Santa Fe Mountain Landscape Resiliency Project: Vegetation Effects Analysis

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1 INTRODUCTION

The US Forest Service proposes to utilize silvicultural treatments and prescribed fire to manage vegetation within the Santa Fe Mountain Landscape Resiliency Project (SFMLRP) area. These treatments are to include thinning, mastication, fuels redistribution, and use of prescribed fire within the project area. The project area includes approximately 50,500 acres of Forest Service land of the Española and Pecos-Las Vegas Ranger Districts of the Santa Fe National Forest. These lands area component of a priority landscape and are an area of concern for the City of Santa Fe, Santa Fe County, the Pueblo of Tesuque, as well as the Santa Fe National Forest.

1.1 PURPOSE AND NEED

The purpose of the SFMLRP is the improvement of ecosystem resiliency from impacts of disturbance; namely wildfire, insects, disease, and climate change. The policy of fire exclusion and limited vegetation management within the project area has promoted conditions (See **Existing and Desired Conditions**) which are highly susceptible to the impacts from agents of disturbance, such as uncharacteristic wildfire as well as insect and disease outbreak. These impacts are also likely to be further exacerbated by the anticipated effects of climate change (Hand et al. 2018).

Vegetation management treatments (thinning and mastication) and fuels treatments (ground fuel rearrangement and prescribed fire) are being proposed in order to ultimately restore fire as an ecological component of the systems within the project area. Objectives of treatments are:

- Move frequent-fire forests in the Project Area towards their characteristic species composition, structure and spatial patterns in order to improve ecological function;
- Create conditions that facilitate the safe reintroduction of fire, allowing fire to play its natural role in frequent fire forest types;
- Reduce the risk for large high-intensity wildfires, create safe, defensible zones for firefighters and minimize the risk of fire to nearby valued resources;
- Improve and maintain diverse wildlife habitats to provide a large array of habitat types, habitat components, seral stages and corridors for a variety of species that utilize the area; and
- Improve watershed conditions by restoring the vegetative structure and composition of riparian ecosystems and by maintaining and improving water quality.

1.2 NEED FOR A PROJECT-SPECIFIC FOREST PLAN AMENDMENT

A project-specific plan amendment to the 1987 Santa Fe National Forest Land Management Plan (hereafter referred to as “the LMP” or “the Forest Plan”), as amended through Amendment 13 (June 2010), is needed because the LMP includes outdated direction for Mexican spotted owl management. Management direction is currently based off of the 1995 Mexican spotted owl recovery plan, but a revision of the recovery plan was published in 2012: the 2012 Mexican Spotted Owl (MSO) Recovery Plan, First Revision (USDI FWS 2012). There is a need for the project analysis to be in alignment with the management direction provided in the revised recovery plan.

For the project, the LMP would be amended under the 2012 Planning Rule (36 CFR 219). The 2012

Planning Rule has different provisions than the 1982 Planning Rule under which the existing LMP was developed. The draft amendment would:

- Update definitions and direction for protected activity centers (PACs), recovery habitat, and other forest and woodland types to be in alignment with the current recovery plan.
- Update language and direction related to prescribed cutting and fire treatments in PACs to be consistent with the current recovery plan.
- Add forest structure guidelines for recovery habitat.
- Add direction for riparian forest habitats.
- Update survey information.
- Remove the direction for treating habitat in incremental percentages.

In cases where the direction in the Forest Plan is not amended it is because the language does not conflict with project needs (based on the Recovery Plan). Forest Plan direction will be followed but augmented by the MSO Recovery Plan direction, which provides specific details for management that are not included in the more broadly-written Forest Plan language.

There is a need for the project analysis to be in alignment with the best available science for northern goshawk management.

The 1987 Forest Plan provides direction for frequent-fire forest types on three levels: management scale, outside goshawk post-fledgling areas, and within goshawk post-fledgling areas. Therefore, a project- specific Forest Plan amendment would need to address the direction provided on all three levels. The Santa Fe National Forest is currently undergoing Forest Plan Revision, but because a final revised forest plan is not expected until 2021 an amendment to the 1987 Forest Plan is needed to:

- Replace forest plan standards and guidelines for ponderosa pine and dry mixed conifer (including northern goshawk direction) with desired conditions and guidelines.

Please refer to the **Project Record** for additional details related to the Forest Plan amendment.

1.2.1 Proposed Action Amendment Language

- Amend the Santa Fe National Forest Plan to be in alignment with the management direction provided in the revised MSO Recovery Plan when direction between the two plans is in conflict. A project-specific plan amendment is needed because the Forest Plan, as amended, includes direction from the former (1995) MSO recovery plan.
- Amend the 1987 Santa Fe National Forest Plan to add clarifying language for northern goshawk management to: (1) describe desired conditions for the project area managed for northern goshawk.

1.2.2 Proposed Forest Plan Amendment

For the purpose of this amendment, the following definitions apply:

1. A stand is defined as a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Three classification characteristics are generally used to distinguish forest stands: bio-physical site (soils, aspect, elevations, plant community association, climate, etc.), species composition, structure (density and age (1-aged, 2-aged, uneven-aged)), and

management emphasis (administrative requirements and local management emphasis that would shape structure over time).

2. Openings are defined as generally persistent treeless areas having a fairly distinct shape or size, occurring naturally due to difference in soil types as compared to sites that support forests or woodlands. Openings include meadows, grasslands, rock outcroppings, and wetlands. In contrast, created openings result from disturbances like severe fire or windthrow, or management activities to intentionally create space for new tree regeneration. Natural and created openings are not the same as interspaces found in the frequent-fire forests or woodlands.

1.3 Issues Addressed

In addition to meeting the Purpose and Need of the Project, additional issues have been identified in the Scoping process from the public. Issues related to vegetation and silviculture will be addressed as a component of this report. These issues include the following:

- Address Purpose and Need related to Silviculture:
    - Promote the restoration of species composition, structure, and spatial pattern;
    - Establish conditions where fire can a part of frequent fire systems;
    - Reduce the of risk of large high intensity fires; and
    - Establish a diversity of seral stages.
- Address issues related to Forest Health:
    - Manage the impacts of dwarf mistletoe;
    - Slash management to mitigate the impacts of *Ips* spp.;
    - Reduce the risk of bark beetle outbreaks; and
    - Manage the impacts of Douglas-fir tussock moth.
- Address issues related to the management of upland vegetation:
    - Manage and preserve Southwestern white pine;
    - Retain and promote large and old trees;
    - Effects of canopy cover reduction; and
    - Develop snag retention strategy.
- Address issues related to Old Growth:
    - Retention and culturing of Old Growth Conditions and
    - Implementation of a large tree retention strategy.
- Address the site specific amendments to the Forest Plan:
    - Treatment of vegetation related to MSO PACs;
    - Adoption of aspects of the new proposed MSO recovery plan;
    - Clarification of activity restrictions during MSO breeding seasons; and
    - Clarification of need for Northern Goshawk interspaces.

1.4 Scope of Analysis

The project covers roughly 50,500 acres on the Española and Pecos-Las Vegas Ranger Districts of the Santa Fe National Forest (Figure 1). The project is located within and immediately adjacent to the larger 107,000-acre Greater Santa Fe Fireshed. The project boundary does not include all National Forest System lands in the Greater Santa Fe Fireshed. Forest Service lands not included in the project area

include the City of Santa Fe's Municipal Watershed, La Cueva, Hyde Park, and Pacheco Canyon due to other NEPA decision associated with these. The project boundary aligns with the Greater Santa Fe Fireshed boundary, particularly in the southeast corner of the project area. In this area, the project boundary extends outside of the Greater Santa Fe Fireshed boundary to include high priority treatment areas in the Pecos-Las Vegas Ranger District.

Table 1. Acres by Ecological Response Units (ERU) within SFMLRP Area

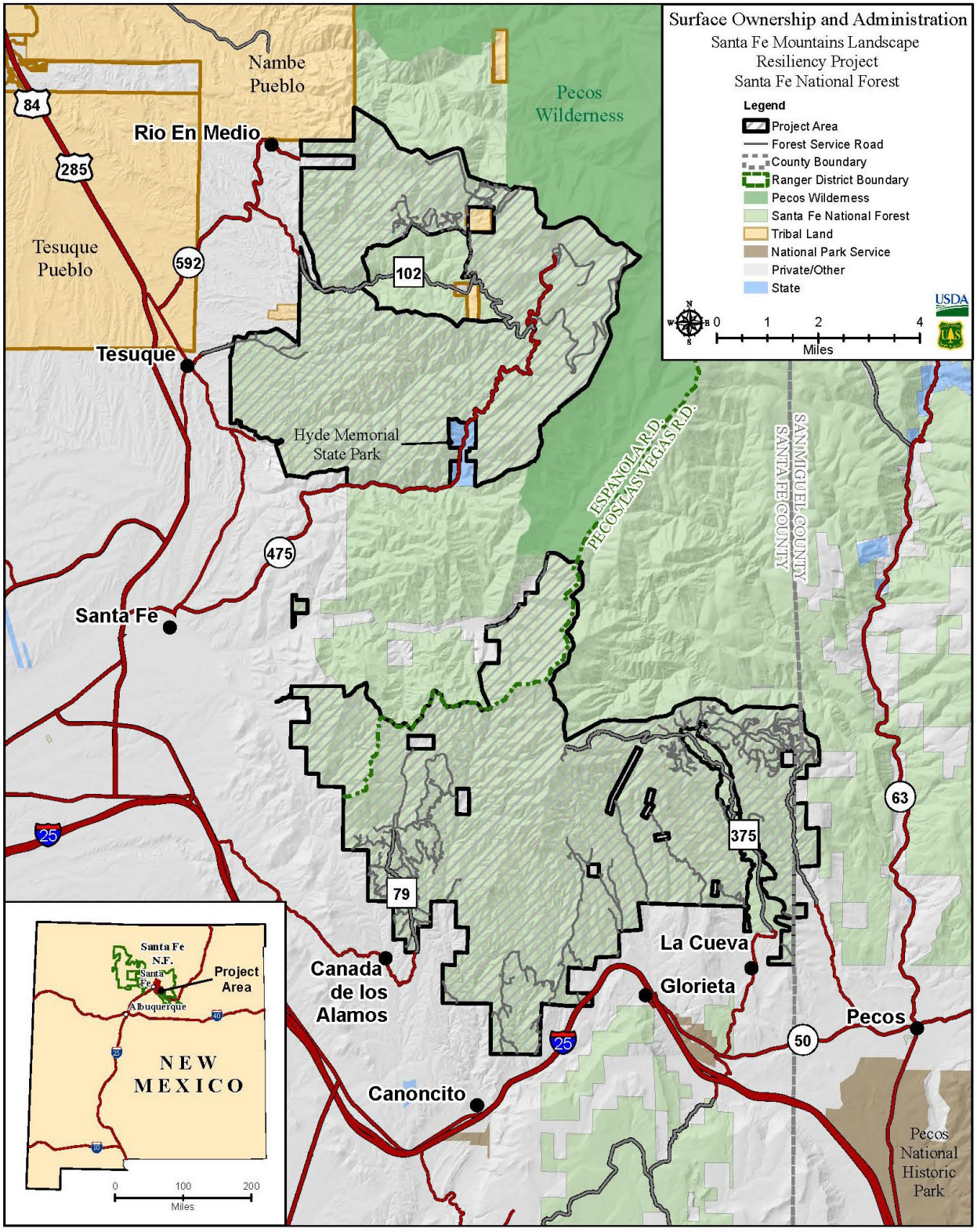
Ecological Response Unit	Approximate Acres in Project Area
Spruce-Fir Forest	5,022
Montane/Subalpine Grassland	491
Mixed Conifer with Aspen	456
Mixed Conifer–Frequent Fire Forest	17,875
Ponderosa Pine Forest	17,347
Pinyon-Juniper Woodland	8,660
Narrowleaf Cottonwood/Shrub	503
Colorado Plateau/Great Basin Grassland	139
Other	63
Total	**50,566**

While the project area is 50,500 acres in size and covers a variety of Ecological Response Units (ERU), it is anticipated that only portions of the project area and ERU are to be treated by management actions resulting from the proposed action. More specifically, silvicultural and fuels management are proposed to take place within the Mixed Conifer-Frequent Fire Forest, Ponderosa Pine Forest, Piñon-Juniper Woodland/Grassland ERUs (please refer to Table 16 for acres of ERU to be treated by thinning and Prescribed fire). Given the focus of treatment within these ERUs, the analysis of this report will follow suit and focus upon the Mixed Conifer-Frequent Fire, Ponderosa Pine, and Piñon-Juniper ERU. The remaining forest ERU will be addressed only as a component of the **Existing Conditions**.

Given that the size of the project area and limitations of Forest resources, it is likely that the implementation of the proposed management actions would take place over 10-20 years, if not longer. The modeling efforts (see **Methodology**), which provide much of the data for future conditions analyzed as part of this report, utilize a 50 year planning horizon in which to project data/conditions. This projected data is not intended represent exact conditions, but to indicate trends based upon the best available science.

The vegetation-based analysis of this report is limited to the SFMLRP area identified by Figure 1. With the exception of the **Cumulative Effects** analysis, areas outside of the project area are not considered or analyzed.

This report only relates to the silviculture of upland vegetation and ecological systems. This report will not address riparian areas, transportation, recreation, wildlife, or scenic values.



The data used to create this map is intended for broad-scale planning purposes. The Forest Service provides no warranty regarding its accuracy or use for other purposes.
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Figure 1. Map of SFMLRP Area and Vicinity

1.5 METHODOLOGY

This report makes use of data derived from the Forest Vegetation Simulator (FVS), which utilizes Common Stand Exam (CSE) data, and a State and Transition model, which utilizes spatial delineations of vegetation data. FVS is an individual tree growth and yield model which utilizes field sampled data (CSE data), from forested and woodland stands from the project area and adjacent to the project area, and "grows" these trees (collectively as "stands") over a set period of time, with and without management activities. Data from these model runs were utilized to provide information related to reasonably anticipated trends of proposed and no action alternatives on the fine to mid-scale scope. FVS models were ran through a 50-year planning horizon. The state and transition model uses space, time, change over time as a stochastic process, as well as rates of change to represent a vegetated landscape, in this case, and changes over time due to ecological processes.

1.5.1 Data Sources

The FVS modeling utilized CSE data collected from the Española and Pecos-Las Vegas Ranger Districts of the Santa Fe National Forest collected from 2009-2019. Stands were selected for the predominant ERU and Seral States found within the project area. As many as 20 stands per seral state were selected; however, some less common seral states were more poorly represented in terms of stand data and substantially fewer stands were added to the modeling effort. The results of FVS modeling is not intended to represent specific stands or specific conditions; however, results are intended to represent anticipated trends of conditions based upon proposed management actions.

The state and transition model uses and projects spatial delineations of vegetation data over time. Spatial data utilized includes Ecological Response Units, vegetation size class, canopy cover, and number of vegetation stories. ERU represents potential natural vegetation under natural disturbance events. This data was the Region 3 ERU GIS data (https://www.fs.usda.gov/detailfull/r3/landmanagement/gis/?cid=stelprdb5201889&width=full). Vegetation size class, canopy cover, and vegetation stories was derived from the Region 3 Midscale Vegetation dataset. Data from FVS, Forest Health aerial detection surveys, and potential locations and parameters of potential treatments were also factored into this model. Similarly to the FVS modeling, results of the state and transition modeling are intended to represent trends and not specific values or conditions.

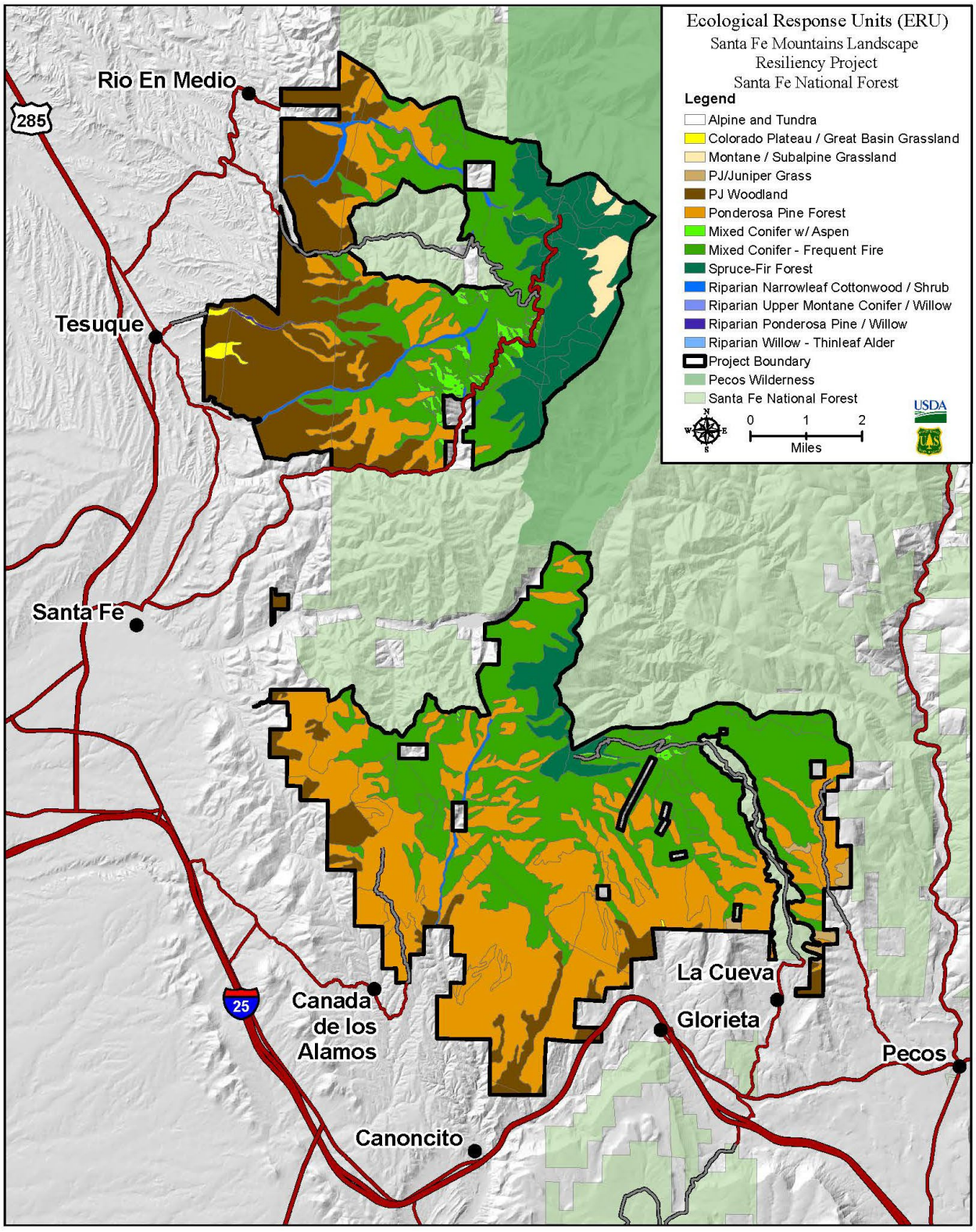

Figure 2. Ecological Response Units (ERUs) of the SFMLRP

2 EXISTING AND DESIRED CONDITIONS

The existing condition data is based upon USFS spatial data which utilizes Ecological Response Units, tree size class, canopy cover, and number of vegetation stories. This data represents potential natural vegetation under natural disturbance events (Please refer to **Methodology** for additional description of data). Desired condition data is based upon the ERU descriptions (Walberg et al 2014) which utilizes ERU descriptions; reference conditions for seral states, coarse wood and snags, and fire regimes; and contemporary seral states. This data was used to develop the conditions identified by "Desired Conditions for Use in Forest Plan Revision in the Southwestern Region" (USDA 2014) as well as Santa Fe National Forest Draft Land Management Plan (USDA 2019).

2.1 ECOLOGICAL RESTORATION UNITS

2.1.1 Spruce-fir

This high- elevation forest community is generally found to range between 9,500 and 12,000 feet on Tesuque Peak. This community occupies the coldest and highest sites with the most precipitation of Forest. Engelmann spruce (*Picea engelmannii*) tends to be the dominant climax species within this community. Subdominant species include corkbark fir (*Abies lasiocarpa*), white fir (*Abies concolor*), and bristlecone pine (*Pinus aristata*). Lower elevation seral species include quaking aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*), white fir, blue spruce (*Picea pungens*), and southwestern white pine (*Pinus strobiformis*) (USDA 2019). Typical natural fire regimes are infrequent (150-400 years) and are of moderate to high severity (USDA 2014).

2.1.2 Mixed Conifer with Aspen (Wet Mixed Conifer)

This community, also known as "Wet Mixed Conifer", is generally found between 6,500 to 10,000 feet elevations within the project area, typically in moister areas such as northern and eastern aspects, lower slopes, valley bottoms, and higher reaches of the elevation range. Species composition is dependent upon several factors such as: seral state, elevation, precipitation/moisture level. Typical tree species generally includes quaking aspen, Douglas-fir, New Mexican locust (*Robinia neomexicana*), southwestern white pine, white fir, blue spruce, Engelmann spruce, corkbark fir, and ponderosa pine (*Pinus ponderosa*) (USDA 2019). Shade tolerant tree species tend to be climax species while other, less shade tolerant, trees tend to be seral. Natural fire regimes are typically infrequent (22-150 year) with moderate to high severity fires (USDA 2014).

Within the project area, the mixed conifer with aspen forests are nearly entirely composed of the early and mid-seral states. The grass/forb/shrub stages are absent from the project area. As is, this system is lacking in diversity and resilience given that roughly 100% of the ERU is within the early and mid-seral stages.

Table 2. Desired Mixed Conifer with Aspen Conditions

Seral Stage	Desired	Existing	Tree Size	Cover	Structure
Grass, Forb, Shrub	7%	0%	N/A	<10%	Single
Aspen	21%	0%	All	All	All
Early	18%	75%	0-9.9"	10 to> 30%	All
Mid	14%	25%	10-19.9"	10 to >30%	All

Late	40%	0%	≥20”	≥30%	1-2 stories or more than 3

2.1.3 Mixed Conifer- Frequent Fire (Dry Mixed Conifer)

This community, also known as “Dry mixed Conifer” is generally found in the range of 6,000 to 9,500 within the project area. Ponderosa pine, quaking aspen, southwestern white pine, and Gambel oak (*Quercus gambelii*) are, generally, dominant. Other co-dominant to common species include Douglas-fir, white fir, and blue spruce (USDA 2019). Typical natural fire regimes include frequent (2-24 year) low severity fire (USDA 2014).

Within the project area, the dry mixed conifer forests depart from desired conditions on two primary characteristics, density and size. More specifically, stands of the dry mixed conifer type are denser and more overstocked (80% of the “closed” state as compared 28% as desired). Additionally, a much larger component of this ERU is dominated by smaller trees as opposed to larger trees. This is depicted by nearly half of the ERU is classified as being of the Mid-Closed seral stage, and the desired representation of this stage in very minor (3%).

Table 3. Desired Mixed Conifer- Frequent Fire Conditions

Seral Stage	Desired	Existing	Tree Size	Cover	Structure
Grass, Forb, Shrub- Early	9%	1%	0-4.9”	All	All
Mid-Open	3%	0%	5-9.9”	10-30%	All
Mid-Closed	3%	47%	5-9.9”	>30%	All
Late-Open	60%	7%	>10”	10-30%	Uneven-age
Late-Closed	25%	45%	>10”	>30%	All

2.1.4 Ponderosa Pine Forests

Within the project area, two sub-classes of the Ponderosa Pine ERU are found: ponderosa pine bunchgrass and ponderosa pine Gambel oak. These subgroups are analyzed as a single ERU within this report. This community is generally found in elevations of 5,000 to 9,000 feet. Tree vegetation is dominated by ponderosa pine, but also includes various oaks (*Quercus* sp.), juniper (*Juniperus* sp.), two-needle piñon pine (*Pinus edulis*), quaking aspen, Douglas-fir, white fir, and blue spruce (USDA 2019). Natural fire regimes consist of frequent (2-24 years) low severity fire (USDA 2014).

Within the project area, the ponderosa pine ERU deviate from desired conditions, primarily, on two basic conditions, cover and dominant tree size. In general, the stands that compose the ERU are overstocked. Desired conditions are such that the total area in excess of 30% canopy cover is minor, while the current conditions are predominant in terms of percentage of total ERU area. Additionally, areas dominated by smaller trees are overly abundant as compared to desired conditions. That is, this ERU is dominated by smaller trees (5-9.9” DBH) as compared to the relatively minor amounts of the desired conditions.

Table 4. Desired Conditions Ponderosa Pine Forests

Seral Stage	Desired	Existing	Tree Size	Cover	Structure
Grass, Forb, Shrub- Early	2%	13%	0-4.9”	All	All
Mid-Open	2%	1%	5-9.9”	10-30%	All
Mid-Closed	2%	41%	5-9.9”	>30%	All
Late-Open	82%	7%	>10”	10-30%	Uneven-age

Late-Closed	12%	39%	>10”	>30%	All

2.1.5 Piñon-Juniper Woodlands and Grasslands

Tree species of this group predominantly includes two-needle piñon (*Pinus edulis*), one-seed juniper (*Juniperus monosperma*), and alligator juniper (*Juniperus deppeana*). Other juniper species, such as Utah juniper (*Juniperus osteosperma*) and Rocky mountain juniper (*Juniperus scopulorum*) may be present (USDA 2019). Grassland fire regimes are typically frequent (0-35 years) and low severity, while woodland and sagebrush fire regimes vary from infrequent (35-200 years) moderate severity to infrequent (>200 year) high severity fires (USDA 2014).

Within the project area, both the Piñon-Juniper Grassland/Juniper Grassland ERU and the Piñon-Juniper Woodland ERU have the same issue with respect to deviation from desired conditions. That is, the “Early-Closed” seral stage is overabundant within the ERU. Additionally, within the grassland types, there is an absence of areas with low/open canopy cover and as well as areas dominated by large trees. Within the woodland type, there is an under-representation of areas dominated by large trees.

As related to this project, the Piñon-Juniper ERU will not be treated with the objective of meeting or moving towards the desired conditions identified by the Region. This ERU would be treated to meet objectives related to fire, fuels, and wildland-urban interface (WUI). The Purpose and Need states “reduce the risk for large high-intensity wildfires, create safe, defensible zones for firefighters and minimize the risk of fire to nearby valued resources”. The desired condition within this ERU is the reduction of fuel (surface, ladder, and canopy) loading and extreme fire risk. However, seral state data would be presented as part of this report for this ERU in order to express the anticipated changes within this ERU over time, for both the No Action and Proposed Action Alternatives.

Table 5. Desired Piñon-Juniper Grassland and Juniper Grassland Conditions

Seral Stage	Desired	Existing	Tree Size	Cover
Grass, Forb, Shrub	5%	0%	N/A	<10%
Early-Open	25%	2%	0-9.9”	10-30%
Early-Closed	10%	94%	5-9.9”	>30%
Late-Open	50%	0%	>10”	10-30%
Late-Closed	10%	3%	>10”	>30%

Table 6. Desired Piñon-Juniper Woodlands Conditions

Seral Stage	Desired	Existing	Tree Size	Cover
Grass, Forb, Shrub	10%	0%	N/A	<10%
Early-Open	5%	1%	0-9.9”	10-30%
Early-Closed	15%	85%	5-9.9”	>30%
Late-Open	10%	1%	>10”	10-30%
Late-Closed	60%	13%	>10”	>30%

2.2 FOREST HEALTH

Every year, Forest Health and Protection conducts aerial detection surveys (ADS) for the purposes of detecting and identifying the extent of insects and disease within forests and woodlands within the Region. The following table (Table 7) summarizes the results from 2017-2019 within the project area.

Table 7. Aerial Detection Results within Project Area (2017-2019)

Damage	Affected Species or Causal Agent	2017	2018	2019
Mortality	Douglas-fir Beetle (Douglas-fir)	173 ac.	55 ac.	468 ac.
	Fir Engraver (White Fir)	6 ac.	0 ac.	0 ac.
	Pine Beetle (Ponderosa Pine)	8 ac.	81 ac.	61 ac.
Defoliation	Janet's Looper	0 ac.	334 ac.	420 ac.
	Western Spruce Budworm	921 ac.	114 ac.	182 ac.
	Douglas-fir Tussock Moth	1,186 ac.	0 ac.	0 ac.
	Aspen Defoliation	1,124 ac.	867 ac.	773 ac.
Other Damage	Ponderosa Pine Discoloration	0 ac.	0 ac.	81 ac.
	Other Crown Discoloration	0 ac.	46 ac.	0 ac.
	Douglas-Fir Tussock Moth-Caused Mortality	0 ac.	275 ac.	0 ac.

2.2.1 Bark Beetles

2.2.1.1 Douglas-fir beetle

Douglas-fir beetle (*Dendroctonus psuedotsugae*) is common through the project area. Douglas-fir beetle is host specific to the Douglas-fir tree. Stands which are, generally, more susceptible are dense, more moist sites, older (>120 years), with root disease present, and with injuries common (Kegley 2011). In order to mitigate Douglas-fir beetle, prevention management activities are to be carried out. Suppression (sanitation) is impractical due to the limited scope of management activities; i.e. the 16" diameter cap of the thinning activities and the lack of removal of infected material (product not to be removed from the site). However, implementation of prevention measures, such as density management (thinning to improve health and vigor), is practical and core to the management activities and would reduce the risk of Douglas-fir beetle outbreak. However, thinning from below and application of prescribed fire can create potential issues. These include the removal of the less susceptible smaller Douglas-fir (Kegley 2011) and promoting fire damage related to application of prescribed fire which is known to stimulate Douglas-fir beetle activity. Mitigation measure (such as MCH) may be needed to protect high value trees (recreation sites and old growth stands) after fire when risk is high that beetle activity may be increased (Kegley 2011).

2.2.1.2 Fir Engraver

The primary hosts for the fir engraver (*Scolytus ventralis*) include white fir but may also infest Douglas-fir and subalpine fir. Fir engraver generally causes top kill and dead branches. Mortality is generally induced when infestation occurs in addition to other effects; such as root disease, drought, or defoliation (Randall 2012). Fir engraver has been a very minor issue within the project area for the last three years and the proposed action should reduce susceptibility by reduction of white fir stocking and improving vigor of residual trees through density management.

2.2.1.3 Ips Beetle

Pine engraver affects ponderosa pine and generally is found in logging slash, damaged or dead trees (tops), and in small diameter (sapling/pole) sized trees. Outbreaks can occur after disturbance events which may include harvest operations, drought, and windthrow (Livingston 2010). Activities from the proposed action, specifically the creation of logging slash that is not being removed, are likely to exacerbate *Ips* spp. activity. Project design features related to slash management are to be enacted in order to mitigate issues with *Ips* spp. outbreak. Slash creation activities should occur between August to November and green slash should not be created between December to June (Livingston 2010). Alternate slash management methods which decrease desirability of slash to *Ips;* such as: chipping, mastication, and lop and scatter; may be utilized during months where risk of outbreak is high (Livingston 2010). The resulting conditions; reduced stocking, increased vigor, and removal of smaller trees; created by the management actions should create conditions where risk of *Ips* spp. infecting green trees should be reduced.

2.2.1.4 Western Pine Beetle

Western pine beetle (*Dendroctonus brevicomis*) attacks typically occur in ponderosa pine and often reaches outbreak conditions within periods of drought or following fires. The ponderosa pine trees which are most susceptible to western pine beetle attack are older, with poor crown rations, and slow growth. Stands which are most susceptible to western pine beetle outbreak are overstocked with larger trees and of a more simple structure (Randall 2010a). Management activities may produce mixed results with respect to ponderosa pine and Western pine beetle. On one hand, activities would improve vigor and reduce stress among residual trees. On the other hand, use of prescribed fire may damage residual trees and create conditions which are favorable to Western pine beetle. These conditions may be further exacerbated by dwarf mistletoe infections within the project area. Furthermore, management activities which focus on the removal of understory trees may have a negative effect upon resilience of stands impacted by Western pine beetle outbreaks. USFS Forest Health Protection will monitor for bark beetle activity during their yearly aerial detection surveys. Further activity and NEPA compliance may be required in order to mitigate (suppression) any infestation that may be found if potential risk is substantial.

2.2.2 Defoliators

2.2.2.1 Douglas-fir Tussock Moth

The Douglas-fir Tussock Moth (*Orgyia pseudotsugata*) can affect Douglas-fir, true fir, and spruce. The larvae are the defoliation agent and have the potential to cause topkill, mortality, and to increase susceptibility to bark beetle attack. Outbreaks are generally cyclical and happen every 8-12 years (USDA 2011). Given this cyclical period and that the previous outbreak was in 2018, it can generally be expected that another outbreak within the project area would be likely during the life of the project. When the next outbreak occurs, it can reasonably be expected that there would be some delayed mortality from repeated defoliation as well an increase in vulnerability to other agents, such as Douglas-fir beetle, due to defoliation induced stress. Suppression is possible through the use of chemical agents (USDA 2011). Silvicultural prevention methods may be implemented through species management (favoring retention of non-host species) as well as the thinning to promote stand health and vigor to improve resilience of residual stocking (Randal 2010b).

2.2.2.2 Janet's Looper

In 2018, the Janet's Looper (*Nepytia janetae*) caused defoliation damage on approximately 9,000 acres on the Santa Fe National Forest. These caterpillars can defoliate true fir, spruce, and pine trees, which can lead to tree stress and potentially tree mortality (Coleman 2018). Defoliation from Janet's looper has had an effect on mixed conifer and spruce-fir stands within the project area, but have peaked and are expected to subside. However, if Janet's looper presence rises over the life of the project, it can reasonably be expected that defoliation would cause stress in affected trees and may make them more susceptible to other insects and disease.

2.2.2.3 Western Spruce Budworm

The host species for the western spruce budworm (*Choristoneura occidentalis*) include Douglas-fir, true fir, and spruce. The effects on the host include defoliation, top kill, deformities, mortality, and seed loss. Populations tend to be cyclical. Stand characteristics which tend to relate to pest impact and damage include: multi-stories stands, higher portions of stocking in host species, and southern facing aspects (Pederson et al. 2011). The proposed action would likely reduce the risk of Western spruce beetle outbreak in treated stands which are dominated by host species by way of density management, favoring of early seral species, as well and improving overall stand vigor.

2.2.3 Dwarf Mistletoe

Dwarf mistletoe is very common parasitic plant infecting the ponderosa pine and Douglas-fir (*Arceuthobium vaginatum* subspecies *cryptopodum* and *Arceuthobium douglasii* respectively) within the project area. Dwarf mistletoe infections alter tree form; diminish growth, vigor, seed production; increase susceptibility to other insects and disease; and can lead to topkill and mortality (Beatty and Mathiasen 2003 and Hadfield et al. 2000). In addition to parasitizing trees, Dwarf mistletoe also provides habitat (witches brooms and dwarf mistletoe snags) and food sources (mistletoe shoots) for many wildlife species within the project area. However, little to no evidence exists that any wildlife species is dependent upon dwarf mistletoe (Worrall 2015).

Thinning treatments within dwarf mistletoe infected stands carry several issues and concerns. Given the limitation of the diameter caps (16" DBH for "forest" tree species), sanitation of thinned stands in unlikely and only possible in lightly to moderately infected stands where only trees less than 16" DBH are infected. Thinning treatments which leave infected trees would succeed in increasing the ability for dwarf mistletoe to spread (Geils et al. 2002). Stands with retained overstories which are infected with dwarf mistletoe are likely to have regeneration, once established, and understories which are infected with mistletoe due to mistletoe seed raining down from the infected overstory (Worrall 2015).

It is largely considered that the lack of fire upon the landscape is a substantial contributing factor to the high levels of infection of dwarf mistletoe upon the landscapes of the West. Given that, application of prescribed fire and the re-introduction of fire as a component of these frequent fire ecosystems is anticipated to have a positive effect upon the control and management of dwarf mistletoe within the project area. Trees with dwarf mistletoe infections are more prone to fire effects due to dwarf mistletoe related characteristics, such as: low crowns, witch's brooms, and resin (Geils et al. 2002). These effects may take the form of scorch pruning of infected limbs and through tree mortality (Conklin and Geils 2008). It can be anticipated that more heavily infected trees would be more prone to fire effects. It is anticipated that stands treated with prescribed fire would experience an overall decrease in dwarf

mistletoe rating due to mortality of highly infected trees and the pruning of infected branches from crown scorching (scorch pruning) (Conklin and Geils 2008).

Specific dwarf mistletoe treatments would depend upon existing stand conditions, silvicultural objectives, available resources, and the latest scientific information available. However, the following management recommendation (Hoffman 2010 and Worrall 2015) are to be considered.

- Sanitize when appropriate. This includes that there is sufficient un-infected stocking available to meet stocking thresholds and infected stock is of a treatable size (under diameter cap).
- When sanitation is not feasible, focus thinning on the removal of heavily infected trees (DMR >3) and trees that are not anticipated to outgrow the infection (infections not primarily in the lower 1/3 of the tree canopy).
- Favor the retention of non-host species when applicable and when all infected trees cannot be removed.
- Utilize prescribed fire as a standalone treatment and in conjunction with thinning to reduce dwarf mistletoe infection levels.
- Utilize even-aged management in stands where all infected trees cannot be removed in order to prevent understory infections, reduce infection severity, and to improve stand productivity.
- When the management actions that are necessary to improve the stand are infeasible (outside the scope of the project) or would not improve the health of the stand (stand heavily infected), it is an advisable practice to not treat the stand.

2.2.4 White Pine Blister Rust

White pine blister rust (*Cronartium ribicola*) is an introduced fungal disease that can affect the Southwestern white pine within the project area. The fungus can cause top kill or tree mortality by girdling the stem and can affect pine of any size. Management of natural white pine in mixed forest stands includes the retention of white pine for the purposes of maintaining genetic diversity and for retention of blister rust resistant stock (Schwandt et al. 2013). Given the philosophy of retaining all Southwestern white pine for the purpose of retaining genetic diversity, removal of Southwestern white pine is to be explicitly avoided. However, situations may arise; such as safety, operational necessity, or for the overall improvement of stand health; where removal may be required.

2.3 OLD GROWTH

The Forest Plan, as amended in 2010, provides descriptions for old growth by ERU, minimum criteria for Old Growth classification (Table 8), as well as guidance for the management of Old Growth upon the Santa Fe National Forest (USDA 2010). These descriptions (pages 206-207 of the Forest Plan) for the ERU within the project area as follows:

<u>Spruce-Fir</u>

> "*Spruce/Fir old growth stands would also have a high component of large trees 150 to 170 years old. While Corkbark-fir seldom exceeds two hundred years, some Spruce in this region have lived to be 500 years old. The typical diameter may be 16 to 20 inches but individual trees may attain diameters of 30 or more inches. As with the other species, the older and larger trees will exhibit the best old growth habitat characteristics. The forest floor is typically strewn with large rotting down woody material. If weather and other conditions become extreme; and catastrophic*

wildfire occurs, the result is frequently complete replacement of the existing old growth stand. Under normal weather patterns fire seldom plays a significant role in this Forest's Spruce-fir stands." -Santa Fe National Forest Plan, page 207

Mixed Conifer

"Mixed Conifer stands would appear as being over mature and the numerous large trees would be in advanced stages of their natural longevity. It would be natural for these trees to be spike topped or weakened by a varied assortment of insects or diseases. Typically the predominant overstory age would be 150 to 170 years or more. Douglas-fir may live 500 years in places on the Santa Fe National Forest. Some of the trees would likely be 24 inches or more in diameter. The stand would typically be multi-storied, uneven-aged, and display a varied composition of snags. The snag component would be comprised of suppressed trees as well as overmature trees killed by insects or diseases. The stand would contain a significant composition of down woody materials. This material is seldom consumed by fire and is often large, coarse, and in advanced stages of decay. These stands offer a more mesic micro-habitat due in part to the high level of canopy closure." -Santa Fe National Forest Plan, page 207

Ponderosa Pine

"Ponderosa Pine old growth would have mature and overmature yellow-barked Ponderosa Pines dominating the visual appearance of the area. A portion of these trees will be at least 200 years old and some may be 300 years or older. These trees would frequently be 24 inches or more in diameter. The highest quality old growth would have a substantial portion of the dominants approaching their natural longevity. Individual trees have fire scars near the base, tops may be broken or dead, and there would likely be cavities in the bole of the tree. Where fire is playing a more natural role, the understory has little down woody debris. A significant grass component would be apparent on the Forest floor. Where fire is not approaching natural frequencies the woody debris, lack of grasses and younger Ponderosa age classes would be apparent. The stand influenced by a more natural role of fire may be patchy in appearance, as fire occasionally removes a tree or cluster of trees. The seral progression of these patches provide groups of trees varying the age within the old growth stand. The stand exhibiting fire suppression will trend towards greater homogeneity in the dominant age class. Snags will generally be composed of dead overmature trees in various stages of decomposition." -Santa Fe National Forest Plan, page 206

Piñon-Juniper

"Pinyon/Juniper old growth stands will have an evident component of mature and overmature trees which would be reaching the end of their natural longevity. The canopy may appear layered. The age of the overmature trees would exceed 300 years; and the diameter of these trees would be around 14 to 20 inches. Understory with frequent, more natural fire histories will be sparse containing some large woody debris, grasses and shrubs. Understories without the natural presence of fire will contain more large woody debris with less grasses and shrubs." -Santa Fe National Forest Plan, page 207

Table 8. Minimal Old Growth Criteria- Forest Plan

Criteria		Spruce-Fir / Subalpine Fir	Mixed Species Group	Interior Ponderosa Pine	Piñon-Juniper
		Site: Low to High	**Site: Low to High**	**Site: Low to High**	**Site: Low to High**
Live Trees in Main Canopy	Trees/Acre	20-30	12-16	20	12-30
	DBH/DRC	10-14"	18-20"	14-18"	9-12"
	Age	140*/170**	150	180	150-200
Dead Trees Standing	Trees/Acre	3-4	2.5	1	½-1
	DBH/DRC	12-16"	14-16"	14"	9-10"
	Height	20-30'	20-25'	15-25'	8-10'
Dead Trees Down	Pieces/Acre	5	4	2	2
	Diameter	12"	12"	12"	9-10"
	Length	16	16'	15'	8-10'
Structure- Stories		single or multi-storied			
Basal Area per Acre		120-140 ft²	80-100 ft²	70-90 ft²	6-24 ft²
Canopy Cover		60-70%	50-60%	40-50%	20-35%

* Engelmann spruce less than 50% of stand composition

** Engelmann spruce greater than 50% of stand composition

The provided guidance by the Forest Plan is summarized within the **Consistency with Relevant Laws, Regulations, and Policy** section of this report. However, the following items are pertinent to the existing and desired conditions of Old Growth upon the Santa Fe National Forest. Stands managed for Old Growth are to be at least 40 acres in size and at least 20% of each ecosystem management area and forest type (ERU) is to be managed for Old Growth.

Areas that currently meet or likely to be able to meet in the near future have been classified to be managed as Old Growth within the project area (i.e. 20% of each forest/woodland vegetation type). Some areas managed for wildlife habitat, i.e. Mexican Spotted Owl (MSO) nest/roost areas (Cores) and replacement nest/roost areas as well as Northern goshawk (NoGo) post-fledgling family areas (PFA) and nest areas, are considered de facto Old Growth areas due to the desired structural and density characteristics of these areas. The official spatial dataset for these locations islocated within the GIS databases of the Santa Fe National Forest.

Table 9. Crosswalk: Old Growth to Seral Stages

Forest Cover Type	Ecological Response Unit	Seral Stage	Dominant DBH/DRC		Canopy Cover		Estimated Existing Area	Estimated Existing Acres	Target "20%" Acres
			OG Criteria	SS Criteria	OG Criteria	SS Criteria			
Engelmann Spruce Subalpine Fir	Spruce-Fir	Mid	>10-14"	10-19.9"	>60-70%	≥10%	23%	1,176	1,004 (adequate stocking)
		Late		≥20"		≥30%	1%	67	
Mixed-Species Group	Mixed Conifer, Wet	Mid	>18-20"	10-19.9"	>50-60%	≥10%	25%	115	3,666 (adequate stocking)
		Late		≥20"		≥30%	0%	0	
	Mixed Conifer, Dry	Late-Closed		≥10"		≥30%	45%	8,037	
Interior Ponderosa Pine	Ponderosa Pine	Late-Closed	>14-18"	≥10"	>40-50%	≥30%	39%	6,682	3,469 (adequate stocking)
Piñon-Juniper	Piñon-Juniper	Early-Closed	>9-12"	5-9.9"	>20-35%	≥30%	85%	7,349	1,732 (potentially adequate stocking)
		Late-Open		≥10"		10-29.9%	1%	68	
		Late-Closed		≥10"		≥30%	13%	1,120	

Explanation of Table 9 Columns.

- *Forest Cover Type*- Vegetation types identified by the 1987 Forest Plan (as amended)
- *Ecological Response Units*- Vegetation types identified by the Draft Forest Plan and utilized by Region 3
- *Seral Stage*- Various seral stages of each identified ERU that could qualify as Old Growth
- *Dominant DBH/DRC*- Size of trees within the dominant overstory canopy layer
- *Canopy Cover*- Percentage of ground surface covered by tree crown/canopy
- *OG Criteria*- Minimal Old Growth criteria identified by 1987 Forest Plan (as amended)
- *SS Criteria*- Criteria used to qualify seral stages within the ERU
- *Estimated Existing Area*- Estimated percentage of area within the project area as this seral stage by ERU based upon existing conditions
- *Estimated Existing Acres*- Estimated acres within the project area as this seral stage by ERU based upon existing conditions
- *Target "20%"*- Amount of acres that would be needed to meet the "20%" target for Old Growth identified by the 1987 Forest Plan (as amended)

3 ENVIRONMENTAL CONSEQUENCES

3.1 ALTERNATIVE 1 (NO ACTION)

3.1.1 Summary

Under the No Action Alternative, current management plans would continue to guide management of the project area. No prescribed burning, vegetation and restoration treatments, or road maintenance, would be implemented to accomplish project goals within the project area, unless approved through a separate NEPA document and decision. Without implementing the treatments, forest conditions would continue to depart from desired conditions. The risk of fire with uncharacteristic fire severity and intensity would continue to increase within the project area. Forest structure would continue to transition into a homogenous state and would continue to be dominated by a single age class. Forests would lack the desired level of diversity in structure, species composition, and density. Forest susceptibility to insects and disease (e.g. bark beetles, defoliators, and mistletoe) would continue to increase. Ultimately, the landscape would not be moved toward desired conditions, and as such, the no action alternative would not meet the purpose and need for the project.

3.1.2 Direct and Indirect Effects of the No Action Alternative

It can reasonably be expected, given current trends of vegetation development and without the effects of disturbance (wildfire, insects, and disease), that all ERUs within the project area would continue to experience individual tree growth, establishment of regeneration, increases in stand densification (canopy cover and basal area), and increases in tree to tree competition. However, disturbance is a component of the ecosystems of the project area and risk of disturbance events may increase or decrease over time as conditions change. It is expected that late seral and shade tolerant species would continue the trend of becoming the dominant species within the ecosystems of the project area. In general, shade intolerant species; such as ponderosa pine, Southwestern white pine, and quaking aspen; would become less represented in stands which have become more dense, while shade tolerant species, such as true firs, become more dominant due to their ability to grow and develop in areas that are more shaded. Additionally, given the shade intolerance of Southwestern white pine and the continued pressure exerted by white pine blister rust, it can reasonably be expected that Southwestern white pine would continue to diminish within the project area. It is expected that frequent fire systems, such as the dry mixed conifer and ponderosa pine forests, would become more simple, structurally, on a landscape level (see modeled results of Tables 12 and 13) as stands trend towards a more homogeneous state and spatial pattern dissolves as stands trend towards similar sized trees of similar density. State and transition modeling indicates a trend of the other systems of the project area becoming more diverse over time. This is due to the impacts of disturbance agents (fire, insects, and disease) which is accounted for by the model. Catastrophic fire risk is expected to remain high for the frequent fire systems (see **Appendix B**). This is due to the uncharacteristically high loading of ground, canopy, and ladder fuels within the dry mixed conifer and ponderosa pine forest systems. This trend is likely to continue until fire is re-introduced upon the landscape in the form of wildfire (which has a strong possibility of being uncharacteristic in severity and intensity) and, once re-introduced, the result is likely to be a resetting of seral stages to the Early Seral Stage (i.e. stand replacing crown fire).

Overall health and vigor of forested stands are expected to diminish as stand stocking and resource competition increases. This is likely to result in impacts from disturbance agents such as drought, insects, and disease. Dwarf mistletoe, which is common in ponderosa pine and Douglas-fir, is likely to continue to slowly spread and is would continue to stress infected trees and increase susceptibility to other disturbance agents, such as drought and other insects and disease (Beatty and Mathiasen 2003, Geils et al. 2002, and Hadfield et al. 2000). The bark beetles of the project area are expected to continue to create an impact upon the landscape. That is, endemic populations would continue and outbreaks may become more common and larger in scale as tree vigor diminishes, resource based competition increases, and vegetative diversity diminishes (landscapes and ERUs become more homologous) (Randall 2010a and Kegley 2011). Defoliation of Douglas-fir tussock moth and Western spruce budworm are expected to continue the trend of periodic outbreak, especially given that susceptible/host trees (Douglas-fir, true fir, and spruce) are common to dominant upon the landscape (USDA 2011 and Pederson et al. 2011).

Given current trends related to individual tree and stand growth and development, it can reasonably be expected that Old Growth, large trees (≥20" DBH/DRC), and snags would increase. More specifically, until acted upon by an agent of disturbance, stands would grow more decadent and develop late-seral characteristics and individual trees would grow and, eventually, die (snag creation). State and transition models representing the No Action Alternative (Tables 10-15) show an overall increase in representation of late seral stages across forest and woodland ERU across the project area and indicate a likelihood, as modeled, that Old Growth may become dominant upon the landscape. This would represent a substantial reduction in diversity and resilient capacity as early seral species and structure become scarcer and threats to late seral species and structure (bark beetles, tussock moths, fire, and so on) become more substantial in terms of impact and intensity.

Overall, the No-Action Alternative is expected to promote conditions which are more prone to uncharacteristic disturbance events and patterns, diminishing health and vigor of trees and stands, increasing dominance and over-representation of late seral species and late seral stand conditions, the simplification of species compositions and spatial patterns, and the reduction of fire-adapted ecosystems upon the landscape. None of these conditions are in-line with the Purpose and Need of the SFMLRP and are not anticipated to contribute to a healthy, resilient, and properly functioning ecosystem.

Table 10. Modeled Trend of Seral Development- Spruce-Fir

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	7%	0%	0%	0%	0%	0%	0%
Aspen	21%	8%	13%	19%	24%	29%	32%
Early	18%	67%	53%	41%	32%	27%	24%
Mid	14%	23%	28%	27%	25%	22%	19%
Late	40%	1%	7%	13%	18%	22%	25%

Table 11. Modeled Trend of Seral Development- Mixed Conifer with Aspen

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	7%	0%	0%	0%	0%	0%	0%
Aspen	21%	0%	2%	4%	6%	8%	9%
Early	18%	75%	63%	57%	54%	51%	50%
Mid	14%	25%	30%	30%	29%	28%	27%
Late	40%	0%	5%	9%	11%	13%	14%

Table 12. Modeled Trend of Seral Development- Mixed Conifer- Frequent Fire

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub- Early	9%	1%	9%	14%	17%	19%	20%
Mid-Open	3%	0%	1%	1%	1%	0%	0%
Mid Closed	3%	47%	33%	24%	20%	17%	16%
Late-Open	60%	7%	7%	7%	8%	8%	9%
Late-Closed	25%	45%	51%	54%	55%	55%	55%

Table 13. Modeled Trend of Seral Development- Ponderosa Pine Forest

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub- Early	2%	13%	12%	10%	8%	6%	5%
Mid-Open	2%	1%	0%	0%	0%	0%	0%
Mid Closed	2%	41%	35%	29%	25%	21%	19%
Late-Open	82%	7%	3%	2%	2%	2%	2%
Late-Closed	12%	39%	50%	59%	66%	71%	75%

Table 14. Modeled Trend of Seral Development- Piñon-Juniper Grassland and Juniper Grassland

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	5%	0%	0%	0%	0%	1%	1%
Early-Open	25%	2%	12%	14%	12%	10%	8%
Early-Closed	10%	94%	55%	33%	20%	13%	9%
Late-Open	50%	0%	6%	17%	26%	35%	43%
Late-Closed	10%	3%	26%	37%	40%	41%	40%

Table 15. Modeled Trend of Seral Development- Piñon-Juniper Woodland

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	10%	0%	1%	2%	4%	5%	6%
Early-Open	5%	1%	3%	4%	4%	4%	4%
Early-Closed	15%	85%	67%	52%	40%	31%	25%
Late-Open	10%	1%	2%	4%	7%	9%	11%

Late-Closed	60%	13%	27%	38%	45%	50%	53%

3.2 ALTERNATIVE B (PROPOSED ACTION)

3.2.1 Summary

Under the Proposed Alternative, up to 18,000 acres would be treated by thinning and/or mastication and up to 38,000 acres would be treated by prescribed fire. These actions are intended to have two essential objectives: the reduction of fuel loadings; surface, ladder, and canopy; as well as the re-establishment of fire upon the landscape as a naturally occurring and desirable ecological process. Beyond these two, other vegetation-based objectives; such as ecological resilience, forest health, catastrophic wildfire risk reduction, and old growth promotion and retention; are to be met through the achievement of these primary two objectives.

Table 16. Proposed Area Treated by ERU

Ecological Response Unit	Acres within Project Area	Proposed Acres of Thinning or Mastication	Percentage Thinned or Masticated	Proposed Acres of Prescribed Fire	Percentage Burned
Mixed Conifer-Frequent Fire	17,875	7,500	42%	17,000	95%
Ponderosa Pine	17,347	6,500	37%	17,000	98%
Piñon-Juniper Group	8,660	4,000	46%	4,000	46%

3.2.2 Silvicultural Practices of the Proposed Action

The following treatments are proposed to be implemented under a "conditions-based" approach. These treatments may be used as "stand alone" treatments or in conjunction with other treatments described within this section in order to meet management objectives.

Silvicultural Prescriptions are to be written prior to treatment by a USFS Certified Silviculturist prior to treatment. These prescriptions will be written to meet Regional standards for silvicultural prescriptions.

3.2.2.1 Thinning

Thinning is defined as an intermediate treatment intended to reduce stand density in order to improve stand health and vigor, as well as to mitigate potential mortality (competition, insect, disease, and so on). For this project, thinning treatments would, generally, be applied to dense, overstocked stands in order to improve health and vigor as well as to reduce risk of non-characteristic fire behavior which may result in the application of prescribed fire treatments. The thinning treatments of this project would be applied as thinning from below (low thinning) and mastication. However, exceptions would be made with respect to retaining uneven-aged structure and desirable/preferred species. Thinning treatments

would utilize a “species preference” in order to target some species for removal while targeting others for retention. In general, early seral, shade intolerant, and/or fire resistant trees would be retained over late seral, shade tolerant, and/or fire intolerant tree species (please refer to Table 20 for species seral state and tolerance to shade and fire).

3.2.2.1.1 Thin from Below

Thinning treatments of the SFMLRP would be of the “thin from below” or “low thinning” variety. The objective of these treatments is the removal of smaller trees while retaining larger trees. A “diameter cap” has been assigned to this project. The implementation of this cap would limit the size of trees that can be removed by thinning activities. For “forest” tree species (ponderosa pine, white fir, and so on) a 16” DBH (diameter at breast height- 4.5’) diameter cap is to be applied. For “woodland” tree species (junipers, piñon pine, and so on) a 12” DRC (diameter at root collar) is to be applied. Depending upon existing conditions of stands, diameter caps may be lower for individual stands. That is, thinning objectives may be achieved without thinning to higher diameters in stands that are stocked with smaller trees or are more open. This is to be determined on a stand by stand basis, based upon stand diagnoses and silvicultural prescriptions.

Thinning activities are to be performed by hand (chainsaw) or mechanized harvest equipment (harvester, feller-buncher, and the like). Fuelwood is the only “forest product” intended for removal. Outside of the scope of fuelwood, other residual material produced from thinning would be left on site to be either piles (hand or machine) and burned, lopped and scattered, masticated, and/or broadcast burned. Determination of fuelwood availability, piling, redistribution, and mastication of thinned material and pre-existing surface fuels would be made on a site by site basis by Fuels Staff Officers and/or Certified Silviculturist.

3.2.2.1.2 Mastication

Similarly to the thin from below treatment, the intended purpose of the mastication treatment is the removal of smaller trees in order to reduce stocking, competition, and risk of non-characteristic fire behavior. Mastication treatments involve a mechanized piece of machinery, either rubber tired or track-based, with a mastication attachment (drum attached to the front end of a tractor, a mastication head attached to a boom of a harvester, or some other form of configuration) which would be used to masticate or grind standing trees targeted for removal. Masticated material would, generally, be 2-6” in size and beds of masticated material would be, typically, up to 4” deep. Depending upon existing down fuel loading within masticated stands, existing coarse woody material may be masticated. Mastication treatments are, generally, to be followed by broadcast burn treatments.

Diameter caps of 16” DBH and 12” DRC remain in effect, however, generally only material of 12” diameter or less would be masticated.

3.2.2.2 Prescribed Fire

Prescribed fire is a general term for management actions which apply fire in order to meet predetermined conditions on order to meet management objectives related to fuels or habitat improvement. This project includes the use of broadcast burning, jackpot burning, and pile burning.

3.2.2.2.1 Broadcast Burning

A broadcast burn is a controlled application of fire to remove fuels, under specified environmental conditions that allow fire to be confined to a predetermined area and produces the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

3.2.2.2.2 Pile Burning

Pile burning involves the construction of burns piles of woody debris (slash) for the purpose of burning in order to consume and reduce loading of hazardous woody fuels. These piles are made from the slash left after mechanical thinning or cutting of trees has occurred. Slash piles can, generally, range in size from 6'x6'x6' (length x width x height) for piles stacked by hand to 12'x12'x12' for piles created by machines (generally by dozer or excavator).

3.2.2.2.3 Jackpot Burn

A prescribed fire to deliberately burn natural or modified concentrations (jackpots) of wildland fuels under specified environmental conditions, which allows the fire to be confined to a predetermined area and produces the fireline intensity and rate of spread required to attain planned resource Management Objectives.

3.2.3 Conditions Based Management

Condition-based management is defined as: “a system of management practices based on implementation of specific design elements from a broader proposed action, where the design elements vary according to a range of on-the-ground conditions in order to meet intended outcomes”. In essence, certain management actions are to be applied, on the ground, to stands that meet certain pre-defined conditions (Tables 17 through 19). Please note that not all of these conditions need to be met in order for treatment to occur and treatments may not occur in stands in which these treatments are met. This is intended to be a general guide to quantify the types of stand conditions where treatments would be necessary in order to improve stand conditions and to meet objectives identified by the Purpose and Need.

Table 17. Stand Conditions Where Thinning Treatments May Be Considered

ERU	Basal Area*	Trees Per Acre*	Quadratic Mean Diameter*	Canopy Cover*	Canopy Base Height*
Mixed Conifer- Frequent Fire	>70 ft²/acre	>500	>6” DBH	>30%	<8’
Ponderosa Pine	>60 ft²/acre	>500	>6” DBH	>30%	<8’
Piñon-Juniper Types	>60 ft²/acre	>400	>7” DRC	>30%	<4’

**Stand conditions need not meet all above thresholds in order to be considered for treatment*

Table 18. Potential Treatments for Dry Mixed Conifer and Ponderosa Pine ERUs

Seral Stage	Dominant Tree Size Class	Canopy Cover Class	Potential Treatments
Grass, Forb, Shrub	0-4.9”	Any	Thinning and/or Prescribed Fire
Mid-Open	5-9.9”	10-29.9%	Prescribed Fire
Mid-Closed	5-9.9”	≥30%	Thinning and/or Prescribed Fire
Late-Open	≥10”	10-29.9%	Prescribed Fire
Late-Closed	≥10”	≥30%	Thinning and/or Prescribed Fire

Table 19. Potential Treatments for Piñon-Juniper Woodland and Grasslands and Juniper Grassland ERUs

Seral Stage	Dominant Tree Size Class	Canopy Cover Class	Potential Treatments
Grass, Forb, Shrub	N/A	<10%	Prescribed Fire
Early-Open	0-9.9”	10-29.9%	Prescribed Fire
Early-Closed	5-9.9”	≥30%	Thinning and/or Prescribed Fire
Late-Open	≥10”	10-29.9%	Prescribed Fire
Late-Closed	≥10”	≥30%	Thinning and/or Prescribed Fire

3.2.4 Direct and Indirect Effects of Proposed Action Alternative

The Proposed Action, as intended, has two essential objectives: the reduction of fuel loadings; surface, ladder, and canopy; as well as the re-establishment of fire upon the landscape as a naturally occurring and desirable ecological process. Other vegetation-based objectives; such as ecological resilience, forest health, catastrophic wildfire risk reduction, and old growth promotion and retention; are to be met through the achievement of these primary two objectives.

Thinning and mastication treatments (see **Silvicultural Actions of the Proposed Action**) are to be implemented as a precursor for the prescribed fire treatments, as necessary based upon stand conditions, in order to create conditions and fuel loadings that would allow for a more predictable and desirable post-fire condition. More specifically, prescribed fire would create conditions where fire can be more easily controlled and risk of high mortality would be minimized in areas where stand conditions are such that undesirable results are likely. Thinning and mastication treatments would remove ladder fuels and reduce canopy bulk density. Activity fuels, logs and limbs form thinned trees, would be piled (and burned when appropriate), lopped and scattered, or left in place (generally larger logs and masticated material). In addition to activity fuels, existing surface fuels may be piled (and burned), lopped and scattered, or masticated depending upon levels of existing surface fuels. Additionally, these treatments would utilize a species preference in order to target early seral, shade intolerant, and fire tolerant tree species for retention.

Following the necessary mechanical fuels treatments, prescribed fire may be applied with decreased risk of non-characteristic fire behavior (high severity and high intensity crown fire). Prescribed fire would include the burning of piles (as necessary), jackpot burning, and broadcast burning (see **Silvicultural Actions of the Proposed Action**). These treatments are intended to remove fuel load, modify species

composition, restore structural diversity, restore spatial pattern, and improve forest health. Fuel load removal is to be accomplished by way of combustion through the implementation of the various prescribed fire methods. The removal of fuels (surface, ladder, and canopy) by way of mastication, thinning, and prescribed fire would reduce the risk of uncharacteristic high intensity/severity fire within treated areas by removing the available fuel needed to carry the fire and to create high intensity flames (Agee and Skinner 2005).

The restoration of species diversity is to be achieved by way of species preference within the thinning phase as well as targeted mortality of tree species not tolerant of fire within the prescribed fire phase of active management. Some tree species, such as white fir, who have thrived in the era of fire exclusion would be more prone to fire induced mortality due to physical characteristics, such as thin bark (see Table 20). It can be expected that shade intolerant species would be, generally, more likely to regenerate in areas which are open or have been opened by active management activities, while shade intolerant species would be more likely to regenerate in areas which have retained closed canopies.

Table 20. Common Trees: Seral State, Shade and Fire Tolerance

Common Tree Species	Seral State	Shade Tolerance	Fire Tolerance
Colorado Blue Spruce	Early-Late	Intermediate	Intolerant
Corkbark Fir	Late	Tolerant	Intolerant
Douglas-fir	Early-Late	Intermediate	Tolerant
Engelmann Spruce	Early-Late	Tolerant	Intolerant
Limber Pine	Early-Late	Intolerant	Intermediate
One-seed Juniper	Early-Late	Intolerant	Tolerant
Two-Needle Piñon Pine	Early-Late	Intolerant	Intermediate
Ponderosa Pine	Early-Late	Intolerant	Tolerant
Quaking Aspen	Early	Intolerant	Tolerant
Rocky Mountain Juniper	Early-Late	Intolerant	Intolerant
Southwestern White Pine	Early-Late	Intolerant	Tolerant
White Fir	Late	Tolerant	Intolerant

The restoration of both structural diversity and spatial pattern would be achieved over time through the restoration of fire upon the landscape as an ecological process, i.e. repeated application of low intensity prescribed fire as well as natural fire which may or may not be managed in order to meet management objectives. With the application of prescribed fire, it is expected that there would be mortality. This mortality would largely affect small to medium sized trees of the understory and mid-story, but would also affect large trees and, occasionally patches or clumps of trees. The reduction of canopy cover, resulting from management activities is anticipated to have an effect on light intensity upon the forest floor, soil pH, soul depth, as well as litter depth and cover (Everson et al 1980). The creation of openings is critical for the establishment of shade intolerant regeneration, horizontal diversity (group/clump structure), and growth of herbaceous material. However, opening of the canopy may promote the growth and development of a shrub layer in the frequent fire forest types and woodlands. Follow-up prescribed burning, thinning, or other treatments may be required as adaptive management methods in order to mitigate this potential result.

Improvements in forest health is to be attained though thinning, mastication, and prescribed fire and maintained through the application of prescribed fire upon the frequent fire ecosystems of the project area. This includes the density control as well as the effects upon dwarf mistletoe. The re-introduction of frequent low severity fire is anticipated to create and maintain density and species composition more in line with conditions prior to fire exclusion. That is, lower overall stocking, an increase in the relative stocking of early seral species as compared to late seral species, as well as an increase in both horizontal and vertical diversity (more uneven-aged structure as well as groupy/clumpy spatial arrangement).

The decrease in stocking resulting from management activities is anticipated to reduce resource (water, nutrients, and light) competition among trees which would allow for improved resistance and resiliency from the impacts of agents such as bark beetles and defoliators (Kegley 2011, Livingston 2010, Pederson et al. 2011, Randall 2010a, Randall 2010b, Randall 2012). For example, healthier trees are more able to defend themselves from bark beetles, and more able to bounce back from defoliation events. Additionally, opportunities for the establishment of regeneration would promote resilience from change by allowing for the growth and development of the next generation or cohort of trees within stands. Additionally, prescribed fire has been documented to reduce dwarf mistletoe within treated stands. Heavily infested trees are less likely to survive application of prescribed fire and lightly to moderately infected trees are likely to experience reduction of infection through the heat and flames of prescribed fire on lower limbs (Conklin and Geils 2008). However, prescribed fire may stimulate certain forest pests. High incidence of scorch and fire-induced mortality can stimulate Douglas-fir bark beetle (Kegley 2011) and Western pine beetle (Randall 2010a). Additionally, fire effects may provide excessive environmental stressors on trees affected by defoliation which may increase effects; such as topkill, die-back, and mortality. Additional measures may be necessary in order to mitigate potential insect and disease issues resulting from treatments. These include the established slash management methods for management and monitoring for potential bark beetle infestation within burned areas. Details on these measures can be found within the **Project Design Feature** section of the **Environmental Assessment (EA)**.

The proposed action is not anticipated to have a substantial effect upon “Old Growth” (as defined by the Forest Plan) or large trees within the project area. The proposed action includes a “diameter cap” of 16” DBH for “forest species” and 12” DRC for “woodland species”. Given these limits, no large tree would be removed by thinning or mastication operations. However, there would likely be some impact from prescribed fire application. It is expected that these would be minor and any losses of large trees upon the landscape would likely be replaced by ingrowth from smaller trees over time. Similarly, the proposed action is not expected to have a substantial impact upon Old Growth. Areas managed for Old Growth are to be mapped and identified prior to implementation. Treatments may occur in these areas if the treatment would enhance the development of Old Growth characteristics in areas which are insufficient and are not to occur in areas with existing conditions that meet the Old Growth minimum criteria (see Table 9 and the **Consistency with Relevant Laws, Regulation, and Policy** section). Other Old Growth and wildlife key habitat features (large down logs and snags) may be impacted by the proposed action and would have project design features in place to ensure that management action do not reduce populations below minimum thresholds. Impacts on large down logs and snags from prescribed fire activities can be unpredictable; however, Large logs and snags would be retained and not cut or targeted for ignition or piling (except where they pose a safety concern). Felled hazard trees or snags would remain on site to contribute to large downed wood debris habitat. If the desired number of snags per acre is not available for retention, snag creation would be considered, through methods such as

girdling or through prescribed fire. (see **Project Design Feature** section of the **Environmental Assessment**).

Overall, the Proposed Action, as designed, would either produce the desired vegetation-based conditions or move conditions toward meeting desired vegetation-based conditions. Treatments would: allow for the safe application of prescribed fire, reduced the risk of catastrophic wildfire in historically frequent fire ecosystems, improve forest health by re-establishing diversity and reduction of tree to tree resource completion; and restore more diversity in terms of species composition, seral states, and spatial distribution within the frequent fire ecosystems of the project area.

3.2.4.1 Modeled Effects of Action- Landscape Scale

The following Tables (21 through 24) are the modeled results (ERU based State and Transition Model) of the Proposed Action by Seral Stage. These results are provided to indicate trends seral stage development and are not intended to be exact results. The results indicate a general move towards desired conditions over time within the treated ERU areas. It should be noted that the Mixed Conifer-Frequent Fire and Ponderosa Pine ERU experience multiple applications of prescribed fire through the 50-year planning horizon while the piñon-juniper only experience a single application of prescribed fire.

Table 21. Modeled Trend of Seral Development- Mixed Conifer- Frequent Fire

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub- Early	9%	1%	21%	25%	26%	26%	25%
Mid-Open	3%	0%	3%	2%	2%	2%	2%
Mid Closed	3%	47%	9%	6%	7%	7%	6%
Late-Open	60%	7%	47%	48%	46%	46%	47%
Late-Closed	25%	45%	21%	19%	20%	20%	20%

Table 22. Modeled Trend of Seral Development- Ponderosa Pine Forest

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub- Early	2%	13%	14%	16%	17%	16%	16%
Mid-Open	2%	1%	1%	1%	1%	1%	1%
Mid Closed	2%	41%	20%	14%	12%	12%	11%
Late-Open	82%	7%	23%	26%	27%	29%	30%
Late-Closed	12%	39%	41%	42%	43%	42%	42%

Table 23. Modeled Trend of Seral Development- Piñon-Juniper Grassland and Juniper Grassland

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	5%	0%	9%	16%	19%	20%	22%
Early-Open	25%	2%	11%	13%	11%	9%	7%
Early-Closed	10%	94%	49%	26%	15%	9%	6%
Late-Open	50%	0%	7%	17%	25%	31%	37%
Late-Closed	10%	3%	23%	30%	30%	29%	27%

Table 24. Modeled Trend of Seral Development- Piñon-Juniper Woodland

Seral Stage	Desired	Current	Year 10	Year 20	Year 30	Year 40	Year 50
Grass, Forb, Shrub	10%	0%	37%	42%	34%	27%	22%
Early-Open	5%	1%	19%	16%	14%	12%	10%
Early-Closed	15%	85%	26%	17%	18%	18%	18%
Late-Open	10%	1%	7%	13%	18%	20%	22%
Late-Closed	60%	13%	11%	12%	18%	23%	28%

3.2.4.2 Modeled Effects of Action- Fine/Mid-Scale

Forest and woodland stands of the ERU proposed for treatment were modeled in FVS, as part of the analysis process, to provide insight into the anticipated developmental trends related to the effects of the No Action and Proposed Action Alternatives within the project area. A summary of these results is found in **Appendix A** of this report.

The treated ERUs share very similar results, in terms of trends, as related to the anticipated effects of the proposed action. Basal area and canopy cover of the stands which are both thinned/masticated and treated with prescribed fire (closed canopy stands) are anticipated to substantially decrease while experiencing a minor to moderate decrease in stands that are only burned ("Late-Open" stands). Canopy base height, crowning and torching Index are anticipated to substantially increase, in general, from treatments in closed canopy stands and to experience a minor to moderate increase in open stands that are only treated by prescribed fire. Conversely, total flame lengths are anticipated to substantially decrease in these stands. "Late-Open" seral stands are anticipated to experience an increase to crowning index relative to the amount of canopy cover being reduced from mechanical thinning/mastication. This is likely an effect of the 16" diameter cap policy that is a component of the proposed action, i.e. reduction of risk of crown fire cannot be substantially reduced without removing larger trees.

Table 25. Anticipated Impacts from Proposed Treatments Relative to No Action

Ecological Response Unit	Seral State	Basal Area*	Canopy Cover*	Total Flame Length*	Crowning Index*	Torching Index*	Canopy Base Height*
Mixed Conifer-Frequent Fire	Mid-Closed	↓	↓	↓	↑	↑	↑
	Late-Open	-	-	-	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑
Ponderosa Pine Forest	Mid-Closed	↓	↓	↓	↑	↑	↑
	Late-Open	-	-	-	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑
Piñon-Juniper	Early-Open	↓	↓	↓	↑	↑	↑
	Early-Closed	↓	↓	↓	↑	↑	↑
	Late-Closed	↓	↓	↓	↑	↑	↑

* Key: Major Decrease (↓), Major Increase (↑), Minor Decrease (↓), Minor Increase (↑), No Substantial Change (-)

Over a 20 year period following initial implementation, if there is a >40% change in quantified metric there is a major change, if there is a 10-39.9% change in quantified metric there is a minor change, if there is a <10% change in quantified metric there is a no substantial change.

3.2.5 Effects of Proposed Forest Plan Amendments

The proposed Forest Plan amendments are related to the potential vegetation treatments within MSO PACs, the adoption of aspects of the 2012 MSO recovery plan, clarification of breeding season activity restrictions, and clarification of the need for interspaces related to the Northern goshawk habitat. The proposed forest plan amendments related vegetation treatments within MSO PACs are anticipated to have a positive effect on the effectiveness of the proposed action with respect to vegetation ecology. More specifically, the allowance of removal of trees greater than 9" DBH within PACs would allow for greater flexibility, on a site-specific basis, to restore desired stand characteristics such as species composition, structure, and health/vigor. This will subsequently have a positive effect upon spatial pattern, resilience to agents of disturbance (insects/disease/fire), as well as the diversity of seral stages on a landscape level. The amendments that adopt aspects of the 2012 MSO recovery plan, such as language and terminology, are not anticipated to have an impact on the effectiveness of the proposed action with respect to vegetation ecology. These changes are for the purpose of adopting the most recent guidance related to species recovery and would not have an impact upon the proposed treatments. The amendment which adds clarification to activity restriction during MSO breeding seasons is anticipated to have a positive impact on the effectiveness of the proposed action with respect to vegetation ecology. More specifically, treatments would be permitted if "non-breeding" is confirmed or inferred. This would allow for the potential for treatments in "non-breeding" PACs to occur more efficiently. The amendment which adds clarification the need for interspaces for Northern goshawk habitat is not anticipated to have an impact upon the effectiveness of the proposed action with respect to vegetation ecology. More specifically, this amendment reflects the adoption of the most Northern goshawk recovery guidelines and would not have an impact upon the proposed treatments.

3.2.6 Cumulative Effects

The following table (Table 26) is a summary of anticipated Cumulative Effects of the proposed action in relation to other actions and activities; previous, present, and future. This table only depicts the interactions related to upland vegetation.

Table 26. Actions that May Have Cumulative Impacts to Resources within the Study Area

Action	Summary of Action	Cumulative Effects Related to Vegetation/Silviculture
Pacheco Canyon Forest Resilience Project	The scope of the project is to thin and use prescribe fire on approximately 2,042 acres northeast of the City of Santa Fe, near several popular recreation sites, including the Big Tesuque Campground, Aspen Vista Picnic Area, and the Santa Fe Ski Basin. Tesuque Pueblo lands are within and northeast of the project area. The purpose of the project is to change stand conditions in predominantly ponderosa pine forests in the Pacheco Canyon area. The actions proposed to accomplish this change would be thinning and burning about 2,042 acres. Decision signed on June 1, 2018.	The implementation of this action along with the SFMLRP proposed action would increase the amount of area moving towards a state of desired conditions upon the Santa Fe National Forest.
La Cueva Fuelbreak Project	The purpose of the project is to change fire behavior in treated areas to reduce the risk of a large-scale, high intensity wildfire spreading to or from the communities of La Cueva, Dalton Canyon, and the Santa Fe Watershed. This project proposes creation of a shaded fuelbreak by thinning 995 acres and conducting prescribed burns (pile and broadcast burning) on approximately 1,100 acres. Decision signed on February 4, 2005	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
County Line Fuel Wood Treatments	The purpose of the project is to improve forest health and wildlife habitat through a combination of thinning and prescribed burning across approximately 900 acres on Borrego Mesa. Decision signed on August 6, 2010	The implementation of this action along with the SFMLRP proposed action would increase the amount of area moving towards a state of desired conditions upon the Santa Fe National Forest.
Southern Rowe Mesa Restoration Project	The purpose of this project is to promote a mosaic of healthy forest stands and natural grasslands through thinning and prescribed burning activities on approximately 17,500 acres on Rowe Mesa. Decision signed on February 21, 2013.	The implementation of this action along with the SFMLRP proposed action would increase the amount of area moving towards a state of desired conditions upon the Santa Fe National Forest.
Hyde Park Wildland Urban Interface Project	The scope of the project is to thin and use prescribe fire on up to 1,840 acres. The project area is dominated by dense stands of ponderosa pine forests with a lesser component of mixed conifer and pinon-juniper. The project area is located in forests east of the community of Hyde Park Estates, near Hyde Memorial State Park, and adjacent to Black Canyon campground. The purpose of this project is to reduce the risk of uncharacteristic, stand-replacing wildfire and reduce the risk for insect and disease related tree mortality within the project area. Decision signed on March 21, 2018.	The implementation of this action along with the SFMLRP proposed action would increase the amount of area moving towards a state of desired conditions upon the Santa Fe National Forest.

Santa Fe Municipal Watershed	The scope of the project is to use a combination of tree thinning and prescribed burning on up to 7,270 acres of national forest and city lands in the Santa Fe Municipal Watershed. The proposal is designed to reduce the risk of a severe crown fire and to restore sustainable forest and watershed conditions in the Watershed. Record of Decision signed in October 2001.	The implementation of this action along with he SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
Santa Fe Municipal Watershed Pecos Wilderness Prescribed Burn Project	The project proposes to perform prescribed burns of between 200 and 2,100 acres at one time in ponderosa pine and mixed conifer stands within an approximately 2,900-acre, mid elevation (8,500 – 10,000 ft) treatment area within the Pecos Wilderness. Decision signed on April 28, 2015.	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
Rowe Mesa II (U.S. Forest Service n.d.)	Fuel treatment to promote a mosaic of healthy forests stands and natural grasslands by thinning and prescribed burning in pinon/juniper, and ponderosa pine trees that have encroached into the understory of woodlands and into meadows of Rowe Mesa. Project initiation 12/19/2018; expected implementation 4/2020.	The implementation of this action along with the SFMLRP proposed action would increase the amount of area moving towards a state of desired conditions upon the Santa Fe National Forest.
Century Link/PNM Santa Fe to Los Alamos Fiber Optic Project (U.S. Forest Service n.d.)	Proposal to bury a fiber optic line along Forest Road 24 on Santa Fe National Forest land to a PNM transmission line where it will be carried to DOE facilities to improve service to Los Alamos National Lab and Los Alamos community. Notice of initiation 10/1/2018.	This is not anticipated to have an effect upon the upland vegetation of the project area.
Issuance of Forest-wide Temporary and Priority Special Use Permits (SUPs) for Non-Motorized Over-Snow Activities (U.S. Forest Service n.d.)	Proposal to approve issuance of temporary and priority SUPs for outfitter and guides throughout the Santa Fe National Forest to conduct guided recreation activities related to over-snow uses, including but not limited to cross country skiing and snow shoeing. Notice of initiation 12/1/2019.	This is not anticipated to have an effect upon the upland vegetation of the project area.
Rio Chama Aquatic and Wetland Habitat Restoration Project (U.S. Forest Service n.d.)	Species habitat improvement project to increase diversity and quality of aquatic habitat for fish and invertebrates in Rio Chama downstream from Abiquiu Dam approximately 5.6 miles between Santa Fe and Carson National Forests to point 1.34 miles upstream of Highway 84 bridge. Notice of initiation 10/1/2019; expected implementation 4/2020.	This is not anticipated to have an effect upon the upland vegetation of the project area.
Comexico Jones Hill Exploration (U.S. Forest Service n.d.)	Exploratory drilling operation on unpatented mining claims in Pecos/Las Vegas Ranger District of SFNF. Proposal will cause approximately 5-7 acres of surface disturbance in an area that has been previously disturbed by earlier exploration date. All activities will occur within 1 year of the state date.	This is not anticipated to have an effect upon the upland vegetation of the project area.

	Scoping was conducted in December 2019; expected implementation 10/2020.	
Pecos Bike Trails (U.S. Forest Service n.d.)	Project to develop trail system and impress access and promote visitor safety in Canada de Los Alamos/Glorieta area. Notice of initiation 11/1/2019; expected implementation 2/2020.	This is not anticipated to have an effect upon the upland vegetation of the project area.
Pecos Rio Grande Cutthroat (RGCT) Trout Restoration (U.S. Forest Service n.d.)	Project to restore RGCT populations to Willow Creek and upper Cow Creek by adding 9 miles of stream to currently occupied distribution. Scoping occurred February 2019.	This is not anticipated to have an effect upon the upland vegetation of the project area.
Non-Forest Service Projects		
Aztec Springs, Phase 2 & 3 (City of Santa Fe, The Nature Conservancy, New Mexico State Forestry)	150 acres of thinning, piling, and prescribed burning activities.	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
Aspen Ranch (Pueblo of Tesuque)	160 acres of thinning, piling, and prescribed burning activities in ponderosa pine and mixed conifer.	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
Vigil Grant (Pueblo of Tesuque)	158 acres of thinning, piling, and prescribed burning activities in ponderosa pine and mixed conifer.	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
Hyde Memorial State Park (New Mexico State Forestry)	Thinning, piling, and prescribed burning across 276 acres in Hyde Memorial State Park.	The implementation of this action along with the SFMLRP proposed action would create a synergistic effect with respect to reducing risk of severe and uncharacteristic fire upon the landscape and wildland urban interfaces.
City of Santa Fe Planned Communities and Infrastructure Projects	Three master planned communities that is projected to absorb most of Santa Fe's growth through 2030 • Tierra Contenta Master Plan (1995) approved as many as 5,200 housing units and to date is 50% completed with up to 2,500 homes and apartment units completed. The western portion of Phase 2 and Phase 3 await construction and includes 400 acres of developable land and 100 acres of open space/parks. • Las Soleras Master Plan (2008) covers 400 acres with most of the land along I-25 slated for commercial and mixed use. Internal portion of master plan are reserved for residential units which could be developed with 1,000-1,500 housing units.	This is not anticipated to have an effect upon the upland vegetation of the project area.

	• Northwest Quadrant (2010) covers approximately 160 acres of 2,000 acres the city owns in the northwest corner of the city. The Master Plan calls for 750 housing units to the southeast of Highway NM 599. Roadway improvements, trails and urban mixed use and parks (Southwest Activity Node, Las Soleras Park, and South Meadows Park) (City of Santa Fe 2017). Multiple drainage projects are proposed by City of Santa Fe in Council Districts 1, 2, 3, and 4 to be completed in three phases between 2019 and 2022 (City of Santa Fe n.d.).	
Santa Fe River Greenway R&PP Lease Project	EA (released 11/21/19) for the conveyance of 23.5 acres of BLM-administered public lands to Santa Fe County under the Recreation and Public Purpose Act (R&PP) for the construction and maintenance of a short segment of the greenway and for bank stabilization of the Santa Fe River. The proposed project will create a greenway of public parks and multi-use recreational trails along the Santa Fe River from Two-mile Reservoir in eastern Santa Fe west to the Santa Fe County wastewater treatment plant, which is located just west of New Mexico Highway 599 (BLM 2019a).	This is not anticipated to have an effect upon the upland vegetation of the project area.

Note: Projects that are listed as on hold in the January 2020 through March 2020 Schedule of Proposed Action (SOPA) were not included in this table.

4 CONSISTENCY WITH RELEVANT LAWS, REGULATIONS, AND POLICY

4.1 LAND AND RESOURCE MANAGEMENT PLAN (FOREST PLAN)

The current Forest Plan was originally signed in 1987 and has been amended. Periodically, up until 2010. This Forest Plan will remain in effect until replaced by the Revised Forest Plan. This Plan is currently in draft and may be "signed" prior to the "signing" of the SFMLRP. If not, the policies and guidance of the 1987 plan, as amended, would be utilized for this project.

4.1.1 Forest-Wide Direction

4.1.1.1 Timber management

LRMP, Page 20.

> *Utilize integrated stand management on all forested lands identified as suitable for commercial timber production. Timber management planning activities will integrate considerations for water quality, soil productivity, economics, site productivity, visual quality and any other resource value that is appropriate to the area being considered for harvest or salvage activities.*

Project uses interdisciplinary approach in the analysis/planning phase.

> *Apply integrated stand management not only to sawtimber harvest, but also to forest product harvest (small dimension material, vigas, latillas, Christmas trees, and posts), timber stand improvement, and reforestation activities.*

Project uses interdisciplinary approach in the analysis/planning phase.

> *Utilize small sales to sanitize stands and salvage timber. These sales will be targeted for the smaller logging and manufacturing interests in local communities.*

Treatments would be used to sanitize stands as allowable give the scope of the project. Commercial treatments are not part of this project.

> *Develop a sustained yield program for firewood and implement it through integrated stand management. Shift program emphasis away from the use of green pinyon as the primary firewood. Allow harvest of green pinyon only within the productive capabilities of the species. Emphasize logging slash and other down materials to meet the demand for firewood.*

Removal of forest products for public use may be considered during implementation phase as long as implementation of collection practices do not oppose findings and parameters of the planning process.

LRMP, Page 68, E00

> Review classification of forest and woodland inventories as part of project planning.
>
> Maintain a stand database for forest and woodlands utilizing compartment exams, project activity records, and woodland inventories as the basis for providing a continuous forest inventory.

Integrated resource management would be used for planning all timber related activities. These activities include timber sales, firewood removal, thinning, salvage sales, reforestation, and sanitation projects.

Forest utilizes NRM databases to store documentation/records of activities and stand exams (FACTs and FSVeg).

LRMP, Page 68, E03

Complete compartment stand examinations to regional standards to provide data for detailed stand prescriptions and to monitor plan results. Stand sizes should range from 10 acres to 100 acres with the preferred size being 20-80 acres. Exceptions would be in areas of little anticipated activity, to meet other resource needs, or where inventoried as large, truly homogeneous stands. Exceptions will be reviewed by the appropriate line officer before the environmental analysis is complete.

Forest utilizes NRM databases to store documentation/records of activities and stand exams (FACTs and FSVeg).

4.1.1.2 Silvicultural Direction

LRMP, Pages 94-95, P34 E03

Stands will have residual stocking in at least three canopy levels. These canopies will include a component of seedlings and saplings; a component of poles and small saw timber; and a component of mature and over mature saw timber.

Silvicultural treatments will leave sound snags (10"+ DBH). Manage for 220 natural snags per 100 acres on a minimum of 40% of the ecosystem area with emphasis on peripheral edges of openings. Areas unavailable for harvest are considered as part of the 40% as long as good spatial distribution is maintained. Additional criteria for snags are:

1. Unmerchantable trees selected for snag recruitment will be due to dead or broken tops, heart rot and lightning strikes and not primarily due to poor genetics.

2. Leave dwarf mistletoe free unmerchantable trees for snag recruitment and all existing snags 10" d.b.h. and above except those to be removed for public safety or fire management.

3. If unmerchantable trees are not available, then merchantable trees may be considered for snag or recruitment.

Leave at least one group of turkey roost trees per 160 acres in Ponderosa pine and mixed conifer type if stands providing suitable habitat are not available. Ideally, roosting habitat should have southerly to easterly exposures and be within one mile of water. Timber activities in turkey nesting areas will be coordinated to minimize impacts between April 20 and June 10.

Stands within 200 ft. of canyon rims in Peregrine falcon feeding zones will receive uneven age, deferral, or other silvicultural treatment which enhances this key habitat and its features.

Adequate cover status should be maintained within 8 chains (530 feet) of actively used elk wallows, licks, and seeps. The area surrounding this feature will be managed as an uneven aged stand which provides cover over time.

Accessible unutilized cull material and slash over 3" in diameter should be made available for firewood for up to two years after timber harvests except as prescribed to meet other resource needs. Direct the public to areas to be cleaned up. Design road systems to accommodate the post-harvest use by the public. Use road management to restrict use periods as needed for resource protection.

Openings created through harvest of timber or firewood will not exceed 40 acres in size, except with regional approval to meet resource objectives. Definitions of created openings by species are found in the "Regional Guide for the Southwestern Region" on pages 3-12 through 3-17. The guide also sets standards for minimum width between openings, maximum distance to hiding cover from openings, and defines when created openings are no longer considered to be openings. The Santa Fe National Forest will maintain the standards established in the Regional Guide.

Forest products such as Christmas trees, posts, poles, and vigas will be available if removal complements other resource objectives for the management area.

Factored into treatment development and monitoring plan

4.1.1.3 Insect and Disease Management

LRMP, Page 22.

Through integrated pest management (I.P.M.), manage affected forest resources to minimize the likelihood of unacceptable outbreak conditions of insects and diseases.

Proposed treatments are designed in order to improve stand resilience and to improve forest health.

Reduce the potential effects of common pests such as dwarf mistletoe and Western Spruce Budworm through sound silvicultural treatments.

Proposed treatments are designed in order to improve stand resilience and to improve forest health.

Give priority to early detection and management of stands highly susceptible to infection or infestation.

Proposed treatments are designed in order to improve stand resilience and to improve forest health.

LRMP, Page 97, P34 P39 E03

Actively inform and involve the public in all work dealing with forest insects or diseases that are, or may become areas of public concern. Conduct annual surveys to detect important insects and diseases. Supplement surveys by training field-going personnel to recognize insects and diseases, to understand the role these organisms play in forest ecosystems, and the importance of early detection. When conditions warrant, conduct evaluations designed to develop alternatives to prevent or reduce damage to acceptable levels.

Factored into treatment development and monitoring plan

4.1.1.4 Visuals

LRMP, Page 57.

> *Ponderosa Pine/Mixed Conifer, <40% slope (even-aged): Maintain inherent scenic values, enhance viewing opportunities & increase variety where appropriate. Achieve a VQO of retention on seen areas of the viewshed. Maintain and enhance old growth stands and characteristics. Maintain 25-40 trees per acre with an average diameter of at least 20", in clumps, for as long as possible. This should include at least 3 trees per acre in the 32" size.*

Areas of VQO are to be identified prior to implementation activities. Thinning activities would only take place within the confines of the “diameter cap” (<16” forest species and <12” woodland species).

> *Ponderosa Pine/Mixed Conifer/Spruce-Fir, <40% slope (uneven-aged): Maintain inherent scenic values, enhance viewing opportunities & increase variety where appropriate. Achieve a VQO of retention on seen areas of the viewshed. Maintain and enhance old growth stands and characteristics. Strive for stands with at least 3 age classes present, intermixed.*

Areas of VQO are to be identified prior to implementation activities. Areas treated by thinning activities may not exhibit uneven-aged structure due to low thinning practices. Implementation of low thinning for the purpose of reducing risk torching from fire within stands.

> *Ponderosa Pine/Mixed Conifer, >40% slope: Maintain inherent scenic values, enhance viewing opportunities & increase variety where appropriate. Achieve a VQO of retention on seen areas of the viewshed. Maintain and enhance old growth stands and characteristics. Maintain 25-40 trees per acre with an average diameter of at least 20", in clumps, for as long as possible. This should include at least 3 trees per acre in the 32" size.*

Areas of VQO are to be identified prior to implementation activities. Thinning activities would only take place within the confines of the “diameter cap” (<16” forest species and <12” woodland species).

4.1.1.5 Old Growth

Summary of Old Growth Management Direction form LRMP, Pages 68-69A.

> *Allocate no less than 20% of each forested ecosystem management are to old growth.*
>
> *Manage old growth in patterns that provide for a flow of functions and interactions at multiple scales across the landscape through time.*
>
> *All analyses should be at multiple scales- one above and one below the ecosystem management areas. The amount of old growth can be provided and maintained will be evaluated at the ecosystem management area level and based on forest type, site capability, and disturbance regimes.*
>
> *Seek to develop and maintain flow of 20% old growth by forested area by forest type in any landscape.*
>
> *Use pre-settlement conditions at appropriate scales when considering importance of various factors.*

Consider effects of spatial arrangement on old growth function; including groups, landscapes, goshawk nest sites, Mexican spotted owl PAC, wilderness, RNA, and other areas managed for old growth function.

Use appropriate scale when managing for old growth.

Use qualitative models at appropriate scales.

Thinning is permitted in stands being management for old growth when the result will enhance the attainment of old growth characteristics. No treatment should occur in a stand managed for old growth once the stand has achieved minimum structural characteristics used to define old growth.

Old Growth Standards and Guidelines were considered and factored in the development of this project and are to be carried out through implementation. Please refer to the **Old Growth** portion of this report for more information/detail.

4.1.2 Management Area Direction

Table 27. Management Areas within Project Area

Management Area	Definition	Acres
A	Timber/Wildlife	2,461
D	Recreation/Visual/Timber	11,094
E	Dispersed Recreation/Visual/Timber	14,220
G	Wildlife/Range/Firewood	14
H	Wilderness	12
H/O	SFWS & Wilderness	12
L	Semi-Primitive Non-Motorized Recreation	20,738
O	Quality Water Production	1,951

4.1.2.1 Management Area A Direction

LRMP, Page 100, E06 E07

All timber management activities will be planned and implemented to avoid or properly mitigate any disturbance to any known archeological sites.

Archeological sites are to be identified prior to treatment and excluded as necessary as advised by Heritage Staff Officer.

4.1.2.2 Management Area D Direction

LRMP, Page 115, E00

Timber harvesting will be coordinated with an approved Viewshed Corridor Plan. Harvesting activities and slash disposal work will be designed to achieve VQO standards of Retention.

Areas of concern for Viewshed are to be identified prior to implementation by Viewshed Coordinator. Implementation of treatment would be in accordance to the standards proposed by Viewshed Corridor Plan.

LRMP, Page 115, E01

> *Manage timber stands under uneven-aged or extended rotation even-aged systems to provide or retain visual diversity and benefit non-game species*
>
> *Created openings will not have linear openings In excess of 300 feet/mile along each side of sensitivity level 1 roads and trails.*
>
> *Regenerate aspen by patch cutting for wildlife and visual diversity as stands become decadent or as natural succession replaces them with conifers. Manage for a minimum of 5% aspen in timber component where feasible.*
>
> *Locate decks and landings outside of the immediate foreground zone whenever feasible. Restore visible landings to original or characteristic contours and revegetate within one year of project completion.*

Proposed treatments do not qualify as a "Timber Sale" treatments. No decks or landings are to be produced.

LRMP, Page 115, E05

> *Timber stand improvement projects will be designed to provide for a variety of tree sizes and densities in project areas which will create or maintain visual variety as well as improving growing conditions.*

Factored into treatment design.

4.1.2.3 Management Area E Direction

LRMP, Page 119, E00

> *Timber emphasis will be to treat stands to provide a uniform age class distribution, including old growth and uneven-aged. Priority for treatment will be:*
>
> *1. Sanitation and salvage*
>
> *2. Insect and disease management*
>
> *3. Regeneration of mature and overmature stands with high site index values.*

Factored into treatment design within scope of project.

LRMP, Page 119, E05

> *Timber stand improvement projects will be designed to provide for a variety of tree sizes and densities in project areas which will create or maintain visual variety as well as improving growing conditions.*

Factored into treatment design.

LRMP, Page 119, E06 E07

> *Timber sales will be prepared and harvested to maintain or enhance visual variety and achieve VQO standards for retention and/or partial retention.*

Not a “timber” project. However, areas where VQO is an issue are to be identified prior to implementation and specific treatment design should factor VQO issues.

4.2 Other Relevant Law, Regulations, or Policy

No other relevant law, regulation, or policy has been identified at the time of the completion of this report.

5 CONCLUSION

The Proposed Action addresses the issues and objectives of the Purpose and Need in a superior manner than the No Action Alternative. If the No Action Alternative were to be implemented, it can reasonably be expected that vegetation based trends form recent history would continue, i.e. increasing fuel loading, diminishing forest health and vigor, increasing impacts of insects and disease, increasing resource based competition and mortality, as well as a simplification of forest structure and species composition. The Proposed Action can be reasonably expected to either meet or move conditions closer towards meeting the silviculturally-based objectives set forth by the Purpose and Need. Namely these include restoration of species composition and spatial patters with the objective of improvement of ecological function, re-establishment of fire as an ecological component upon the landscape, and reduced risk on uncharacteristic fire.

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7 APPENDICES

7.1 APPENDIX A: SUMMARY OF STAND LEVEL MODELING- FVS

7.1.1 Vegetation Data Definitions

Table 28. Measurements and Definitions Utilized by FVS Modeling

Measurement	Abbreviation	Unit	Description
Basal Area	BA	Ft^2/acre	Horizontal surface area occupied by boles of trees at 4.5' per acre
Trees per Acre	TPA	Count	Count of number of trees per acre, all sizes
Trees per Acre, Less than 5" Diameter	TPA <5"	Count	Count of number of trees per acre, less than 5" diameter
Trees per Acre, 5"-9.9" diameter	TPA 5-10"	Count	Count of number of trees per acre, 5"-9.9"
Trees per Acre, 10-19.9" Diameter	TPA 10-20"	Count	Count of number of trees per acre, 10"-19.9"
Trees per Acre, 20" Diameter and Greater	TPA >20"	Count	Count of number of trees per acre, 20" diameter and greater
Quadratic Mean Diameter	QMD	Inches	Diameter corresponding to the mean basal area, QMD=(BA/(TPA*0.005454))^½
Quadratic Mead Diameter, Greater than 5" Diameter	QMD >5"	Inches	Diameter of trees, 5" diameter or more, corresponding to the mean basal area, QMD=(BA/(TPA≥5"*0.005454))^½
Canopy Cover	CC	Percent	Percentage of surface area of the stand directly covered by tree crowns

7.1.2 Mixed Conifer- Frequent Fire

Table 29. Average Model Results- Mid-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	166	166	186	88	203	102	217	96	226	93	232	102
TPA	1206	1206	1162	324	1129	492	1088	341	1044	298	995	466
TPA <5"	853	853	786	210	763	380	726	254	692	226	653	396
TPA 5-10"	287	287	290	45	258	30	229	12	201	4	182	3
TPA 10-20"	65	65	84	67	104	78	129	70	145	61	153	57
TPA >20"	2	2	3	3	4	4	4	5	6	6	7	9
QMD	5	5	6	7	6	6	6	7	6	8	7	6
QMD >5"	9	9	9	12	10	13	10	14	11	16	11	17
CC	65	65	68	34	70	38	70	33	70	30	69	32

Table 30. Average Model Results- Late-Open Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	59	59	66	60	73	66	78	64	84	63	89	67
TPA	115	115	171	237	226	407	279	280	329	254	378	424
TPA <5"	66	66	124	195	181	368	236	248	289	225	331	397
TPA 5-10"	7	7	5	3	3	2	2	0	2	0	11	0
TPA 10-20"	38	38	36	32	32	29	29	22	25	16	20	12
TPA >20"	4	4	7	6	9	9	12	10	14	12	16	15
QMD	11	11	9	7	8	5	7	6	7	7	7	5
QMD >5"	15	15	16	16	17	18	18	19	19	20	19	21
CC	21	21	23	21	25	24	27	21	30	20	32	23

Table 31. Average Model Result: Late-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	217	217	230	144	239	157	244	150	248	145	250	153
TPA	1269	1269	1219	341	1153	510	1068	346	1005	304	959	473
TPA <5"	988	988	936	233	875	404	808	258	764	228	730	399
TPA 5-10"	143	143	138	12	129	7	110	3	95	1	85	1
TPA 10-20"	129	129	133	84	135	84	133	67	126	53	119	45
TPA >20"	9	9	12	12	15	15	17	18	20	22	25	28
QMD	6	6	7	9	7	8	7	9	7	9	7	8
QMD >5"	12	12	12	16	12	16	13	18	14	19	14	19
CC	66	66	68	43	68	45	67	40	66	38	65	38

7.1.3 Ponderosa Pine Forests

Table 32. Average Model Results: Mid-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	150	150	172	76	189	89	204	83	213	83	217	92
TPA	1025	1025	1007	277	988	445	974	316	946	279	907	447
TPA <5"	695	695	663	185	646	356	633	249	617	222	596	391
TPA 5-10"	271	271	259	25	231	9	203	2	177	1	157	2
TPA 10-20"	57	57	83	65	109	77	136	61	148	51	148	45
TPA >20"	2	2	2	2	3	3	3	4	5	6	5	8
QMD	5	5	6	7	6	6	6	7	7	7	7	6
QMD >5"	9	9	9	12	10	14	10	15	11	16	11	17
CC	61	61	64	29	65	33	66	29	66	27	65	30

Table 33. Average Model Results: Late-Open Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	61	61	69	63	75	69	81	68	86	68	91	72
TPA	74	74	131	223	188	393	242	277	295	251	347	421
TPA <5"	27	27	86	183	144	355	201	244	255	222	302	393
TPA 5-10"	5	5	3	2	1	1	0	0	2	0	8	0
TPA 10-20"	38	38	35	31	31	28	27	21	23	15	18	11
TPA >20"	4	4	8	7	11	10	14	12	16	14	18	16
QMD	13	13	10	7	9	6	8	7	7	7	7	6
QMD >5"	16	16	17	17	18	18	19	19	19	21	19	22
CC	21	21	23	21	24	23	26	21	28	20	31	23

Table 34. Average Model Results: Late-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	160	161	174	100	187	109	198	107	207	106	212	112
TPA	862	863	863	258	866	427	872	307	859	279	840	447
TPA <5"	644	644	643	184	649	356	662	245	658	224	643	394
TPA 5-10"	109	110	99	3	91	1	81	1	73	0	70	0
TPA 10-20"	103	103	113	63	117	60	118	49	116	40	113	33
TPA >20"	6	6	8	8	9	11	11	13	12	15	14	19
QMD	6	6	7	8	7	7	7	8	7	8	7	7
QMD >5"	12	12	12	16	12	17	13	18	13	19	14	20
CC	56	56	60	31	62	33	63	32	63	30	63	31

7.1.4 Piñon-Juniper Types

Table 35. Average Model Results: Early-Open Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	77	77	103	28	126	35	148	43	165	52	173	62
TPA	775	775	806	189	794	283	794	375	771	463	710	549
TPA <5"	559	559	536	103	474	199	453	292	384	382	346	469
TPA 5-10"	205	205	251	77	276	68	279	55	300	39	255	23
TPA 10-20"	10	10	19	8	44	16	62	27	87	42	109	55
TPA >20"	0	0	0	0	0	0	0	0	0	0	0	1
QMD	4	4	5	5	5	5	6	5	6	5	7	5
QMD >5"	7	7	7	8	8	9	8	10	9	11	9	12
CC	30	30	38	12	44	15	50	18	53	21	55	24

Table 36. Average Model Results: Early-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	144	144	156	42	164	49	169	55	173	63	175	71
TPA	1145	1145	1008	169	884	263	796	354	739	443	694	528
TPA <5"	770	770	640	102	520	199	448	293	408	383	390	470
TPA 5-10"	333	333	313	37	294	21	260	7	227	3	185	2
TPA 10-20"	42	42	54	29	69	42	87	53	103	54	116	53
TPA >20"	0	0	0	0	1	1	1	2	2	2	3	3
QMD	5	5	5	7	6	6	6	5	7	5	7	5
QMD >5"	8	8	8	11	9	12	9	13	10	14	10	15
CC	49	49	52	18	54	20	55	22	56	23	56	25

Table 37. Average Model Results: Late-Closed Seral State

Evaluation Criteria	Year 0		Year 10		Year 20		Year 30		Year 40		Year 50	
	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA
BA	157	157	169	78	177	87	183	96	186	105	187	114
TPA	1065	1065	1003	201	944	295	887	386	833	474	786	559
TPA <5"	758	758	682	101	623	197	576	292	542	382	503	470
TPA 5-10"	226	226	226	38	220	27	202	18	177	12	163	8
TPA 10-20"	79	79	92	60	99	67	106	72	109	74	114	73
TPA >20"	2	2	2	2	3	3	3	5	4	6	5	8
QMD	5	5	6	8	6	7	6	7	7	6	7	6
QMD >5"	9	9	9	12	10	13	10	14	11	15	11	15
CC	51	51	53	28	55	30	55	32	55	34	55	35

7.2 Appendix B: Fire and Fuels Data

7.2.1 Fire and Fuels Data Definitions

Table 38. Explanation of Fire and Fuels Terms and Criteria

Measurement	Abbreviated	Units	Description
Surface Flame Length-Severe	Surf. Flame- Sev	Feet	Potential surface flame length under severe conditions without active crown fire factored
Surface Flame Length-Moderate	Surf. Flame- Mod	Feet	Potential surface flame length under moderate conditions without active crown fire factored
Total Flame Length- Severe	Total Flame- Sev	Feet	Potential total flame length under severe conditions with active crown fire factored
Total Flame Length-Moderate	Total Flame- Mod	Feet	Potential total flame length under moderate conditions with active crown fire factored
Probability of Torching-Severe	Torch Prob.- Sev	Percent	Potential probability of torching, under severe conditions
Probability of Torching -Moderate	Torch Prob.- Mod	Percent	Potential probability of torching, under moderate conditions
Torching Index	Torching index	mph	20 ft wind speed where surface fire is expected to ignite the crown layer
Crowning Index	Crowning Index	mph	20 ft wind speed needed to support an active crown fire
Canopy Base height	Can. Base Height	Feet	Average height of the bottom of the canopy layer of a stand
Canopy Bulk Density	Can. Bulk Density	kg/m^3	Density of available canopy fuel in a stand
Basal Area Mortality-Severe	BA Mort- Sev	Percent	Potential tree mortality under severe condition, by percentage of basal area
Basal Area Mortality-Moderate	BA Mort- Mod	Percent	Potential tree mortality under moderate condition, by percentage of basal area

7.2.2 Mixed Conifer- Frequent Fire

Table 39. Average Fire and Fuels Model Results: Mid-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	5	4	5	5	5	6	6	7	6	7	7	7	8	7	7	7	7	7
Surf. Flame-Mod	4	4	4	4	4	5	5	6	5	5	6	6	6	6	5	6	6	6
Total Flame- Sev	36	40	41	43	46	49	6	7	6	7	7	7	8	7	7	7	7	7
Total Flame- Mod	13	11	15	15	15	17	5	6	5	5	6	6	6	6	5	6	6	6
Torch Prob.- Sev	96%	90%	84%	82%	84%	87%	49%	54%	32%	24%	27%	20%	72%	54%	28%	26%	27%	18%
Torch Prob.- Mod	92%	84%	78%	79%	81%	84%	34%	37%	18%	10%	13%	8%	48%	34%	13%	10%	12%	7%
Torching index	11	14	15	12	8	7	33	27	37	40	31	34	21	24	33	31	31	34
Crowning Index	15	15	15	14	14	15	28	26	29	32	30	33	29	27	30	32	31	33
Can. Base Height	5	6	8	7	6	6	17	19	24	26	26	28	19	20	24	26	27	28
Can. Bulk Density	0.149	0.149	0.147	0.147	0.147	0.146	0.058	0.065	0.055	0.049	0.052	0.047	0.057	0.063	0.054	0.049	0.052	0.047
BA Mort.-Sev	97	93	85	84	90	92	65	76	64	63	62	49	89	79	65	66	64	50
BA Mort.- Mod	78	69	72	74	71	68	56	60	40	36	35	28	72	59	38	37	35	28

Table 40. Average Fire and Fuels Model Results: Late-Open

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	8	8	8	7	7	6	8	8	8	8	8	8	8	8	8	8	8	8
Surf. Flame-Mod	7	6	6	6	6	5	7	7	6	7	7	7	7	7	6	7	7	7
Total Flame- Sev	8	8	8	9	12	12	8	8	8	8	8	8	8	8	8	8	8	8
Total Flame- Mod	7	6	6	7	8	8	7	7	6	7	7	7	7	7	6	7	7	7
Torch Prob.- Sev	44%	39%	37%	34%	34%	46%	43%	39%	27%	27%	27%	22%	43%	39%	27%	27%	28%	22%
Torch Prob.- Mod	28%	24%	22%	21%	25%	41%	27%	25%	14%	12%	12%	9%	27%	24%	14%	12%	13%	9%
Torching index	20	19	18	10	1	0	22	19	24	24	23	25	22	19	24	24	23	25
Crowning Index	44	36	35	34	34	33	47	38	40	42	41	43	47	38	40	42	41	43
Can. Base Height	22	21	18	9	2	2	24	21	25	26	26	27	24	21	25	26	26	27
Can. Bulk Density	0.034	0.043	0.045	0.046	0.046	0.047	0.031	0.040	0.037	0.035	0.036	0.034	0.031	0.040	0.037	0.035	0.036	0.034
BA Mort- Sev	87	82	77	79	90	93	88	86	78	77	76	67	88	86	77	77	76	67
BA Mort- Mod	59	50	48	51	67	70	62	57	46	45	44	35	62	57	45	44	44	35

Table 41. Average Fire and Fuels Model Results: Late-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	5	5	5	5	5	5	6	6	6	6	7	7	7	7	6	6	7	7
Surf. Flame-Mod	4	4	4	4	4	5	5	5	5	5	6	6	6	5	5	5	6	6
Total Flame- Sev	29	34	38	39	38	39	6	6	6	6	7	7	8	7	6	6	7	7
Total Flame- Mod	11	12	15	14	15	17	5	5	5	5	6	6	6	5	5	5	6	6
Torch Prob.- Sev	91%	93%	91%	92%	90%	91%	33%	37%	21%	25%	32%	21%	46%	35%	19%	22%	27%	23%
Torch Prob.- Mod	86%	89%	86%	88%	85%	85%	17%	18%	7%	9%	13%	7%	27%	15%	6%	7%	10%	7%
Torching index	9	9	6	8	10	9	37	31	43	41	25	27	30	25	35	40	26	28
Crowning Index	17	16	16	16	15	15	27	26	28	29	29	30	27	26	28	29	29	30
Can. Base Height	6	6	5	6	7	7	19	21	23	24	24	25	20	22	23	24	25	25
Can. Bulk Density	0.122	0.135	0.137	0.140	0.143	0.143	0.061	0.064	0.059	0.055	0.057	0.053	0.060	0.063	0.059	0.055	0.057	0.053
BA Mort- Sev	86	88	95	92	84	80	47	53	38	45	54	45	63	56	37	44	54	46
BA Mort- Mod	73	74	76	63	61	66	26	29	19	21	24	19	47	28	18	21	24	19

7.2.3 Ponderosa Pine

Table 42. Average Fire and Fuels Model Results: Mid-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	4	4	5	5	6	6	5	6	6	6	6	6	8	6	6	6	6	6
Surf. Flame-Mod	3	4	4	4	5	5	4	5	5	5	5	5	6	5	5	5	5	5
Total Flame- Sev	43	50	55	57	60	62	6	6	6	6	6	6	8	6	6	6	6	6
Total Flame- Mod	17	17	24	25	25	27	4	5	5	5	5	5	6	5	5	5	5	5
Torch Prob.- Sev	96%	94%	93%	92%	92%	93%	43%	41%	26%	21%	27%	20%	71%	50%	28%	19%	23%	21%
Torch Prob.- Mod	93%	90%	90%	90%	90%	90%	26%	24%	12%	9%	12%	8%	48%	30%	12%	7%	9%	8%
Torching index	12	12	9	10	7	7	41	38	43	46	41	39	24	32	38	47	43	42
Crowning Index	14	13	13	13	13	13	25	23	26	28	27	29	25	24	26	28	27	29
Can. Base Height	5	5	6	7	6	7	17	18	21	23	23	25	18	20	22	24	24	25
Can. Bulk Density	0.171	0.174	0.175	0.177	0.179	0.178	0.070	0.076	0.066	0.059	0.062	0.056	0.069	0.074	0.065	0.058	0.061	0.055
BA Mort- Sev	97	94	93	90	93	93	57	59	48	45	51	41	83	65	52	45	50	41
BA Mort- Mod	73	75	84	80	74	70	47	42	31	28	29	23	68	45	31	28	29	23

Table 43. Average Fire and Fuels Model Results: Late-Open

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	8	8	7	7	7	6	8	8	8	8	8	8	8	8	8	8	8	8
Surf. Flame-Mod	6	6	6	6	5	5	6	7	6	6	7	6	6	7	6	6	7	6
Total Flame- Sev	8	9	9	10	12	13	8	8	8	8	8	8	8	8	8	8	8	8
Total Flame- Mod	6	7	7	7	8	9	6	7	6	6	7	6	6	7	6	6	7	6
Torch Prob.- Sev	50%	52%	56%	58%	55%	60%	45%	41%	31%	28%	31%	25%	45%	41%	31%	29%	31%	25%
Torch Prob.- Mod	36%	41%	44%	49%	47%	56%	31%	28%	18%	13%	16%	12%	31%	28%	18%	13%	17%	12%
Torching index	19	15	14	9	1	0	20	18	24	24	23	25	20	18	24	24	23	25
Crowning Index	40	34	33	32	32	32	43	37	39	41	40	42	43	37	39	41	40	42
Can. Base Height	20	17	14	8	2	1	21	19	24	25	25	26	21	19	24	25	25	26
Can. Bulk Density	0.036	0.044	0.047	0.049	0.050	0.051	0.032	0.040	0.037	0.034	0.036	0.034	0.032	0.040	0.037	0.034	0.036	0.034
BA Mort- Sev	84	85	81	80	89	93	84	83	76	77	77	69	84	83	76	77	77	69
BA Mort- Mod	60	59	59	62	73	77	62	60	48	48	49	40	62	60	48	48	49	40

Table 44. Average Fire and Fuels Model Results: Late-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	5	5	6	6	7	7	6	6	6	6	7	6	8	6	6	6	7	6
Surf. Flame-Mod	4	4	5	5	5	6	5	5	5	5	5	5	6	5	5	5	5	5
Total Flame- Sev	53	55	59	62	63	63	11	12	9	6	7	6	15	12	9	6	7	6
Total Flame- Mod	27	27	29	33	33	34	5	5	5	5	5	5	6	5	5	5	5	5
Torch Prob.- Sev	92%	94%	94%	93%	92%	92%	39%	41%	23%	22%	28%	19%	67%	41%	30%	18%	28%	20%
Torch Prob.- Mod	89%	89%	87%	85%	83%	82%	27%	29%	10%	7%	9%	6%	46%	29%	17%	6%	8%	5%
Torching index	13	13	11	9	9	9	47	31	37	34	28	31	21	31	35	39	29	31
Crowning Index	13	13	12	12	12	12	21	20	22	23	22	23	21	20	21	23	22	23
Can. Base Height	7	7	8	8	9	10	19	19	21	22	22	23	20	20	22	23	23	24
Can. Bulk Density	0.184	0.188	0.189	0.188	0.187	0.185	0.092	0.097	0.088	0.081	0.085	0.078	0.092	0.096	0.088	0.082	0.085	0.079
BA Mort- Sev	88	88	92	92	96	92	53	49	34	32	37	31	78	53	39	28	38	32
BA Mort- Mod	77	70	77	75	73	73	27	24	18	17	18	14	54	25	19	15	17	14

7.2.4 Piñon-Juniper

Table 45. Average Fire and Fuels Model Results: Early-Open

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	8	7	6	6	6	6	9	12	11	10	9	9	9	12	11	10	9	9
Surf. Flame-Mod	6	5	5	5	5	5	6	9	8	7	7	7	6	9	8	7	7	7
Total Flame- Sev	23	30	35	38	39	41	10	14	13	12	12	13	10	14	13	12	13	13
Total Flame- Mod	12	15	18	21	23	23	7	9	9	8	8	8	7	9	9	8	8	8
Torch Prob.- Sev	100%	100%	100%	100%	100%	100%	89%	84%	92%	83%	87%	88%	89%	84%	93%	89%	87%	88%
Torch Prob.- Mod	100%	100%	100%	100%	100%	100%	89%	84%	92%	83%	86%	87%	89%	84%	93%	89%	86%	88%
Torching index	0	1	2	3	3	4	3	3	3	4	1	0	3	3	3	4	1	0
Crowning Index	16	14	13	12	12	12	39	37	34	33	31	30	39	37	34	33	31	30
Can. Base Height	3	3	4	4	5	5	5	6	7	7	4	4	5	6	7	7	4	4
Can. Bulk Density	0.121	0.144	0.160	0.179	0.186	0.183	0.037	0.042	0.047	0.050	0.054	0.058	0.038	0.042	0.047	0.051	0.054	0.058
BA Mort- Sev	99	99	99	100	100	100	99	99	99	99	99	99	99	99	99	99	99	99
BA Mort- Mod	99	99	99	99	99	99	99	99	99	99	99	98	99	99	99	99	99	98

Table 46. Average Fire and Fuels Model Results: Early-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	6	5	5	5	5	5	6	9	9	9	8	8	6	9	9	9	9	8
Surf. Flame-Mod	5	4	4	4	4	4	5	7	7	6	6	6	5	7	7	7	7	6
Total Flame- Sev	48	50	51	52	52	53	8	13	13	13	14	14	8	13	13	13	13	13
Total Flame- Mod	36	37	38	38	37	37	5	8	8	8	8	8	5	8	8	8	8	8
Torch Prob.- Sev	100%	100%	100%	100%	100%	100%	80%	85%	85%	81%	78%	75%	73%	79%	79%	73%	76%	76%
Torch Prob.- Mod	100%	100%	100%	100%	100%	100%	73%	84%	84%	79%	75%	73%	65%	78%	76%	70%	73%	74%
Torching index	1	2	1	2	3	3	10	5	6	7	3	2	11	5	6	6	2	2
Crowning Index	9	9	10	10	10	10	28	27	26	26	26	26	34	33	31	31	30	30
Can. Base Height	4	4	4	4	4	4	8	8	8	9	6	5	8	8	9	10	6	5
Can. Bulk Density	0.264	0.262	0.256	0.248	0.239	0.228	0.060	0.062	0.065	0.067	0.068	0.069	0.050	0.050	0.055	0.056	0.057	0.058
BA Mort- Sev	100	100	100	100	100	100	98	99	99	99	99	99	99	99	99	99	99	98
BA Mort- Mod	100	100	100	100	100	100	93	98	98	96	96	95	93	99	98	96	94	93

Table 47. Average Fire and Fuels Model Results: Late-Closed

	No Action						Thin/Burn						Masticate/Burn					
Year	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**	**1**	**10**	**20**	**30**	**40**	**50**
Surf. Flame- Sev	6	5	5	5	5	5	6	7	7	7	7	7	5	7	7	7	7	7
Surf. Flame-Mod.	5	4	4	4	4	4	5	6	6	6	5	5	4	6	6	6	6	5
Total Flame- Sev	45	47	48	49	48	48	9	13	13	13	13	13	7	12	12	12	12	13
Total Flame- Mod	28	28	29	29	28	26	5	8	7	7	7	7	4	7	7	7	7	7
Torch Prob.- Sev	100%	100%	100%	100%	100%	100%	82%	80%	78%	78%	72%	74%	75%	78%	73%	72%	72%	70%
Torch Prob.- Mod	100%	100%	100%	100%	100%	99%	76%	75%	73%	73%	67%	69%	63%	72%	68%	67%	67%	65%
Torching index	1	2	2	2	2	3	9	7	7	8	7	6	12	7	7	8	7	6
Crowning Index	12	12	12	12	12	13	28	28	27	27	26	26	29	29	28	28	28	28
Can. Base Height	4	4	4	4	4	4	7	8	8	8	7	7	7	8	8	9	8	6
Can. Bulk Density	0.192	0.194	0.193	0.189	0.183	0.176	0.061	0.062	0.065	0.066	0.067	0.068	0.058	0.059	0.062	0.063	0.064	0.065
BA Mort- Sev	100	100	100	100	100	100	93	95	95	95	94	96	86	95	95	94	93	96
BA Mort- Mod	99	97	99	99	99	97	81	92	90	85	80	76	72	91	87	83	78	76

7.3 APPENDIX C: MODELING ASSUMPTIONS

7.3.1 Modeled Regeneration

The following table indicates that regeneration that was utilized per 10 year cycle in FVS modeling simulations.

Table 48. Modeled FVS Regeneration

Species	Dry Mixed Conifer/Ponderosa Pine Forests		Piñon-Juniper Woodlands & Grasslands	
	No Action	**Proposed Action**	**No Action**	**Proposed Action**
White Fir	40/acre	25/acre	0	0
Ponderosa Pine	10/acre	100/acre	0	0
Douglas-fir	10/acre	50/acre	0	0
One-Seed Juniper	0	0	20/acre	20/acre
Rocky Mountain Juniper	0	0	20/acre	20/acre
Two-Needle Piñon	0	0	20/acre	60/acre

7.3.2 Modeled Fire/Fuels Conditions

The following table indicates the fuel moistures and weather conditions for moderate (90th percentile) and severe (97th percentile) conditions. These are derived from local RAWS weather stations.

Table 49. Modeled FVS Fire and Fuels Conditions

Fuel Moisture	1 hour	10 hour	100 hour	1,000 hour	Duff	Live Woody	Live Herb	Wind Speed 20’	Temp
Moderate	2%	3%	5%	8%	10%	60%	2%	11 mph	69° F
Severe	1%	2%	4%	6%	8%	60%	2%	14 mph	71° F

7.4 Appendix D: Stand and Stock Tables

7.4.1 Species Codes

Table 50. Species Codes

Code	Common Name	Code	Common Name	Code	Common Name
ABCO	White fir	PIED	Piñon pine	PIPU	Colorado blue spruce
ABLAA	Corkbark fir	PIEN	Engelmann spruce	PIST3	Southwestern white pine
JUMO	One-seed juniper	PIFL2	Limber pine	POTR5	Quaking aspen
JUSC2	Rocky Mountain Juniper	PIPO	Ponderosa pine	PSME	Douglas-fir

7.4.2 Species Composition by Basal Area, Mixed Conifer: Frequent Fire

Table 51. Species Composition: Dry Mixed Conifer: Mid-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	20%	20%	0%	0%	0%	0%	0%	0%	5%	5%	0%	0%	7%	7%	40%	40%	0%	0%	0%	0%	6%	6%	22%	22%
2030	14%	16%	0%	0%	0%	0%	0%	0%	3%	5%	0%	0%	5%	7%	45%	41%	0%	0%	0%	0%	9%	7%	23%	24%
2040	14%	17%	0%	0%	0%	0%	0%	0%	2%	5%	0%	0%	5%	7%	45%	38%	0%	0%	0%	0%	10%	7%	23%	25%
2050	15%	18%	0%	0%	0%	0%	0%	0%	2%	5%	0%	0%	4%	7%	46%	36%	0%	0%	0%	0%	8%	7%	25%	26%
2060	15%	20%	0%	0%	0%	0%	0%	0%	1%	4%	0%	0%	3%	7%	49%	34%	0%	0%	0%	0%	7%	7%	26%	27%
2070	15%	21%	0%	0%	0%	0%	0%	0%	1%	4%	0%	0%	3%	7%	48%	32%	0%	0%	0%	0%	7%	7%	26%	27%

Table 52. Species Composition: Dry Mixed Conifer Late-Open

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	6%	6%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%	2%	2%	70%	70%	0%	0%	6%	6%	1%	1%	14%	14%
2030	4%	5%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	2%	2%	73%	70%	0%	0%	5%	6%	1%	2%	15%	14%
2040	5%	5%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	2%	2%	72%	68%	0%	0%	5%	6%	1%	2%	15%	15%
2050	4%	6%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	2%	74%	65%	0%	0%	3%	7%	0%	4%	16%	15%
2060	4%	7%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	2%	2%	74%	62%	0%	0%	3%	7%	0%	5%	17%	16%
2070	5%	9%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	2%	72%	58%	0%	0%	3%	7%	0%	6%	18%	17%

Table 53. Species Composition: Dry Mixed Conifer: Late-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	20%	20%	2%	2%	0%	0%	0%	0%	1%	1%	0%	0%	7%	7%	22%	22%	11%	11%	0%	0%	6%	6%	30%	30%
2030	20%	21%	1%	2%	0%	0%	0%	0%	1%	1%	0%	0%	6%	7%	22%	18%	8%	11%	0%	0%	8%	7%	34%	31%
2040	20%	22%	1%	3%	0%	0%	0%	0%	1%	1%	0%	0%	6%	7%	21%	17%	8%	11%	0%	0%	9%	7%	34%	32%
2050	21%	22%	1%	3%	0%	0%	0%	0%	0%	1%	0%	0%	4%	7%	22%	16%	7%	11%	0%	0%	8%	6%	37%	33%
2060	21%	23%	0%	3%	0%	0%	0%	0%	0%	1%	0%	0%	4%	7%	22%	15%	5%	10%	0%	0%	8%	6%	39%	33%
2070	21%	24%	0%	3%	0%	0%	0%	0%	0%	1%	0%	0%	4%	7%	21%	14%	5%	10%	0%	0%	9%	6%	39%	34%

7.4.3 Species Composition by Basal Area, Ponderosa Pine

Table 54. Species Composition: Ponderosa Pine: Mid-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	16%	16%	0%	0%	4%	4%	1%	1%	6%	6%	0%	0%	5%	5%	46%	46%	0%	0%	0%	0%	5%	5%	19%	19%
2030	7%	8%	0%	0%	2%	4%	2%	2%	2%	6%	0%	0%	4%	6%	58%	51%	0%	0%	0%	0%	9%	5%	15%	17%
2040	7%	9%	0%	0%	2%	5%	2%	2%	2%	6%	0%	0%	4%	6%	59%	49%	0%	0%	0%	0%	9%	6%	15%	18%
2050	7%	9%	0%	0%	2%	5%	1%	2%	1%	6%	0%	0%	3%	6%	60%	47%	0%	0%	0%	0%	9%	6%	17%	19%
2060	7%	10%	0%	0%	1%	5%	0%	2%	0%	6%	0%	0%	2%	6%	64%	45%	0%	0%	0%	0%	8%	7%	18%	19%
2070	7%	11%	0%	0%	1%	5%	0%	2%	0%	6%	0%	0%	2%	6%	63%	42%	0%	0%	0%	0%	9%	7%	18%	20%

Table 55. Species Composition: Ponderosa Pine: Late-Open

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	7%	7%	0%	0%	1%	1%	3%	3%	6%	6%	0%	0%	5%	5%	44%	44%	0%	0%	9%	9%	1%	1%	24%	24%
2030	5%	6%	0%	0%	0%	1%	1%	3%	1%	7%	0%	0%	3%	5%	54%	44%	0%	0%	14%	9%	0%	1%	23%	24%
2040	5%	6%	0%	0%	0%	1%	1%	3%	1%	7%	0%	0%	3%	5%	53%	41%	0%	0%	14%	9%	1%	2%	24%	26%
2050	5%	7%	0%	0%	0%	1%	0%	3%	0%	7%	0%	0%	2%	5%	55%	39%	0%	0%	12%	9%	0%	2%	26%	27%
2060	5%	7%	0%	0%	0%	1%	0%	3%	0%	7%	0%	0%	2%	5%	56%	36%	0%	0%	10%	10%	0%	3%	27%	28%
2070	5%	8%	0%	0%	0%	1%	0%	3%	0%	7%	0%	0%	2%	5%	55%	34%	0%	0%	10%	10%	0%	3%	28%	29%

Table 56. Species Composition: Ponderosa Pine: Late-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	6%	6%	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	4%	4%	73%	73%	0%	0%	6%	6%	0%	0%	9%	9%
2030	3%	3%	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	3%	4%	80%	76%	0%	0%	5%	7%	0%	0%	8%	8%
2040	3%	3%	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	3%	4%	79%	75%	0%	0%	5%	7%	0%	0%	9%	8%
2050	3%	4%	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	2%	4%	82%	74%	0%	0%	4%	7%	0%	0%	9%	9%
2060	3%	5%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	1%	4%	84%	72%	0%	0%	3%	7%	0%	0%	9%	9%
2070	3%	6%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	1%	3%	82%	70%	0%	0%	3%	7%	0%	0%	10%	10%

7.4.4 Species Composition by Basal Area: Piñon-Juniper

Table 57. Species Composition: Piñon-Juniper: Early-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	0%	0%	0%	0%	12%	12%	9%	9%	61%	61%	0%	0%	0%	0%	12%	12%	0%	0%	0%	0%	0%	0%	5%	5%
2030	0%	0%	0%	0%	9%	10%	8%	10%	45%	62%	0%	0%	0%	0%	23%	12%	0%	0%	0%	0%	0%	0%	14%	6%
2040	0%	0%	0%	0%	9%	10%	8%	10%	45%	61%	0%	0%	0%	0%	24%	12%	0%	0%	0%	0%	0%	0%	14%	6%
2050	0%	0%	0%	0%	9%	10%	8%	11%	44%	61%	0%	0%	0%	0%	24%	11%	0%	0%	0%	0%	0%	0%	15%	7%
2060	0%	0%	0%	0%	9%	10%	8%	11%	44%	60%	0%	0%	0%	0%	24%	11%	0%	0%	0%	0%	0%	0%	15%	8%
2070	0%	0%	0%	0%	9%	10%	8%	11%	44%	59%	0%	0%	0%	0%	23%	11%	0%	0%	0%	0%	0%	0%	15%	9%

Table 58. Species Composition: Piñon-Juniper: Early-Open

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	0%	0%	0%	0%	4%	4%	43%	43%	47%	47%	0%	0%	0%	0%	6%	6%	0%	0%	0%	0%	0%	0%	0%	0%
2030	0%	0%	0%	0%	2%	3%	37%	44%	45%	45%	0%	0%	0%	0%	16%	7%	0%	0%	0%	0%	0%	0%	0%	0%
2040	0%	0%	0%	0%	2%	3%	36%	45%	44%	45%	0%	0%	0%	0%	18%	7%	0%	0%	0%	0%	0%	0%	0%	0%
2050	0%	0%	0%	0%	2%	3%	35%	45%	44%	45%	0%	0%	0%	0%	19%	7%	0%	0%	0%	0%	0%	0%	0%	0%
2060	0%	0%	0%	0%	2%	3%	34%	45%	44%	45%	0%	0%	0%	0%	19%	7%	0%	0%	0%	0%	0%	0%	0%	0%
2070	0%	0%	0%	0%	2%	3%	33%	45%	45%	45%	0%	0%	0%	0%	19%	7%	0%	0%	0%	0%	0%	0%	0%	0%

Table 59. Species Composition: Piñon-Juniper: Late-Closed

Year	ABCO		ABLAA		JUMO		JUSC2		PIED		PIEN		PIFL2		PIPO		PIPU		PIST3		POTR5		PSME	
	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA	PA	NA
2020	11%	11%	0%	0%	9%	9%	14%	14%	38%	38%	0%	0%	1%	1%	20%	20%	0%	0%	0%	0%	3%	3%	4%	4%
2030	16%	12%	0%	0%	6%	9%	9%	13%	25%	37%	0%	0%	2%	1%	32%	20%	0%	0%	0%	0%	3%	4%	7%	4%
2040	16%	13%	0%	0%	6%	8%	9%	13%	25%	36%	0%	0%	2%	1%	32%	20%	0%	0%	0%	0%	3%	4%	7%	5%
2050	16%	14%	0%	0%	6%	8%	9%	12%	25%	35%	0%	0%	2%	1%	32%	19%	0%	0%	0%	0%	3%	5%	7%	5%
2060	16%	16%	0%	0%	6%	7%	9%	12%	24%	34%	0%	0%	2%	1%	32%	18%	0%	0%	0%	0%	3%	6%	7%	5%
2070	17%	17%	0%	0%	6%	7%	9%	12%	24%	33%	0%	0%	2%	1%	32%	18%	0%	0%	0%	0%	3%	7%	7%	5%