At risk
		Cienega	At risk	At risk
		Sulphur	At risk	At risk
		Upper Armijo	At risk	At risk
		West Upper San Antonio	At risk	At risk

Alternative B

Direct effects to water resources features related to the proposed action include the removal of trees, compaction and disturbance from motorized and mechanized equipment and vehicles, prescribed fire, hand piling, burning piles, and re-routing trails.

Within the proposed treatment areas, there are 2 springs, 21 acres of riparian areas, and 3.4 miles of intermittent and ephemeral streams. While these features will be protected through the use of project design features and mitigation, it is expected there will be some short term impacts to these features. The impacts will be prevented and mitigated through the use of design features and Best Management Practices as described in the appendix B. For example, stream channels in the project area would not be used as pathways for motorized vehicles. Areas with riparian characteristics, including the springs would be protected by buffer zones where trees would be retained and motorized vehicles would be excluded. These areas have some opportunities for site improvement as described in the wildlife report, which could include removal of non-native plants and removal of selected trees to promote desired species. Many stream channels contain stringers of ponderosa pine as described in the vegetation report. These areas would be retained as groups of trees. Openings would not be created where stream channels are present or on concave slopes. These practices are described in appendix B, Best Management Practices, based on soil and water conservation practices described in FSH 2509.22 (USDA 1990). Potential effects to water resource features are measured by the presence of these features in the treatment area since mitigations are not 100% effective and adaptive in nature. There is a process for assessing mitigations, also known as Best Management Practices (BMPs) which monitors the use of these practices. The implementation and effectiveness of BMPs is tracked to ensure these practices are reducing effects to water resources (USDA 2012). The use of BMPs which includes project design features and mitigations is detailed in BMP appendix.

Ground disturbing activities have the potential to mobilize sediment into adjacent water resources features. Stream channels and riparian areas will have a 300 foot buffer established around them where mechanized and motorized activities would not be allowed. Springs will be protected by a 500 foot

buffer. By implementing this buffer, there would be little direct or indirect effects on water quality from the proposed activities. Ephemeral, intermittent and spring waters would largely remain as described in the affected environment section. There may be some increased sedimentation during runoff events from soil disturbance within the project area. The prescribed buffers are expected to reduce the overland component of sediment. Other practices, such as water bars, restrictions on motorized use, and location of hand piles are expected to further reduce the input of sediment to these features. Concentrated surface runoff which has the potential to breach the prescribed buffers would be reduced by these practices. This will apply to the 31.3 acres of water resource features within 300 feet of the proposed treatments area.

In addition, the direct effects of the proposed re-routes would mobilize sediment from these relatively undisturbed areas while at the same time allowing the old trail segments to stabilize and reduce sediment inputs. Since the new locations are located away from water resource features, the overall effect is to improve water resource condition in the area of the re-routes. Project design features and mitigations are used to ensure appropriate location of re-route, drainage features on these new trails, and rehabilitation of the old trail segments. This is especially true of the .4 miles of trail removed from the riparian area of the Cañoncito drainage.

Because project design features and mitigations are expected to reduce inputs of sediment related to the proposed activities, it is unlikely there would be effects to the downstream impaired waters in each of the sub-watersheds intersecting the project area. Mechanical shredding has been shown to reduce sediment yields and improve infiltration in juniper woodlands (Cline et al 2010). The impaired reaches in San Pedro Creek and Tijeras Arroyo do not include sediment as a cause for not attaining the designated use. In addition, these two reaches are located miles downstream from the project area. By using the BMPs as described in the appendix, there would be no impact from the proposed activities to these impaired stream reaches.

It is unlikely that there will be changes in water yield could occur in the project watersheds due to the removal of vegetation and ground disturbance in project area. To check the potential for this, the percent proposed for treatment in each project watershed was calculated. As mentioned previously, when at least 20 % of the forest cover in a watershed is removed; base flows can increase in locations with favorable characteristics (Brown et al 2005). Favorable characteristics in the project area generally do not exist in the piñon-juniper vegetation type but may occur occasionally in the higher elevation vegetation types when snow can accumulate. Therefore, to supplement the amount of treatment proposed in each project watersheds, the amount of each vegetative type was also calculated. Water yield potential has been linked to vegetation type in several research papers (Zou et al 2010, Baker 1986, and Brown et al 2005). This link is related to the precipitation within the vegetation types. Where there is snow accumulation, as in the ponderosa pine and mixed conifer sites, there is a greater potential for water yield increases related to vegetation treatments.

As shown in Tables 43 and 44, less than 20% of the project watersheds are proposed for treatment. In addition, the amount of ponderosa pine and mixed conifer proposed for treatment in these watersheds is 0%-7%. It is these two vegetation type where the potential for water yield increases is the greatest but very little of these types is proposed for treatment in the project watersheds. The combination of these two factors makes it unlikely that water yield would increase as a result of the proposed activities. This applies to base flows, peak flows, and overall annual water yields.

Table 44 - Vegetation Types in Treatment Areas by Project Watershed

Watershed	Size (acres)	PJ (acres) - percent	Ponderosa Pine + Mixed Conifer (acres) - percent
Cañoncito	1252	75.7 (6%)	21.5 (2%)
Cienega	1341	114.4 (8%)	97.6 (7%)
Sulphur	2721	84.1 (3%)	146.4 (5%)
Upper Armijo	1359	82.8 (6%)	0 (0%)
West Upper San Antonio	680	105.1 (15%)	27.4 (4%)

Watershed condition in the smaller project watersheds has the potential to be changed by the proposed activities. Direct effects from the proposed alternative are unlikely to result in a watershed condition change. However, an indirect effect from improved control opportunities for wildfire has the potential to prevent project watershed condition from becoming non-functional or 'poor'. However, due to the lack of reduced fire in the piñon-juniper in the project watersheds, including amounts not proposed for treatment, it is unlikely the proposed action would result in an improved watershed condition rating in the project watersheds. As a result, the watershed condition rating in the project watersheds would remain 'at risk' or 'fair.'

Cumulative Effects

Cumulative effects generally refer to impacts that are additive or interactive (synergistic) in nature and result from multiple activities over time, including the project being assessed. The US Council on Environmental Quality defines cumulative effects as "the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions."

Actions occurring within the Cibola National Forest that could potentially combine with the effects of the proposed action and result in environmental impacts include vegetation treatment, thinning, prescribed fires, road management, recreation, and wildlife habitat improvements. Road maintenance has a beneficial effect on watershed and soil condition as it improves road drainage and reduces erosion and sedimentation in the long-term. The effects from increased recreation activity in the Sandias Mountains have been considerable on watershed, soil condition, and riparian condition. New development is ongoing on private land.

The cumulative effect of interest for soils is soil condition. The analysis area is the project area within a ten year timeframe. This is because ten years is long enough for effects to soil from the proposed activities to become apparent. The project area was selected since this project is designed to improve landscape condition. Project activities are expected to improve soil condition on over 200 acres of impaired and unsatisfactory soils in the treatment area. This is almost 20% of the project area and over 90% of the impaired soils in the project area. This makes an important gain in this area on improving soil condition for this landscape.

The cumulative effect of interest for water resources is watershed condition as described in the WCF (USDA 2011). The cumulative effects boundaries for this project are the sub-watersheds, Headwaters of San Pedro Arroyo and Upper Tijeras Arroyo. Beyond this scale, any effects of the proposed action will become indistinguishable from background levels. Cumulative effects will be bound temporally 10 years in the past to 10 year in the future. The no action alternative has the most potential for changing watershed condition, due to the susceptibility for large wildfires. A large wildfire has the potential to change watershed condition to 'poor' on any of the 6th code watersheds in the project area. Implementing one of the action alternatives could provide control opportunities, thereby reducing the size and severity of potential wildfires. However, due to the small amount of treatment proposed and localized

control opportunities that would be created, the proposed action would not reduce this risk enough to make a change in the potential for changing watershed condition class.

Recreation

Affected Environment

According to the National Visitor User Monitoring Survey, the Cibola National Forest has the most recreation use in New Mexico. The Sandia Ranger District receives the highest recreation use on the forest, due to its proximity to metropolitan Albuquerque. The district manages lands in the Sandia and Manzanita Mountains. The Sandia Mountains have been managed primarily for day-use developed recreation (picnic grounds, scenic overlooks, and interpretive trails) and non-motorized recreation in the last 20 years.

The Sandia Mountains are the portions of the district north of I-40. The elevation ranges from 6,000 to over 10,000 feet, providing diversity in vegetation and terrain. Residential development is common adjacent to the forest boundary, including the communities of Albuquerque, Placitas, Tijeras, Carnuel, and other East Mountain communities. The Sandia Mountains are highly valued for their scenic quality. The landscape is predominantly natural appearing. Recreation developments are evident along the Crest Highway and in Las Huertas Canyon. Developed recreation is prominent in the Sandia Mountains, with most sites concentrated around NM 536 (Crest Highway), NM 165 (Las Huertas Canyon), and the Juan Tabo Basin. All of the developed recreation in the Sandia Mountains is day use only, with no overnight campgrounds.

Trail use is the primary dispersed recreation use. There are 153.5 miles of National Forest System (NFS) trails in the Sandia Mountains. Trails in the Sandias are primarily used for hiking, horseback riding, and mountain biking. One hundred miles of NFS trails are located in Sandia Mountain Wilderness and 53.5 are outside of the wilderness. No motorized or mechanized vehicles are permitted in wilderness.

In addition to trails, a variety of other dispersed recreation activities occurs on the Sandia Mountains including biking, wildlife and bird watching, and firewood cutting. Motorized dispersed camping is permitted, but is not a common activity. Only bow hunting is permitted on the district, and there are hunting permits for bear, cougar, and deer. Discharge of firearms is prohibited on the entire district, except by tribal members under existing treaty rights.

Recreation resources within and adjacent to the Sulphur Project include Sulphur Canyon, Cienega Canyon, and Doc Long Picnic Areas, eight trails or segments of trails and associated trailheads, the Sandia Mountain Wilderness Area, and the Sandia Crest Byway (portion of the Turquoise Trail National Scenic Byway). The Sandia Crest Byway is a popular visitor destination offering access to a variety of recreational opportunities and experiences.

<u>Recreation Opportunity Spectrum (ROS)</u>
The lands within the project area are classified as Roaded-Natural and Semi-primitive Non-motorized. Table 45 lists the lands classification. Each classification of the spectrum is described in the ROS Users Guide. Information pertinent to Roaded Natural and Semi-Primitive Non-Motorized is included below (ROS Users Guide 1982 USDA-FS).

Table 45 – Recreation Opportunity Spectrum

ROS Class	Acres	% Acres
Roaded Natural	1367	82
Semi-Primitive Non-Motorized	309	18
Total	1676	100

Roaded Natural

Setting Characterization -Area is characterized by predominantly natural appearing environments with moderate environments of the sights and sounds of man. Such evidences usually harmonize with the natural environment. Interaction between users may be low to moderate, but with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment conventional motorized use is provided for in construction standards and design of facilities.

Experience Characterization - About equal probability to experience affiliation with other user groups and for isolation from sights and sound of humans Opportunity to have a high degree of interaction with the natural environment Challenge and risk opportunities associated with more primitive type of are not very important. Practice and testing of outdoor skills might be important. Opportunities for both motorized and non-motorized forms of recreation are possible.

Remoteness criteria-An area designated within ½ mile from better than primitive roads, and railroads.

Evidence of Humans Criteria- Natural setting is culturally modified to the point that it is dominant to the sensitive travel route observer. May include pastoral, agricultural intensively managed wildland resource landscapes, or utility corridors Pedestrian or other slow moving observers are constantly within view of culturally changed landscape. There is strong evidence of designed roads and/or highways. Structures are generally scattered, remaining visually subordinate or unnoticed to the sensitive travel route observer. Structures may include power lines, micro-wave installations and so on.

Semi-Primitive Non-Motorized

Setting Characterization -Area is characterized by a predominantly natural or natural-appearing environment of moderate-to large size. Interaction between users is low but there is often evidence of other users. The area is managed in such a way that minimum on-site control and restrictions may be present but are subtle. Motorized use is not permitted.

Experience Characterization- High but not extremely high probability of experiencing isolation from the sights and sounds of humans, independence, closeness to nature, tranquility and self-reliance through the application of woodsman and outdoor skills in an environment that offers challenge and risk

Remoteness criteria-An area designated at least ½ mile but not further than 3 miles from all roads, railroads or trails with motorized use; can include the existence of primitive roads and trails if usually closed to motorized use.

Evidence of Humans Criteria- Natural settings may have subtle modifications that would be noticed but not draw the attention of an observer wandering through the area. Little, or no evidence of primitive roads and the motorized use of trails and primitive roads. Structures are rare and isolated.

Picnic Areas/Trailheads

The following four picnic areas/trailheads are 15 miles from Albuquerque, New Mexico and lie adjacent to the Sandia Crest Scenic Byway. In addition to picnic facilities, these areas also serve as trailheads for a variety of trails within the project area.

Cienega Canyon
Cienega Canyon picnic Area is set back approximately 1/2 mile west of the Sandia Crest Scenic Byway. The area provides picnic facilities for individual family size groups and one larger group reservation site. The altitude is approximately 7500 feet. Cienega Nature Trail and Cienega Canyon Trail are located adjacent to this picnic area.

Cienega Horse Trailhead
The Cienega Horse Trailhead is accessed via the road leading to the Cienega Canyon Picnic Area. The trailhead provides one of the only parking areas suited for large horse trailers in the Sandia Mountains. The trailhead provides access to the Cienega Horse Bypass Trail.

Doc Long
Doc Long Picnic Area includes two group shelters and individual picnic tables. This picnic area lies amongst tall pine trees and mountainous terrain. The area provides access to the Bill Spring and Doc Long-Sulphur Link Trails. The two reservation picnic shelters are located within the area and are replicas of a mid-1930's CCC design.

Sulphur Canyon
Sulphur Canyon Picnic Area includes picnic facilities for individual family size groups. The Sulphur Canyon Trail and Doc Long-Sulphur trail start at this location. The area has a larger component of oak trees than other areas and is often frequented by bears in autumn for the crop of acorns the oak trees provide.

Turquoise Trail National Scenic Byway (Sandia Crest Byway)
The Sandia Crest NM Scenic Byway was designated as a part of the Turquois Trail National Scenic Byway on June 15, 2000. Sandia Crest Byway is the highest scenic drive in the southwest, following NM 536 for nearly 14 miles it climbs nearly 4,000 feet as it travels through the high desert and dense forests of the Sandia Mountains. The byway meanders and switchbacks up the mountain to the 10,678-foot Sandia Crest where observation platforms provide spectacular panoramic views. Come nightfall, visitors are treated to a beautiful display of Albuquerque's twinkling city lights. The craggy western face of the Sandia Mountains contrasts the forested eastern slopes that you'll follow up to Sandia Crest.

The byway lies within the borders of Cibola National Forest, which holds its own in offering recreation and wildlife viewing. Miles of trails provide biking and hiking in warm weather and snowshoeing and cross-country skiing in colder months. Many picnic areas along the byway provide a good spot for relaxing a bit and enjoying a lunch or early dinner The Sandia Mountains reside within the forest, and mountain wildlife such as Rocky Mountain bighorn sheep, deer, black bears, and golden eagles can all be seen here. One and a half miles of the project area boundary are adjacent to the Sandia Crest Byway.

Trails
Trails within the Sulphur project area provide a variety of recreational opportunities. They range from relatively low or moderate use to very high use. The area is visited year round by experienced and novice hikers, horseback and mountain bicycle riders in the dry season followed by winter recreationists including cross-country skiers in the winter.

Eight multi-use, non-motorized trails lie within the Sulphur Project Area. Table 46 provides a brief description including use levels of the trails within the Sulphur Project Area. These trails have the potential to be directly or indirectly affected by the proposed project.

Table 46 - Trails

Trail Name	Trail #	Length Affected (miles)	Use level during proposed operating season	Description
Armijo	222	1.85	Moderate	1.85 mile trail from Cienega recreation complex to junction with Faulty Trail (#195)
Bill Spring	196	0.10	Moderate	1 mile trail from Doc Long Picnic Area to junction with Faulty trail (#195)
Canoncito	150	0.21	Moderate	3 mile trail from Cole Springs Rd to Crest trail (#130)
Cienega	148	0.39	Moderate	2.25 mile trail from Cienega recreation complex to Crest trail (#130)
Cienega Horse Bypass	266	1.78	Moderate	1.78 mile trail from Cienega Horse trailhead to Faulty trail (#195)
Cienega Nature	96	0.19	Moderate	0.25 mile interpretive trail within the Cienega recreation complex
Doc Long – Sulphur	345	0.24	Moderate	.24 mile trail from Doc Long to Sulphur recreation complexes
Faulty	195	3.23	Moderate	8.85 mile trail from Crest trail (#130) to junction with Bill Spring trail (#196)

Sandia Mountain Wilderness Area

The western boundary of the Sandia Mountain Wilderness Area represents the eastern boundary of the Sulphur project area. The Sulphur Project does not propose any activities within the designated wilderness.

The United States Congress designated the Sandia Mountain Wilderness Area in 1978 and has a total area of 37,877 acres. Despite the fact that these mountains tower above the very nearby sprawl of Albuquerque and despite the fact that the trails of this Wilderness may be more heavily used than any other trail system in the state, Sandia Mountain Wilderness still provides an opportunity to get out of town but solitude may be difficult to find.

The area lies primarily on the western slope of the Sandia Mountains, but it crosses over to the eastern side at the north and south ends. Spruce and fir dominate the high country, with stands of mixed conifers just below. Many raptors migrate through these mountains in spring and fall, sharing their territory with a few mule deer and black bears. Accessible from the tram is the Crest Trail, which runs along 26.54 miles of the main ridge of the Sandias at an elevation averaging 10,000 feet.

There are 100 miles of trails in the Sandia Mountain Wilderness which is primarily used for day use recreation, from walks along flatter terrain to hikes on steep and rugged trails that access the higher ridges. Trails located within the Sulphur project area are used to access the Wilderness. Potential effects on recreation, including disruptions to individual trails and dispersed recreation, are discussed in the Recreation analysis.

Sandia Mountain Wilderness Area is very easily accessible to the west from the city of Albuquerque, to the east from Sandia Crest Highway (NM 536), to the south from US Highway 40/Historic Rt. 66, and to

the north from NM 165. Unique to the Sandia Wilderness is the bisection of the area by an aerial tramway. The Sandia Crest Tramway further increases public access to the wilderness.

To the east and northeast lies the Sandia Crest Highway, a national scenic byway and a substantial two-lane road that receives a considerable amount of traffic. The associated traffic noise is audible year-round in the Sandia Mountain Wilderness. Additionally traffic noise from US Hwy. 40 and urban noise from Albuquerque infiltrates into the wilderness year-round.

In general, Wilderness values and characteristics of the Sandia Mountain Wilderness diminish in direct correlation to distance from the Wilderness core. This is especially true as there are many off-site intrusions visible from higher vantage points, specifically the urban landscape of Albuquerque at the base of the mountain.

Along the Sandia Crest Highway, opportunities for solitude are encumbered by road noise and heavy visitor traffic to sites in close proximity to this highly traveled Scenic Byway.

Wilderness Characteristics

Wilderness character is not defined in the Wilderness Act nor is its meaning discussed in the legislative history of this Act. It is often best described as the combination of biophysical, experiential, and symbolic ideals that distinguish wilderness from all other lands. The Definition of Wilderness from Section 2(c) of the 1964 Wilderness Act was used to identify four qualities of wilderness related to wilderness character (Landres, et. al, 2008).

The four qualities of wilderness are:

Untrammeled**:** The Wilderness Act states that wilderness is “an area where the earth and its community of life are untrammeled by man,” and “generally appears to have been affected primarily by the forces of nature.” In short, wilderness is essentially unhindered and free from modern human control or manipulation.

Natural**:** The Wilderness Act states that wilderness is “protected and managed so as to preserve its natural conditions.” In short, wilderness ecological systems are substantially free from the effects of modern civilization.

Undeveloped**:** The Wilderness Act states that wilderness is “an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation … where man himself is a visitor who does not remain” and “with the imprint of man’s work substantially unnoticeable.”

Outstanding opportunities for solitude or a primitive and unconfined type of recreation**:** The Wilderness Act states that wilderness has “outstanding opportunities for solitude or a primitive and unconfined type of recreation.” This quality is about the opportunity for people to experience wilderness; it is not directly about visitor experiences per se.

These criteria are used to analyze the effects of the Sulphur project; to determine if proposed actions would affect the wilderness characteristics of the Sandia Mountain Wilderness. Use of these criteria is consistent with Monitoring Selected Conditions Related to Wilderness Character: A National Framework (Landres, P. et. al. 2005).

Picnic Areas/Trailheads **–** Picnic facilities on the Sandia Ranger District experience their highest visitation from Memorial Day through Labor Day holiday weekends. Visitation spikes on the

aforementioned holidays as well as Independence Day and during the Albuquerque International Balloon Fiesta held annually generally in the first two weeks of October. The District experiences smaller, more localized, increases in use on Easter and Mother's Day. Use of areas that provide trail access loosely follows trends associated with utilization of picnic facilities but is more consistent as well as dependent on weather and trail conditions.

Sulphur, Cienega, and Doc Long are popular picnic areas and lie within Subunit A of the project area. All, or part, of these areas are administratively closed annually from October 15 through May 15. An administrative closure allows public entry into the area however the site is not maintained for use during the administrative closure. During the winter months, the front portions of Sulphur and Cienega remain open for trailhead parking and see minimal use of picnic tables. Between November and April these areas receive very low use as picnic areas serving primarily as trailhead parking. However, during the same months, the total use is low to moderate depending on weather conditions.

The timber stands inside these picnic areas are currently even aged with a primarily mature over-story. The mature age of the over-story has led to a large number of hazard trees to be identified and removed from these sites over the past two years.

In the event of a wildfire, there is only limited access provided for public and emergency personnel safety to and from the project area. There is currently nothing in place (aka. a gate) that will allow the Forest to completely close off the Cienega and Sulphur Picnic Areas for fire activity. The areas immediately surrounding the recreation sites are heavily wooded with fuel material.

National Forest System Trails (NFST) – Approximately 8.4 miles of NFST's are located within the project area and are in varied condition. Poor design and location of several segments of trails are resulting in unacceptable damage to trail and other resources which violate the National Quality Standards for Trails (FSH 2353.15). More specifically, the Canoncito trail lies within a drainage with perennial water flow resulting in excessive soil erosion, segments of wet, boggy trail and damage to rare natural features including travertine terraces/waterfalls. Additionally, segments of the Faulty trail exhibits varying degrees of soil loss due to excessive grades, poor design and location.

Picnic areas/trailheads within the project area provide the only immediate general-public access to National Forest System trails. The closest alternative points of public access are Canyon Estates Trailhead approximately four miles south of the project area and Tree Springs Trailhead approximately two miles to the northwest of the project area. Public access to the Cole Springs area via Canoncito Road has been cut off by a private landowner who has denied passage across private property.

Unauthorized Trails – Many adjacent landowners have private access through gates in the Forest boundary fence leading to the establishment unauthorized trails. Some of the unauthorized trails have historically been used by an Outfitter/Guide Special Use Permit holder. This individual is not currently permitted to operate on the Sandia RD.

An undetermined number and mileage of unauthorized trails exist within the project area. Unlike NFST's, these trails are not part/do not assist in meeting the objectives of the area and in many cases are improperly designed leading to damage to natural and cultural resources. Further, in many cases, their existence creates a confusing number of trail junctions and turnoff's not known to many trail users.

Wilderness – A number of short segments of the Faulty Trail north of the Canoncito Trail are located within the Sandia Mountain Wilderness leading to incursion by bicycles and a diminished primitive quality for which wilderness is established.

Environmental Consequences

The analysis area for direct and indirect effects on recreation is defined as the Sulphur Forest Restoration project area. The time frame is 2–10 years based on the potential effects. However, nearly all of the effects are expected to last for the duration of operations, 2–4 years. This analysis area and time duration were selected because once the management action ceases, so do the majority of effects.

The analysis area for direct and indirect effects on Wilderness is the entire Sandia Mountain Wilderness. This analysis area was chosen because effects to wilderness characteristics would be limited to Wildernesses within a reasonable distance from the project area. The Sandia Mountain Wilderness boundary coincides with the western project area boundary. Nearly all of the project area is within 1.25 miles of the Wilderness. The timeframe for the direct and indirect effects analysis is the duration of the project — approximately 2–4 years. This analysis area and time duration was selected because once the management action ceases, so do the effects.

Alternative A - No Action

Alternative A would not alter the current recreation opportunities. From a trail management standpoint, not relocating the Canoncito and Faulty trails will allow for continued erosion and negative effects on soil and water resources (Olive & Marion, 2009) as well as trail management objectives (FSM 2350.2). Many portions of existing trails lie within the drainages and are affected by perennial water flow resulting in large segments of wet, boggy trail. Further, due to grades exceeding USFS trail design standards (as well as generally accepted trail design specifications), many portions are un-repairable.

Alternative A proposes “No Action” in the Sulphur project area or the Sandia Mountain Wilderness and thus would have no short-term direct and indirect effects on the wilderness characteristics of the analysis area. The Sandia Mountain Wilderness would retain its current degree of natural integrity. There would be no management-induced changes or improvements to the ecological function within the Sandia Mountain Wilderness (Natural). This alternative would have no effect on the existing opportunities within the Sandia Mountain Wilderness. There would be no changes to the availability of primitive recreation or the opportunity to experience natural quiet (Outstanding opportunities).

Alternative B

ROS

The vast majority of the project area (82%) is classified as “Roaded Natural” (RN) with the remaining area (18%) classified as “Semi-primitive Non-Motorized” (SPNM). The descriptions of relevant classification s are included above. All of the actions associated with the Proposed Action alternative falls within these classifications. Proposed actions in Alternative B will not affect the current ROS classifications.

Closures

Picnic Area/Trailhead Closures- Implementation of this project will require complete closure of Sulphur, Cienega, and Doc Long picnic areas during active operations. These areas will be placed under a Forest Supervisor closure order restricting all public access within the defined area. These closures will be temporary, lasting only as long as deemed necessary to provide for the health and safety of the public.

A majority of the activities in the project area will occur prior to the annual May 15th full seasonal opening of the picnic areas and after August 1st when cutting may commence and may continue through to the annual winter seasonal closure of October 15th. Burning may occur starting in monsoon season of July through September as well as into the fall and winter. Chipping and masticating may start September 1st.

These timing restrictions are based on other natural resource considerations such as fire restrictions, Ips beetle, and wildlife concerns. Peak recreation season lasts from Memorial Day in late May through mid-October. This represents approximately five months of the year and would be too restrictive to prohibit management activities during the peak season. Measures will be taken to limit the impact of management operations during the latter part of the peak season when activities may occur.

While the above listed picnic areas are temporarily closed during project operations, access will be restricted and the recreating public be will be displaced. However, this displacement will be temporary in nature and operations will be timed to minimize the impact of closures on the recreating public to the extent practicable. Operations may be scheduled to stagger the closures so the three picnic areas are not all closed at the same time; or operations may be scheduled to so that all three areas are closed but for a shortened time. Either way, efforts will be made to limit the extent of the closures.

The District provides alternative picnicking opportunities along NM Highway 536 and elsewhere on the District. These picnic areas are rarely full and should easily be able to accommodate the additional use from displaced users.

Trail Closures- Several trails are located in the project area. These trails lie at a lower elevation on the mountain than many others on the District and therefore receive continual use year-round. Some of these trails may need to be closed to the public at various times while operations are occurring to protect public health and safety. These closures will be temporary in nature and operations will be timed to minimize the impact of closures on the recreating public to the extent practicable. The above listed rational for effects related to picnic areas are adopted for trails.

Vegetation Management
Conducting uneven aged vegetation management inside the boundaries of picnic areas allows for higher species diversity and age class diversity of vegetation inside the picnic areas. Age class diversity is important to allow for natural replacement of the over-story canopy while easing the transition between age classes in the over-story. Developed recreation areas with a single age-class of shade trees often experience long periods of time between the death of the mature trees and when the younger cohort is mature enough to replace the shade. Active vegetation management will provide an opportunity to remove trees with evidence that they may become an overhead hazard in the near future.

A thinner forest may impact recreation experience insofar as it alters the visual environment. A reduction in screening could lead to a reduced feeling of privacy within the picnic areas. Care will be taken to retain the existing underbrush screening between picnic tables in developed areas. A thinned forest may also lead to increased sight distances into the canopy which could lead to a reduced feeling of seclusion. Additional discussion on visual impacts can be found in the scenery specialist report.

Wilderness
The limited scope of this project is not expected to have any effect on the long-term ecological processes within the Sandia Mountain Wilderness. Ecological effects of the project are discussed in specific resource analyses within this document (Natural). Refer to project effects on Wildlife, Water Resources, and Soils.

A short-term increase in air pollutants would be expected due to exhaust from trucks and harvesting equipment. These are temporary sources of emissions and particulate matter; they would occur in the context of larger sources such as vehicle use in Albuquerque and along Sandia Crest Highway, NM 165, and US 40 around the Wilderness periphery (Natural).

The action alternatives would have short-term indirect effects, related to natural quiet, on the Sandia Mountain Wilderness for the duration of the management activities. These alternatives propose harvest activities within a 1.25 mile periphery of the Sandia Mountain Wilderness. Harvest activities may increase the noise level in those areas within 1–2 miles of harvest units and have short-term effect on the opportunity for solitude.

Noise
Noise associated with harvest activity may be apparent to visitors within one or two miles of harvesting operations. This estimate is based on data from the Forestry Vibration and Noise Study, University of Washington, (Neitzel & Yost, 2003, p 15). The distance is generally based on the average decibels produced by machinery and measured over distance from the specific source. The sound-to-distance estimate does not take into account the buffering effects of vegetation, wind, or topography; these would further reduce the sound (Timerson, 1999, p 5; Claflin, 2008). Noise effects would be limited to the area surrounding harvest units and would be short-term in nature, limited to the duration of the vegetation management activities (Outstanding opportunities).

Assuming the maximum distance of two miles, it is possible that noise could be audible on, at most, up to 14% or 5,125 acres of the Sandia Mountain Wilderness. However, it is important to note that all of the management activity would not occur at one time, rather over the duration of the entire project timeframe, drastically reducing the percent of the Wilderness area affected at any one time. Potential effects to recreation associated with these alternatives were discussed elsewhere in this document (Outstanding opportunities)

The effects on the existing opportunity for solitude resulting from mechanical noise would be short term and limited in scope due to the amount of the Wilderness within a close proximity to the Sulphur project. Effects from noise to solitude should be viewed in the context of the existing condition. Noise associated with Sulphur operations would be very similar to other vehicle noise heard within this Wilderness, with the distinction being that the majority of the other sources of noise are permanent contributors (i.e. vehicle traffic along NM Highways 536, 165 and US 40). The Sulphur project would be short term in nature and would not persist, restoring existing opportunities for solitude at the close of operations (Outstanding opportunities).

Beyond the considerations its impact on the wilderness, noise associated with harvest operations may be apparent to visitors outside, as well as, within the wilderness area. The above listed rational also applies to the effects of this noise on recreation users outside of the wilderness area.

Trails
Implementation of reroutes on the Canoncito and Faulty trails will allow for better location and design limiting further degradation of resources. Removal of segments of the Faulty trail within the Sandia Mountain Wilderness will help eliminate incursion of bicycles thereby improving the primitive quality of the area.

Removal of unauthorized trails helps limit degradation of resources and reduce confusion by reducing the number of unidentified trail junctions.

Planned Ignition Fire Impacts to Recreation
Smoke- Planned ignition burns to reduce fuel loads will produce smoke. This smoke has the potential to negatively impact the recreation experience of those recreating in close proximity to the burns. During the periods of time when smoke is in the air recreationists may be displaced. This impact will be temporary and only occur during active burning and shortly thereafter. The public will be notified prior to ignition via standard means of press release and signs.

Evidence of Fire- Following planned ignitions the visual aesthetics will be noticeably altered and may contribute to an altered recreation experience. Visual aesthetics are covered in the scenery specialist report.

Other considerations
Evidence of harvest operations may be evident to those driving for pleasure along the Scenic Byway. Harvesting equipment such as masticators may be seen in the area or in transport to and from the project area. The visual appearance of the forest will also change. Management of scenic resources is discussed in the Scenery report.

Area closures and management actions may limit unconfined recreation such as cross country travel for wildlife viewing, hunting, and personal exploration. As with trail and picnic area closures, these closures will be temporary and limited to the time necessary to protect public health and safety. These temporary closures may displace these types of forest users for short periods. Additionally, the activity and sounds of management activities may disturb and displace some wildlife from the area. This displacement may alter the experience of visitors hoping to view wildlife during their visit. Wildlife is further discussed in the biological evaluation of this project.

Cumulative Effects

The analysis area for cumulative effects on recreation is defined as north of I-40, the western District boundary, east of the Sandia Mountain Wilderness Area, and south of NM Highway 536. The analysis area was chosen because it is bound by geographic features (roads) and an area that is managed in a significantly different way than wilderness.

The time frame is the past (10 years), present, including ongoing activities and the foreseeable future (10 years; 2004–2024). This time frame was chosen because it is a reasonable length of time for measuring past effects and for projecting upcoming projects.

<u>Past projects</u>
The Hondo Fuels Reduction Project area lies directly to the south of the Sulphur project area between the Forest and Sandia Mountain Wilderness Area boundaries. Implementation of this project began in 2011. Hondo did not include the alteration of any recreation resources.

<u>Future projects</u>
The La Madera Forest Restoration Project will be a large comprehensive forest restoration project covering the Sandia Ranger District north of I-40. Planning for this project is anticipated to begin in FY’2014 with a signed decision and implementation in FY’2015. The project area will include the cumulative effects analysis area described above. In addition to vegetation management, the La Madera project will propose recreation and trails enhancement activities. It is unlikely that implementation of Sulphur and La Madera projects will overlap therefore limiting the chance of negative cumulative effects on recreation resources.

The Casa Loma Trail Access Project will propose to construct new miles of trail and a new trailhead in the Hondo project area and the southern end of the Sulphur project area. Planning for this project is anticipated to begin in FY’14 with implementation beginning in FY’15. The purpose of this project is to increase public access for trail users to the southeastern corner of the Sandia Mountains following the loss of public access across private property along Canoncito Road. This project will also address neighborhood access to the National Forest System trails in the project area. This project will overlap with the Sulphur and La Madera projects. However, negative cumulative effects are not anticipated.

No past or future projects have or are anticipated to affect the recreational resources in the Sulphur project area. Therefore, no negative cumulative effects are anticipated.

Scenic Resources

This section serves as an analysis of the possible impacts of the proposed Sulphur Forest Restoration Project on the scenic resources. The purpose of this section is to compare alternative treatment actions on the landscape and disclose effects of these actions.

Regulatory Requirements for Scenic Resources

The Forest Service has routinely included scenery resources planning as directed by the 1960 Multiple Use-Sustained Yield Act. It is Forest Service policy to:

- Inventory, evaluate, manage, and, where necessary, restore scenery as a fully integrated part of the ecosystems of National Forest System lands and of the land and resource management and planning process.
- Employ a systematic, interdisciplinary approach to scenery management to ensure the integrated use of the natural and social sciences and environmental design.
- Ensure scenery is treated equally with other resources.
- Apply scenery management principles routinely in all National Forest System activities.

Forest Service Manual Direction

FSM 2380 Landscape Management states that Forest Supervisors have the responsibility to:

- Conduct and document a scenery assessment for all activities that may affect scenic resources and that require analysis under the National Environmental Policy Act.
- Ensure application of the principles of landscape aesthetics, scenery management, and environmental design in project-level planning; refer to the Agriculture Handbook series on Landscape Management.
- FSH 1909.15 Land Management Planning Handbook Chapter 10- Land Management Plan- Subpart 13.13a- Recreation and Scenery Management
- FSH 1909.15 NEPA Handbook Chapter 10- Environmental Analysis – Subpart 12.22

Forest Plan – Visual Quality Objectives

The 1985 Cibola National Forest Land and Resource Management Plan utilized the Forest Service Visual Management System to determine visual quality objectives for all National Forest System lands within the Cibola (USDA Forest Service 1974). Visual Quality Objectives are designed to integrate the public's concern for scenic quality (sensitivity levels) with the diversity and scenic attractiveness of the natural features (variety classes.) These objectives describe the degree of acceptable alteration of the natural landscape based upon the importance of esthetics (USDA Forest Service 1974). VQOs are used to describe the degree of alteration that may occur to the visual resource on lands within the Cibola's management areas.

Retention - This visual quality objective provides for management activities which are not visually evident. Under retention activities may only repeat form, line, color, and texture which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident. (1,601 acres in the analysis area)

Partial Retention - Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color, and texture must be reduced as soon after project completion as possible but within the first year. (75 acres in the analysis area)

The Sulphur analysis area is located in Management Area 2 as specified in the Forest Plan. The current visual management direction was developed using the Visual Management System. The visual quality objectives (VQO) were derived using the VMS process. MA 2 provides for a variety of VQO's across the landscape within this management area. The majority of the Sulphur analysis area is managed as Retention with two small pockets of Partial Retention along the northwest boundary with another two small pockets south of the Armijo Trail. Please refer to the VQO map located in Appendix B.

General Guidelines for All Management Areas

- Acceptable variations in VQO classifications from the acreages presented in the standards and guidelines for specific management areas are as follows:
    - Preservation**:** No Change
    - Retention**:** + or - 2 percent in foreground, + or - 5 percent in middle ground and background
    - Partial Retention**:** + or - 5 percent in foreground, + or - 10 percent in middle ground and background
    - Modification**:** + or - 10 percent in all zones
- Manage for the visual quality objectives of retention or partial retention for developed site plan perimeter using a definition of characteristic landscape which includes manmade features.
- Accomplish viewshed corridor planning as needed for timber sales.
- Inventory for existing visual condition (EVC) and visual absorption capability (VAC).
- Within 5 years after disturbance meet Visual Quality Objectives and provide forage.
- Enhance viewing opportunities by selective removal of vegetation while maintaining the visual integrity of the foreground.
- The visual quality of lands viewed from recreation sites, prominent vista points, and scenic travel ways is becoming increasingly important. Forest visitors appreciate the natural quality of the landscape and are not eager to see it altered.
- Dispose of all activity slash within seen area or up to approximately 200 feet on either side of roads and trails where the VQO is retention. Retain/enhance retention by Landscape Architect (LA) specifying basal area and vista opportunities appropriate to each site and coordinated with special basal area and old growth requirements for wildlife. Use slash disposal techniques appropriate for given area.
- Where the foreground VQO is partial retention, the following will be required: Dispose of all activity slash occurring within 200 feet of recreation sites, forest trails, forest roads, and paved or all-weather roads. Slash will be disposed of within 1 growing season after completion of the project which generates the slash. Regain/enhance partial retention areas by having the LA specify basal area and vista opportunities appropriate to a given site. Use slash disposal techniques appropriate for given area.
- Newly created tree stumps in individual tree selection areas will have cut-face away from any recreation sites, trails, or roads within 200 feet of the stumps.

The following VQOs were assigned to Management Area 2 (which includes all of the non-Wilderness acres on the Sandia Ranger District.

- 11,996 Retention
- 28,623 Partial Retention
- 2,666 Modification

Affected Environment

Landscape Character

The Sandia Mountains are highly valued for their scenic quality. NM 536 (the Crest Highway) has been designated a National Scenic Byway in conjunction with the Turquoise Trail by the Federal Highway Administration, and as a State of New Mexico and US Forest Service scenic byway. The highest use recreation site is the scenic overlook development at the top of the Sandia Crest. The Sulphur Project Area can be seen from both the Turquoise Trail and the Crest Highway.

The Sandias are characterized by the variety of landscape types encountered. This variety is captured in the description "the range…contains mixtures of the lush and the arid, the wild and the developed." (Greene 2006) The Sandias are located in the Mexican Highland section of the Basin and Range physiographic province. (USDA Forest Service 1999)

The east face of the Sandias (including the Sulphur project area) is a broad gently sloping plane. The views change with the elevations. Lower elevations are open grasslands, transitioning to Pinyon and juniper forests. The Ponderosa pine forests are found at the higher elevations, eventually mixing with the spruce-fir which is primarily tall stately spruce, Douglas and white firs with patches of aspen providing color in the fall. The forested areas tend to be fairly dense, with continuous canopy cover, especially where Ponderosa pine and mixed conifer dominate. Visitors are attracted to area streams such as Cole Spring. The President's Commission on Americans Outdoors identified natural beauty as the most cited reason for choosing an outdoor recreation site (Rosenberger and Smith 1998).

The landscape is predominantly natural appearing. Recreation developments are evident in the northern section of the project area. Doc Long, Sulphur Canyon, and Cienega Canyon are day use picnic sites and trailheads located within the project boundaries. Along the eastern boundary of the project area is the residential community of Sandia Park. In contrast, the western boundary abuts the Sandia Mountain Wilderness. The Sulphur project area is viewed from adjacent residences, the Crest Highway (NM536), the Turquoise Trail (NM14), the day use sites within the project area, and both system and non-system trails through the project area.

The visual quality of the Sulphur Forest Restoration Project analysis area is important to many people for its scenic character. Residents along the eastern project boundary have often selected to purchase homes in the area in part because of the scenic quality. In a quality of life survey completed for the 2006 East Mountain Area Plan, 77% of residents indicated that they have selected to live in the East Mountains for open space and scenic appeal. One of the primary community vision statements includes "A nature-dominated landscape. Instead of artificial structures, natural flora and fauna dominate; rurality has and values its abundant unspoiled scenery, wildlife, wildflowers, birds, coyotes, woods, trees, undeveloped meadows — a place where residents can follow seasonal change in a predominantly natural landscape." When asked about the recreation facilities that they use, 76% of residents stated that they use Forest Service trails and Wilderness, which are the most common recreation facilities used by East Mountain residents. (Bernalillo County 2006)

There are a number of systems and non-system hiking trails that cross through and near the project area, including the Faulty Trail on the western edge of the project area. A number of trails connect area subdivisions to the Faulty Trail, including Sandia Park, San Antonito, and the Canoncito area. Most of

these are not included in the forest trail system database. However, they are constructed trails that have been signed with stolen forest service signs, so they appear to be system trails to area residents and are frequently used.

Cumulative Effects Area

The cumulative effects area for Scenic Resources includes NM 14 (through the San Antonio and Cedar Crest area), and the residential area between the project boundary and NM 14, NM 536 and Sandia Park residential area, and the eastern edge of the Sandia Mountain Wilderness. The project area can be viewed from these locations. Viewers in these locations often have high concern for scenic quality. Both NM 14 and NM 536 are designated National and State Scenic Byways (Turquoise Trail Scenic Byway and Sandia Crest Scenic Byway)

NM 14 is a busy route. Not only is it the primary transportation route for the east mountain communities, but recreationists use NM 14 to access developed recreation on the Sandia Ranger District, and the highway is often used as a scenic backway between Albuquerque and Santa Fe. The project area is viewed as middleground from the highway. Because of the high concentration of visitors to the project area, the visual resources of the project area are important to their experience and perceptions.

Environmental Consequences

Alternative A - No Action

No vegetation management activities would be proposed under Alternative A. Individual tree selection of dense stands would not occur. There would be no impacts to the scenic resources associated with, burning, and mechanical treatments since these actions would not be implemented.

The VQOs of retention and partial retention would be met in the project area; however, the overall scenic quality of the project area would decline over time. The existing trend of even-aged stands of mixed conifers would continue, the canopy would continue to close and visual diversity would decrease. Large diameter trees would be stressed and tree health and vitality would decline as stand density increased. Views into the project area from roads, trails, recreation sites and residential areas would be reduced due to the overstocked condition of the stands, and the grass/forb/shrub understory component would continue to be crowded out. Under this alternative there would be no opportunities to enhance and improve scenic resources or achieve the desired condition described in the project record, since there would be no individual tree selection or other treatments.

Because stands would not be thinned, the risk of stand replacement fire would continue to be of concern to the Cibola National Forest and residents of the surrounding communities. This concern would be amplified with the increasing potential for escaped camp fires from dispersed recreation use and private residential developments intermingled with and/or adjacent to National Forest lands.

In the event of an uncharacteristic high severity wildfire such as the Las Conchas Fire, the existing landscape character would be suddenly altered with little opportunity to slow or control the change. The VQOs in the project area would be met because fire is considered a natural part of the ecosystem; however, an uncharacteristic high severity, 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 in a dense, jack-straw pattern.

For two to three growing seasons, the blackened, exposed ground surfaces would be highly visible due to lack of vegetation. Sedimentation and erosion would increase, raveling soils that would take a long time to revegetate. Eventually these areas would be covered with scattered invasive plants and other spotty vegetation until native material 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 NM Highway 14, Sandia Park, Canoncito, San Antonito, and developed recreation sites. If the fire were not contained within the project boundary, scenic quality of the Sandia Mountain Wilderness would be at risk. The changes would contrast with the natural appearance of the landscape and degrade the scenic quality.

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 (Ryan 2005). 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 unnatural scars on the landscape. With rehabilitation and other mitigation measures, the immediate impacts of the suppression and emergency treatments should not be evident to the casual forest visitor within 2 to 3 years of completion 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 became more abundant. However, the presence of dead standing trees would remain a dominant and somewhat negative visual reminder for many years.

Alternative B

Studies have shown that there are generalizations that can be applied to predict the perception of scenic beauty and anticipate how changes to the landscape will impact visual quality. A stand composition that is made up of a variety of tree species has a strong, positive effect on perceived scenic beauty. Stand age also has a positive effect on perceived scenic beauty. Study participants have indicated that large trees have a positive effect on scenic beauty, and dense, small trees (saplings and young poles) have a negative effect. A high density of saplings has a negative effect, while increased tree density in large trees has positive effect in general. Understory and diversity of the understory, and vegetative groundcover (grasses, forbs, and seedlings) has been determined to improve the scenic beauty of Western forests (Rosenberger and Smith 1998).

<u>Visual Impacts of Fuel Reduction Treatments</u>

The following discussion will describe expected visual changes to the landscape in the short term (1-5 years), and in the long term (6+ years). Visual impacts of treatments are determined by the type and magnitude of treatments being implemented. The primary goal is reducing density and removing the ladder fuels. The impact is most evident in the immediate foreground, where details such as stumps and slash are discernible. In distant foreground and middleground views, the change is most evident during winter months, when the contrast with the snow makes the density reduction more apparent. Treatments would maintain greater irregularity in canopy levels and also maintain textural variety in the short and long term, especially as viewed from NM 14.

When total basal area is reduced to below 80 square feet per acre, the disturbance becomes visually dominant in the immediate foreground and foreground views, opening the stand to more light, longer views and less sense of enclosure. In immediate foreground views, stumps are evident, ground disturbance is increased, and slash begins to dominate the view. In foreground to middleground views openings created are apparent, but do not dominate the view.

Slash has been shown to have a high negative impact on visual quality (Rosenberger and Smith 1998). During harvest operations, where slash debris and ground disturbance is evident, visitors will likely feel that visual quality has been reduced. Many visitors may prefer the immediate foreground views after harvest activities where there has been less than 50% removal to pre harvest immediate foreground views, especially where there has been clearing of small diameter understory vegetation (McCool and Benson, 1989).

Viewers may perceive loss of scenic beauty in middleground views. The angle that the harvested area is viewed, and the amount removed correlates with the perception of reduction of scenic quality. It was found that the greater the amount harvested, negative preference ratings increased. It was also discovered that the foreground and middleground views of treatments were preferred over the No Action (untreated) alternative because of the accelerated forest recovery when decreasing density. (McCool, Benson and Ashor, 1989). Orland, Daniel, Paschke, and Hetherington (1993).

Vegetation

The openings created by reducing the vegetation density will be visible from Highway 14, Highway 536, and area subdivisions. The line created in the forest canopy cover by treating to the project boundary will likely be visible from some locations along Highway 14, since greater than 50% of the stand will be removed. This will provide a linear contrast from the adjacent forest cover in the Wilderness and the residential areas.

In the Pinion and Juniper forested areas, basal area per acre of trees greater than 1” dbh/drc will be reduced from a range of approximately 48 -225 square feet per acre to approximately 26 – 131 square feet per acre. Depending on existing stand conditions this equates to reduction of approximately 0 – 74 percent reduction in trees greater than 5” dbh/drc, the average reduction of trees per acre greater than 5” dbh/drc is approximately 54%.

In the Ponderosa forest areas, basal area per acre of trees greater than 1” dbh/drc will be reduced from a range of approximately 65 -180 square feet per acre to approximately 41 - 146 square feet per acre. Depending on existing stand conditions this equates to reduction of approximately 0 – 76 percent reduction in trees greater than 5” dbh/drc, the average reduction of trees per acre greater than 5” dbh/drc is approximately 50%.

In the mixed conifer forested areas, basal area per acre of trees greater than 1” dbh/drc will be reduced from a range of approximately 53 -184 square feet per acre to approximately 43 - 112 square feet per acre. Depending on existing stand conditions this equates to reduction of approximately 0 – 70 percent reduction in trees greater than 5” dbh/drc, the average reduction of trees per acre greater than 5” dbh/drc is approximately 57%.

Some stands contain brush species such as gamble oak where the number of stems less than 5” drc can be 1000 or more, no gamble oak is planned to be removed so discussing trees per acre greater than 5” dbh/drc is a more meaningful measure than including all stems for this discussion.

The irregular nature of proposed treatments should appear more natural, stands will be more open and grass, forb and shrub species should increase. This will result in a much more open forest appearance, especially since clumps will be maintained. The clumpy nature of the treatment will be more natural, but will leave large open areas between clumps. Most people who are familiar with the area will perceive a substantial change from the continuous canopy in the existing condition.

In the Riparian forested areas, designated native conifers and nonnative (invasive) species will be thinned in order to move the vegetation in this area towards native hardwoods and riparian vegetation species. Treatments will enhance visual diversity by maintaining a natural appearing landscape.

Stumps, slash and ground disturbance will dominate the view in the immediate foreground of area trails where they cross through treatment areas. This proposed action will change the undeveloped character until stumps have aged and the slash has been treated or has diminished over time. A decrease in the sense of solitude and diminished scenic quality will likely occur while traveling area trails. Viewers may perceive diminished scenic quality in this area until slash has been removed or decomposed and the ground cover has reestablished in the treatment area. Mitigation will not be applied to the non-system trails. Since many of these are frequently used by local residents, they are likely to perceive diminished quality. These trails may not be usable upon completion of the project. For anyone who uses these trails frequently to access the Faulty Trail, this is likely to displace the users of these trails.

The existing landscape character is predominantly natural appearing to natural evolving away from residential and recreation developments. Near residential areas, the landscape is influenced by the rural development character within view of the homes. The landscape character would change from natural evolving and natural appearing to an altered landscape with a managed appearance, at least in the short term for up to 10 years. The foreground and middleground views throughout the project area are Class B scenic attractiveness. Scenic attractiveness classes are developed to determine the relative scenic value of lands within a particular Landscape Character. Class B is described as “Typical” scenic value, where Class A is “Distinctive” and Class C is “Indistinctive”. The landscape elements of landform, vegetation, rocks, cultural features, and water features are described in terms of their line, form, color, texture, and composition for each of these classes. The scenic attractiveness rating is not expected to change as a result of this project, however for people who prefer the appearance of an unmanaged landscape this will decrease the scenic quality.

Mexican Spotted Owl Restricted Habitat
Twenty percent (215 acres) of the project area will not be treated and maintained for threshold conditions for Mexican Spotted Owl restricted habitat. This restricted habitat is identified as treatment 7. Throughout the project area NFST 195 Faulty Trail either borders or travels through treatment 7. There is potential for trail users to observe an abrupt contrast in vegetation cover between Treatment 7 and other treatment areas. This contrast will display existing conditions of dense populated forest on one side of the trail and treated conditions with open areas and visual diversity on the other. Placing users along the boundary between treated units and none treated units will create the perspective of an altered landscape with a managed appearance. Trail users who prefer a natural appearing landscape will have their scenic quality decreased.

Recreation Sites
Within the project area are 3 recreation day use areas. Cienega, Sulpur, and Doc Long all consist of typical day use amenities with picnic sites, restrooms, trailheads, and horse facilities. Views from these recreation sites and users in this area will likely see the treatment activities and the visual impacts during and after completion. Viewing thinned areas, including slash and downed trees, burned slash piles, and hearing chain saws during recreation activities will likely reduce the recreation experience and sense of natural surroundings.

Trails
NFST 195 Faulty Trail is located within the project area and runs along the entire western boundary of the project area. NFST 225 Bart’s Trail, NFST 150 Canoncito Trail, and NFST 148 Cienega Trail all connect to the Faulty Trail and head west into the Sandia Mountain Wilderness. These trails are within view from

the project area and users in this area will likely see the treatment activities and the visual impacts during and after completion. Mitigations will be applied along the NFST 195 Faulty Trail, NFST 148 Cienega Trail and NFST 222 Armijo Trail. Viewing thinned areas, including slash and downed trees, burned slash piles, and hearing chain saws during activities will likely reduce their Wilderness experience and sense of solitude. There are many user created trails within the project area and are not considered system trails within the Cibola National Forest trails database. As a result, the mitigations to reduce the scenic impacts along those trails will not be applied in those areas. The scenic quality will be reduced for many trail users along those trails.

Mechanical Treatment
Mechanical treatments include, but are not limited to: use of chainsaws or harvester to cut trees and lop slash and specialized equipment such as masticator and tree shears to cut, chop, break, and lop fuel material.

There would be a slight to moderate effect on scenic quality during and immediately following these treatment methods. Where this equipment has been used on other projects, contract specifications call for stumps to be left no more than 6 inches high; typically stumps are cut flush unless prevented by rocks or other natural features.

The ground disturbance resulting from using machines to pile slash would be noticeable for up to 1 year after project completion, depending on how quickly the areas were rehabilitated and vegetation regenerated.

Fuel wood Removal
In the immediate foreground fuel wood removal appears as disrupted forest litter (fallen needles, leaves and other natural debris) and exposed soil, which is often lighter in appearance to the surrounding area. During the period where trees are being cut and removed, residual slash will be visible. This would give a coarse textural quality to the ground, until ground cover has been established. It is anticipated that within five years, the color contrast created by the ground disturbance will be reduced as normal forest litter is deposited and ground cover has been established.

Prescribed Fire Treatment
Prescribed burns have been found to negatively impact scenic beauty in the short term, but with ground vegetation recovery, can enhance scenic beauty within five years (Rosenberger and Smith 1998). Fire effects are seen as a natural phenomenon by most visitors, expressing strong support for prescribed natural fire policies. While fire was considered to have diminished scenic values, the presence of fire did not adversely affect visitor satisfaction (Love and Watson 1992). Light prescribed fires are perceived to enhance scenic quality for up to five years. (Taylor and Daniel 1984). Prescribed fire causes short and long term visual impacts, and may begin to dominate the view as the size of the area burned increases. Where prescribed fire is limited to slash reduction, there are isolated areas of burned piles evident. Once these piles have been scattered there may be some short term evidence of darkened litter and soil that will be reduced within five years and generally only be noticeable within the immediate foreground. Where broadcast burning is used to reduce slash visual impacts include charred bark of standing trees and down logs, and a blackened appearance to the ground plane and burned understory plants. The visual impacts will be reduced within two years, with the regeneration of ground cover plants and the deposition of forest litter over the burned sites. Charred bark, limbs and other features may be visible for many years.

Visual Quality Objectives
The VQOs of Retention and Partial Retention would be met under this alternative. Scenic quality would be enhanced to a greater extent and for a longer period as the diversity of tree species, size, and spatial

distribution increased. Throughout much of the project area, stand density would be reduced. The views along NM Highway 536, NFST 195 Faulty Trail, NFST 148 Cienega Trail and NFST 222 Armijo Trail in particular would be more diverse. Visitors traveling along these corridors would experience a sequence of enclosures and openings that add variety and afford more expansive views into the project area. Natural meadows would be restored which would increase visual diversity and place more emphasis on valued scenic features. Stands would feature clumped, uneven-aged groups interspersed with openings. The understory component of shrubs, grasses and forbs would develop and respond to the open canopy conditions, further increasing visual diversity.

Cumulative Effects

Alternative A

The impacts to the cumulative effects area are similar to the direct effects from the project. No action will result in little perceived change. Uncharacteristic wildfire is a greater risk in the no action alternative. If a large fire or series of fires occur, views of a fire altered landscape may begin to dominate.

Alternative B

There may be a perceived diminished scenic quality for residents and travelers who are familiar with the area. For the casual observer, they will likely not notice the changes as viewed from a distance. Due to the location, terrain, and existing use of the project area, the cumulative effects from adjacent lands and past or future projects are negligible.

Cultural Resources

Methodology Used for Data Collection and Analysis

The following discussion and recommendations resulted from a review of the various descriptions of the alternatives and an assessment of the potential impacts each could have to cultural resources within the analysis area. The criteria used for establishing the area of potential effect (APE) for cultural resources was based on the boundaries of the proposed Sulphur Forest Restoration Project. In order to collect cultural resource data for the Sulphur analysis area, a records search of CNF heritage files and digital databases was completed to determine the amount of previous survey in the analysis area and the location and density of previously identified archaeological sites. Site and survey records were reviewed using the NMCRIS and INFRA database records and hard copy files at the Sandia Ranger District and the Cibola Supervisor's Office. Site records were reviewed for status of NRHP eligibility, current condition, and if the site was fire sensitive.

Regulatory Requirements

The primary legislation governing cultural resource management is the National Historic Preservation Act (NHPA) of 1966 (amended in 1976, 1980, and 1992). Section 106 of NHPA requires that federal agencies take into consideration the effects of their undertakings on historic properties, which are defined in 36 CFR 800.16(l) as any district, site, building, structure, or object that is included in or eligible for inclusion in the NRHP. The "Section 106 review process," entails five steps: 1) determining whether the proposed action is an undertaking that has the potential to affect historic properties); 2) identifying historic properties; 3) evaluating the significance of historic properties; 4) assessing effects; and 5) consulting with interested parties (including Native People), the SHPO, and the ACHP. Section 110 (Federal Agencies' Responsibility to Preserve and Use Historic Properties) of the NHPA provides direction to federal agencies to establish programs and activities to identify and nominate historic properties to the NRHP and to consult with tribes. Federal Regulations 36 CFR 800 contains procedures for implementing Section 106 of NHPA.

The Southwestern Region has a programmatic agreement (PA) with the Advisory Council on Historic Preservation (ACHP) and State Historic Preservation Officers (SHPOs) that stipulates the Forest Service's responsibilities for complying with NHPA. This agreement provides guidance for the development of standard consultation protocols for common or special undertakings.

Important laws and their accompanying regulations that affect the forests' management and treatment of cultural resources include the following:

- Organic Act of 1897 (Title 16, United States Code (U.S.C.), section 473-478, 479-482, 551)
- Antiquities Act of 1906 (34 Statute 225, 16 U.S.C. 431-433), Uniform regulations at 43 CFR part 3 implement the act.
- National Historic Preservation Act (NHPA) of 1966 as amended, (16 U.S.C. 470) Uniform and departmental regulations at 36 CFR part 800 implement NHPA.
- National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4346). The act is implemented by the Council on Environmental Quality (CEQ) regulations at 40 CFR 1500-1508.
- Archaeological Resources Protection Act of 1979 (ARPA) (16 U.S.C. 470aa *et seq*). Uniform regulations and departmental regulations at 36 CFR part 296 implement ARPA.
- Archeological and Historic Preservation Act of 1974 (16 U.S.C. 469-469c-2)
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 U.S.C. 1701)
- American Indian Religious Freedom Act of 1978 (AIRFA) requires federal agencies to consider the impact of their actions on tribal traditional cultural practices and access to cultural sites.
- Executive Order 11593, Protection and Enhancement of the Cultural Environment (13 May 1971),
- Executive Order 13007, Indian Sacred Sites (24 May 1996),
- Executive Order 13175, Consultation and Coordination with Indian Tribal Governments (6 November 2000),
- Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 CFR 44716)

The project treatments and associated activities will be conducted in compliance when applicable with the above laws and regulations. Forest Plan standards and guidelines for cultural resources are stated under forest wide management areas. Forest Service Manual 2360 provides the basis of specific Forest Service heritage resource management practices.

Affected Environment

Previous Cultural Resource Inventory Surveys

There have been 18 previous compliance and inventory cultural resource surveys within the Sulphur analysis area. These surveys were conducted during the 1980s through the 2000s for habitat creation and restoration projects, roads, transmission lines, and recreation opportunities. Two archaeological surveys (2007-03-029 and 2007-03-058) were specifically conducted for anticipated forest restoration projects on the district.

Table 47 - Previous survey in project area

Report Number	Report Title	Area (in acres)
1983-03-051	Sandia Park Power Line	0.09
1984-03-069	Cienega Picnic Ground Water System	0.6
1986-03-115	Sandia Park Country Club Subdivision Power Line Extension	1
1987-03-093	Sulphur Canyon Picnic Ground Rehabilitation	9
1987-03-094	Sandia Park Electric Line	1
1988-03-042	Faulty Trail Extension	48
1989-03-109	Tree Spring, Bill Spring and Cienega Trail Construction	9
1992-03-020	Doc Long Picnic Area Rehabilitation	25
1993-03-037	Cienega Equestrian Trailhead and Trail	71
1993-03-037B	Toilet at Cienega Trailhead	1
1993-03-140	Cienega and Sulphur Picnic Grounds Rehabilitation and Enhancement	356
1993-03-184	Sulphur Trail Survey	2
1994-03-009	Evaluation of Sulphur and Cienega Picnic Grounds	441
1995-03-097	Proposed State Highway 536 Pullout	0.55
1997-03-003	Proposed Guardrail Project in District 3	2
1998-03-062	2070-Acre Armijo and David Canyon Prescribed Burns	2070
2001-03-031	Armijo Canyon Forage Enhancement	13.2
2001-03-031B	Armijo Canyon Forage Enhancement II	10.5
2007-03-029	Hondo Archaeological Survey	1845 (539 in project)
2007-03-058	Archaeological Survey of the Sulphur WUI Project Area	456 (273 in project)

Cultural Resources in the Analysis Area

Cultural resources represent the tangible and intangible evidence of human behavior and past human occupation. They may consist of archaeological sites, historic-age buildings and structures, traditional use areas and cultural places that are important to a group's traditional beliefs, religion or cultural practices. The following discussion provides information on previously recorded sites, a summary of contemporary Native American uses and documentation of tribal consultation within the area of potential effect.

Contemporary American Indian uses

The Cibola National Forest routinely consults with fourteen American Indian tribes that may have used or may continue to use the Sandia Ranger District lands for traditional cultural or religious activities, and that might attach religious or cultural significance to properties within the Sandia Mountains. The Sandia Mountains hold considerable cultural significance for many of the area tribes, including the Navajo Nation, the western Pueblos of Acoma, Laguna, and Zuni, many of the Rio Grande and northern Tewa Pueblos, and the Jicarilla Apache Nation. These mountains have long standing and ongoing historical, cultural, religious importance for these tribes. All consider the mountains to be sacred, and some acknowledge and have identified specific sites of traditional cultural and religious significance in the mountains. The Sandia Mountains are a place where tribes continue to perform ceremonial activities in accordance with traditional cultural practices that are essential in maintaining their cultural identity and the continuity of their culture. The mountains are used by many of the area tribes for a variety of traditional cultural and religious activities such as hunting, traditional plant and mineral gathering, religious pilgrimages, accessing springs, and as a place for special offerings.

Tribal consultation
Consultation pursuant to Section 106 of the National Historic Preservation Act was initiated in 2010 when the Forest included the Sulphur Fuels Reduction project in its list of proposed projects that was sent to the tribes in February 2010. Scoping pursuant to NEPA was also initiated in 2010.While the name of the proposed project has been changed, and the intent has evolved from fuels reduction to forest restoration, the elements of the project are the same as was shared with the tribes in 2010. Follow up consultation meetings were held from May through September of 2010 with the Pueblos of Isleta, Sandia, Santo Domingo, Zia, Santa Ana, Jemez, and Zuni, as well as the Navajo Nation and the Jicarilla Apache. None expressed concern about the proposed project. Scoping was done again in 2013 for the current project and no tribal comments were received. To date, no historic properties of religious and cultural significance to an Indian tribe have been identified within or near the proposed project area.

Summary of site types in the analysis area:
A total of 20 archaeological sites have been recorded in the Sulphur Analysis Area (CNF inventory and site files). All of the sites have been previously evaluated for eligibility into the National Register of Historic Places. Eight of the sites are considered to be eligible, six sites are undetermined until further testing, and five sites were determined to be not eligible. Site records indicate that there are 8 sites associated with a pre-contact occupation, 11 historic period sites, and 1 multi-component site in the analysis area. The sites found in the project area range in size, function and temporal affiliation. Specific information about each site is included in Table 48 of this report. There is a diversity of archaeological features found with the Sulphur Analysis Area. Sites range from low intensity use areas, to agricultural features, historic recreation areas, roads and homesteads.

Table 48 - Archaeological Sites in the Sulphur Analysis Area

Site Number AR-03-03-xx-xxxx	LA Number	Site Name	Date Range	Cultural Affiliation	Feature/type	NRHP Status
05-00249	88709	Doc Long Picnic Ground	1930 – 1940 AD	Historic American	Picnic Ground	Eligible
05-00303	100828		BC 9500 – 500 AD	Paleoindian – Developmental	Fire Pit/ Lithic Scatter	Eligible
05-00316	102638		1846 – 1945 AD	Historic American	Acequia	Undetermined
05-00318	103526	Cienega Canyon Picnic Ground	1920-Present	Historic American	Picnic Ground	Not Eligible
05-00319	103527	Sulphur Canyon Picnic Ground	1920-Present	Historic American	Picnic Ground	Not Eligible
05-00406	121913		BC 6000 – 500 AD	Archaic – Developmental	Lithic Scatter	Eligible
05-00407	121914		BC 6000 – 500 AD	Archaic – Developmental	Lithic Scatter	Eligible
05-00408	121915		BC 9500 – 500 AD	Paleoindian – Developmental	Lithic Scatter	Eligible
05-00868	157405	Tejano Canyon Road	1870 – 1930 AD	Historic American	Road	Not Eligible
05-00869	157406		1923 -1970 AD	Historic American	Recreation Residence	Not Eligible
05-00870	157407	Historic Crest Highway	1927 – 1960 AD	Historic American	Road	Undetermined
05-00871	158133		BC 800 – 400 AD	Late Archaic	Lithic Scatter	Undetermined
05-00872	158134		1880 – 2007	Historic American	Rock Alignment/Pile	Not Eligible
05-00873	158135		BC 4500 – BC 1500	Late Archaic	Lithic Scatter	Undetermined
05-00874	158136		BC 5500 – 200 AD	Late Archaic	Lithic Scatter	Eligible
05-00875	158137		1821 – 2007 AD	Historic American	Acequia/Water Control Feature/ Structure	Eligible
05-00876	158138		1546 – 1920 AD	Historic American	Prospector's Pit	Not Eligible
05-00882	158143		BC 9500 – 500 AD	Paleoindian – Developmental	Lithic Scatter	Undetermined
05-00883	158144		1890 – 1950 AD	Historic American	Historic Structure	Undetermined

05-00884	158145		1425-1600 AD/ 1880-1960 AD	Classic Period Ancestral Puebloan/ Historic American	Precontact Artifact Scatter and Check Dams/Historic Homestead/ Historic-Modern Picnic Area	Eligible

Table 49 - Types and Frequencies of Archaeological Features Documented on Sites in the Sulphur Analysis Area.

Site Type	Total in Analysis Area
Lithic Scatter	8
Artifact Scatter	1
Water Control Devices	3 (2 acequias)
Rock Alignment	1
Homestead	3
Recreation Residence	1
Picnic Ground	4
Roads/Trails	2
Mineral Extraction	1

*Some sites may contain 2 or more features.

Fire Sensitive Site Types

A review of available literature on the effects on fire on cultural resources and on the experience of Forest Service heritage resource specialists and the SHPO indicates that there are two categories of fire-sensitive sites. The first consists of sites long-known to be vulnerable to the effects of even low-temperature fires and/or light fuel loads, such as sites that contain organic materials, exposed wooden architecture, etc. The second group includes sites that have generally been considered to have less risk for fire effects in most situations, including prehistoric and historic sites with deeply buried cultural deposits; prehistoric and historic artifact scatters; and prehistoric and historic sites with non-flammable surface features. However, depending on field conditions -- especially fuel loading -- as well as specific site characteristics and expected fire behavior, these other site types may be fire-sensitive in certain fuels reduction projects.

Known Fire-Sensitive Site Types in the Southwestern Region:

- Historic sites with standing, or down wooden structures or other flammable features or artifacts
- Rock art sites (depending on rock type, exposure, fuel type, and fuel loading)
- Cliff dwellings
- Prehistoric sites with flammable architectural elements and other flammable features or artifacts
- Prehistoric sites with exposed building stone of soft or porous material such as volcanic tuff
- Culturally modified trees, including aspen art and peeled/scarred trees
- Certain traditional cultural properties (based on consultation with tribes)

Other Project-Specific Fire-Sensitive Sites:

- Other sites, based on local field conditions and Forest-specific concerns
- Other sites, based on consultation with SHPO staff
- Other sites, based on consultation with fire management staff, fire behavior specialists or fire effects researchers (Information compiled from Appendix J, Section III of the *First Amended Programmatic Agreement, for Large-Scale Fuels Reduction, Vegetation Treatment, and Habitat Improvement Projects*).

In the Sulphur Analysis Area there are three previously recorded sites that are fire sensitive. Fire sensitive sites include all historic period structures/features with combustible materials. Table 50 lists the fire sensitive sites in the analysis area. In addition to these sites, there are several sites that are potentially fire sensitive because they *may* have combustible materials or may have other construction materials that would be sensitive if fire temperatures are too high or if the duration of the burn is too long.

Table 50 - Fire-Sensitive Archaeological Sites in the Sulphur Analysis Area

Site Number AR-03-03-xx-xxxx	LA Number	Site Name	Date Range	Cultural Affiliation	Feature/type	NRHP Status
05-00249	88709	Doc Long Picnic Ground	1930 – 1940 AD	Historic American	Picnic Ground	Eligible
05-00883	158144		1890 – 1950 AD	Historic American	Historic Structure	Undetermined
05-00884	158145		1425-1600 AD/ 1880-1960 AD	Classic Period Ancestral Puebloan/ Historic American	Precontact Artifact Scatter and Check Dams/Historic Homestead/ Historic-Modern Picnic Area	Eligible

Winthrop (2004) compiled information from a series of studies that analyzed the effects of fire on archaeological materials found in the western United States (See Appendix E for a summary of temperatures that may alter or damage archaeological material). Fire effects to cultural resources vary depending on temperature and duration of exposure to heat. Generally, higher temperatures and longer duration of exposure to heat increase the potential for damage to cultural resources. Some of the variables that would impact fire temperature and duration of exposure include: the type of fuel present, the fuel load and the distribution of the fuels (Hanes 2001; Winthrop 2004). Winthrop's results indicate that most archaeological material can withstand *sustained* temperatures as high as 500-600º F and many material classes can withstand much higher temperatures. At temperatures exceeding 500-600 º F (which is typical of most wildland and prescribed fires which generally burn between 800-1000 º F), the duration of the exposure is significant (personal communication with fire instructors from the Eagar Fire Department, 2011). A fast-moving fire will minimize direct impacts to cultural material, particularly if the area has been previously burned. It is also important to note that fire will generally not impact material buried below the ground surface. Previous studies indicate that ~10 cm of soil cover is sufficient to protect cultural materials (Oster, n.d.). However, if sites contain fuel types that smolder and burn for prolonged intervals (i.e. heavy duff, surface logs, and large tree roots) there is greater potential to adversely impact subsurface materials (Winthrop 2004).

Previous Impacts

Archaeological sites within the analysis area have been impacted by several different activities related to resource extraction and recreational use of forest service lands. The cumulative effects of these impacts need to be assessed in order to determine how the proposed project may affect cultural resources. The following section provides an overview of the types of activities that have previously affected and/or continue to affect cultural resources on the forest.

Table 51 - Summary of Previous Impacts to Archaeological Sites

Type of Activity	Direct and Indirect Effects	Number of Sites Impacted
Natural Erosion	Displacement of features and artifacts.	12
Timber Harvesting and Fuel wood Collection	Displacement, alteration and damage to features and artifacts. Removal of artifacts Erosion	2
Recreational Activities and Trail Construction	Unintentional Vandalism (clearing features and artifacts from area for camping, reuse of features and masonry for camping activities)	6

Type of Activity	Direct and Indirect Effects	Number of Sites Impacted
	Displacement, alteration and damage to features and artifacts Compaction Erosion	
Other Construction or FS Activities		1

Timber harvesting and fuel wood collection:
The comments reviewed on existing site records documented impacts from logging and wood cutting. Logging on the forest can damage sites by direct impacts caused by construction of hauling roads and landings, movement of heavy equipment across the ground surface, skidding of trees and indirect impacts from over-harvesting, which can lead to erosion. Two of the sites in the Sulphur Analysis Area showed evidence of logging activity (including temp road construction) and/or wood-cutting.

Recreation:
Recreation activities have had significant impacts to archaeological sites on the forest (and in the analysis area specifically). As populations in surrounding communities have increased, so have the visitor impacts to archaeological sites. Recreational impacts to archaeological include, but are not limited to: vandalism /inadvertent looting associated with recreational activities, non-motorized roads/trails located on sites, motorized roads/trails located on sites, and damage from camping. Recreation related activities and/or trail construction was noted at 6 of the sites in the analysis area. Four of the sites were impacted by trail construction, one site by camping and one site by recreation development.

Environmental Consequences
Under the regulations, an adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a cultural resource that qualify the property for inclusion in the National Register. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. Specific examples of adverse effects cited in statute include (36 CFR 800.5):

- Physical destruction of or damage to all or part of the property.
- Removal of the property from its historic location.
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.

Impacts to cultural resources, especially archeological sites, can be generally defined as anything that results in the removal of, displacement of, or damage to artifacts, features, and/or stratigraphic deposits of cultural material. In the case of traditional cultural properties and sacred places, additional considerations may include alterations that would affect the character and use of the location, and/or presence and availability of a specific traditionally used natural resource.

Alternative A - No Action
Under Alternative A, the current conditions of the Sulphur Analysis Area would remain the same. There would not be any direct project impacts to heritage resources and sites would only be exposed to the customary and natural threats, such as weathering, erosion, and exposure to the elements. Indirect effects of the "No Action" alternative include an expected buildup of fuels, which will lead to more intense

wildfire behavior. This may cause increased damage to fire sensitive archaeological sites exposed to the sustained, intense heat from wildfires (Lenz et al1996).

Alternative B

The removal of trees will reduce long-term fuel continuity, fuel loading, and fire hazard. This type of treatment will benefit cultural resources within the project area by decreasing the potential for adverse effects caused from high intensity, high severity wildfires. If the mitigation measures discussed above are followed, the proposed mechanical and manual vegetation treatments should have no direct or indirect effects on eligible and unevaluated heritage resources. The use of prescribed fire, however, may have some direct impacts. The direct impacts of fire on prehistoric archaeological sites include but are not limited to, the refiring of ceramic material, melting obsidian artifacts, and the accelerated erosion of site features caused by hydrophobic soils, denuding of the ground surface exposing cultural materials. Historic sites that are either combustible or include combustible cultural material are the most vulnerable to fire because archaeological material can be completely consumed during a fire event. Although unpredictable creeping and spread of prescribed fires have the potential to damage fire sensitive cultural material, proper mitigation and consultation between the fire management staff and forest service archaeologists will decrease the likelihood of negative direct effects to cultural resources.

The indirect impacts of fire on archaeological sites often have more lasting effects than the direct impacts. Fire suppression and/or heavy machinery associated with fire suppression has damaged several sites in the analysis area. In addition, increased site visibility caused by removal of vegetation can substantially increase inadvertent or advertent looting activities. The biggest indirect impact of prescribed fire to site condition, however, is due to increased erosion from loss of ground cover (North et al 2003). Although a catastrophic fire would have more impact on cultural material than a broadcast burn, prescribed burning would also increase erosion on archaeological sites throughout the analysis area. It is unclear the extent to which fire-induced erosion will impact sites in the analysis area.

Cumulative Effects

The cumulative effects on cultural resources should take into account all surface-altering actions that have occurred or are likely to occur within the Sulphur Analysis Area. As discussed in detail in the ‘Previous Impacts’ section of this report, current and previous Forest Service management activities, public resource procurement and recreational use and natural processes have impacted cultural resources. However, through the use of standard mitigation measures, these impacts have substantially diminished. Within the Forests, there are other planned or reasonably foreseeable activities that may affect cultural resources. Although many of these activities will coincide with the proposed action, if proper mitigation measures are followed and sites sensitive to erosion and fire are monitored during the prescribed burns, it is not anticipated that the cumulative effects will have a significant impact on heritage resources.

Transportation

The tabular data for the roads in the analysis area were obtained from the Forest Service infrastructure database (Infra). The geographic information system (GIS) application ArcMap was used to obtain road lengths and to display road locations. There is a 0.42 mile difference in the analysis area road system mileage between Infra and GIS. This difference is due primarily to an error in the length of NFSR 190 in Infra.

Affected Environment

There are 2.46 miles of NFS roads (system roads) in the analysis area. Table 52 displays the system roads in the analysis area, along with some of the pertinent characteristics of each road.

Table 52 - National Forest System Roads in the Analysis Area

Road No.	Road Name	Length (miles)	Maintenance Level*	Number of Lanes	Surface Type
16AA	Doc Long	0.25	4	1	Asphalt
190	Cienega Canyon	1.16	4	2	Asphalt
190A	Nature Trail	0.07	4	2	Asphalt
190D	Cienega Horse Parking	0.20	3	1	Gravel
190E		0.39	1	2	Asphalt
281	Sulphur Canyon	0.39	4	1	Asphalt

* Refer to Appendix D for complete descriptions of the road maintenance levels.

The Forest Service uses five maintenance levels (ML): ML 1 to ML 5. An ML 1 road requires the least amount of maintenance effort and an ML 5, the greatest. There are no ML 5 roads in the analysis area. ML 1 roads are closed to all motorized traffic for periods exceeding one year. ML 2 roads are maintained for high clearance vehicles. These are typically single lane roads with a native material surface and limited turnouts. ML 3 and 4 roads are maintained for standard passenger cars and generally provide for a greater degree of driver comfort. ML 3 roads typically have a gravel surface, while ML 4 roads can be surfaced with either gravel or asphalt. Refer to the Appendix C for complete descriptions of the road maintenance levels.

All of the NFS roads in the analysis area except 190E are designated for highway legal motor vehicles, as indicated on the Sandia Ranger District motor vehicle use map (MVUM). NFSR 190 is the primary access route through the northern portion of the analysis area, which contains Cienega Canyon and Sulphur Canyon Picnic Areas, as well as trailheads for several NFS trails. NFSR 190 accesses Cienega Canyon Picnic Ground, Cienega Nature Trail and the trailhead for NFST 05148 (Cienega) directly, and is the parent road for NFS Roads 190D, which accesses the trailhead for NFST 05266 (Cienega Horse Bypass), and 281, which accesses Sulphur Canyon Picnic Ground and the trailhead for NFST 05281 (Sulphur). There is a large graveled parking lot at the end of NFSR 190D, which provides ample parking and turnaround space for vehicles towing horse trailers. NFSR 190E is closed to all motorized traffic (ML 1) and is used for access to NFS Trails (NFST) 05222 (Armijo) and 05266 (Cienega Horse Bypass).

The majority of the NFS roads in the analysis area are in good condition. Maintenance needs consist of cleaning culverts, re-establishing grade dips and lead-out ditches, and some light roadside brushing. NFSR 190E has been closed to motor vehicle traffic for some time. It is barricaded at the beginning of the road (junction with NFSR 190) with closely-spaced steel posts. The asphalt surface on this road has been allowed to deteriorate, and there is no intent to repair it in the near future.

Environmental Consequences

Alternative A – No Action

Because no activities would be proposed under this alternative, road maintenance would be accomplished as funding allows and priorities dictate.

Alternative B

Road maintenance would likely be accomplished on all of the roads in the analysis area. Refer to Table 53 for descriptions of the maintenance tasks that are recommended for these roads. Most of the maintenance identified in the table is recommended for the purpose of improving surface drainage.

Table 53 - Recommended Road Work

Road No.	Length	Work Description	Est. Cost
16AA	0.25	Clean culverts (6)	$1,800
190	1.16	Clean culverts (15)	$4,500
190A	0.07	Clean culverts (2)	$600
190D	0.20	Grade road; re-establish grade dip and lead-out ditch	$275
190E	0.39	Clean culverts (5); remove/reinstall barricade posts; brush roadsides	$4,750
281	0.39	Clean culverts (6)	$1,800
		Total:	**$13,725**

No new roads, permanent or temporary, would be constructed for this project. Wood products would be removed through any one, or a combination, of:

- personal fuel wood sales,
- commercial fuel wood sales, or
- commercial timber sales.

All wood products generated from project activities would be removed using NFS roads. All of the roads in the analysis area are adequate to accommodate all foreseeable project-related traffic. NFSR 190E is closed to motor vehicles. It would be opened during project implementation for project-related traffic, and then closed again to motor vehicles when project activities have concluded.

Any of the roads in the analysis area could be closed temporarily to traffic not associated with project activities if deemed necessary to ensure the safety of the public. A closure order signed by the Forest Supervisor would be used for each temporary closure.

Cumulative Effects

The only other project involving the transportation system in the vicinity of the Sulphur Landscape Restoration analysis area is the Hondo Fuels Reduction project. The Hondo Fuels Reduction project area abuts the Sulphur Landscape Restoration analysis area directly to the south. No road construction or decommissioning was proposed with the Hondo Fuels Reduction project. Some road maintenance was proposed but it will have no effect on the system roads in the Sulphur Landscape Restoration analysis area. Therefore, there would be no cumulative effects associated with the combination of effects from the Sulphur Landscape Restoration project and the Hondo Fuels Reduction project.

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