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Appendix A – Project Record Index

Table 51. **Four-Forest Restoration Initiative Coconino and Kaibab NF Project Record Index**

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Appendix B – Map Packet

Note: Hard copies of the DEIS include a packet of poster-sized maps for alternative B, C, and D. Electronic copies of the DEIS are available in DVD and web-based formats

Appendix C – Forest Plan Amendments

Alternative B - Coconino National Forest Site-Specific Non-Significant Forest Plan Amendments

Three non-significant forest plan amendments are proposed for alternative B. Current forest plan direction and the need for plan variance is provided below. Table 52 provides the current forest plan direction and the proposed amendment language for comparison purposes.

Amendment 1. Mechanical treatment up to 16-inch dbh in 18 Mexican Spotted Owl Protected Activity Areas (PACs)

Relevant Forest Plan Direction

Standard: Allow no timber harvest except for fuelwood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service (Coconino National Forest Plan, replacement, p. 65)

Guideline: Protected Activity Centers, Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area (Coconino National Forest Plan, p. 65-2).

Background

There are 190 Mexican spotted owl (MSO) protected activity centers (PACs) entirely or partially within the Coconino National Forest (NF) (Coconino NF 2011) and approximately 117,636 acres of PACs[1]. There are 117 PACs (36,455 acres of PAC habitat) located in the 4FRI project area. Coconino National Forest Plan (hereafter referred to as “forest plan”) direction for MSO is derived from the USDI MSO Recovery Plan (1995). As written, the forest plan standard excludes mechanical treatments within PACs unless it is for fuelwood collection or fire risk abatement. This standard effectively eliminates the ability to address any deficiency in the forest structure that is required by MSOs.

The forest plan allows for treatments that include fuelwood and fire risk abatement outside of the 100-acre core area up to 9-inch dbh. The 9-inch dbh limit is not derived from ecological considerations, but was instead based on commercial value, i.e., the 9-inch dbh limitation effectively prevented commercial harvest within PACs, which was a concern in the early 1990s (Noble, personal communication 2011).

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the U.S. Fish and Wildlife Service (USFWS) worked together to review individual PACs within the project area. PAC reviews included an evaluation of past survey results, existing forest conditions, past

[1] There are 168 MSO protected activity centers (PACs) occurring entirely on the Coconino NF. In addition, six PACs on the Coconino NF overlap with the Apache-Sitgreaves NFs, four PACs overlap with Walnut Canyon National Monument, four PACs overlap with state lands, three PACs overlap with the Kaibab NF, one PAC overlaps with the Navajo Army Depot, one PAC overlaps with the Naval Observatory and state land, one PAC overlaps with private property, and two PACs overlap with both private property and the Apache-Sitgreaves NFs.

management activities, current management planning outside the 4FRI project area, administrative status (e.g., wilderness or general forest status), and on-the-ground familiarity with the sites. Landscape databases and remote imagery, including aerial photography, were reviewed spatially. The evaluation process was based on whether the proposed silvicultural treatments would move existing spotted owl habitat towards the desired conditions described in the Recovery Plan. Eighteen PACs were identified as having habitat that could be improved with vegetation treatments. Each stand within the 18 PACs was modeled to identify treatments that would yield the best existing and future MSO habitat conditions. See the wildlife report for complete details on the habitat evaluation process.

Need for Plan Amendment

MSO PAC field reviews, data evaluation, and vegetation simulation modeling indicate 18 MSO PACs within the 4FRI project area need habitat structural improvements to improve nesting and roosting habitat. Approximately 3,616 acres or 32 percent of PAC habitat within 18 PACs would move towards Recovery Plan desired conditions from mechanical treatments up to 9-inch dbh. An additional 7,656 acres within 18 PACs would have nesting and roosting habitat benefits from mechanical treatment up to 16-inch dbh. Mechanical treatments above 9-inch dbh would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs.

Amendment Description

The amendment, which is specific to 18 MSO PACs within the 4FRI project area, would: (1) add language to allow mechanical treatments to improve habitat structure, and, (2) add language to allow mechanical treatment within 18 MSO PACs up to 16-inch dbh to improve nesting and roosting habitat. Edited text is **bolded** in table 52. Figure 45 displays the general locations of PACs to be mechanically treated up to 16- inch dbh in relation to PACs that would be prescribed burned or not treated.

***Table 52*. Amendment 1 Current and Proposed Forest Plan Language**

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Standard: Allow no timber harvest except for fuelwood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with US Fish and Wildlife Service. (Coconino NF Forest Plan, p. 65)	Allow no timber harvest except for fuelwood, fire risk abatement, in established protected activity centers **except as follows: Allow fuelwood, fire risk abatement, and habitat structure improvement in the following established protected activity centers: Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring.** For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service.

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Guideline: Protected Activity Centers, Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area (Coconino NF Forest Plan, p. 65-2).	**Guideline**: Protected Activity Centers, Treat fuel accumulations to abate fire risk. Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area **except as follows:** **Use combinations of thinning trees up to 16 inch dbh within the Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring PACs, mechanical fuel treatment and prescribed fire to abate fire risk and improve habitat structure in the remainder of the selected protected activity center outside the 100 acre "no treatment" area.**

* Edited text is **bolded.**

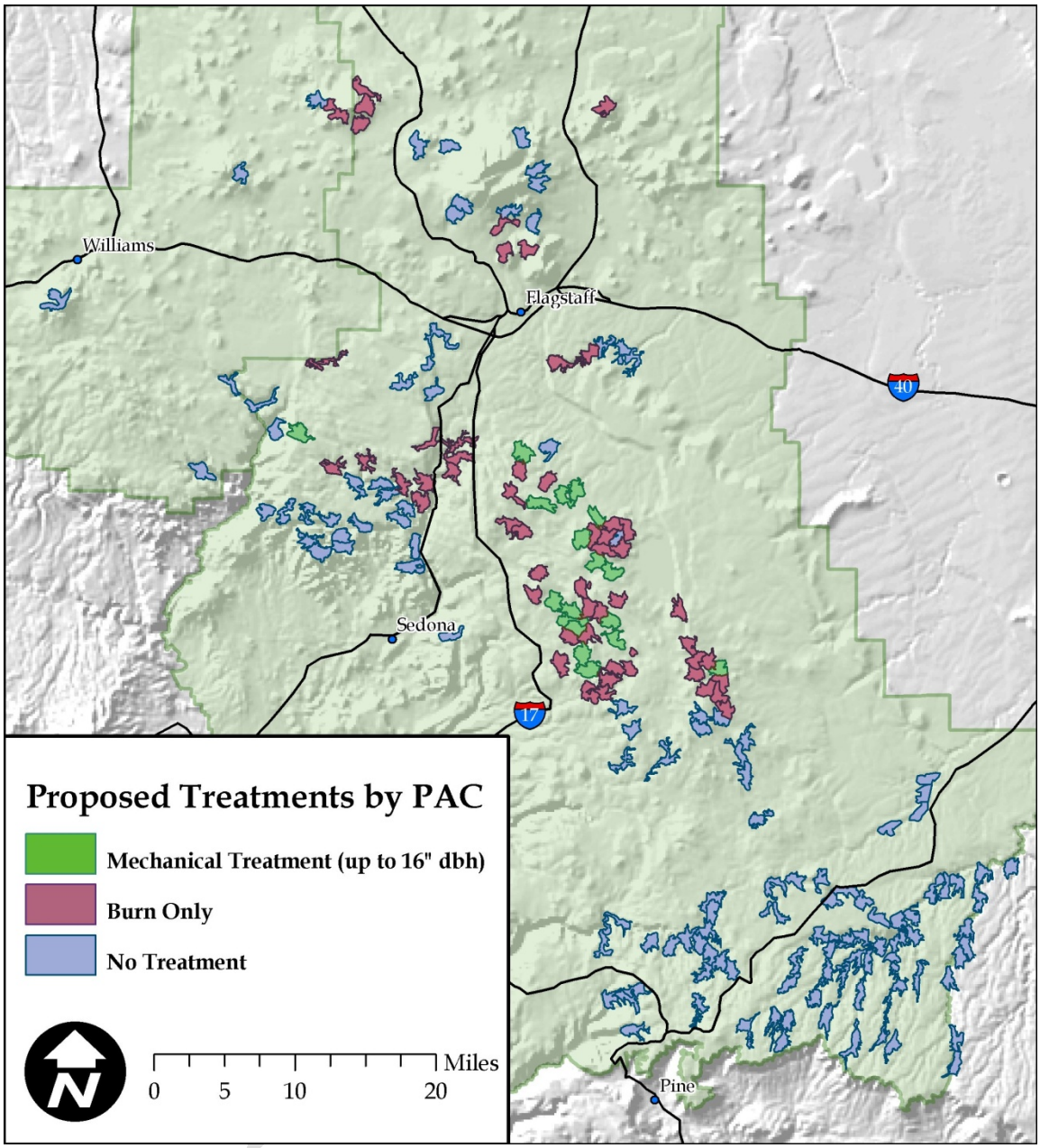

***Figure 45*. Alternative B Mexican Spotted Owl Protected Activity Center (PAC) Treatments**

Consistency with the MSO Recovery Plan

The current Recovery Plan (USDI FWS 1995) states "Two primary reasons were cited for the listing: historical alteration of its habitat as the result of timber management practices, specifically the use of even-aged silviculture…" and "The danger of catastrophic wildfire…" While the Recovery Plan is clear that the primary existing threat is high-severity wildland fire, the Recovery Plan also states that "[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl." The Recovery Plan recognizes that "ecosystems are temporally dynamic [and] provisions are needed to ensure owl habitat in the long term." The primary objective to be achieved by the Recovery Plan guidelines is protection of the best available habitat for the MSO, while maintaining sufficient flexibility for land managers to abate high fire risks and to improve habitat conditions for the owl and its prey (p. 89). The potential for using silviculture as a tool for meeting objectives such as maintaining and developing MSO habitat and enhancing various ecological factors is specifically identified in the Recovery Plan.

The Recovery Plan recommends that recovery efforts concentrate on the recovery units with the highest owl populations and where significant threats exist. The project is located within the Upper Gila Mountain Recovery Unit (UGM RU). The UGM RU contains the largest known number of MSOs with approximately 55 percent of known spotted owl territories. The major land use within this recovery unit has been timber harvest.

The Recovery Plan describes a change in the size-class distribution of trees that occurred on commercial forest lands in Arizona and New Mexico between the 1960s and the 1980s. The density of large trees (greater than 19-inch dbh) decreased by 20 percent and sapling-sized trees (1- to 4.9-inch dbh) decreased in both absolute density and in relative contribution to the size-class distribution. Trees 5- to 12.9-inch dbh increased in density by 40 percent and in relative proportion of the size-class distribution and trees 13- to 19-inch dbh increased in density but not in the relative proportion of the tree distribution. The decrease in large trees was described as "an alarming negative trend with respect to a very critical component of spotted owl habitat" (p. 68) given that "the basis to maintain owl populations is to ensure that adequate habitat quality and quantity will be sustained through time." In order to achieve this, the Recovery Plan advocates using coarse and fine filters for ecosystem management.

Coarse filters should be used "to maintain the natural array of conditions that exist with the biotic and physical limits of the landscape" while fine filters may be used "to provide specialized habitats or habitat elements within that overall landscape." They recommend "innovative applications of uneven-aged management" for developing and maintaining important but difficult-to-replace spotted owl habitat elements, including large pine and oak trees and key habitat components, such as trees greater than 24-inch dbh, and prey habitat. The amendment allows for using silvicultural treatments in 18 PACs at risk of losing key MSO habitat elements through declining forest health. Treatment objectives in the 18 PACs are to develop and maintain adequate MSO habitat quality and quantity through time.

The need to evolve from managing solely for fuelwood collection and fire risk abatement is reflected in the Draft Revised Recovery Plan for the Mexican spotted owl (USFWS 2011). The Draft Revised Recovery Plan (USFWS 2011) is being prepared for final release and is expected to be finalized before the project is implemented. In it the USFWS states "Management is the most conservatively oriented toward owl management within PACs, but is by no means "hands off." The draft recognizes situations exist where management is needed to sustain or enhance desired future conditions for the owl..." It goes on to state "Mechanical treatments to achieve

these objectives require a landscape analysis to determine where the needs are greatest" which is the process we are currently undergoing.

Non-Significance Evaluation

Significance of proposed forest plan Amendment 1 was evaluated against the criteria in Forest Service Manual (FSM) 1926.51 and 1926.52. Factors include timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions.

In terms of timing, the forest plan has been in place and amended several times since 1987, and, revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region's 1996 Amendment of Forest Plans Record of Decision (USDA 1996). The actions allowed via the amendment are consistent with existing forest plan direction in that it improves nesting and rooting habitat and reduces the risk of loss from fire. Because a draft MSO Recovery Plan is being developed by the USFWS (USDI 2011), forest plan direction is likely to be amended to incorporate desired conditions and recognizing that habitat restoration, in addition to the reduction of fire risk, is key to improving habitat quality.

Approximately 36,455 acres of MSO PAC habitat occurs within the project area. The amendment would affect 7,656 acres or 21 percent of the habitat in the project area and approximately 7 percent of the total PAC habitat on the forest. The amendment facilitates moving ponderosa pine towards the desired forest structure that enhances owl roosting and nesting habitat needs. Mechanical treatments above 9inch dbh would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs.

The amendment is consistent with forest plan goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest Plan, replacement page 22-1) and for improving habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest Plan, replacement page 23).

The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called prescriptions and the land units are called management areas. Prescriptions are management practices selected and scheduled to apply to a specific area to attain multiple-use and other goals and objectives (36 CFR 219.3(u)). The amendment is consistent with goals and objectives by protecting conditions and structures used by spotted owls where they exist and to set other stands on a trajectory to grow into replacement nest habitat or to provide conditions for foraging and dispersal (USDI 1995).

The proposed amendment is predominantly within management area (MA) 3 (ponderosa pine below 40 percent slopes) and MA 35 (Lake Mary Watershed). The amendment intent is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and meeting MSO standards and guidelines which emphasize improving and maintaining the quality of the habitat (MA 3) and moving ponderosa pine towards desired forest structure, including northern goshawk and MSO habitats (MA 35). MA 3 (511,015 acres) and MA 35 (62,536 acres) account for 573,933 total acres forest-wide. The proposed amendment would affect about 5,580 acres or 1 percent of MA 3 and about 1,821 acres or 3 percent of MA 35 total acres. Acres within other MAs total 222 acres. The amendment would not impose requirements on future management of the PACs as the amendment is site-specific to this analysis and addresses current conditions within the 18 PACs.

Outputs identified in the forest plan are associated with MBBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MBBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM) and permitted livestock use (MAUM). Due to the minimal acres affected, the amendment would not alter outputs on a forest-wide basis or change the long-term relationship between levels of goods (timber, firewood) and services.

The forest plan currently allows for treating up to 9-inch dbh within MSO PACs and alternative B and D would include treating up to 9-inch dbh on about 3,616 acres. Amendment 1 would allow for improving habitat structure on an additional 7,656 acres. In comparison the forest's total suitable timber lands (626,326 acres), the amendment affects about 1 percent of those lands. For this reason, treatments within PACs do not measurably increase or decrease timber outputs or firewood availability. Treatment within PACs would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 2. Management of canopy cover and ponderosa pine with an open reference condition within goshawk habitat

The forest plan directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- Stands are 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. Four classification characteristics are generally used to distinguish forest stands: bio-physical site (soils, aspect, elevation, 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 will shape structure over time). Based upon agency guidelines, the minimum stand mapping size is 10 acres.
- Interspaces are defined as the open space between tree groups intended to be managed for grass-forb-shrub vegetation during the long term. Interspaces may include scattered single trees.

Relevant Forest Plan Direction

Vegetation Management – Landscapes Outside Goshawk Post-fledging Family Areas

General: Snags are 18-inch or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8-feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Coconino National Forest Plan, p. 65-9).

Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Coconino National Forest Plan, p. 65-9).

Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per

group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre (Coconino National Forest Plan, p. 65-10).

Vegetation Management - Within Post-fledging Family Areas

General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area (Coconino National Forest Plan, p. 65-10).

Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Coconino National Forest Plan, p. 65-10).

Woodland: Maintain existing canopy cover levels (Coconino National Forest Plan, p. 65-10).

Background

Canopy cover is defined as "the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage" (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, we used the FVS crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The only reference the forest plan has in terms of measuring canopy cover is in directing projects to measure "vertical crown projection on average across the landscape" (see Coconino National Forest Plan, p. 65-9). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between non-forested areas (interspace) and natural openings across the landscape. The forest plan is also silent on what percent of the landscape should be managed for non-forested areas (interspaces) that occur between individual trees, tree clumps, and tree groups. These non-forested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long-term. Refer to the silviculture report and the implementation plan (appendix E) which provides minimum stocking guidelines that have been developed to assure canopy cover requirements are met.

There are 128,922 acres of habitat outside of goshawk post-fledgling family areas and 10,386 acres within goshawk post-fledgling family area habitat specific to the canopy cover portion of the amendment.[2] There are approximately 512,178 acres of ponderosa pine within the 4FRI project area. Of this total, 322, 722 acres are within the Coconino NF. Approximately 198,136 acres (61 percent) of the forest areas (within the project area) have an open reference condition that corresponds to mollic-integrade soils. The association between an open reference condition

[2] In alternative C, the acres of goshawk habitat affected by the canopy cover portion of the amendment is reduced to 139,161 acres.

and soils is supported by reference condition research. Structural characteristics widely reported for historical southwest ponderosa pine are relatively open forests with trees typically aggregated in small groups within a grass/forb/shrub matrix (Cooper 1960, White 1985, Pearson 1950, Covington et a1.1997, Abella and Denton 2009). Recent work in northern Arizona has shown that tree densities across nine different ponderosa pine ecosystems depended to a large extent on soil type and climatic variables such as minimum spring and fall temperatures, and May precipitation (Abella and Denton 2009). This work also showed that the degree to which trees were aggregated into groups was largely explained by ecosystem soil type. Twenty-eight to 74 percent of all trees were in groups; the remaining trees were scattered individuals (Abella and Denton 2009). These structural conditions were maintained by frequent low-intensity surface fires that more often killed small rather than large trees (Dieterich 1980, Weaver 1951, Fiedler et al. 1996, Cooper 1960).

Need for Plan Amendment

See figure 46. There is a need to define and describe interspace, clarify the relationship between interspace to the vegetation structural stage (VSS) classes, and describe how canopy cover would be measured in landscapes outside and within goshawk post-fledgling family areas.

In 29,017 acres managed for an open reference condition (figure 47), there is a need to allow for managing for less than 40 percent canopy cover in VSS 4 to VSS 6, remove the 200 foot width metric related to openings, allow for creating reserve groups comprised of 1 to 2 residual trees if trees are not currently present. This amendment does not include those acres of habitat where no treatments are proposed (goshawk nest stands), or acres where prescribed burn-only treatment is proposed.

Amendment Description

In the “Vegetation Management - Landscapes Outside Goshawk Post-fledgling Family Areas” and “Vegetation Management -Within Post-fledgling Family Areas” section of the forest plan, a non-significant plan amendment would: (1) add the desired percentage of interspace within uneven-aged stands to facilitate restoration and defines interspace, (2) add the interspace distance between tree groups, and, (3) add language clarifying where canopy cover is and is not measured, and, (4) add language clarifying reserve trees are specific to created regeneration openings in landscapes outside goshawk post-fledgling family areas. New or edited text is underlined in the “Proposed New Guideline Language” column in table 53.

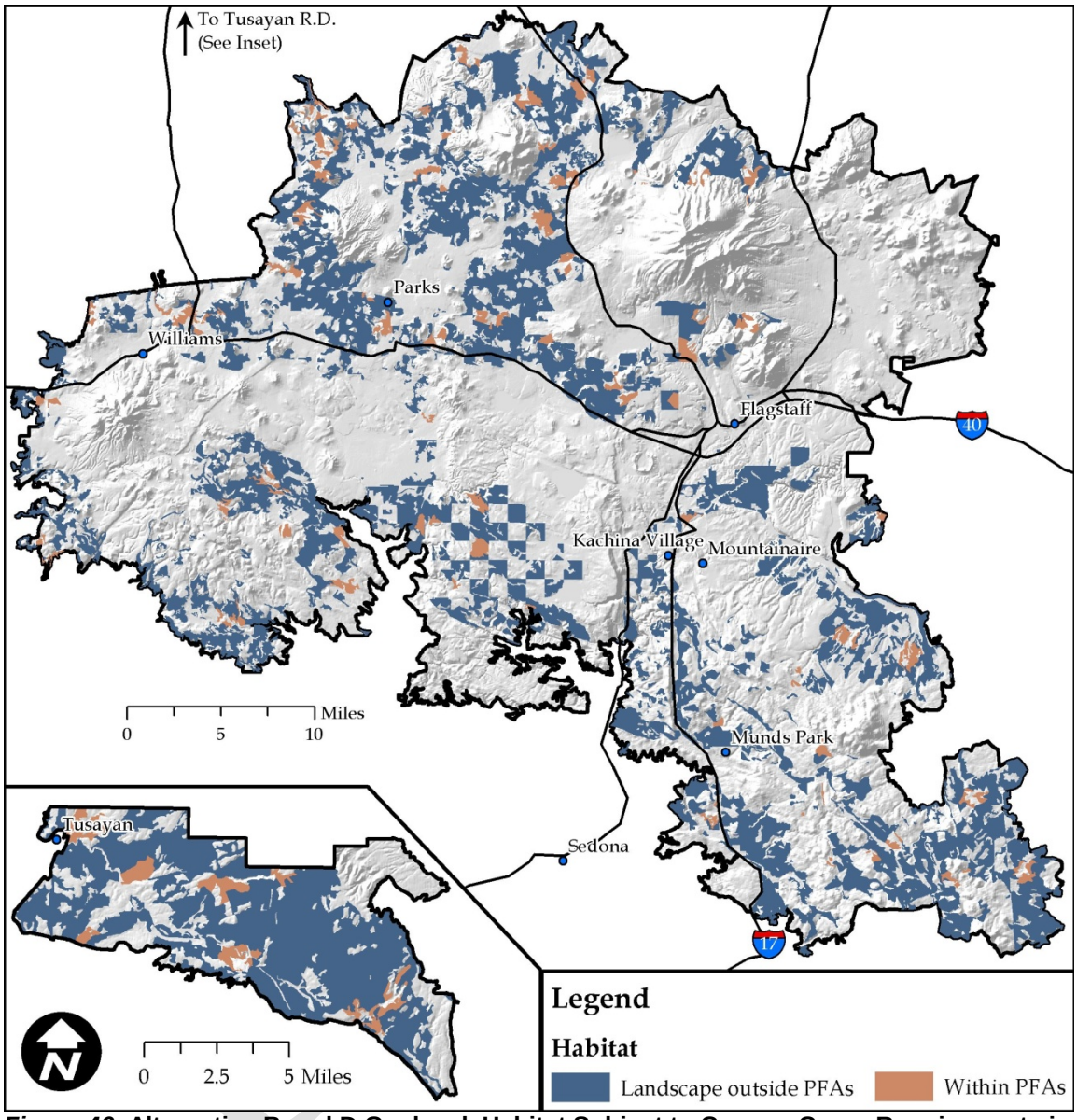

***Figure 46*. Alternative B and D Goshawk Habitat Subject to Canopy Cover Requirements in Vegetation Structural Stages (VSS) 4 and VSS 6 (Coconino NF)**

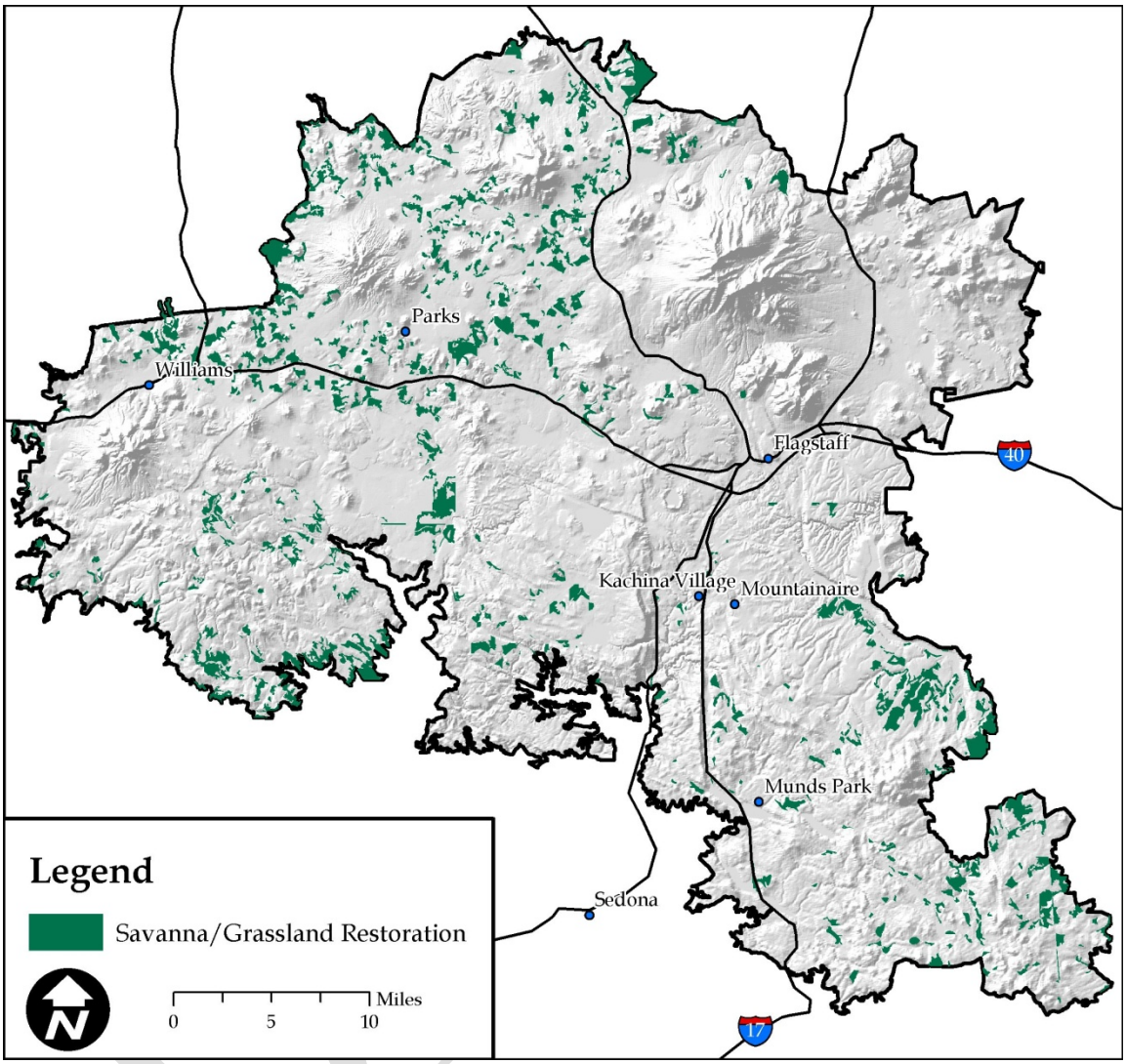

***Figure 47*. Alternative B-D Acres to be Managed for a Ponderosa Pine Open Reference Condition (Coconino NF)**

Non-Significance Evaluation

Significance was evaluated against the criteria in Forest Service Manual (FSM) 1926.51 and 1926.52. Factors include timing, location, and size, relationship to forest goals, objectives, outputs, and management prescriptions. In terms of timing, the forest plan has been in place (and amended) since 1987 and plan revision efforts are underway.

Suitable goshawk habitat on the Coconino NF encompasses about 791,897 acres (Green 2011, draft unpublished data). Approximately 237,289 acres of goshawk habitat (non-PFA, PFA, dispersal PFA, and nest stands) located on the forest is within the 4FRI project area. The canopy cover portion of the amendment would affect 139,308 (59 percent) of all goshawk habitat within the project area. This percentage is reduced to 18 percent in the context of all goshawk habitats on

the Coconino NF. For this reason, location (confined to the ponderosa pine cover type) and size was determined to be non-significant.

Managing ponderosa pine for an open reference condition would affect approximately 4 percent of all suitable goshawk habitats on the forest and about 8 percent of goshawk habitats within the project area. For this reason, location and size was determined to be non-significant. The amendment would facilitate moving over 29,000 acres of ponderosa pine towards the desired forest structure (groups and clumps with herbaceous openings) that maximizes prey base species habitat and allows for the reintroduction of fire into the ecosystem.

Although the definition of interspace, the relationship between interspaces and VSS, specifics for measuring canopy cover, and managing a portion of the landscape as an open reference condition, the environmental analysis and subsequent decision must address how forest plan canopy cover requirements in VSS 4 to 6 are met and how treatments move towards the desired VSS size class distribution. For this reason, the amendment is consistent with forest goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest Plan, replacement page 22-1) and for improving habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest Plan, replacement page 23).

The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called prescriptions and the land units are called management areas. Prescriptions are management practices selected and scheduled to apply to a specific area to attain multiple-use and other goals and objectives (36 CFR 219.3(u)).

The canopy cover portion of the amendment would affect 92,301 acres of management area (MA) 3 (ponderosa pine below 40 percent), 14,337 acres of MA 35 (Lake Mary Watershed), and 12,844 acres of MA 38 (West). In sum, MA 3 (511,015 acres), MA 35 (62,536 acres), and MA 38 (36,298 acres) account for 609,849 total acres forest-wide.[3] The proposed amendment would affect 18 percent of MA 3, 23 percent of MA 35, and 35 percent of MA 38. The amendment would affect between 18 and 35 percent of the forest's MA 3, 35, and 38; however, this is not significant as the amendment would not impose requirements on the Coconino NF's future management of goshawk habitat. Because forest plan canopy cover requirements would be met in VSS 4 to 6 and movement towards balanced age classes would occur, the amendment is consistent with the management emphasis of achieving diverse and healthy stands.

The acres that would be managed for an open reference condition actions are predominantly within 19,010 acres of MA 3 (ponderosa pine below and above 40 percent slopes) and 5,840 acres of MA 35 (Lake Mary Watershed). The two management areas account for 573,551 total acres forest-wide. The proposed amendment would affect about 4 percent of MA 3 and MA 35's total acres. The amendment would not impose requirements on the future management of the 29,017 acres of goshawk non-PFA. The amendment is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat (MA 3) and moving ponderosa pine towards desired forest structure, including northern goshawk habitats (MA 35).

[3] In alternative C, the acres of mangement areas affected vary slightly in MA 3 and MA 35. In alternative C, acres in MA 3 decrease to 92,204 and acres affected in MA 35 decrease to 14,287. Overall percentages of MAs affected remain the same as alternative B.

Outputs identified in the current forest plan are associated with MBBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MBBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM) and permitted livestock use (MAUM). The canopy cover portion of the amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services and would not result in a change land productivity or timber suitability classification.

Managing a portion of the landscape for an open reference condition affects about 29,017 acres and the forest plan estimates there are 626,326 acres of suitable timber lands. In the short term (10-year period), the amendment affects about 4 percent of the suitable land base. However, due to the minimal acres affected, the amendment would not measurably alter outputs in the foreseeable future on a forest-wide basis or change the long-term relationship between levels of goods (timber, firewood) and services. There would be no change in land productivity; therefore, it would not affect timber suitability classification. Whether the 29,017 acres would continue to be managed as suitable timber in the long term will be evaluated during the forest plan revision process. No portion of the amendment would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Table 53. **Amendment 2 Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition in Goshawk Habitat**

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk Post-fledgling Family Areas	
No similar direction in forest plan	General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces should be variable. Over time the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Coconino NF Forest Plan, p. 65-9).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), and 20% old forest (VSS 6). Note: the specified percentages are a guide and actual percentages are expected to vary plus or minus up to 3%.
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the distribution of VSS, tree density and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2 - 2.5 mile spacing across the landscape (Coconino NF Forest Plan, p. 65-9).	No change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Snags are 18" or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Coconino NF Forest Plan, p. 65-9).	Snags are 18" or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5 and 6).**
No corresponding forest plan direction	Develop and maintain a highly diverse vegetation mosaic: 30 - 90% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 -30% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns..
No corresponding forest plan direction	Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20-200 feet, but generally between 25-100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
No corresponding forest plan direction	Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Coconino NF Forest Plan, p. 65-9).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Coconino NF Forest Plan, p. 65-9).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage groups (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10-15 tons of woody debris per acre (Coconino NF Forest Plan, p. 65-9).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3-5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10-15 tons of woody debris per acre (Coconino NF Forest Plan, p. 65-10).	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre (Coconino NF Forest Plan, p. 65-10).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4-VSS 6 groups do not apply. One group of reserve trees, with a minimum of 1-2 trees per group will be left if the interspace size is greater than an acre in size. Interspace size is up to 4 acres.** Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre
Woodland: manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Coconino NF Forest Plan, p. 65-10).	No Change
Vegetation Management – Within Post-fledgling Family Areas	
General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area (Coconino NF Forest Plan, p. 65-10). .	No change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
No similar direction in forest plan	Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Coconino NF Forest Plan, p. 65-10).	No change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+%.	No change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Coconino NF Forest Plan, p. 65-10).	No change
No corresponding forest plan direction	Develop and maintain a highly diverse vegetation mosaic: 30 - 90% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.
No corresponding forest plan direction	Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20-200 feet, but generally between 25-100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
No corresponding forest plan direction	Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.

* Edited text is **bolded.**

Alternative B - Kaibab National Forest Site-Specific Non-Significant Forest Plan Amendments

One non-significant forest plan amendment is proposed for alternative B. Current forest plan direction and the need for plan variance is provided below. Table 54 provides the current forest plan direction and the proposed amendment language for comparison purposes.

Amendment 1. Management of canopy cover and ponderosa pine managed for an open reference condition within goshawk habitat

The Kaibab National Forest Plan (hereafter referred as "forest plan") directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an

interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- Stands are 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. Four classification characteristics are generally used to distinguish forest stands: bio-physical site (soils, aspect, elevation, 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 will shape structure over time). Based upon agency guidelines, the minimum stand mapping size is 10 acres.
- Interspaces are defined as the open space between tree groups intended to be managed for grass-forb-shrub vegetation during the long term. Interspaces may include scattered single trees.

Relevant Forest Plan Direction

Vegetation Management – Landscapes Outside Goshawk Post-fledging Family Areas

General: Snags are 18" or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Kaibab NF Land Management Plan, p. 29).

Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Kaibab NF Land Management Plan, p. 29).

Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre, (including the downed logs) (Kaibab NF Land Management Plan, p.30).

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

Vegetation Management - Within Post-fledging Family Areas

General: Provide for a healthy sustainable forest environment for the post-fledgling family needs of goshawks. The principle difference between within the post-fledgling family area and outside the post-fledgling family area is the higher canopy cover within the post-fledgling family area and smaller opening size within the post-fledgling family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledgling family area (Kaibab NF Land Management Plan, p.30).

Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Kaibab NF Land Management Plan, p.30).

Woodland: Maintain existing canopy cover levels (Kaibab NF Land Management Plan, p. 30).

Background

Canopy cover is defined as "the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage" (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, we used the FVS crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The only reference the forest plan has in terms of measuring canopy cover is in directing projects to measure "vertical crown projection on average across the landscape" (see Kaibab NF Land Management Plan, p.29). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between non-forested areas (interspace) and natural openings across the landscape. The forest plan is also silent on what percent of the landscape should be managed for non-forested areas (interspaces) that occur between individual trees, tree clumps, and tree groups. These non-forested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long-term.

Savanna treatments are proposed in 27,637 acres of ponderosa pine move towards the historic mollic-integrade soil characteristics consistent with a ponderosa pine "open" reference condition. The desired condition is to move towards restoring pre-settlement grass/forb interspaces and restore historic forest structure and pattern. The location of interspaces and reserve (leave) trees would be determined through the use of several tools including site quality and productivity and pre-settlement evidence. An amendment is needed because meeting 40 percent (or greater) canopy cover in VSS 4 to VSS 6 and having 3 to 5 reserve (leave) trees could not be guaranteed.

Need for Plan Amendment

In alternative B and D, there are 96,403 acres of habitat outside of goshawk post-fledgling family areas and 10,182 acres within goshawk post-fledgling family area habitat specific to this amendment (see figure 48). There is a need to define and describe interspace, clarify the relationship between interspace to the vegetation structural stage (VSS) classes, and describe how canopy cover would be measured in landscapes outside and within goshawk post-fledgling family areas (PFAs).

In acres managed for an open reference condition, there is a need to allow for managing for less than 40 percent canopy cover in VSS 4 to VSS 6, remove the 200 foot width metric related to openings, allow for creating reserve groups comprised of 1 to 2 residual trees if trees are not currently present. This amendment does not include those acres of habitat where no treatments are proposed (goshawk nest stands), or acres where prescribed burn-only treatment is proposed (see figure 49).

Amendment Description

In the "Vegetation Management - Landscapes Outside Goshawk Post-fledgling Family Areas" and "Vegetation Management -Within Post-fledgling Family Areas" section of the forest plan, a non-significant plan amendment would: (1) remove and/or replace references to using vertical

crown projection to measure canopy cover with language specific to this analysis, (2) add the desired percentage of interspace within uneven-aged stands to facilitate restoration and defines interspace, (3) add the interspace distance between tree groups, and, (4) add language clarifying where canopy cover is and is not measured, (5) add language clarifying reserve trees are specific to created regeneration openings in landscapes outside goshawk post-fledgling family areas, and (6) add language for the management of canopy cover and reserve trees in ponderosa pine managed for an open reference condition. New or edited text is underlined in the "Proposed New Guideline Language" column in table 54.

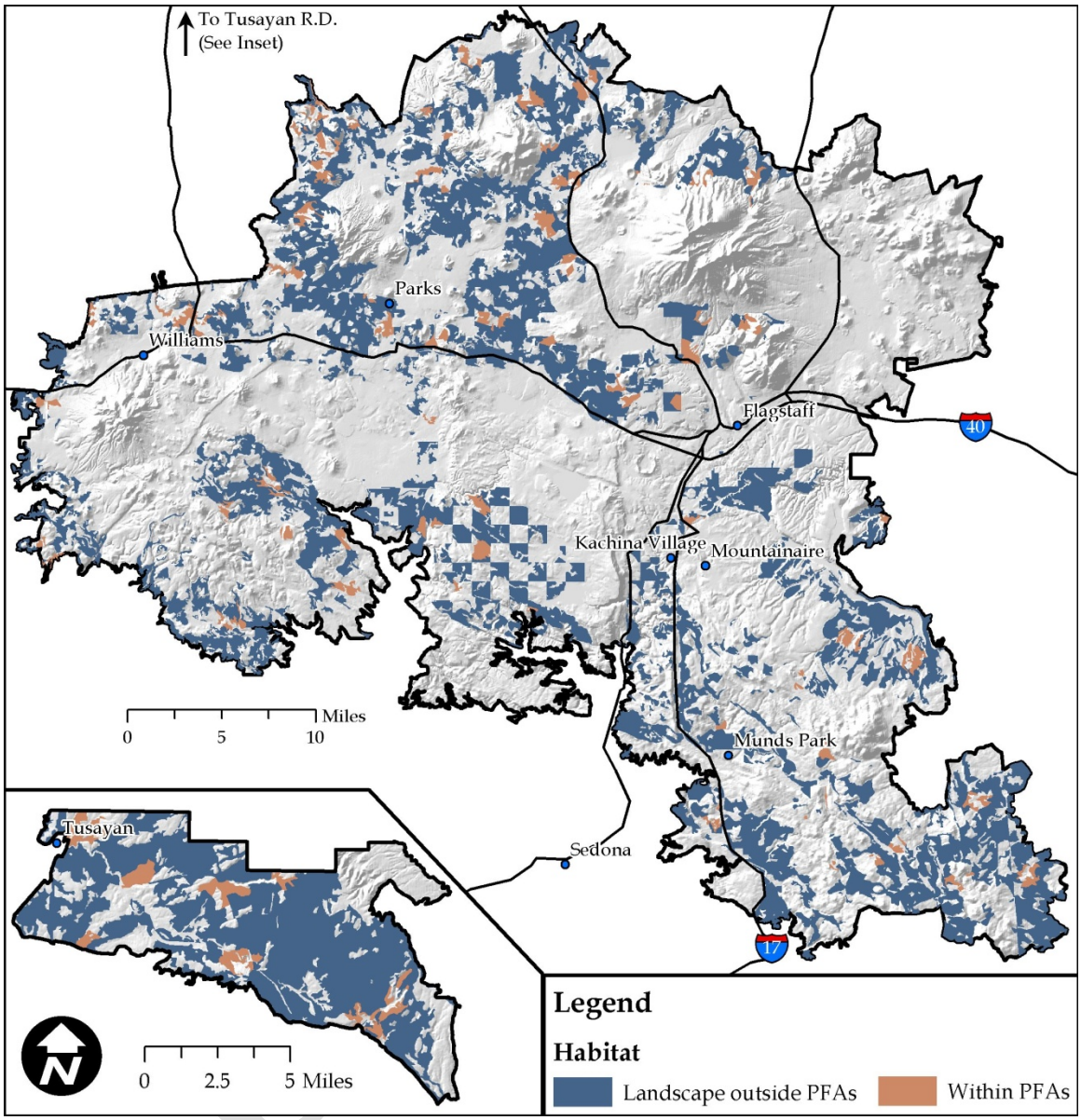

***Figure 48*. Alternative B -D Goshawk Habitat Subject to Canopy Cover Requirements in Vegetation Structural Stages (VSS) 4 and VSS 6 (Kaibab NF)**

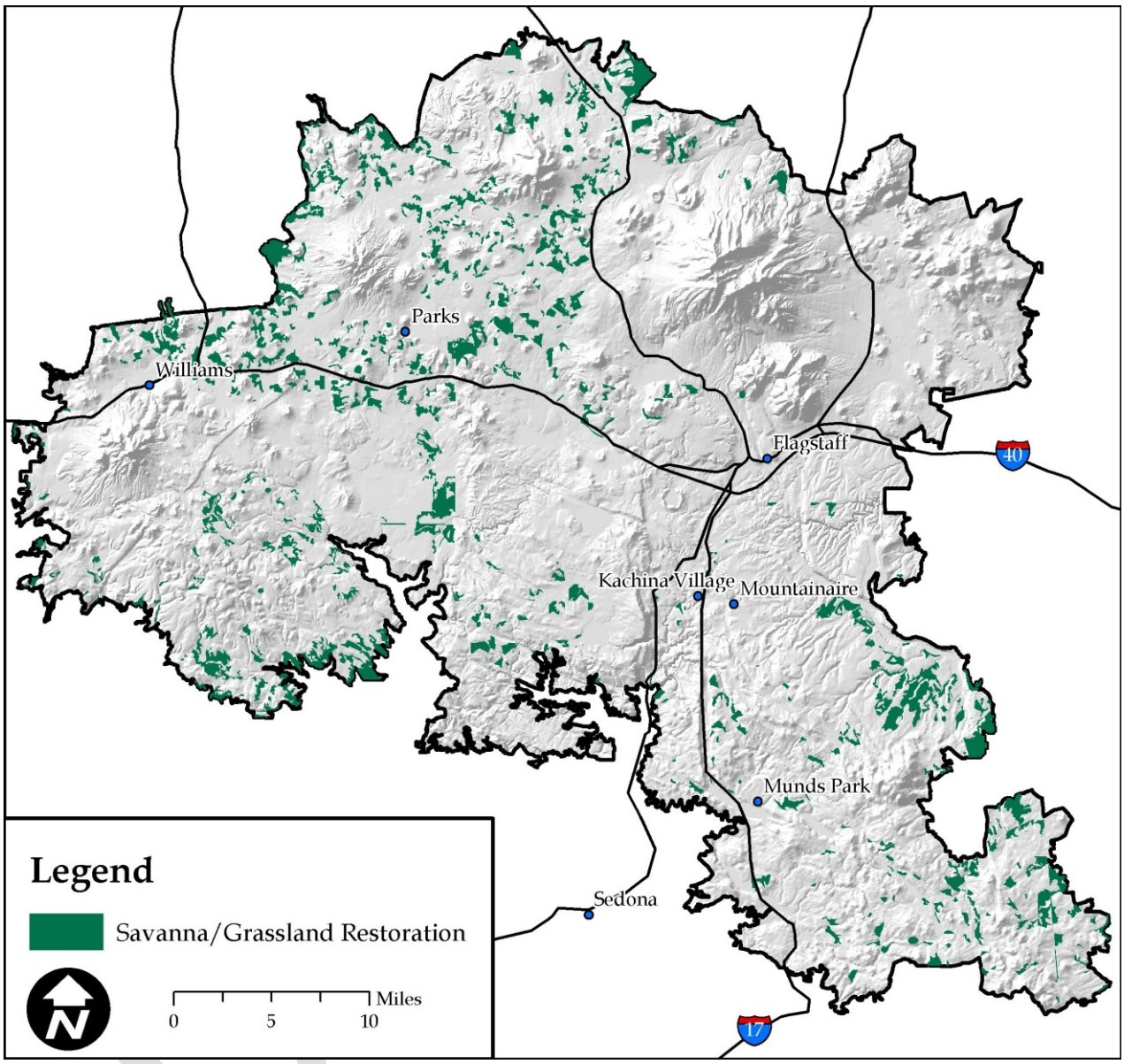

***Figure 49*. Alternative B-D Acres to be Managed for a Ponderosa Pine Open Reference Condition (Kaibab NF)**

Non-Significance Evaluation

Significance was evaluated against the criteria in Forest Service Manual (FSM) 1926.51 and 1926.52. Factors include timing, location, and size, relationship to forest goals, objectives, outputs, and management prescriptions. In terms of timing, the Kaibab National Forest Land Management Plan has been in place (and amended) since 1988 and plan revision efforts are underway. While the amendment does provide clarification that has been lacking since the forest plan was implemented, it is specific to this project.

Suitable goshawk habitat on the Kaibab NF encompasses approximately 541,000 acres (Keckler 2011, unpublished data) and the project area is comprised of about 399,633 acres of goshawk habitat (non-PFA, PFA, dPFA, and nest stands). The amendment would affect approximately 20 percent of all suitable goshawk habitats on the forest and about 27 percent of goshawk habitat within the project area. For this reason, location and size was determined to be non-significant.

Although the definition of interspace, the relationship between interspaces and VSS, and specifics for measuring canopy cover are addressed in this amendment, the environmental analysis and subsequent decision must address how forest plan canopy cover requirements in VSS 4 to 6 are met and how treatments move towards the desired VSS size class distribution. For this reason, the amendment is consistent with forest goals for wildlife and fish that promotes improving habitats through the development of habitat quality and diversity and the identification and protection of key habitats; and, for improving habitats for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Kaibab NF Land Management Plan, p.18).

The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. The land units on the Kaibab NF are geographic areas (GA) and land use zones (LUZ). Prescriptions are management practices selected and scheduled to apply to a specific area to attain multiple-use and other goals and objectives (36 CFR 219.3(u)). On the forest, the amendment provides direction 106,585 acres for the following geographic areas (GAs):

- 73,352 acres within GA 2 (Williams Forestland)
- 28,247 acres within GA 10 (Tusayan Forestland)
- 1,287 acres within GA 3 (North Williams Woodland)
- 1,970 acres in GA 1 (Western Williams Woodland)
- 1,025 acres in GA 8 (Tusayan Woodland)
- 702 acres in LUZ 21 (existing developed recreation sites)

Approximately 24 percent of GA 2 (of 308,394 total acres), 33 percent of GA 10 (of 86,250 total acres), 1 percent GA 1 (of 169,041 total acres). 2 percent of GA 3 (of 65,533 acres total), and less than 1 percent of LUZ 21 would be affected by the amendment. Two acres are unaccounted for as they are incorrectly attributed to Camp Navajo. Although the amendment provides direction for up to 33 percent of GAs, the amendment is specific to this analysis and would not impose requirements on future management. Because forest plan canopy cover requirements would be met in VSS 4 to 6 and movement towards balanced age classes would occur, the amendment is consistent with the management emphasis of achieving diverse and healthy stands.

Outputs identified in the forest plan are associated with sawtimber and other product harvest levels (meet demand for timber while reducing conflict with other resources), commercial and personal-use fuelwood programs (MBF), grazing capacity (AUM), watershed (acres in

unsatisfactory condition and water yield), developed recreation (management of public sites at the standard service level), developed and dispersed recreation outputs (RVD), and transportation (acres closed to off-road vehicle use), habitat diversity (change in Habitat Diversity Index), Old Growth Habitat (Acres), and Average Annual Wildlife and Fish Use (WFUD). This amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services. Therefore, the amendment would not result in a change land productivity or timber suitability classification; and, would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use. For these reasons, the amendment is considered non-significant.

Non-Significance Evaluation for Ponderosa Pine Managed for an Open Reference Condition

Significance was evaluated against the criteria in FSM 1926.51 and 1926.52. Factors include timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions. In terms of timing, the Kaibab NF forest plan has been in place (and amended seven times) since 1988 and plan revision efforts are underway.

Suitable goshawk habitat on the forest encompasses about 541,000 acres (ponderosa pine cover type) and the project area includes approximately 215,591 acres of goshawk habitat (non-PFA, PFA, dPFA, and nest stands). Of this total, approximately 193,941 acres is non-PFA habitat. The amendment would affect approximately 5 percent of all suitable goshawk habitats on the Kaibab NF and about 13 percent of non-PFA goshawk habitat within the project area. For this reason, location and size was determined to be non-significant. The amendment would facilitate moving approximately 27, 637 acres of ponderosa pine towards the desired forest structure (groups and clumps with herbaceous openings) that maximizes prey base species habitat and allows for the reintroduction of fire into the ecosystem.

The amendment is consistent with forest goals for wildlife and fish that promote improving habitats through the development of habitat quality and diversity and the identification and protection of key habitats; and for improving habitats for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Kaibab NF Forest Plan, page 18).

Ponderosa pine savanna restoration is not new to the Kaibab NF. A review of past and current vegetation projects indicates this has been a common restorative practice since at least 1992 (Government Vegetation Treatment project, Williams District). Since 1992, other projects that have included savanna restoration on the Williams District include the 1995 Little Aso Habitat Diversity Project, the 2002 Spring Valley WUI, the 2003 French Vegetation Project, the 2005 City Project, and the 2011 Community Tank Grassland Restoration Project.

The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. The land units on the Kaibab are geographic areas (GA) and land use zones (LUZ). Prescriptions are management practices selected and scheduled to apply to a specific area to attain multiple-use and other goals and objectives (36 CFR 219.3(u)). On the Kaibab NF, the proposed amendment is within the following geographic areas: 26,831 acres is within GA 2, Williams Forestland, 500 acres is within GA 3, North Williams Woodland, and 302 acres is within GA 1, Western Williams Woodland. Three acres are incorrectly (forest plan mapping) attributed to Camp Navjao. The proposed amendment would affect approximately 9 percent of GA 2 (of 308,394 total acres) and less than 1 percent of GA 3 (of 65,533 acres total) and GA 1 (of 169,041 total acres). In alternative C, there is less than a 50-acre difference in

comparison to alternative B and D. For this reason, there is no measurable difference for the analysis on relevancy to the GAs. The amendment would not impose requirements on future management of the 27,637 acres of goshawk non-PFA habitat as the amendment is site specific to this analysis. The amendment is consistent with the management direction for wildlife and fish resources, which directs the forest to ensure a moderate to high level of habitat diversity and capability (Kaibab NF Forest Plan, pages 50 and 53)

Outputs identified in the current forest plan are associated with sawtimber and other product harvest levels (meet demand for timber while reducing conflict with other resources), commercial and personal-use fuelwood programs (MBF), grazing capacity (AUM), watershed (acres in unsatisfactory condition and water yield), developed recreation (management of public sites at the standard service level), developed and dispersed recreation outputs (RVD), and transportation (acres closed to off-road vehicle use), habitat diversity (change in habitat diversity index), old growth habitat (acres), and average annual wildlife and fish use (WFUD).

The amendment affects about 27,637 acres and the forest plan estimates there are 490,368 acres classified as tentatively suitable timberland. Therefore, the amendment affects about 6 percent of the suitable land base. Due to the minimal acres affected and the age of the forest plan, the amendment would not alter outputs in the foreseeable future on a forest-wide basis or change the long-term relationship between levels of goods (timber, commercial, and personal use fuelwood) and services. Any predicted impacts/benefits to water yield are under analysis but expected to be minimal due to the acres being treated in the context of a 5th or 6th code watershed. The amendment would not result in a change to land productivity; therefore, it would not affect timber suitability classification. Whether the 27, 637 acres would be suitable in the long term will be evaluated during the forest plan revision process. The amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Table 54. **Amendment 1 - Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition in Goshawk Habitat**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk Post-fledgling Family Areas	
No similar direction in forest plan (see Kaibab NF Forest Plan, p. 29).	General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces should be variable. Over time the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Kaibab NF Forest Plan, p. 29).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), and 20% old forest (VSS 6). Note: the specified percentages are a guide and actual percentages are expected to vary plus or minus up to 3%.

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the distribution of VSS, tree density and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2 - 2.5 mile spacing across the landscape (Kaibab NF Forest Plan, p.29).	No change
Snags are 18" or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Kaibab NF Forest Plan, p. 29).	Snags are 18" or larger DBH and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5 and 6).**
No corresponding forest plan direction	Develop and maintain a highly diverse vegetation mosaic: 30 -90% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 -30% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.
No corresponding forest plan direction	Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20-200 feet, but generally between 25-100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
No corresponding forest plan direction	Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Kaibab NF Forest Plan, p. 29).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Kaibab NF Forest Plan, p. 29).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage groups (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10-15 tons of woody debris per acre (Kaibab NF Forest Plan, p. 29).	No Change
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3-5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10-15 tons of woody debris per acre (Kaibab NF Forest Plan, pp. 29-30).	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre (Kaibab NF Forest Plan, p.30).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4-VSS 6 groups would not apply. One group of reserve trees, with a minimum of 1-2 trees per group will be left if the interspace size is greater than an acre in size. Interspace size is up to 4 acres. Leave at least 2 snags per acre, 3 downed logs per acre, and 5-7 tons of woody debris per acre.**
Woodland: manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Kaibab NF Forest Plan, p. 30).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Vegetation Management – Within Post-fledgling Family Areas	
General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area (Kaibab NF Forest Plan, p. 30). .	No change
No similar direction in forest plan	Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Kaibab NF Forest Plan, p. 30). .	No change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+% (Kaibab NF Plan, p. 30)	No change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Kaibab NF Forest Plan, p. 30). ..	No change
Woodland: Maintain existing canopy cover levels (Kaibab NF Plan, p. 30)	No change
No corresponding forest plan direction	Develop and maintain a highly diverse vegetation mosaic: 30 -90% of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.
No corresponding forest plan direction	Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20-200 feet, but generally between 25-100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
No corresponding forest plan direction	Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.

* Edited text is **bolded.**

Alternative C - Coconino National Forest Site-Specific Non-Significant Forest Plan Amendments

Two non-significant forest plan amendments are proposed for alternative C. Current forest plan direction and the need for plan variance is provided below. Table 56 provides the current forest plan direction and the proposed amendment language for comparison purposes.

Amendment 1. Mechanical treatment up to 18-inch dbh in 18 Mexican spotted owl protected activity areas (PACs) to improve habitat structure, prescribed fire in 56 core areas, and manage 6,321 acres of target-threshold habitat for a minimum of 110 to 150 basal area.

Relevant Forest Plan Direction

Standards: Allow no timber harvest except for fuelwood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service (Coconino National Forest Plan, p. 65)

Guidelines:

Protected Activity Centers

Harvest fuelwood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl.

Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below, except for the Clark PAC where trees less than 16 inches diameter will be harvested (Coconino National Forest Plan, p. 65-2).

Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area (Coconino National Forest Plan, p. 65-2).

Use light prescribed burns in non-selected protected activity centers on a case-by-case basis. Burning should avoid a 100 acre "no treatment" area around the activity center. Large woody debris, snags, clumps of broad-leafed woody vegetation should be retained and hardwood trees larger than 10 inches diameter at the root collar (Coconino National Forest Plan, p. 65-2)

Restricted Areas (Mixed conifer, pine-oak, and riparian forests)

Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold

values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF (Coconino National Forest Plan, pp. 65-3, 65-4)

***Table 55*. Coconino NF Forest Plan Minimum Threshold Conditions (Current)**

Variable	Mixed Conifer		Pine-Oak
Restricted Area %	10%	+15%	10%
Stand Averages for:			
Basal Area	170	150	150
18 inch+ trees/ac	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing			
12-18”	10	10	15
18-24”	10	10	15
24+”	10	10	15

Background

There are 190 Mexican spotted owl (MSO) protected activity centers (PACs) entirely or partially within the Coconino NF (Coconino NF 2011) and approximately 117,636 acres of PACs[4]. There are 117 PACs (36,455 acres of PAC habitat) located in the 4FRI project area. Coconino National Forest Plan (hereafter referred to as “forest plan”) direction for MSO is derived from the USDI MSO Recovery Plan (USDI FWS 1995).

[4] There are 168 MSO protected activity centers (PACs) occurring entirely on the Coconino NF. In addition, six PACs on the Coconino NF overlap with the Apache-Sitgreaves NFs, four PACs overlap with Walnut Canyon National Monument, four PACs overlap with state lands, three PACs overlap with the Kaibab NF, one PAC overlaps with the Navajo Army Depot, one PAC overlaps with the Naval Observatory and state land, one PAC overlaps with private property, and two PACs overlap with both private property and the Apache-Sitgreaves NFs.

The forest plan allows for treatments that include fuelwood and fire risk abatement outside of the 100-acre core area up to 9-inch dbh. The 9-inch dbh limit is not derived from ecological considerations, but was instead based on commercial value, i.e., the 9-inch dbh limitation effectively prevented commercial harvest within PACs, which was a concern in the early 1990s (Noble, personal communication 2011). As written, the forest plan standard excludes mechanical treatments within PACs unless it is for fuelwood collection or fire risk abatement. This standard effectively eliminates the ability to address any deficiency in the forest structure that is required by MSOs in PACS and within the no-treatment core area.

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the U.S. Fish and Wildlife Service (USFWS) worked together to review individual PACs within the project area. PAC reviews included an evaluation of past survey results, existing forest conditions, past management activities, current management planning outside the 4FRI project area, administrative status (e.g., wilderness or general forest status), and on-the-ground familiarity with the sites.

Landscape databases and remote imagery, including aerial photography, were reviewed spatially. The evaluation process was based on whether the proposed silvicultural treatments would move existing spotted owl habitat towards the desired conditions described in the Recovery Plan (1995). Eighteen PACs were identified as having habitat that could be improved with vegetation treatments. Each stand within the 18 PACs was modeled to identify treatments that would yield the best existing and future MSO habitat conditions. See the wildlife report for complete details on the habitat evaluation process.

Mechanical Treatment up to 18-inch dbh in Select PACs

MSO PAC field reviews, data evaluation, and vegetation simulation modeling indicate 18 MSO PACs and approximately 5,164 acres or 14 percent of PAC habitat within 18 PACs would move towards Recovery Plan desired conditions from mechanical treatments up to 9-inch dbh. An additional 7,656 acres within 18 PACs would have nesting and roosting habitat benefits from mechanical treatment up to 18-inch dbh. Mechanical treatments above 9-inch dbh would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs. Increasing the range of mechanical treatments thresholds up to 18-inch dbh within 18 MSO PACs would provide for maximum improvement of nesting and roosting habitat. The proposal addresses comments from USFWS and is in alignment with the draft MSO Recovery Plan (USDI 2011). Figure 50 displays the general location of mechanical treatment up to 18-inch dbh, prescribed burning, and areas where no treatment is proposed within MSO PACs.

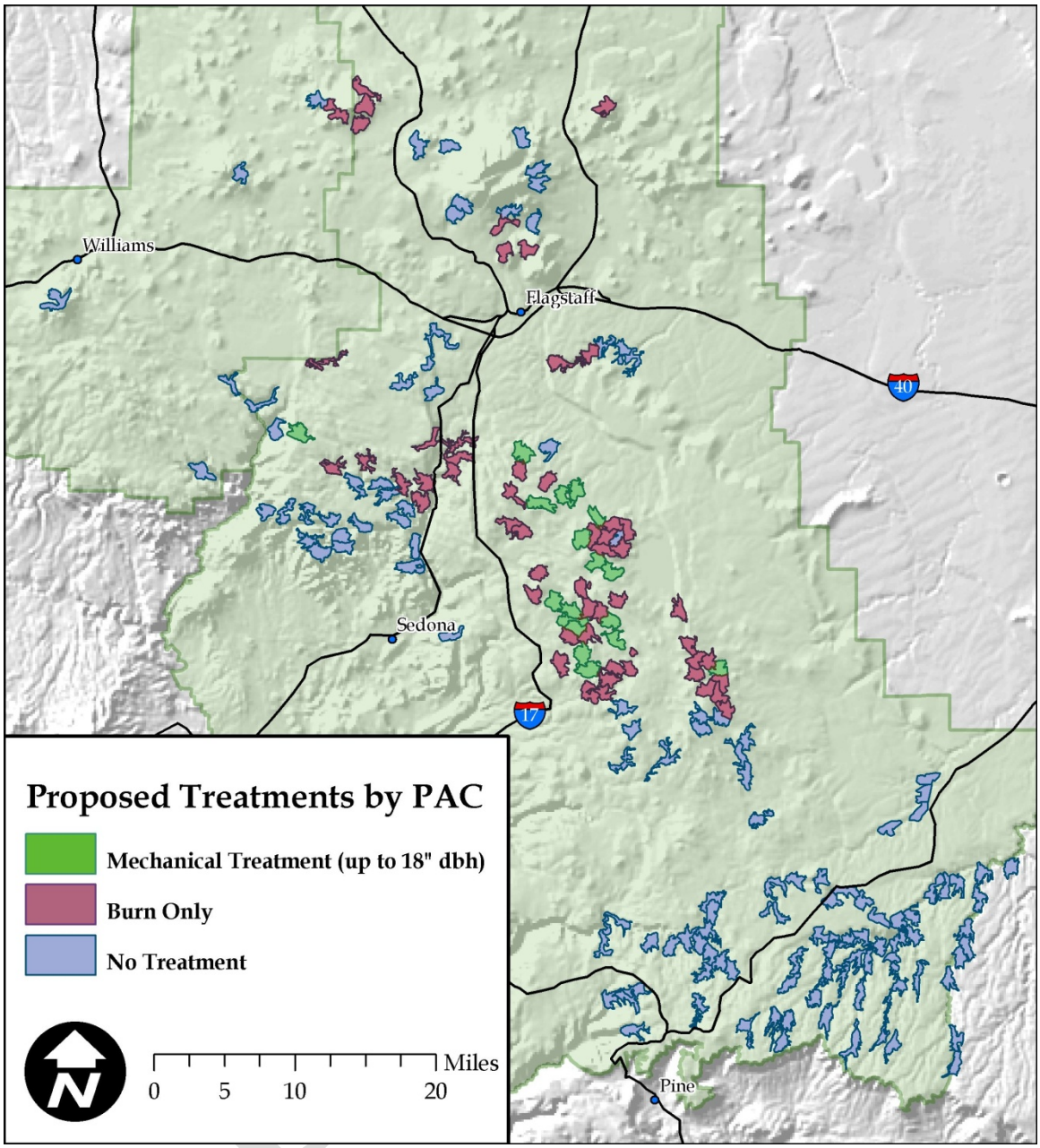

***Figure 50*. Alternative C Proposed Activities in MSO PACs in Relation to no Treatment Areas**

Prescribed Fire within 56 PAC Core Areas

In order to improve habitat conditions outside of the 100-acre core area within 56 PACs, there is a need to use prescribed fire within select PAC core areas. Without the use of low-intensity prescribed fire within the core, each core area would need to have fireline constructed around it to prevent fire from entering the nest site during treatment in the surrounding PAC habitat. Depending on site and weather conditions, this could be anything from a 3-foot wide hand line to a dozer line. The number of acres potentially affected from fireline activities ranges from 0.80 (hand line) acres to 3.2 (dozer) acres. Both hand line and dozer line would likely require habitat post-treatment rehabilitation.

Burning in MSO PACs is difficult as there is a need to address the high fuel loadings while maintaining many of the habitat elements that contribute to fuel loading. Burning has to be conducted in a very short timeframe to avoid the breeding season (i.e., the nonbreeding season, September 1 to February 28). Lining 56 core areas greater than or equal to 100 acres would be expensive in terms of time, money, and other resource commitments. In many projects, PAC treatments have been eliminated for these reasons. Applying low-intensity prescribed burning within the 100-acre core areas would eliminate the need for fireline construction and would potentially minimize impacts on at least 179 acres of protected habitat. Figure 51 displays the general location of MSO PACs proposed for prescribed burning including where burning would occur within core areas.

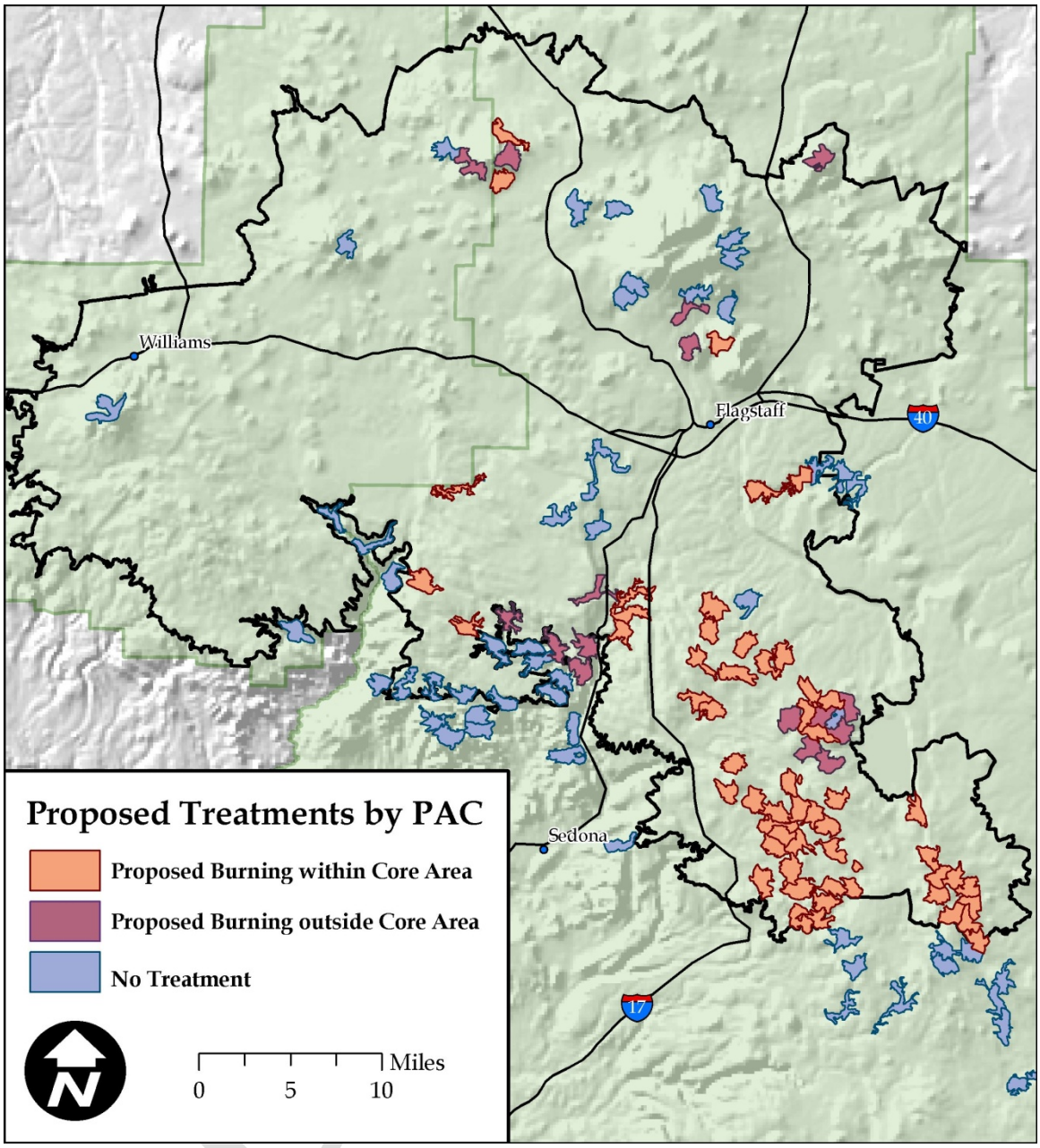

***Figure 51*. Alternative C Prescribed Burning Within and Outside of MSO PAC Core Areas**

Manage 6,321 Acres of Pine-oak Target-threshold Habitat for a Minimum of 110 to 150 Basal Area

Within the Coconino NF portion of the 4FRI project area, approximately 6,321 acres of Mexican spotted owl (MSO) restricted habitat is target/threshold. The existing Mexican spotted owl Recovery Plan (USDI USFWS 1995) states that 150 basal area (BA) is the minimum level managers should consider for nesting and roosting habitat. For this analysis, the USFWS encouraged the Forest Service to use the best science available and not simply follow existing policy from 1995. The draft Mexican spotted owl Recovery Plan (USDI USFWS 2011) is the most recent summary of the science related to managing MSO habitat. The draft Recovery Plan includes a new recommended minimum BA of 110 feet^2 per acre. The draft Recovery Plan is expected to be final before the 4FRI EIS is scheduled to be completed.

Managing 6,321 acres of restricted (target/threshold) pine-oak habitat to a threshold range of 110 to 150 BA would allow more of the uncharacteristic in-growth of mid-aged and mid-sized trees (that currently dominate the 4FRI landscape) to be removed (see figure 51). Thinning more of these trees would improve the ability to retain large trees and increase large tree growth rates. There would be increased spatial heterogeneity, including irregular tree spacing and improved tree age diversity. Increasing the BA range would provide opportunities to mimic canopy gap processes which produce horizontal variation in stand structure. All of the above features are important elements of MSO habitat.

Use of the best science is fundamental to achieving or moving towards a restored landscape. The current Recovery Plan (USDI 1995) puts an emphasis on "the danger of catastrophic wildfire" and additionally states that "[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl." Managing for forest densities below 150 BA would better achieve both objectives. Management of forested ecosystems also needs to address forest health problems, return forested ecosystems to conditions within their natural range of variation, and work toward sustainable and resilient ecosystems (USDI 1995). Managing for conditions below 150 BA immediately after treatment would better meet each of the respective objectives. Finally, the Recovery Plan recommends managers concentrate efforts on the recovery units with the highest owl populations and where significant threats exist, both of which fit the Upper Gila Mountain Recovery Unit where the 4FRI takes place.

Amendment Description

The amendment, which is specific to 18 MSO PACs within the 4FRI project area, would add: (1) language to allow mechanical treatments to improve habitat structure, and, (2) language to allow mechanical treatment within 18 MSO PACs up to 18 inch dbh to improve nesting and roosting habitat, (3) language to allow low-intensity prescribed fire within 56 PAC core areas, and (4) edit the minimum threshold basal area requirement in pine-oak to include a range of 110 to 150 BA. Edited text is highlighted in bold in table 56.

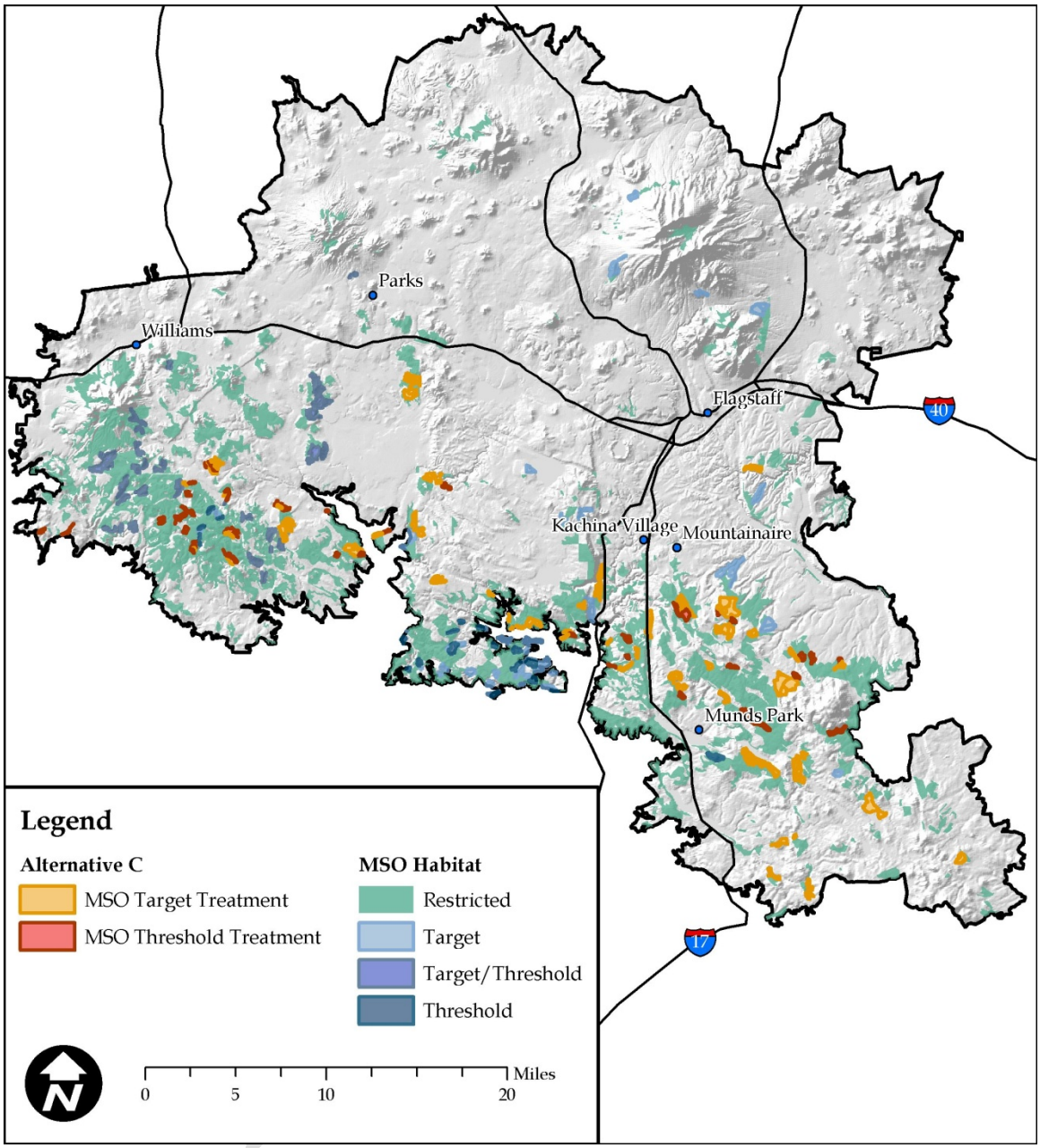

***Figure 52*. Alternative C Locations of MSO Target and Threshold Amendment Actions (Coconino NF)**

Table 56. **Amendment 1 Current and Proposed Forest Plan Language**

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Standard: Allow no timber harvest except for fuelwood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with US Fish and Wildlife Service. (Coconino NF Forest Plan, p. 65)	Allow no timber harvest except for fuelwood, fire risk abatement, in established protected activity centers **except as follows: Allow fuelwood, fire risk abatement, and habitat structure improvement in the following established protected activity centers: Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring.** For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with US Fish and Wildlife Service.
Guideline: Protected Activity Centers, Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area (Coconino NF Forest Plan, p. 65-2).	Guideline: Protected Activity Centers, Treat fuel accumulations to abate fire risk. Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area **except as follows: Use combinations of thinning trees up to 18 inch dbh within the Lake No. 1/Seruchos, Archies, Red Hill, Holdup, Rock Top, Foxhole, Bar M, PACs, and up to 18 inch dbh in Crawdad, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Lee Butte, and Sawmill Springs PACs**, mechanical fuel treatment and prescribed fire to abate fire risk **and improve habitat structure in the remainder of the selected protected activity center outside the 100 acre "no treatment" area. Use low-intensity prescribed burning within 56 select 100-acre core areas to eliminate the need for fireline construction.**
Restricted Areas (Mixed conifer, pine-oak, and riparian forests)	
Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area at 150	Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF. (Coconino NF Forest Plan, pp.65-3 to 65-5).	at 150 basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. **The minimum mixed pine-oak restricted area includes 10% at 170 basal area and an additional amount of area at 110 -150 basal area. The additional area of 110-150 basal area is +10% in BR-E and +15% in all other recovery units.** The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF.

* Edited text is **bolded.**

***Table 57*. Current Coconino NF Forest Plan MSO Minimum Threshold Conditions**

Variable	Mixed Conifer		Pine-Oak
Restricted Area %	10%	+15%	10%
Stand Averages for:			
Basal Area	170	150	150
18 inch+ trees/ac	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing			
12-18”	10	10	15
18-24”	10	10	15
24+”	10	10	15

***Table 58*. Coconino NF Forest Plan Amendment MSO Minimum Threshold Conditions**

Variable	Mixed Conifer		Pine-Oak
Restricted Area %	10%	+15%	10%
Stand Averages for:			
Basal Area	170	150	**110-150**
18 inch+ trees/ac	20	20	20

Variable	Mixed Conifer		Pine-Oak
Oak Basal Area	NA	NA	20
Percent total existing			
12-18”	10	10	15
18-24”	10	10	15
24+”	10	10	15

Consistency with the MSO Recovery Plan

Mechanical treatment up to 18-inch dbh is consistent with the current MSO Recovery Plan which describes “large trees” as either greater than 18 inches dbh (p.92) or greater than 19 inches (p.65) (USDI FWS 1995).

By definition, PAC habitat and especially core areas have high fuel loading and the uncharacteristic accumulation of ground fuels puts them at further risk. Reducing fuels to reduce the risk of high-severity fire in these important habitats would contribute towards conservation of this threatened species. A forest plan variance (allowing low-intensity prescribed burning within the 100-acre core area), would eliminate the need for hand line and/or dozer line construction, allow for the maximum number of surrounding PAC acres to be treated with prescribed fire, and would potentially minimize up to 560 acres of ground disturbance to PAC habitat.

The current Recovery Plan (USDI FWS 1995) states “Two primary reasons were cited for the listing: historical alteration of its habitat as the result of timber management practices, specifically the use of even-aged silviculture…” and “The danger of catastrophic wildfire…” While the Recovery Plan is clear that the primary existing threat is high-severity wildland fire, the Recovery Plan also states that “[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl.” The Recovery Plan recognizes that “ecosystems are temporally dynamic [and] provisions are needed to ensure owl habitat in the long term.” The primary objective to be achieved by the Recovery Plan guidelines is protection of the best available habitat for the MSO, while maintaining sufficient flexibility for land managers to abate high fire risks and to improve habitat conditions for the owl and its prey (p. 89). The potential for using silviculture as a tool for meeting objectives such as maintaining and developing MSO habitat and enhancing various ecological factors is specifically identified in the Recovery Plan.

The Recovery Plan recommends that recovery efforts concentrate on the recovery units with the highest owl populations and where significant threats exist. The project is located within the Upper Gila Mountain Recovery Unit (UGM RU). The UGM RU contains the largest known number of Mexican spotted owls with approximately 55 percent of known spotted owl territories. The major land use within this recovery unit has been timber harvest.

The Recovery Plan describes a change in the size-class distribution of trees that occurred on commercial forest lands in Arizona and New Mexico between the 1960s and the 1980s. The density of large trees (>19 inch dbh) decreased by 20 percent and sapling-sized trees (1- to 4.9-inch dbh) decreased in both absolute density and in relative contribution to the size-class distribution. Trees 5- to 12.9-inch dbh increased in density by 40 percent and in relative proportion of the size-class distribution and trees 13- to 19-inch dbh increased in density but not in the relative proportion of the tree distribution. The decrease in large trees was described as “an alarming negative trend with respect to a very critical component of spotted owl habitat” (p. 68)

given that “the basis to maintain owl populations is to ensure that adequate habitat quality and quantity will be sustained through time.” In order to achieve this, the Recovery Plan advocates using coarse and fine filters for ecosystem management.

Coarse filters should be used “to maintain the natural array of conditions that exist with the biotic and physical limits of the landscape” while fine filters may be used “to provide specialized habitats or habitat elements within that overall landscape.” They recommend “innovative applications of uneven-aged management” for developing and maintaining important but difficult-to-replace spotted owl habitat elements, including large pine and oak trees and key habitat components, such as trees greater than 24-inch dbh and prey habitat. The amendment allows for using silvicultural and prescribed fire treatments in select PACs at risk of losing key MSO habitat elements through declining forest health. Treatment objectives are to develop and maintain adequate MSO habitat quality and quantity through time.

The need to evolve from managing solely for fuelwood collection and fire risk abatement is reflected in the Draft Revised Recovery Plan for the Mexican spotted owl (USFWS 2011). The Draft Revised Recovery Plan (USFWS 2011) is being prepared for final release and is expected to be finalized before the project is implemented. In it the USFWS states “Management is the most conservatively oriented toward owl management within PACs, but is by no means "hands off.” The draft recognizes situations exist where management is needed to sustain or enhance desired future conditions for the owl...” It goes on to state “Mechanical treatments to achieve these objectives require a landscape analysis to determine where the needs are greatest” which is the process we are currently undergoing (USDI USFWS 2011).

Non-Significance Evaluation

Significance of the proposed amendment was evaluated against the criteria in Forest Service Manual (FSM) 1926.51 and 1926.52. Factors include timing, location, and size, relationship to forest goals, objectives, outputs, and management prescriptions. In terms of timing, the Coconino National Forest Plan (hereafter referred to as the “forest plan”) has been in place and amended several times since 1987, and, revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region’s 1996 Amendment of Forest Plans Record of Decision (USDA 1996). The actions allowed via the amendment are consistent with existing forest plan direction in that it improves nesting and rooting habitat and reduces the risk of loss from fire. Because a draft MSO Recovery Plan is being developed by the USFWS (USDI 2011), forest plan direction is likely to be amended to incorporate desired conditions and recognizing that habitat restoration, in addition to the reduction of fire risk, is key to improving habitat quality.

Approximately 59,223 acres of MSO PAC habitat occurs within the project area. Treating select acres up to 18-inch dbh would affect 7,656 acres or 13 percent of the habitat in the project area and approximately 7 percent of the total PAC habitat on the forest. The amendment facilitates moving ponderosa pine towards the desired forest structure that enhances owl roosting and nesting habitat needs. Mechanical treatments above 9-inch dbh would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs. Approximately 14 percent of the 35,566 acres of MSO PAC habitat within the project area would be affected by prescribed burning within 56 MSO core areas. This portion of the amendment is not significant in terms of location and size in that they would affect management of approximately 4 percent of all (117,636 acres) MSO PACs on the forest. The amendment would facilitate moving ponderosa pine towards the desired forest structure that enhances owl nesting habitat and roosting needs. The amendment minimizes up to 560 acres of potential ground disturbance (100 acres per PAC)

within 56 PACs. A maximum of 6,321 acres of restricted (target-threshold) habitat or approximately 9 percent of all MSO restricted-only habitat (73,771 acres) within the project area would be affected by adding a basal area range of 110 to 150. This equates to affecting 13 percent (of the 49,620 acres) of the restricted-only habitat on the Coconino NF

The amendment is consistent with forest plan goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest Plan, replacement page 22-1) and for improving habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest Plan, replacement page 23).

The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called prescriptions and the land units are called management areas. Prescriptions are management practices selected and scheduled to apply to a specific area to attain multiple-use and other goals and objectives (36 CFR 219.3(u)). The amendment is consistent with goals and objectives by protecting conditions and structures used by spotted owls where they exist and to set other stands on a trajectory to grow into replacement nest habitat or to provide conditions for foraging and dispersal (USDI 1995).

The actions are predominantly within management area (MA) 3 (ponderosa pine below 40 percent slopes) and MA 35 (Lake Mary Watershed). The amendment intent is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and meeting MSO standards and guidelines which emphasize improving and maintaining the quality of the habitat (MA 3) and moving ponderosa pine towards desired forest structure, including northern goshawk and MSO habitats (MA 35). MA 3 (511,015 acres) and MA 35 (62,536 acres) account for 573,933 total acres forest-wide. Mechanical thinning up to 18-inch dbh would affect about 5,605 acres or 1 percent of MA 3 and about 1,829 acres or 3 percent of MA 35 total acres. Prescribed fire within 56 core areas would affect about 3,500 acres or 0.7 percent of MA 3 and about 1,200 acres or 2 percent of MA 35 total acres. About 186 acres or 5 percent of MA 5 (3,450 acres forest-wide) would be affected. The restricted habitat component would affect about 4,083 acres or about 1 percent of MA 3 and about 1,926 acres or 3 percent of MA 35 total acres. Acres in the Walnut Canyon and West MAs account for less than 350 acres. Overall, less than 1 percent of the MAs would be affected. There would be no requirements binding future management of the PACs as the amendment is site-specific to this analysis.

Outputs identified in the forest plan are associated with MBBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MBBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM) and permitted livestock use (MAUM). Due to the minimal acres affected, the amendment would not alter outputs on a forest-wide basis or change the long-term relationship between levels of goods (timber, firewood) and services.

In comparison the forest's total suitable timber lands (626,326 acres), the portion of the amendment that proposes mechanical treatment in PACs and expands the basal area in restricted habitat affects about 1 percent of those lands. For this reason, treatments within PACs and the minimal (6,321) acres treated in restricted habitat do not measurably increase or decrease timber outputs or firewood availability. There would be no effect to outputs on a forest-wide basis or change the long-term relationship between levels of goods (timber, firewood) and services as the core areas proposed for treatment have been managed as no-treatment (no timber or firewood outputs). No activity would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 2. Management of canopy cover and ponderosa pine managed for an open reference condition within goshawk habitat. (See alternative B.)

The amendment is similar to what was proposed in alternative B with two minor differences: In alternative C, the acres of goshawk habitat affected is reduced by less than 200 acres to 139,161 acres. This slightly changes the acres affected by MA; however, the percentage of MAs affected is the same as described in alternative B. The proposed amendment affects 92,204 acres of management area (MA) 3 (ponderosa pine below 40 percent), 14,287 acres of MA 35 (Lake Mary Watershed), and 12,844 acres of MA 38 (West). In sum, MA 3 (511,015 acres), MA 35 (62,536 acres), and MA 38 (36,298 acres) account for 609,849 total acres forest-wide. The proposed amendment would affect 18 percent of MA 3, 23 percent of MA 35, and 35 percent of MA 38.

Alternative C – Kaibab National Forest Site-Specific Non-Significant Forest Plan Amendments

Two non-significant forest plan amendments are proposed for alternative C.

Amendment 1. Management of canopy cover and ponderosa pine managed for an open reference condition within goshawk habitat. (See alternative B)

The proposed amendment is the same as described in amendment 2 for alternative B.

Amendment 2. Mechanical treatment and prescribed fire in the proposed Garland Prairie Research Natural Area (RNA).

Background

Management of the proposed Garland Prairie Research Natural Area (RNA) was addressed in the current forest plan but the designation (through an official establishment record) was never completed. When Garland Prairie was originally recommended as a RNA, there was a need for montane grassland type representation. This is no longer true, and as a result it does not meet the criteria identified in Region 3 Research Natural Area process. In the forest plan revision process, the proposed RNA is recognized as having value as a reference area that is protected from activities that directly or indirectly modify ecologic processes (Kaibab NF 2012). However, it is not being proposed as a RNA.

Currently, the proposed RNA is heavily encroached upon by small- to mid-diameter ponderosa pine trees and infestations of Dalmation toadflax. Historically, grassland communities on the forest had less than 10 percent tree cover. Impacts from grazing, logging, and fire suppression practices reduced or eliminated the vegetation necessary to carry low-intensity surface fires across the landscape, thereby altering the natural fire regimes and allowing uncharacteristic forest succession to take place. In addition to past practices, the location of the RNA within the urban interface has hindered the ability to use fire as a natural process within the RNA (Kaibab NF 2012).

Need for the amendment

As written, the forest plan excludes the ability to conduct prescribed burning and mechanical treatments as it focuses on managing natural and human-caused ignitions. However, past management activities have included limited tree cutting for meadow restoration and wildfire risk abatement. Although the forest plan does not provide extensive management direction for the

proposed RNA, Forest Service policy (FSM 4063.02) addresses the need to maintain representative areas in order to preserve and maintain genetic diversity and serve as reference areas for the study of natural ecological processes incuding disturbance. There is a need to restore biodiversity within the grassland ecotone. There is an opportunity, consistent with FSM 4063.02.4, for treatments within to serve as a reference for the study of natural ecological processes (fire) including disturbance.

Amendment Description

The amendment would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed RNA. Figure 53 displays the proposed mechanical and prescribed fire treatments within the proposed RNA.

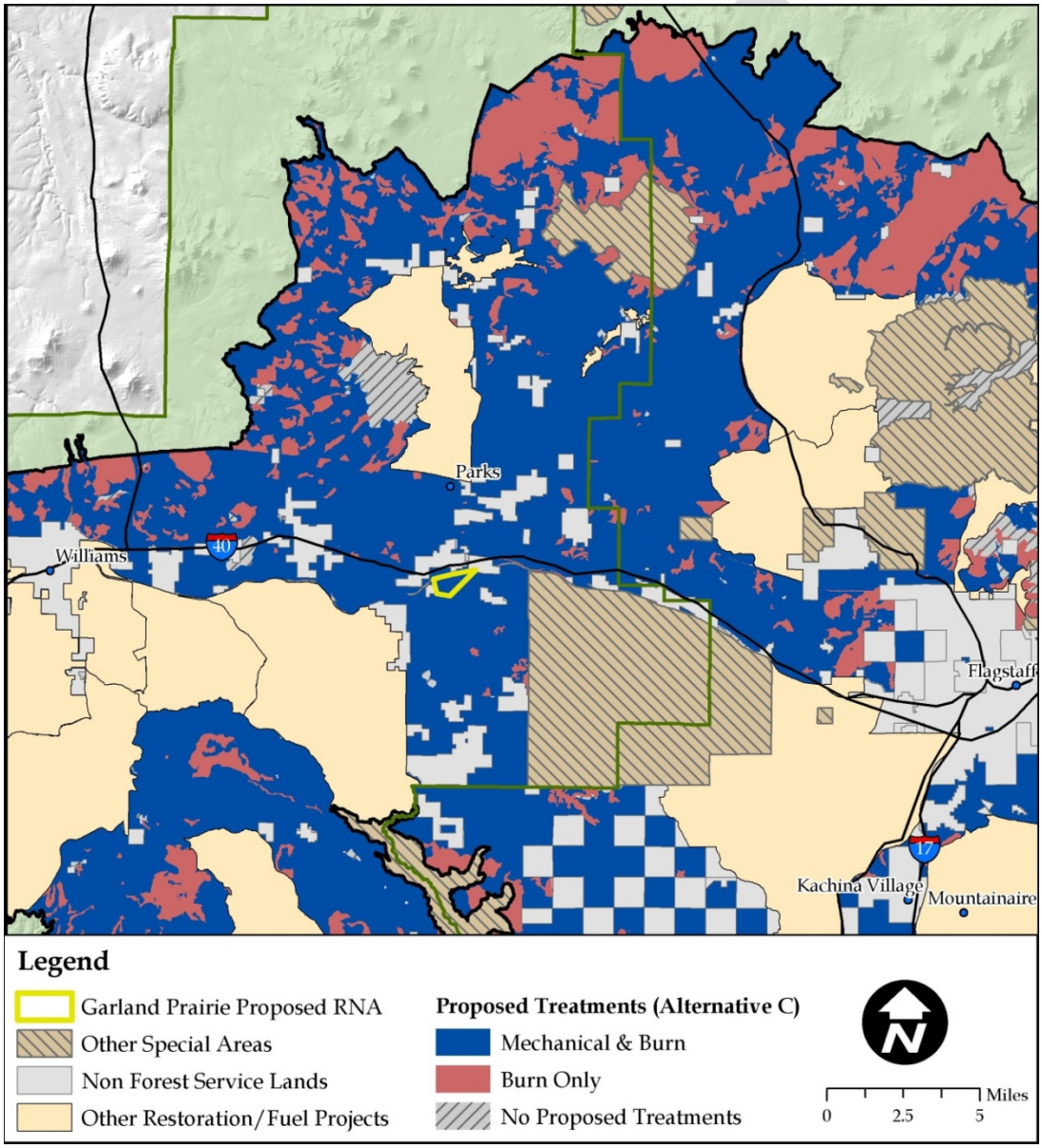

***Figure 53*. Alternative C Treatments in the Garland Prairie Proposed RNA (Kaibab NF)**

***Table 59*. Kaibab NF proposed Garland Prairie Research Natural Area (RNA) Amendment**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
No corresponding plan direction (see Kaibab NF Forest Plan, pp.95-96).	**Vegetation Management Planning and Analysis** **Utilize mechanical treatment and prescribed burning to re-establish the role of fire as a natural process when needed to maintain or restore the high elevation grassland ecotone habitat dominated by Arizona fescue and mountain muhly, to maintain genetic diversity, and move towards historic reference condition. Do not construct fire line.**

* Edited text is **bolded.**

Non-Significance Evaluation

Significance was evaluated against the criteria in Forest Service Manual (FSM) 1926.51 and 1926.52. Factors include timing, location, and size, relationship to forest goals, objectives, outputs, and management prescriptions. In terms of timing, Kaibab NF Land Management Plan has been in place (and amended) since 1988 and plan revision efforts are underway.

The amendment would affect 100 percent of the 300-acre proposed RNA (Special Area 7). In the context of the forest, it would have no effect on other special areas that have been designated because of their unique or special characteristics including other research natural areas, wilderness, botanical areas, and national recreation trails. While the amendment would affect 100 percent of the Garland Prairie, in the context of all forest special areas, location and size was determined to be non-significant.

The amendment is consistent with forest goals for wildlife and fish that promotes improving habitats through the development of habitat quality and diversity and the identification and protection of key habitats; and, for improving habitats for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Kaibab NF Land Management Plan, p.18). The amendment is consistent with the management direction for wildlife and fish resources which directs the forest to ensure a moderate to high level of habitat diversity and capability (Kaibab NF Land Management Plan, pp. 50, 53). The amendment is consistent with the Forest Service policy (FSM 4063.02) by maintaining and/or restoring the ecological values associated with the proposed RNA.

The proposed amendment would affect approximately 100 percent of Special Area 7. However, the amendment would not impose requirements on future management of the RNA. Outputs identified in the current forest plan are associated with sawtimber and other product harvest levels (meet demand for timber while reducing conflict with other resources), commercial and personal-use fuelwood programs (MBF), grazing capacity (AUM), watershed (acres in unsatisfactory condition and water yield), developed recreation (management of public sites at the standard service level), developed and dispersed recreation outputs (RVD), and transportation (acres closed to off-road vehicle use), habitat diversity (change in habitat diversity index), old growth habitat (acres), and average annual wildlife and fish use (WFUD). The RNA is managed as a high-elevation grassland and is not part of the suitable land base (timber, grazing, recreation,

minerals, and energy resource activities). Therefore, the amendment would not alter outputs or change the long-term relationship between levels of goods (timber, commercial and personal use fuelwood) and services. No grazing capacity exists for the proposed RNA and livestock grazing has been excluded since 1989 (Kaibab NF 2012). Therefore, the amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Alternative D – Coconino National Forest Site-Specific Non-Significant Forest Plan Amendments

Amendment 1. Mechanical treatment up to 16-inch dbh in 18 Mexican spotted owl protected activity areas (PACs).

This amendment is the same as presented for alternative B, see pages 261 to 267.

Amendment 2. Management of canopy cover and ponderosa pine with an open reference condition within goshawk habitat.

This amendment is the same as presented for alternative B, see pages 267 to 276.

Alternative D – Kaibab National Forest Site-Specific Non-Significant Forest Plan Amendments

Amendment 1. Management of canopy cover and ponderosa pine with an open reference condition within goshawk habitat.

This amendment is the same as presented for alternative B, see pages 276 to 287.

Appendix D – Design Features, BMPs, and Mitigation

Design features, best management practices (BMPs), and mitigation that are common to all action alternatives are presented for each resource with one exception. Silviculture design features can be found in Appendix E, Implementation Plan.

Table 60. **Alternative B, C, and D Design Features, Best Management Practices, Mitigation**

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	Botany			
B1	Determine potential occurrences and habitat of Southwest Region sensitive plants in potential activity areas when planning for implementation. Identify potential species and survey the area to be treated before implementation.	X		Complies with FSM direction 2670. Manual direction (FSM 2670.5(19)) emphasizes that management actions should avoid or minimize impacts to sensitive species.
B2	Mitigate negative effects from management actions on Southwest Region sensitive plants during design and implementation.	X		Complies with FSM direction, minimizes impacts to Southwest Region sensitive plants.
B3	Prohibit slash pile construction within populations of Southwest Region sensitive plants. Construct slash piles at least 10 to 20 feet away from known populations of Southwest Region sensitive plants. Place slash piles on previously used locations such as old piling sites, old log deck sites, or other disturbed sites to avoid severe disturbance to additional locations where possible. Monitor slash pile sites after burning and control noxious or invasive weeds (see FE10).		X	Mitigates effects of disturbance and burning. Reduces loss of native seed bank, limits extent of severe disturbances, and reduces severely disturbed sites that are more prone to invasion by noxious or invasive weeds.
B4	Prohibit temporary road construction and reconstruction and do not allow tracked vehicles within populations of Southwest Region sensitive plants.		X	Eliminates direct loss of plants.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
B5	Prohibit construction and reconstruction of log landings in identified populations of Southwest Region sensitive plants.	X		Mitigates effects of disturbance. Follows management plan guidance of the management plan for *Hedeoma diffusum* (Flagstaff pennyroyal).
B6	Follow the guidance of the Arizona Bugbane Conservation Assessment and Strategy, Coconino and Kaibab NFs (1995) when planning activities near Arizona bugbane populations. An example of mitigation for this species includes preservation of shade and cool microsites for existing populations. This may require special attention in upland areas near canyon edges.	X		Mitigates effects to Arizona bugbane, a USFWS candidate species. Follows guidance of Conservation Assessment and Strategy and complies with policy.
B7	Manage fire severity in all entries in or near Arizona bugbane populations to minimize tree mortality.	X		Preserves the shady, mesic environment and overstory needed for Arizona bugbane.
B8	Follow the guidance of the management plan for *Hedeoma diffusum* (Flagstaff pennyroyal) when working in suitable habitat for this species. Examples of mitigations include restrictions on distance for building temporary roads near existing populations.	X		
B9	Deferrals and groups may include Southwest Region sensitive plant groups where practical, using areas not occupied by the plants as interspaces.		X	Provide protection and shade needed by the sensitive plants while allowing for the least impact on clump/group/ interspace design and layout during implementation and helps mitigate impacts to Southwest Region sensitive plants.
B10	Survey springs and channels for Southwest Region sensitive plants before implementation of restoration projects and identify locations. Inform the forest botanist if new locations are found and mitigate effects to plants and populations. Mitigations include avoiding plants, altering designs, or including plants in enclosures. Incorporates buffer strips along drainages. See soil and water SW8.	X		Protects populations and habitat of Southwest Region sensitive plants. Protects sneezeweed since it grows in ephemeral stream courses, springs, ponds, stock tanks, and meadows.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
B11	Survey springs and channels for Bebb's willow before implementation and identify locations. Inform the forest botanist if new locations are found and mitigate effects to plants and populations. Mitigations include avoiding plants, altering designs, or including plants in enclosures.	X – Coconino NF only		Protects populations and habitat of Bebb's willow.
B12	Fire lines would be placed around Bebb's willows and dead branches within the clumps would be removed before prescribed burning adjacent areas to reduce the risk of fire impacting willows.		X	Aids in restoring Bebb's willow which is a Southwest Region sensitive species for the Coconino NF and a rare species on the landscape for both forests.
B13	Follow the guidance in appendix B of the Noxious Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott NFs within Coconino, Gila, Mojave, and Yavapai Counties, Arizona (FEIS) including: (1) surveying the treatment area and evaluating weeds present before implementation; avoiding or removing sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds, and (2) treating weed infestations within treatment units before implementing treatments.	X		Provides guidance and mitigation for noxious or invasive weeds and complies with Amendment 20 Coconino NF Forest Plan and amendment 7 Kaibab NF Forest Plan.
B14	Incorporate weed prevention and control into project layout, design, alternative evaluation, and project decisions. Prevent spread of potential and existing noxious or invasive weeds by vehicles used in management activities by washing vehicles and equipment prior to entering the project area and when moving from one area to another. Review timber sale contract clauses for vehicle cleaning and incorporate appropriate clauses. Also see SW4 for timber sale clauses and FE10 that addresses preventative measures for weeds from prescribed burning.	X		Mitigate effects of management actions on existing and potential noxious or invasive weed infestations; measure is complementary to timber sale contract clause CT WO-C/CT 6.36 and watershed best management practices.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
Fire Ecology				
FE1	Burn unit size, as well as strategic placement, would be a consideration in designing units and implementation prioritization (Finney et al. 2003).		X	Arrangements of large treatment areas are more effective at reducing fire behavior than arrangements of smaller ones. Larger burn blocks, when possible, would also be mitigation for emissions by increasing the potential number of acres that could be burned in a burn window. Larger burn units would produce more smoke when prescribed fires are implemented, but for a shorter duration.
FE2	Prescribed fire (pile, broadcast, and jackpot burning) would occur in accordance with Arizona Department of Environmental Quality (ADEQ) requirements.	X		Regulatory requirement.
FE3	Emission Reduction Techniques (see FE8) would be utilized when possible to minimize impacts to sensitive receptors of burn unit(s). Project design for prescribed fire and strategies for managing wildfires should incorporate as many emission reduction techniques as feasible, subject to economic, technical, and safety criteria, and land management objectives. Decision documents (which define the objectives and document line officer approval of the strategies chosen for wildfires) should identify smoke-sensitive receptors, and include objectives and courses of action to minimize and mitigate impacts to those receptors as feasible.		X	ERTs are recommended by the ADEQ as techniques that can be effective for minimizing impacts to sensitive receptors.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
FE4	As needed, the burning of hand piles or machine piles would occur when conditions are favorable and risk of fire spread is low. Piles would be located far enough away from residual trees and shrub patches to minimize canopy scorch or damage to ponderosa pine or large oak (>6”dbh) where it is not desirable. Individual piles or groups of piles may have fireline cut around them if necessary to meet objectives.		X	Prevent undesirable impacts.
FE5	Firelines would be used to facilitate broadcast burns or pile burning operations as needed: (1) Firelines may consist of natural barriers, roads and trails, or may be constructed as needed. Line construction may consist of removing woody and/or herbaceous vegetation, removing surface fuels, pruning, or cutting breaks in fuels by hand, ATV (drag lines), or a dozer as needed, (2) Fireline width would be determined as adjacent fuels and expected fire behavior dictate, assuming compliance with the requirements of cultural, wildlife, and other resource areas, (3) Constructed firelines would be rehabilitated, which may include pulling removed material back into the lines, hand constructing water diversion channels and/or water bars, laying shrubs or woody debris in the lines following burning, or other methods appropriate to the site, and (4) Fireline construction would be coordinated with wildlife.		X	Facilitate broadcast burns or pile burning operations.
FE6	Mechanical treatments following broadcast burns would allow adequate time for surface vegetation to recover.		X	Minimize impacts from mechanical treatments on vegetation and soil.
FE7	Prescribed fires may be conducted before or after mechanical treatments. The sequencing of prescribed fires and mechanical treatments would be decided on a site-specific basis, depending on the site, burn windows, available resources, thinning schedules, etc.		X	Increase the flexibility for implementing both prescribed fire and mechanical treatments.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
FE8	The following ADEQ emissions reduction techniques (ERTs) would be used when practicable to minimize impacts to sensitive receptors: pre-burn fuel removal, mechanical processing, increased burning frequency, aerial/ mass ignition, high moisture in large fuels, rapid mop-up, air curtain incinerators, burn before green-up, backing fire, maintain fireline intensity, underburn before litterfall, isolating fuels, concentrating fuels, mosaic/jackpot burning, moist litter and duff, burn before large activity fuels cure, and utilize piles.		X	Reduce emissions from prescribed fire.
FE9	Mitigation and design features for smoke impacts include: (1) Reducing the emissions produced for a given area treated, (2) Redistributing/diluting the emissions through meteorological scheduling and by coordinating with other burners in the airshed. Dilution involves controlling the rate of emissions or scheduling for dispersion to assure tolerable concentrations of smoke in designated areas, and (3) Avoidance uses meteorological conditions when scheduling burning in order to avoid incursions of wildland fire smoke into smoke sensitive areas. Also see FE8 for ERTs.			See FE9.
FE10	When prescribed burns are conducted in areas with, or near known populations of invasive weeds, follow-up monitoring would be conducted. Also see Botany B4.		X	Detect new weed infestations before they spread.
FE 11	See Rangeland Management: R1, R4, and R5.		X	Prevent damage or loss of infrastructure.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
FE12	When practicable, damage or mortality to old trees, large trees would be mitigated by implementing prescription parameters, ignition techniques, raking, wetting, thinning, compressing slash, or otherwise mitigating fire impacts to the degree necessary to meet burn objectives and minimize fireline intensity and heat per unit area in the vicinity of old trees. Trees identified as being of particular concern (e.g. trees with known nests or roots for herons, eagles, osprey, or other raptors, occupied nest cores, or critical areas in PACs) would be managed in accordance with wildlife design features (see wildlife). Prepare old trees 1 year or more before a burn if possible.		X	Old trees and large trees are rare components and are under-represented across the analysis area. Implementing mitigation measures when possible is a critical component of restoration on a landscape scale. Large trees that are not old are not as susceptible to damage from fire. Mitigation measures that can be implemented a year or more before a burn, such as thinning or raking, may improve the health of the tree, improving its response to fire.
FE13	Mitigation measures and design features for wildlife species including Mexican spotted owl, golden eagle, bald eagle, pronghorn, northern goshawk, bats, northern leopard frog, turkey, deer, and other wildlife can be found in the wildlife section.			
FE14	Aspen, Gambel oak, pine-sage: fire effects would be managed primarily by implementing prescriptions, and ignition techniques to meet objectives in pine/sage systems. In Gambel oak, avoid lighting near the bases of large oak boles.		X	To serve as a detriment to ungulates would be inclined to browse on young aspen.
Fisheries				
F1	See Soil and Watershed SW1, SW3-SW8, SW21, SW25, SW26, SW29, SW31, SW36.			
Heritage Resources and Tribal Relations				
HR/TR-1	The forest complies with the National Historic Preservation Act (NHPA) in decisions involving interactions between cultural and other resources. Cultural resources are managed in coordination with the State Historic Preservation Plan (SHPO). Potential effects are addressed through site avoidance strategies and implementing the	X		Compliance with NHPA and Southwest Region PA with AZ SHPO.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	site protection measures listed in the Southwest Region Participating Agreement (PA), appendix J and in the heritage strategy.			
HR/TR-2	Consult with Native Americans when projects and activities are planned in sites or areas of known religious or cultural significance.	X		Compliance with NHPA and Southwest Region PA with AZ SHPO.
HR/TR-3	Project undertakings are inventoried for cultural resources and areas of Native American religious use.	X		Compliance with NHPA and Southwest Region PA with AZ SHPO.
HR/TR-4	Significant, or potentially significant, inventoried sites are managed to achieve a "No Effect" determination, in consultation with the SHPO and ACHP (36 CFR 800).	X		Regulatory Requirement.
HR/TR-5	Monitoring during and after project implementation is done to document site protection and condition.	X		Forest plan compliance.
HR/TR-6	See Recreation and Scenery RS3 and RS5 for mitigation related to historic roads and trails.	X		Forest plan compliance.
Rangeland Management				
R1	Historic range monitoring sites including witness trees/posts, 1" angle iron stakes, and any other site location markers would be protected. These sites would not be excluded from treatment but care needs to be taken to avoid loss of these site markers. These sites would not be used as locations for temporary access roads, skid trails, landing areas, or large slash piles.		X	Avoid site damage.
R2	The sale administrator would work closely with the district range staff to determine pasture use during harvest activities.		X	Avoid infrastructure damage, and retain allotment and pasture fences within a harvest area.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
R3	All fences in the cutting area would be protected from harvest activities. Skid trail lay out would keep equipment on one side of the fence to avoid having to cut fences. Temporary cattleguards would be installed on all haul roads where gates exist within active grazed pastures. All cattleguards on harvest haul roads would be maintained throughout hauling activities.		X	Protect infrastructure.
R4	Fence lines would be used as burn area boundaries whenever possible. Burning often damages/destroys wood stays and h-brace posts in existing pasture/allotment fencing. The cost of prescribed burning would include fence protection measures and replacement/reconstruction costs for burned wood stays and h-braces.		X	Limit the numbers of pastures affected by the fires in a given year. Protect fences that are critical to the implementation of planned grazing systems and reduce the costs of replacing these items.
R5	Fire personnel would coordinate with district range staff to schedule main pasture burning a year in advance to limit impacts to allotment grazing management. Burns would be restricted to no more than one main grazing pasture/year/allotment in allotments with a less than, or equal to, six pasture grazing system. Burns would be restricted to no more than two main grazing pastures/year/allotment in allotments with a greater than six pasture grazing system. Main pastures are pastures that are large enough to hold the allotment's livestock for more than an average of 20 days/year. This is a general rule of thumb; however, each allotment has specific situations that would need to be addressed.		X	Minimize disruption to grazing.
R6	Restrictions in grazing of livestock would primarily occur after prescribed fire in a pasture. Post-fire grazing may resume within a pasture when soil and perennial plants, that would likely be grazed, would not be permanently damaged by livestock. The range management definition for this is range readiness. Plants are ready for grazing when at least one of the following characteristics is		X	Assessment of post-fire range readiness.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	present: (1) seed heads or flowers, (2) multiple leaves or branches, and/or (3) a root system that does not allow plants to be easily pulled from the ground. These characteristics provide evidence of plant recovery, high vigor, and reproductive ability. An estimate of this restriction is not available because each pasture and burn is unique. Climatic conditions, soils, vegetation, burn intensity, burn amount, and pasture management can vary greatly from year to year or from pasture to pasture.			
R7	The removal or exclusion of livestock water would be mitigated with alternative water sources, providing lanes to the water, or piping water to a livestock drinker.		X	Provide alternate water sources.
Recreation and Scenery				
RS1	**Edges of Individual Units:** (1) Edges of treatment units would be shaped and/or feathered to avoid abrupt changes between treated and untreated areas, (2) Where the treatment unit is adjacent to denser forest (treated or untreated), the percent of thinning within the transition zone (150-250 feet) would be progressively reduced toward the denser edges of the unit, (3) Where the treatment unit interfaces with an opening (including savanna and grassland treatments, and natural openings) the transition zone would progressively increase toward the open edges of the unit, (4) Soften edges by thinning adjacent to the existing unit boundaries. Treat up to the edges; do not leave a screen of trees. Favor groups of trees complying with the prescribed treatment that visually connect with the unit's edge to avoid an abrupt and noticeable change, (5) Treatment boundaries should extend up and over ridgelines to avoid the "Mohawk" look, and (6) Avoid widely spaced individual trees that are silhouetted along the skylines.	X	X	Compliance with forest plans.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
RS2	**Unit Marking**: (1) Avoid using trails as boundaries and (2) Avoid abrupt changes between treatment units. Use the techniques suggested for edges of treatment units (above).	X	X	Compliance with forest plans.
RS3	**Road, Skid Trail and Landing Construction**: (1) Where new temporary roads and skid trails meet a primary travel route, they should intersect at a right angle, then curve after the junction, to minimize the length of route seem from the primary travel route, (2) Log landings, temporary roads, and skid trails should be minimized within sensitive viewsheds, (3) Highest emphasis would be placed on foreground (up to 300 feet) of developed recreation sites, private homes or communities, and concern level 1 roads (paved roads and passenger car level roads) and trails, (4) GPS the log landings for post-treatment consideration for parking or dispersed camping, (5) Log landings, skid trails, and temporary roads would be rehabilitated including restoring proper drainage and reseeding as needed with native species. To hasten recovery and help eliminate unauthorized motorized and non-motorized use of skid trails and temporary roads, use physical measures such as recontouring, pulling slash and rocks across the line, placing cull logs perpendicular to the route, and disguising entrances, (6) National Historic, Recreation and Scenic Trails as well as forest system trails (motorized and non-motorized) would not be used for temporary roads or skid trails. It is acceptable to make perpendicular trail crossings. The locations of crossings would be designated. Trail crossings would be restored to pre-project condition after use, (7) Large, upright trail cairns used on Beale Wagon Road and Overland Trail must be protected, (8) Locate cairns ahead of time, and (9) Logging operations would not damage the cairns.	X	X	Compliance with forest plans.
RS4	**Cull Logs, Stump Heights, and Slash Treatments**: (1) Cull logs would not be abandoned on landings, (2) Use cull logs for closing	X	X	Compliance with forest plans.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	temporary roads and decommissioning roads, (3)Cull logs may also be suitable to use as down woody material, but must be scattered away from the landings, (4) Stump heights should be cut as low as possible, (5) In the foreground of sensitive roads, trails, recreation sites, private homes/communities, stump heights should be 6" or lower, (6) Beyond the foreground (300 feet from centerline of roads, trails, or edge of recreation sites and private land/communities) stump heights may be cut to 8", (7) Slash must be treated or removed, (8) In the seen area immediate foreground of sensitive places (within 300 feet of the centerline of concern level 1 roads or trails, or 300' from the boundary of a recreation site or private land/communities) where whole tree logging occurs, machine piling may occur to the back of log landings. Prioritize slash burning in these locations within one year or as soon as possible after treatment. If conventional logging is used and trees are de-limbed and topped in the forest, machine piled slash should be placed at least 300 feet away from the centerline of roads and trails, developed recreation sites or private land/communities. In these instances piles should be burned as soon as possible or within three years, (8) Root wads and other debris in sensitive foreground areas would be removed, buried, burned, or chipped. If materials are buried, locate in previously disturbed areas where possible. Beyond sensitive immediate foreground areas, it is acceptable to scatter these or use them to help close temporary roads or skid trails, (9) If slash is not removed in grassland treatment areas, it is acceptable to create machine piles 300' away from the centerline of sensitive roads and trails, developed recreation sites, and private land/communities, and (10) Place project-generated slash outside of permitted utility line and pipeline rights-of-way; do not interfere with utility corridor management.			

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
RS5	**Fire Control Lines: (1)** Generally restore control lines to a near undisturbed condition in the foregrounds (within 300') of sensitive roads, trails, and developed recreation sites, (2) To hasten recovery and help eliminate unauthorized motorized and non-motorized use of control lines in these areas, use measures such as recontouring, pulling slash and rocks across the line, and disguising entrances, (3) Do not use motorized equipment on National Historic, Recreation, Scenic or other forest system trails if these are used for control lines.	X	X	Compliance with forest plans.
RS6	Coordinate with landscape architect prior to implementing jack straw treatments.	X	X	Maintain scenic integrity.
RS7	**Recreation and Other Trail Mitigation:** (1) Provide public notice and information about treatment locations, timing and the type of treatment occurring prior to and during vegetation and fire treatments, (2) Use a hotline or link on our web pages that will indicate closures or hazards that may be encountered, also use media and make sure frontliners are well informed about activities occurring on the districts and forests, (3) Place warning signs on all trail access points and along trails where treatment activities are occurring. It is also appropriate to place warning signs at developed recreation sites to inform visitors, (4) When mechanical treatment and burning are occurring along open trails, slash will be pulled back immediately within 100' of the centerline of the trail corridor, (5) If trails are temporarily closed due to harvesting, the trail tread would be cleared of all slash, (6) Character trees and trees that define the trail corridor should be retained where feasible and should conform to the applicable prescription. Avoid lines of trees; strive to achieve a groupy appearance to avoid abrupt changes in the landscape character along the trail corridor, (7) Implement road closures, one-way traffic, and area closure restrictions as deemed necessary by forest officials for health and safety concerns during any operation,	X	X	Compliance with forest plans, inform public, and reduce impacts to recreational opportunities.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	and (8) Prohibit treatment activities in specifically designated units and the forest system roads associated with these units during times of highest recreation use. The highest recreation use and associated traffic occurs during the weeks of Federal observed Memorial Day, July 4th and Labor Day holidays.			
RS8	**In Semi-primitive Non-Motorized ROS classes**: (1) Temporary roads should not generally be built. If they are used, they would be restored to original conditions when projects are completed, (2) Stumps should be cut to 6" or lower throughout the area, (3) Slash must be treated or removed in these areas, (4) Use existing barriers (roads) and natural barriers as control lines whenever possible.	X		Compliance with forest plans.
Silviculture – See Appendix E, Implementation Plan				
Soils and Watershed				
SW1	Implement best management practices prior to project implementation.	X		Minimize impacts to soil and water resources from project implementation, to minimize non-point source pollution, to adhere to the Clean Water Act, and to adhere to the intergovernmental agreement between the Southwest Region of the Forest Service and the Arizona Department of Environmental Quality.
SW2	Minimize mechanical operations when ground conditions are such that soil compaction can occur. All activities should be limited/restricted to when soils are dry or frozen. If compaction occurs, mitigate through ripping, seeding, and covering compacted areas with slash.	X		Minimize soil compaction, soil detachment, and sediment transport. To maintain long-term soil productivity.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW3	All fueling of vehicles would be done on a designated protected, upland site. If more than 1,320 of gallons of petroleum products are to be stored on site above ground or if a single container exceeds 660 gallons, then a spill prevention control and countermeasures plan (SPCC) would be prepared as per 40 CFR 112.	X		Prevent contamination of waters from accidental spills.
SW4	Prior to moving off-road equipment onto the sale area, purchaser shall identify the location of the equipment's most recent operation. Purchaser shall not move any off-road equipment that last operated in an area infested with one or more invasive species of concern onto sale area without having cleaned such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds, and having notified Forest Service, as provided in (iii). If the location of prior operation cannot be identified, then purchaser shall assume that the location is infested with invasive species of concern. (ii) Prior to moving Off-road equipment from a cutting unit that is shown on sale area map to be infested with invasive species of concern to, or through any other area that is shown as being free of invasive species of concern, or infested with a different invasive species, purchaser shall clean such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds, and shall notify the Forest Service, as provided in (iii). (iii) Prior to moving any off-road equipment subject to the cleaning requirements set forth above, purchaser shall advise Forest Service of its cleaning measures and make the equipment available for inspection. Forest Service shall have 2 days, excluding weekends and Federal holidays, to inspect equipment after it has been made available. After satisfactory inspection or after such 2 day period, purchaser may move the equipment as planned. Equipment shall be considered clean when a visual inspection does not disclose seeds, soil, vegetative matter, and other debris that could contain or hold	X		Minimize the spread of noxious weeds.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	seeds. Purchaser shall not be required to disassemble equipment unless so directed by the Forest Service after inspection. (iv) If purchaser desires to clean off-road equipment on National Forest land, such as at the end of a project or prior to moving to, or through an area that is free of invasive species of concern, purchaser shall obtain prior approval from contracting officer as to the location for such cleaning and measures, if any, for controlling impacts.			
SW5	If construction crews are to live on-site, then an approved camp and suitable sanitation facilities must be provided.		X	Protect surface and subsurface water from unacceptable levels of bacteria, nutrients, and chemical pollutants.
SW6	On areas to be prescribed burned, fire prescriptions should be designed to minimize soil temperatures over the entire area. High severity fire should occur on no more than 10% of the treatment area. Fire prescriptions should be designed so that soil and fuel moisture temperatures are such that fire severity is minimized and soil health and productivity are maintained. If containment lines are put in place, rehabilitate lines after use by either rolling berm back over the entire fireline, spreading slash across the fireline, or waterbarring the fireline. If line is only to be waterbarred, disguise the first 400’ of line to discourage use as a trail.	X	X	Maintain long-term soil productivity and minimize sediment delivery from containment lines.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW7	On areas to be prescribed burned, manage for 5-7 tons/acre of coarse woody debris in ponderosa pine to maintain long-term soil productivity outside of the buffers around private land. Within the pinyon-juniper cover type, snags would be managed for one per acre over 75% of the area and coarse woody debris (CWD) would be managed for an after-treatment average of 1 to 3 tons per acre (Huffman personal communication 2012). Where available, a portion of the CWD would include two logs ≥10" and ≥10' in length.	X	X	Maintain long-term soil productivity.
SW8	On areas to be prescribed burned, establish filter strips (also known as streamside management zones). These stream reaches would be designated as protected streamcourses. The following are recommendations to protect streamcourses. **Riparian streamcourse:** Severe erosion hazard: 120' on each side of streamcourse. Moderate erosion hazard: 100' on each side of streamcourse. Slight erosion hazard: 70' on each side of streamcourse. **Non-riparian streamcourse**: Severe erosion hazard: 100' on each side of streamcourse. Moderate erosion hazard: 70' on each side of streamcourse. Slight erosion hazard: 35' on each side of streamcourse. Do not ignite fuels within this buffer area. Some creep may occur into the buffer (also see SW31).	X		Minimize sediment and/or ash delivery into drainages and maintain water quality.
SW9	Complete all required permitting (404 permits) and water quality certification (if necessary), prior to project implementation.	X		Comply with Clean Water Act provisions.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW10	Site rehabilitation on upland sites for stream channel and road rehabilitation projects where ground disturbance occurs: Seed at 5 pounds/acre with native, certified weed free seed mix. Potential vegetation for individual sites should utilize the Kaibab and Coconino National Forest Terrestrial Ecosystem Survey to identify species to be utilized. Where feasible, protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates.	X	X	To minimize soil erosion and minimize noxious weed spread.
SW11	Site rehabilitation on riparian sites for stream channel and road rehabilitation projects where ground disturbance occurs: Seed at 5 pounds/acre with certified weed free native seed mix to rehabilitate the site and minimize impacts of noxious weeds. Potential vegetation for individual sites should utilize the Kaibab and Coconino National Forest Terrestrial Ecosystem Survey to identify species to be utilized. Where feasible, protect site with a variety of methods (e.g. ungulate proof fence, spreading slash etc.).	X	X	Comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover. Minimize noxious weed spread.
SW12	Install silt fences and/or waddles downstream from ground-disturbing activities in stream channels to minimize the chance of sediment being lost downstream during construction and until revegetation is completed.	X		Comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover. Minimize noxious weed spread.
SW13	Provide site protection on newly disturbed soils (e.g. hydromulch, erosion mat, spread slash etc.) in channel restoration sites on all sites as needed and where feasible.	X		Comply with State and Federal water quality standards by minimizing sediment delivery to drainages and creating microclimates for regeneration of grass/forb community. Minimize noxious weed spread.
SW14	Bring rock material from a local upland site to any headcut drop structures that may be installed in channel restoration projects.	X		Minimize disturbance in drainage systems and minimize sediment production within channel.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW15	Site rehabilitation on disturbed sites at and stream channel shaping on previously obliterated roads: Site rehabilitation consists of several revegetation methods, such as, but not limited to: (1) Store sod removed from the initial ground disturbance and replace the sod from the top of the bank on the disturbed site, (2) Seed with a native seed mix (see BMPs above), (3) Protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates. Slash placement would be limited to the upper 2/3 of the bank to limit transport downstream of woody material, (4) Fence out ungulates for 1 to 2 years (or until the site has re-established), (5) consider the use of mycorhizal inoculum on severely disturbed sites where no topsoil is left, and (6) install erosion mat.	X	X	Comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover. Minimize noxious weed spread.
SW16	Do not borrow road fill or embankment materials from the stream channel or meadow surface on road maintenance projects. End-load all material hauled on-site and compact fill.	X		Minimize disturbance in drainage systems and minimize sediment production within channel.
SW17	Where feasible, relocate roads out of filter strips into an upland position. If this is not feasible, use riprap or velocity checks to stabilize or disperse outfall on road maintenance projects when roads are located within filter strips.	X		Minimize sediment delivery into drainage and minimize disturbance in drainage systems and minimize sediment production within channel.
SW18	At riparian stream reach restoration sites, restore riparian dependent grasses through (1) seeding of native species and (2) planting plugs of rushes, sedges, and spike rushes to improve success of regeneration efforts. Fence with ungulate proof fencing for 1 to 2 years (or until plants are established) if grazing is inhibiting regeneration efforts.	X		Comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover. Minimize noxious weed spread.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW19	On areas that have had roads previously obliterated and the remaining roadbed will be removed, add slash/or erosion mat and seed to the disturbed areas.	X		Add surface roughness a to comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover and to diminish the impact of the first rain event and to speed recovery of the site
SW20	At spring restoration sites, restore riparian dependent species through (1) seeding of native species and (2) planting plugs/cuttings of native plants to improve success of regeneration efforts. Fence with ungulate proof fencing for 1 to 2 years (or until plants are established) if grazing is inhibiting regeneration efforts.	X		Comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover. Minimize noxious weed spread.
SW21	Do not blade roads when the road surface is too dry. If the road surface is too dry, a water truck can apply water, or the project can be scheduled for when adequate moisture occurs to complete the project.	X		Minimize sediment detachment and to minimize impacts on severe erosion soils.
SW22	In grassland restoration sites, limit skidding and designate skid trails if wood is to be removed. Where material is not to be removed, do not skid logs in meadows and lop and scatter is the preferred method of treating slash. Do not machine pile within meadows. If skidding has to occur across a riparian or non-riparian streamcourse, designate any crossing prior to skidding.	X		Minimize impacts to streams and soils in meadows from tree harvesting operations.
SW23	Skid trails and obliterated roads would have slash placed on the trail or cross-ditched (waterbarred) to break the energy flow of water. Placing slash on skid trails is the preferred method to dissipate the energy flow of water. Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand.	X		Minimize soil erosion and maintain soil productivity. Minimize impacts on .severe erosion soils.
SW24	Landing locations will be in upland positions out of meadows, and riparian and non-riparian filter strips.	X		Minimize sediment delivery into drainage and minimize impacts on severe erosion soils.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW25	Mechanical harvest or mechanical fuel treatment are only allowed on cinder cones greater than 25% slope with designated skid trails and slash mats placed on the skid trails. On other sites, mechanized harvesting can occur up to 40% slopes.	X - Coconino NF only		Maintain long-term soil productivity on slopes with severe erosion hazard potential.
SW26	Designated skid trails and log landings would be required within the Integrated Resource Service Contract (IRCS) (BMP 24.18 in FSH 2509.22) on all cutting units. Skid trail design should not have long, straight skid trails that would direct water flow. Skid trails should also be located out of filter strips (exceptions are at approved crossings).	X		Minimize the number of acres disturbed and minimize impacts on severe erosion soils.
SW27	Felling to the lead would be required within the IRSC to minimize ground disturbance from skidding operations.	X		Felling of timber should be done to minimize ground.
SW28	The IRSC outlines the timing and application of erosion control methods to minimize soil loss and sedimentation of streamcourses. Seed mix can include any of the following certified weed free native species at a minimum of 5 lbs./acre pure live seed. Potential vegetation for individual sites should utilize the Kaibab and Coconino National Forest Terrestrial Ecosystem Survey to identify species to be utilized. Corresponding BMPs from FSH 2509.22 to minimize soil loss and sedimentation of include 24.13, 24.21, 24.22, 24.23, 24.24, and 24.25. The preferred erosion control method on the skid trails in the harvest areas would be by spreading slash. Other acceptable erosion control measures include, but are not limited to, waterbarring (waterbars should not be more than 2'deep and need at least a 10-foot leadout. Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand to remove berms, seed, mulch, and cross-rip. Erosion control after skidding operations must be timely to minimize the effects of log skidding.	X		Minimize soil loss and sedimentation of streamcourses from skidding operations. Minimize noxious weed spread and re-establish native vegetation. Minimize impacts on severe erosion soils.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
SW29	Road drainage is controlled by a variety of methods (BMP 41.14) including rolling the grade, insloping, outsloping, crowning, water spreading ditches, and contour trenching. Sediment loads at drainage structures can be reduced by installing sediment filters, rock and vegetative energy dissipaters, and settling ponds. Design of roads is included in the transportation plan of the IRSC and T-specs.	X		Minimize soil movement, maintain water quality, and minimize impacts on severe erosion soils.
SW30	Road maintenance (BMP 41.25) through the IRSC should require pre-haul and post-haul maintenance on all roads to be used for haul.	X		
SW31	The designation of filter strips (also known as streamside management zones) minimizes on-site soil movement from timber harvest activities along streamcourses (BMP 24.16). These stream reaches will be designated as protected streamcourses. Locations of protected streamcourses are included in the individual task order maps and will be designated with a protected streamcourse designation. The following are recommendations to protect streamcourses within the proposed tree harvest units in relation to riparian and non-riparian streamcourses. The guidelines for filter strip designation are as follows: **Riparian streamcourse**: Severe erosion hazard: 120’ on each side of streamcourse. Moderate erosion hazard: 100’ on each side of streamcourse. Slight erosion hazard: 70’ on each side of streamcourse. **Non-riparian streamcourse**: Severe erosion hazard: 100’ on each side of streamcourse. Moderate erosion hazard: 70’ on each side of streamcourse. Slight erosion hazard: 35’on each side of streamcourse. Accepted harvest activities within riparian and non-riparian filter strips include mechanical and conventional tree felling and limited	X		

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	skidding on designated skid trails and not across streamcourses. Landings, decking areas, machine piles, and roads (except at designated crossings) are planned outside of riparian and non-riparian filter strips.			
SW32	Manage for 5 to 7 tons of CWD per acre in ponderosa pine.	X		Promote long-term soil productivity.
SW33	Mechanical crushing of lopped slash can only occur on 0-25% slopes.	X		Incorporate slash into the soil to promote long-term soil productivity.
SW34	Identify landings, staging area for heavy equipment, and sites for any in-woods processing sites outside of filter strips and meadows. Sites would be rehabilitated after use by methods such as, but not limited to: (1) ripping to remove compaction, (2) seeding with certified weed free native seed to 5 lbs./acre. Potential vegetation for individual sites should utilize the Kaibab and Coconino National Forest Terrestrial Ecosystem Survey to identify species to be utilized, and (3) spreading of slash to disguise the site and provide for a mulch for seeds	X		Minimize and mitigate impacts from activities that compact sites, restore long-term soil productivity, and minimize impacts on severe erosion soils.
SW35	The TSC outlines the timing and application of erosion control methods in BT6.31, BT6.6, BT6.63, BT6.64, BT6.65, CT6.6, CT6.601, and CT6.602 to minimize soil loss and sedimentation of streamcourses. Seed mix can include any of the following certified weed free native species at a minimum of 5 lbs./acre pure live seed: Arizona fescue (*Festuca arizonica*) Screwleaf muhly (*Muhlenbergia virescens*) Western wheatgrass (*Elymus smithii*) Mountain muhly (*Muhlenbergia montana*) Purple geranium (*Geranium caespitosum*) Western yarrow (*Achillea millefollium*) Pussytoes (*Antennaria marginata*)			Minimize soil loss and sedimentation of streamcourses from skidding operations. Minimize noxious weed spread and re-establish native vegetation.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	Arizona peavine (*Lathyrus arizonicus*) Fringed sagebrush (*Artemisia frigida*) The seed mix can contain a mixture of all or some of these suggested species, but should not contain all of these species and should include at least one grass species. The seed mix depends on the availability of these species. Corresponding BMPs to minimize soil loss and sedimentation of streamcourses include 24.13, 24.21, 24.22, 24.23, 24.24, and 24.25. Erosion control on the skid trails in the harvest areas would be by spreading slash. Other acceptable erosion control measures include, but are not limited to, waterbarring (waterbars should not be more than 2' deep and need at least a 10-foot leadout). Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand. Erosion control after skidding operations must be timely to minimize the effects of log skidding.			
Transportation				
T1	Utilize accepted engineering practices and manual direction for maintenance and reconstruction practices.	X		Maintain a safe and economic road system.
T2	Coordinate any road use in association with the El Paso and Transwestern High Pressure Natural gas pipelines. Hauling can occur at designated crossings with sufficient pad material. No hauling is proposed down these gas pipelines on Forest Roads 160, 796, 6796, 09007P, 09008P, 09228D, 09229Y, and 09231Q.		X	Prevent damage to high-pressure gas pipelines.
T3	On areas to be prescribed burned, if decommissioned roads are to be used as fire lines, return decommissioned roads back to the condition post-burning. Rehabilitation of the surface should refer to the soil and water best management practices for rehabilitation of fire lines and ground disturbed areas.			Discourage use on previously decommissioned road and maintain a safe and economic road system.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
T4	Utilize road safety signage with any project road activities that are related to project implementation.			Provide for user safety.
T5	See SW #21			
T6	Utilize the closest material source that has the specified material type for all road maintenance/reconstruction /relocation to projects.			Minimize energy use for road maintenance/reconstruction/relocation activities.
T7	Road maintenance through the timber sale contract or stewardship contract should require pre-haul and post-haul maintenance on all roads to be used for haul.			Provide for a safe travel surface and provide for access to the project area.
T8	Utilize mitigation measures for soil and water, recreation, cultural resources, timber/silviculture, wildlife and botany/noxious weeds in project design to minimize resource impacts from the transportation system			Minimize resource impacts from the transportation system.
Wildlife				
W-1	Bald eagle winter concentration areas, retain the tallest snags >18" dbh.	X		Bald eagle winter concentration areas.
W-2	No mechanical treatments would occur within a ½ mile (2,500'), unless mitigated by topography, of an occupied bald or golden eagle nest between March 1 and August 31. There is 1 bald eagle nest and 19 golden eagle nests within a ½ mile of the project analysis area. Other project activities will be assessed by the district biologist and limited activities may be acceptable.	X		Bald or golden eagle nests.
W-3	No mechanical treatments would occur within a 300-foot radius of bald eagle nest trees (there is 1 bald eagle nest within 300' of the project boundary).	X		Bald eagle nest trees.
W-4	No project activities will occur within 500' of confirmed bald eagle communal roosts from October 15 – April 15. There are currently 19	X		Bald eagle communal roost sites.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	confirmed roosts in the project area.			
W-5	Raptor nests located during project surveys will be monitored prior to project activities. Known nest trees for any raptor species would be prepped prior to prescribed burning. Buffers will be provided if nests are active.	X		Raptor nests.
W-6	Prescribed burning within 1 mile of eagle nest sites will be coordinated with the district wildlife biologist to insure nesting eagles will not be adversely impacted from smoke.		X	Bald and gold eagle nest sites.
W-7	Forest plan direction will be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 10 acres around occupied sharp-shinned hawk nests.	X		Sharp-shinned hawk nests.
W-8	Forest plan direction will be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 15 acres around occupied Cooper's hawk nests.	X		Cooper's hawk.
W-9	Forest plan direction will be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 20 acres around osprey nest sites (occupied or unoccupied) and all logging activities will be restricted within ¼ mile of active nests from March 1 to August 15.	X		Osprey.
W-10	Forest plan direction will be followed for buffers surrounding raptor nests. Currently, that includes a 50-foot no treatment buffer around other occupied raptors nests.	X		Other raptors.
W-11	Great blue herons – no dominant or co-dominant trees will be cut in rookeries. Known sites will be prepped prior to prescribed burning, fire can enter roosts but do not ignite within roost stands. Timing will avoid mechanical tree harvest while birds are in the nest. Activities will be coordinated with the local biologist.	X		Great blue heron.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
W-12	See Appendix D – Silviculture Design Features and Implementation Plan for MSO habitat design features.	X		
W-13	MSO surveys in the project area the year of implementation or 1 year prior to determine if new areas are occupied by owls.	X		MSO restricted and protected habitat.
W-14	Pre- and post-treatment habitat monitoring would occur as specified in the MSO recovery plan.	X		MSO restricted and protected habitat.
W-15	Spring restoration inside PACs would not occur during the breeding season (March 1 to August 31) if occupied, in Rocktop, Sawmill Spring, Red Raspberry, and Weimer Spring PACs (i.e. 4 out of 78 proposed spring restoration sites would be affected).	X		MSO protected activity centers.
W-16	Ephemeral stream restoration would not occur inside PACs during the breeding season (March 1 to August 31) if occupied, in Bear Seep, Clark, Holdup, Coulter Ridge, and Meadow Tank MSO PACs.	X		MSO protected activity centers.
W-17	Road construction, obliteration, relocation, and maintenance would not occur inside PACs during the breeding season (March 1 to August 31) if occupied.	X		MSO protected activity centers.
W-18	No treatments would occur in PACs within a ¼ mile of core area (potentially adjusted by topography) during the breeding season (March 1 to August 31) if occupied.	X		MSO protected activity centers.
W-19	Hauling would not occur within PACs during the breeding season (March 1 to August 31) except where specific analysis has documented that impacts would not lead to adverse effects.	X		MSO protected activity centers.
W-20	No new wire fencing would be constructed in PACs. Other alternatives would be used for aspen, seep, spring, and ephemeral drainage restoration exclosures. Alternatives would be coordinated with other specialists. If suitable alternatives cannot be identified restoration work would be postponed.		X	MSO protected activity centers.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
W-21	Coordinate burning spatially and temporally to limit smoke impacts to nesting owls, particularly for PACs with nests in draws and canyons (effective March 1 to August 31).	X		MSO protected activity centers.
W-22	Fireline associated with preventing fire from entering PACs and/or core areas will be constructed outside the nesting season. Alt B, C.		X	MSO protected activity centers.
W-23	Implementation would be phased in across the landscape so that not all MSO Habitat would be treated **in 1 year**	X		MSO habitat.
W-24	Prescribed burn plans would be designed and implemented to minimize smoke impacts to nesting birds and minimize loss of nest trees.	X		Goshawk nest stands.
W-25	All harvest activities would not occur in occupied PFAs during the breeding season. However, work could potentially occur on a case-by-case basis through coordination with the district biologist if pre-treatment surveys determine they are not occupied.	X		Goshawk PFAs.
W-26	Spring and ephemeral drainage restoration projects would not occur in the Barney Spring, Tree Spring, Schultz Pass, Squaw, Marteen, Coxcombs, Pumphouse, Walnut, Faye, Marshall Mesa, Newman, Cherry Canyon, and Monument 36 PFAs during the breeding season (March 1 to September 30) if occupied. However, work could potentially occur on a case-by-case basis through coordination with the district biologist if pre-treatment surveys have determined they are not occupied or impacts will not affect nesting birds.	X		Goshawk PFAs.
W-27	Logging trucks will not exceed 25 mph when traveling through PFAs during the nesting season (March 1 to September 30).		X	Goshawk PFAs.
W-28	Road construction, obliteration, relocation, and maintenance would not occur inside PFAs during the breeding season (March 1 to September 30) if occupied.		X	Goshawk PFAs.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
W-29	Because of declining trends in populations, defer logging activities between May 15 and August 31 in fawning habitat as identified by the Arizona Game and Fish Department.	X		Deer habitat.
W-30	Avoid thinning and burning within the known travelway on the Williams RD during the first major snowfall of a given year to allow for seasonal migration.		X	Pronghorn habitat.
W-31	Where hiding cover exists near dependable waters (e.g. stock tanks, lakes, and riparian stream reaches) do not create interspaces and openings habitat as identified by the Arizona Game and Fish Department.		X	General.
W-32	Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain snags >18" dbh and ≥ three logs with >12" mid-point diameter. Do not directly ignite snags. In general, manage for 5 to 7 tons of CWD and at least three logs per acre except in areas with identified WUI treatments.	X		General.
W-33	Protect snags and logs wherever possible by placing landings in existing openings or in areas where snags and/or logs, and old trees would be minimally impacted.		X	General.
W-34	Retain trees with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e. the living dead).		X	General.
W-35	Emphasize retention of snags exhibiting loose bark to provide habitat for roosting bats.		X	Bat habitat.
W-36	No thinning or direct ignition within ¼-mile distant from tanks or designated along logical topographic breaks. (See the wildlife report for a list of location/sites within ¼ mile buffers). The district wildlife biologist may work with implementation teams to determine the	X		Northern leopard frog designated occupied/ critical breeding sites (six sites).

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	habitat protection buffer boundary.			
W-37	Seasonal restrictions (April 15 through September 15) for all proposed activities will be implemented within a 200-foot buffer (or along logical topographic breaks) at all designated important water sites (i.e., 10 sites in restoration unit 1) (see wildlife report for a list of locations and sites). The district wildlife biologist may work with implementation teams to determine the habitat protection buffer boundary.	X		Northern leopard frog potential breeding sites.
W-38	In subunits 1-2, 1-4, 1-5, and 1-6, a 200-foot protection zone (100' either side of the stream) will be established around designated stream courses (see northern leopard frog travel linkage zone in within subunits 1-2, 1-4 and 1-5 in wildlife report for more details). There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zone are allowed. Fall burning and burn plans should be coordinated with district wildlife biologists.	X		Northern leopard frog dispersal habitat.
W-39	Mechanized equipment would avoid wetted soils in northern leopard frog habitat unless decontamination practices for Chytrid are employed first.		X	Northern leopard frog designated, potential, and dispersal habitat.
W-40	A 300-foot no mechanical treatment buffer unless mitigated by logical topographic breaks would be designated around cave entrances and sink-hole rims to protect cave ecosystems (including microclimate, hydrology, and entrance vegetation) from siltation and reduce potential disturbance to roosting bats.	X		Bat habitat: caves, karst, and sink holes.
W-41	Prairie dog surveys would be completed prior to mechanical treatment in documented prairie dog towns within treatment areas to determine if towns are active. If active towns form a large enough complex to support ferrets, black-footed ferret surveys will be completed prior to implementation within prairie dog towns.	ESA		Black footed ferret – prairie dog towns.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommendation	
	Coordinate with local biologists.			
W-42	Attach bird flight diverters (as provided by AZGF) to exclosure fencing around springs, channels, and aspen stands to avoid wildlife collisions.		X	General.
W-43	Avoid fence (i.e. exclosure) construction in PACs and PFAs during the respective breeding seasons (March 1 to August 31 and March 1 to September 30).		X	General.

Appendix E – Alternative B through D Implementation Plan

The Implementation Plan is designed to be integral to Alternative B-D and part of the record of decision (ROD). The Implementation Plan requires both resource specialists and responsible line officer to review and validate all actions. Completion of the checklist is designed ensure that project implementation follows design criteria and that the on-ground design of each activity is within the bounds of the predicted impacts disclosed in the analysis.

Part 1 – Project Summary

***Table 61*. Implementation Checklist**

Project Name:						
Project Location (Legal):						
Summary of activities proposed in this phase:						
Is the project located within the project boundary displayed in the FEIS/ROD?						
Identify the restoration unit (RU) in which the project phase is located based on the FEIS/ROD.	RU1	RU2	RU3	RU4	RU5	RU6
(A) How many acres are allowed to be treated in this RU over the lifetime of the ROD?						
(B) How many acres have been treated by RU since the ROD was signed?						

(C) How many remaining acres are available for treatment by RU over the lifetime of the decision? (A –B)						
(D) How total many acres will this project treat by RU?						
(3) Are the acres to be treated by RU less than remaining acres available for treatment? (C-D)						
Checkpoint 1: Are acres proposed for treatment by RU within the limits approved by the decision?	YES _____			NO_____		

***Table 62*. Checkpoint 2 Annual Accomplishments**

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU2	RU3	RU4	RU5	RU6
Aspen						
Prescribed Fire Only						
AGFD Treatment (Research)						
Grassland Restoration						
Grassland Mechanical						
Intermediate Thin (IT) 10						
Intermediate Thin (IT) 25						

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU2	RU3	RU4	RU5	RU6
Intermediate Thin (IT) 40						
MSO Restricted						
MSO Target						
MSO Threshold						
MSO PAC						
MSO PAC Grassland Mechanical						
Pine-sage						
Savanna						
Stand Improvement (SI) 10						
Stand Improvement (SI) 25						
Stand Improvement (SI) 40						
Uneven-aged (UEA) 10						
Uneven-aged (UEA) 25						
Uneven-aged (UEA) 40						
Wildland Urban Interface (WUI) Pinyon-juniper						

Acre/Miles by Treatment Type to be Implemented in this Phase		RU1	RU2	RU3	RU4	RU5	RU6
Wildland Urban Interface (WUI) 55							
Pile Burning							
Broadcast Burning							
Jackpot Burning							
Fireline Construction							
Existing System and Unauthorized Road Decommission							
Temp Road Construction							
Temp Road Decommission							
Road Reconstruction							
Open Existing Closed Roads for Project Access							
Decommission Existing Closed Roads for Project Access							
Springs	Remove trees to pre-settlement condition						
	Remove noxious weeds						
	Prescribed Fire						
	Protective Measures						

Acre/Miles by Treatment Type to be Implemented in this Phase		RU1	RU2	RU3	RU4	RU5	RU6
Ephemeral Channels	Re-establish drainage, slopes, vegetation						
	Site protection						
	Remove or rehab stock tanks						
	Other						
Construct protective fencing – springs/aspen							
Checkpoint 2: Are acres proposed for treatments in this phase within the limits approved by the decision?		YES _____			NO_____		

***Table 63*. Checkpoint 3**

Is the project within the maximum treatment acres within each RU and subunits?	YES_____	NO_____
Is treatment design consistent with design criteria and desired conditions?	YES_____	NO_____
Are wildlife surveys, if necessary, complete? Is the action consistent with the biological opinion dated_____?	YES_____	NO_____
Are heritage surveys complete? Is the action consistent with the letter of concurrence form the AZ SHPO dated _____?	YES_____	NO_____
Are treatments consistent with Old Tree Implementation Plan (attachment 3 of this document)?	YES_____	NO_____
Are treatments consistent with Large Tree Implementation Plan exceptions (attachment 4 of this document)?		
Has the monitoring and adaptive management plan been evaluated to document compliance with law, regulation, policy, and forest plans?	YES_____	NO_____

Have additional implementation and effectiveness monitoring needs been identified?	YES_____	NO_____
As required by CFLR Act, is multi-party monitoring underway?		
Are adaptive management actions being proposed? If so, clearly analyzed and covered by the decision made (see attachment 3 of this document)?		
Has the administrator checklist been completed and signed by the appropriate resource specialists?	YES_____	NO_____
Is the treatment (burn) plan completed and signed? Objectives have been developed in interdisciplinary manner and are clearly delineated? Objectives are consistent with management direction? Objectives match those described for RU in NEPA analysis? Complexity rating_____	YES_____	NO_____
Do conditions match those described in NEPA analysis? Examples where conditions have changed: New listed species in project area New invasive species in project area Change in regulations Burn/treatment plan doesn't allow implementing design criteria	YES_____	NO_____
Have issues identified in the NEPA analysis been reviewed (see part 2, administrator checklist)?	YES_____	NO_____
Has a post-implementation review been completed (may be filled out after approval)?	YES_____	NO_____

Recommended By:

I have reviewed the project and signed the resource specialist checklist. Based on my review, the project is consistent with the Four-Forest Restoration Initiative, and the Coconino and Kaibab National Forests Final Environmental Impact Statement and Record of Decision (FEIS/ROD) implementing the Coconino and Kaibab NFs' 4FRI Project.

Name/Signature	Date	Resource Area
		Terrestrial and Aquatic Wildlife
		Botany
		Range
		Recreation
		Archaeology
		Fire
		Hydrology
		Silviculture
		Recreation
		Scenery
		Planning/NEPA

Approved By:

I have reviewed the project and signed the Administrator Check List. Based on my review, the project is consistent with the Four Forest Restoration Initiative, and the Coconino and Kaibab National Forests Final Environmental Impact Statement and Record of Decision implementing the Coconino and Kaibab 4FRI Project.

_____ _____

Agency Approving Official, Title **Date**

ATTACHMENTS: (add to as necessary)

Part 2 – Agency Administrator Checklist

Indicate which documents are attached at the end of this checklist.

Table 64. **Agency Annual Consistency Review Checklist**

Y/N	Document Name	Attached? Y/N	Document Name
	Silviculture Implementation Guide		
	Burn Plan		Archeological Surveys
	Safety Plan		Project Maps
	Wildlife Surveys		
	Botany Surveys		
	Archaeological Surveys		
	Monitoring and Adaptive Management Plan		
	Old Tree Implementation Strategy (attachment 3)		
	Large Tree Implementation Strategy (attachment 4, alternative C)		
	LTIS Exception Process - follow when on-ground situation does not meet existing LTIS exception category (included in attachment 3, alternative C)		

Resource Specialist Review

Range

Effects on range structures, livestock, local range economies, grasses, and native vegetation

- Three years (minimum) out, coordination begun with range staff
- Three years (minimum) out, grazing permittee notified
- Sensitive resource areas have been identified and mapped within and adjacent to project area
- Funding is available to repair/replace fire-damaged range infrastructure
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Range Specialist	Date

Wildlife

Effects of proposed activities on special status wildlife, fish, and plant species

- Sensitive resource areas have been identified and mapped within and adjacent to project area
- FWS county lists checked and species verified in project area
- Southwestern Region Forest Service sensitive species identified for project area
- Calculate percent project watershed area burned within 2 years and 1 year (two answers)
- Presence of riparian/aquatic habitats documented
- Reporting and BO checklist completed
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Wildlife Biologist	Date

Soil and Water Resources

Effects of proposed activities on soil and water resources

- Sensitive resource areas have been identified and mapped within and adjacent to project area
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Hydrologist/Soil Scientist	Date

Air Quality

Effects of proposed activities on air quality

- Permits obtained as specified in the burn plan
- Design criteria questionnaire completed
- Specialist signed part 1
- Method of treatment within scope of analysis and predicted effects

Signed:	
Fire/Fuels Specialist	Date

Heritage Resources

Effects of proposed activities on cultural and heritage resources

- Sensitive resource areas have been identified and mapped within and adjacent to project area
- Presence of cultural sites documented
- Tribes notified of burning plans (1 month in advance)
- Surveys completed and documented
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Archaeologist	Date

Recreation and Scenery Management

Effects of proposed activities on scenic quality

- Sensitive resource areas have been identified and mapped within and adjacent to project area
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Recreation Specialist/Landscape Architect	Date

Effects of proposed activities on social considerations

- Neighbors notified
- Public notified
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Public Affairs/Agency Representative	Date

Effects of proposed activities on recreational uses

- Sensitive resource areas have been identified and mapped within and adjacent to project area
- Design criteria selected and applied
- Method of treatment within scope of analysis and predicted effects

Signed:	
Recreation Specialist/Landscape Architect	Date

Attachment 1. Silvicultural Design and Implementation Guide

Section A – Management Direction, Desired Conditions and Treatment Design

Mexican Spotted Owl Habitat - Protected Habitat

Protected Activity Center (PAC)

Vegetation Management Direction: Retain key forest species such as oak; retain key habitat components such as snags and large down logs; harvest conifers less than 9 inches in diameter only within those PACs treated to abate fire risk and avoid treatment in 100 acre nest cores as described in the MSO Recovery Plan. Further 4FRI guidelines include the primary objective of improving MSO habitat when mechanically treating PACs potentially cutting trees greater than 9-inch dbh.

Desired Conditions: Table III.B.1 (USFWS 1995) lists guidance for minimum desired structural elements within PACs. This includes 150 square feet of basal area, 30 percent or more of the stand density index in ponderosa pine trees ≥18-inch dbh, 15 percent or more of the stand density index in ponderosa pine trees between 12- and 18-inch dbh, ≥20 trees per acre ≥18-inch dbh, and ≥20 Gambel oak basal area (BA). Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

PAC Mechanical Thin and Burn Treatment Design:

- Each PAC has 100-acre no treatment area around the known nest or roost sites.
- Outside the 100-acre no treatment area, trees may be thinned and/or prescribed burns may be used to treat fuels and mitigate fuel hazards where feasible.
- Each PAC to be thinned would have an upper diameter limit of trees that may be cut. All trees above that limit would be retained.
- Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.
- Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternative B and D. In alternative C, manage for a minimum of 110 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density.
- Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.
- Manage for individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy. Remove ponderosa pine trees up to the treatment diameter limit within a 50-foot radius that do not meet the old tree definition and whose crowns are outside the old tree crown drip line.
- Manage for large oaks by removing ponderosa pine up to the PAC treatment diameter limit that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch diameter at root collar (drc) or larger.

- Gambel oak, juniper and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

PAC Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.
- Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

Steep Slopes

Vegetation Management Direction: Treat fuel accumulations to abate fire risk. Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire; retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10-inch drc.

Desired Conditions: Table III.B.1 (USFWS 1995) lists structural elements. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

Steep Slopes Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.
- Prescribed fires are designed to maintain and enhance desired MSO protected forest structure, tree densities, snag densities, and CWD levels.

Restricted Habitat

Definition: Pine-oak – ponderosa pine habitat type series; within the Gambel oak or Gambel oak phase of the habitat type; ≥10 percent of the stand basal area or 10 ft²/ac of basal area consists of Gambel oak ≥5 inches drc.

General Vegetation Management Direction: Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Habitat variables are documented in table III.B.1 of the MSO recovery plan (USFWS 1995). Management would attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Allow natural canopy gap processes to occur, thus producing horizontal variation in

stand structure. Emphasize uneven-aged management systems. Both even-aged and uneven-aged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Save all trees greater than 24-inch dbh. Retain existing large oaks and promote growth of additional large oaks. Encourage prescribed fire to reduce hazardous fuel accumulation. Retain substantive amounts of key habitat components (snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods).

***Table 65*. MSO Restricted Habitat Target/Threshold Conditions for Pine-oak Forests**

Stand Averages	
Basal area (BA)	≥150 BA
18 inch + trees/ac (TPA)	≥20 TPA
Oak basal area	≥20 BA
Percent Total Existing SDI by Size Class	
12-18”	≥15
18-24”	≥15
24+”	≥15

Threshold Habitat

Vegetation Management Direction: Stand averages currently meet or exceed threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables below the threshold values.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods.

Threshold Mechanical Thin and Burn Treatment Design:

- Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.
- Manage for ≥150 square feet of BA where present, with a portion of those acres ≥170 square feet of BA in alternative B and D. In alternative C, manage for a minimum 110 square feet of BA.
- Manage to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in all alternatives.
- Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.
- Manage for individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy. Remove ponderosa pine trees up to the treatment diameter limit within a 50-foot radius that do not meet the old tree definition and whose crowns are outside the old tree crown drip line.
- No trees larger than 24-inch dbh would be cut.

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).
- Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Threshold Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.
- Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Target

Vegetation Management Direction: Stand averages currently meet or exceed some threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables that are currently at or above the threshold value below the threshold values. Management would encourage development of threshold values that are lacking.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs greater than 12 inches midpoint diameter, hardwoods.

Target Mechanical Thin and Burn Treatment Design:

- Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.
- Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternative B and D. In alternative C, manage for a minimum 110 square feet of BA and to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density.
- Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.
- Manage for individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy. Remove ponderosa pine trees up to the treatment diameter

limit within a 50-foot radius that do not meet the old tree definition and whose crowns are outside the old tree crown drip line.

- No trees larger than 24-inch dbh would be cut.
- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).
- Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length..
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Target Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.
- Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other

Vegetation Management Direction: Current stand averages meet few of the threshold values in table III.B.1 of the MSO recovery plan (USFWS 1995). Management would encourage development of threshold values that are lacking.

Desired Conditions: Uneven aged (3 plus age classes) - Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods.

Restricted Other Mechanical Thin and Burn Treatment Design:

- Uneven age thinning and group selection would be used to establish interspace between tree groups, thin tree groups and create regeneration openings.
- Treatments would strive to attain the following overall average density and structural characteristics:

***Table 66*. Restricted Other Habitat Treatment Criteria**

Stand Averages	
Basal area (BA)	70-90 ft²
Stand density index - % of max	25-40
18 inch + trees/acre (TPA)	≥20
Oak basal area (square feet)	≥20+
Percent Total SDI by Size Class	
12-18”	≥15
18-24”	≥15
24+”	≥15

- Manage for a range of density and structural characteristics by thinning areas with a southerly aspect to an overall average of 60 to 80 square feet of BA and areas with northerly aspect to an overall average of 80 to 100 square feet of BA. Density would vary within these ranges depending on existing stand structure.
- Individual trees and tree groups would occupy approximately 60 to 75 percent of the area.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing ponderosa pine trees up to 18-inch dbh that do not meet the old tree definition within a 50-foot radius.
- No trees larger than 24-inch dbh would be cut.
- Tree groups, on average, would range in size from 0.1 to 1 acre with northerly aspects and highly productive microsites having larger average group sizes. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature or old tree groups.
- Interspace would occupy approximately 25 to 40 percent of the area.
- Interspace width between tree groups would average from 25 feet to 60 feet with a maximum width of 200 feet.
- Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on depending on current age class distribution. They would average 0.3 to 0.8 acre and would not exceed 200 feet wide. In general, regeneration openings would not be larger than 2 acres. However,

they may extend up to 4 acres in specific areas where ponderosa pine mistletoe infections are heavy. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

- Manage moderate to heavy dwarf mistletoe infection centers that are not intended for regeneration openings for improved tree vigor and growth by retaining the best growing dominant and co-dominant trees with the least amount of mistletoe.
- Manage for large oaks by removing conifers up to 18-inch dbh within 30 feet of oak 10 inches drc or larger that do not meet the old tree definition and do not have interlocking crown with oaks.
- Gambel oak, juniper and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre; downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired MSO restricted other habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.
- Prescribed fires are designed to maintain and enhance desired MSO restricted other forest structure, tree densities, snag densities, and CWD levels.

Goshawk Habitat

General – Ponderosa Pine

Vegetation Management Direction: Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout ponderosa pine forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Provide for or preserve existing clumps of trees with interlocking crowns. Sustain a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape. Encourage aspen and oak regeneration. Provide habitat for goshawk prey.

Desired Conditions: Highly interspersed, heterogeneous pattern and size of tree groups and interspace across the landscape. Tree groups are dominated by trees of a similar age and range from young to old (uneven aged). Interspace has a robust herbaceous layer.

Landscapes Outside of Goshawk Post-fledgling Areas (LOPFA) – Ponderosa Pine

Vegetation Management Direction: Distribution of vegetation structural stages for ponderosa pine – 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), 20 percent old forest (VSS6). The distribution of VSS, tree density, and tree age are a product of site quality in the EMA. Use site quality to guide in the distribution of VSS, tree density and tree ages. Snags are ≥18-inch dbh and ≥30 feet in height, downed logs are 12 inches in diameter and are ≥8-feet long, woody debris is ≥3 inches on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape. Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6). Further 4FRI direction is documented in the forest plan amendment that clarifies openness and clarifies that guidelines for canopy cover apply to mid-aged to old forest structural stage dominated tree groups across the LOPFA.

Desired Conditions: Uneven aged – balance of age classes. Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

LOPFA, WUI55, UEA40, UEA25 and UEA10 Mechanical Thin and Burn Treatments Design:

- Uneven age thinning and group selection would be used to establish interspace between tree groups, thin tree groups, and create regeneration openings within LOPFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a quadratic mean diameter (QMD) ≥ 8.5 inches.
- Treatments would strive to attain an overall stand average density of 50 to 70 square feet of basal area and 15 to 35 percent of maximum stand density index (SDI). Density would vary within this range depending on treatment intensity and existing stand structure.
- Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as follows:

***Table 67*. Percent of Trees, Tree Groups, and Interspaces by Treatment Intensity (LOPFA)**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree	Percent of Area Occupied by Interspace
WUI55	30 - 45	55 - 70
UEA40	45 - 60	40 - 55
UEA25	60 - 75	25 - 40
UEA10	75 - 90	10 - 25

- Individual trees, tree groups, and interspaces would be managed to move towards a balance of age classes by reducing the most abundant tree size classes and maintaining the under-represented tree size classes.

- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. Stocking guidelines for tree groups for the WUI55, UEA40, UEA25, and UEA10 mechanical thin treatments are as follows:

***Table 68*. LOPFA WUI and UEA Treatments Stocking Guidelines for Tree Groups**

VSS Class (% of area)	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (ft)	Basal Area[2] (ft²/ acre)
1 & 2 (20)	0-4.9	19	48	96	144	193	12 - 18	N/A
3 (20)	5-11.9	14	34	68	102	136	N/A	50
4 (20)	12-17.9	5	12	23	35	46	N/A	60
5 (20)	18-23.9	3	8	15	23	30	N/A	70
6 (20)	≥24	2	5	11	16	21	N/A	85

Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature or old tree groups.
- Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions, and approximately 10 percent remain unthinned.

- Interspace width between tree groups would average from 25 feet to 120 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 69*. Interspace Percent and Width in LOPFA WUI and UEA Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
WUI55	55 -70	80 - 120
UEA40	40 - 55	60 - 100
UEA25	25 - 40	40 - 60
UEA10	10 - 25	25 - 40

- Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on depending on current VSS distribution. They would average 0.3 to 0.8 acre and would be no larger than 4 acres or 200 feet wide. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.
- One group of reserve trees, three to five trees per group, would be left in created regeneration openings greater than an acre in size.
- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired LOPFA UEA forest structure, tree densities, snag densities, and CWD levels.

LOPFA UEA – AZGF Design Mechanical Thin and Burn (Alternative C) Design:

- Same as LOPFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

LOPFA Intermediate Thin (IT) 40, 25, and 10 Mechanical Thin and Burn Treatments Design:

- Intermediate thinning (IT) would be used to establish interspace between tree groups and thin tree groups within LOPFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.
- Treatments would strive to attain an overall average density of 70 to 90 square feet of BA and 25 to 40 percent of maximum SDI. Density would vary within these ranges depending on treatment intensity and existing stand structure.
- Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as follows:

***Table 70*. Percent of Area Occupied by Trees, Tree Groups, and Interspace in LOPFA IT**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45 - 60	40 - 55
IT25	60 -75	25 - 40
IT10	75 - 90	10 - 25

- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and co-dominant trees with the least amount of mistletoe within each group.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups. Stocking guidelines for VSS 4, 5, and 6 tree groups for the IT40, IT25, and IT10 mechanical thin treatments are as follows:

***Table 71*. Stocking Guidelines for VSS 4 - 6 Tree Groups in LOPFA IT treatments**

VSS Class	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
4	12 - 17.9	5	12	23	35	46	N/A	60
5	18 - 23.9	3	8	15	23	30	N/A	70
6	≥24	2	5	11	16	21	N/A	85

Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Interspace width between tree groups would average from 25 feet to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 72*. Percent and Width of Interspace in LOPFA IT Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40 - 55	60 - 80
IT25	25 - 40	40 - 60
IT10	10 - 25	25 - 40

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired LOPFA IT forest structure, tree densities, snag densities, and CWD levels.

LOPFA Stand Improvement (SI) 40, 25, and 10 Mechanical Thin and Burn Treatments Design:

- Stand improvement thinning would be used to establish interspace between tree groups and thin tree groups within LOPFA sites with none to low dwarf mistletoe infection and are even age sites with a QMD ≤ 8.5 inches.
- Treatments would strive to attain an overall stand average density of 20 to 25 percent of maximum SDI. Density would vary within this range depending on treatment intensity and existing stand structure.
- Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as follows:

Table 73. **Percent of Area Occupied by Individual Trees, Tree Groups, and Interspace in LOPFA SI Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
SI40	45 - 60	40 - 55
SI25	60 - 75	25 - 40
SI10	75 - 90	10 - 25

- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and co-dominant trees.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. Stocking guidelines for tree groups for the SI40, SI25, and SI10 mechanical thin treatments are as follows:

***Table 74*. Stocking Guidelines for Tree Groups in LOPFA SI Treatments**

VSS Class	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
1 & 2	0 - 4.9	19	48	96	144	193	12 - 18	N/A
3	5 - 11.9	14	34	68	102	136	N/A	50
4	12 - 17.9	5	12	23	35	46	N/A	60
5	18 - 23.9	3	8	15	23	30	N/A	70
6	≥24	2	5	11	16	21	N/A	85

Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Interspace width between tree groups would average from 25 feet to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 75*. Interspace Percent and Width LOPFA SI Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
SI40	40 -55	60 - 80
SI25	25-40	40 – 60
SI10	10-25	25 – 40

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous

vegetation. Prescribed fires are designed to maintain and enhance desired LOPFA SI forest structure, tree densities, snag densities, and CWD levels

LOPFA Pine Sage Mechanical and Burn Treatment Design:

- Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.
- Treatment would strive to attain an overall average density of 40 to 60 square feet of BA and 15 to 25 percent of maximum SDI. Density would vary within this range depending on existing stand structure.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences.
- Replacement tree density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups as follows:

***Table 76*. Stocking Guidelines for VSS 4 – VSS 6 Tree Groups in LOPFA Pine Sage Treatments**

VSS Class	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
4	12 - 17.9	5	12	23	35	46	N/A	60
5	18 - 23.9	3	8	15	23	30	N/A	70
6	≥24	2	5	11	16	21	N/A	85

Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak,

juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.

- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired understory composition and cover as well as LOPFA pine sage forest structure, tree densities, snag densities, and CWD levels.

Savanna/Grassland Restoration Mechanical and Burn Treatments Design:

- Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance. Manage for an open reference condition with 10 to 30 percent of the area under ponderosa pine and deciduous tree crowns.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. A higher leave tree to evidence ratio may be required to maintain the desired tree cover range.
- Manage for a range of 70 percent to 90 percent of the treatment area as interspace (grass/forb) between tree groups or individuals. Amount of interspace would vary within this range depending on current conditions.
- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- All Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch drc may be cut; and when there is no other option to facilitate logging operations (skid trail and landing locations).
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired LOPFA savanna/grassland forest structure, tree densities, snag densities, and CWD levels.

LOPFA Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.
- Prescribed fires are designed to maintain and enhance desired LOPFA forest structure, tree densities, snag densities, and CWD levels.

Goshawk Post-fledgling Areas (PFA) – Ponderosa Pine

Vegetation Management Direction: Provide for a healthy, sustainable forest environment for the post-fledgling family needs. The principle difference between "within the post-fledgling family area" and "outside the post-fledgling family area" is the higher canopy cover and smaller opening size within the post-fledgling family area. Vegetative structural stage distribution and structural conditions are the same within and outside the post-fledgling family area. Ponderosa pine canopy cover for mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent. Further 4FRI direction clarifies that canopy cover guidelines apply to mid-aged to old forest structural stage dominated tree groups.

Desired Conditions: Uneven aged – balance of age classes. Within group structure specific to mid-aged to old classes (VSS4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

dPFA/PFA UEA40, dPFA/PFA UEA25 and dPFA/PFA UEA10 Mechanical Thin and Burn Treatments Design:

- Uneven age thinning and group selection would be used to establish interspace between tree groups, thin tree groups, and create regeneration openings within dPFA/PFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a QMD ≥ 8.5 inches.
- Treatments would strive to attain an overall average density of 70 to 80 square feet of BA and 25 to 40 percent of maximum SDI. Density would vary within this range depending on treatment intensity and existing stand structure.
- Individual trees, tree groups and interspaces would occupy the following percent of the area by treatment intensity as follows:

***Table 77*. Percent of Area Occupied by Individual Trees, Tree Groups, and Interspace in dPFA/PFA UEA Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
UEA40	45 - 60	40 - 55
UEA25	60 - 75	25 - 40
UEA10	75 - 90	10 - 25

- Individual trees, tree groups, and interspaces would be managed to move towards a balance of age classes by reducing the most abundant tree size classes and maintaining the under-represented tree size classes.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. Stocking guidelines for tree groups for the dPFA/PFA UEA40, UEA25, and UEA10 mechanical thin treatments are as follows:

***Table 78*. Stocking Guidelines for Tree Groups in dPFA/PFA WUI and UEA Treatments**

VSS Class, %	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
1 & 2, 20	0-4.9	19	48	96	144	193	12 - 18	N/A
3, 20	5-11.9	14	34	68	102	136	N/A	50
4, 20	12-17.9	7	18	35	53	70	N/A	85
5, 20	18-23.9	4	10	20	29	39	N/A	90
6, 20	≥24	3	7	14	20	27	N/A	110

Densities within the VSS 4 class are equivalent to 55 percent canopy cover.
Densities within VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature or old tree groups.
- Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions, and approximately 10 percent remain unthinned.
- Enhance and maintain mid-aged, mature, or old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within the larger group.
- Interspace width between tree groups would average from 25 feet to 70 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 79*. Interspace Percent and Width in dPFA/PFA WUI and UEA Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
UEA40	40 - 55	55 - 70
UEA25	25 - 40	40 - 55
UEA10	10 - 25	25 - 40

- Regeneration openings (group selection) account for 10 to 20 percent of tree groups. They would average 0.3 to 0.8 acre and would be no larger than 2 acres or 200 feet wide. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.
- One group of reserve trees, three to five trees per group, would be left in created regeneration openings greater than an acre in size.
- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous

vegetation. Prescribed fires are designed to maintain and enhance desired dPFA/PFA UEA forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA UEA – AZGF Design Mechanical Thin and Burn (Alternative C) Design:

- Same as dPFA/PFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

dPFA/PFA IT40, 25 and 10 Mechanical Thin and Burn Treatments Design:

- Intermediate thinning would be used to establish interspace between tree groups and thin tree groups within dPFA/PFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.
- Treatments would strive to attain an overall average density of 70 to 90 square feet of BA and 25 to 40 percent of maximum SDI. Density would vary within this range depending on treatment intensity and existing stand structure.
- Individual trees, tree groups and interspaces would occupy the following percent of the area by treatment intensity as follows:

***Table 80*. Percent of Area Occupied by Trees and Interspace for dPFA/PFA IT**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45 - 60	40 - 55
IT25	60 - 75	25 - 40
IT10	75 - 90	10 - 25

- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and co-dominant trees with the least amount of mistletoe within each group.
- Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups. Stocking guidelines for VSS 4, 5, and 6 tree groups for the dPFA/PFA IT40, IT25, and IT10 mechanical thin treatments are as follows:

***Table 81*. dPFA/PFA IT Treatments Stocking Guidelines for VSS 4 – 6 Tree Groups**

VSS Class	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
4	12 - 17.9	7	18	35	53	70	N/A	85
5	18 - 23.9	4	10	20	29	39	N/A	90
6	≥24	3	7	14	20	27	N/A	110

Densities within the VSS 4 class are equivalent to 55 percent canopy cover.
Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Interspace width between tree groups would average from 25 feet to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 82.* Interspace Percent and Width in dPFA/PFA IT**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40 - 55	60 - 80
IT25	25 - 40	40 - 60
IT10	10 - 25	25 - 40

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired dPFA/PFA IT forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA SI40, 25, and 10 Mechanical Thin and Burn Treatments Design:

- Stand improvement thinning would be used to establish interspace between tree groups and thin tree groups within dPFA/PFA even age sites with a QMD ≤ 8.5 inches and with none to low dwarf mistletoe infection.
- Treatments would strive to attain a stand average density of 20 to 25 percent of maximum SDI. These ranges would vary depending on treatment intensity and existing stand structure.
- Individual trees, tree groups and interspaces would occupy the following percent of the area by treatment intensity as follows:

***Table 83*. Percent of Area Occupied by Individual Trees, Tree Groups, and Interspaces in dPFA/PFA SI Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
SI40	45 - 60	40 - 55
SI25	60 - 75	25 - 40
SI10	75 - 90	10 - 25

- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Manage for sustainability of individual old ponderosa pine trees as defined in the Old Tree Implementation Strategy by removing all ponderosa pine trees that do not meet the old tree definition within a 50-foot radius.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and co-dominant trees.
- Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. Stocking guidelines for tree groups for the dPFA/PFA SI40, SI25, and SI10 mechanical thin treatments are as follows:

***Table 84*. Stocking Guidelines for Tree Groups in dPFA/PFA SI Treatments**

VSS Class, %	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
1 & 2, 20	0-4.9	19	48	96	144	193	12 - 18	N/A
3, 20	5-11.9	14	34	68	102	136	N/A	50
4, 20	12-17.9	7	18	35	53	70	N/A	85
5, 20	18-23.9	4	10	20	29	39	N/A	90
6, 20	≥24	3	7	14	20	27	N/A	110
1 & 2, 20	0-4.9	19	48	96	144	193	12 - 18	N/A

Densities within the VSS 4 class are equivalent to 55 percent canopy cover.
Densities within VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Interspace width between tree groups would average from 25 feet to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as follows:

***Table 85*. Interspace Percent and Width in dPFA/PFA SI Treatments**

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
SI40	40 - 55	60 - 80
SI25	25 - 40	40 - 60
SI10	10 - 25	25 - 40

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak,

juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.

- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired dPFA/PFA SI forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA Pine Sage Mechanical and Burn Treatment Design:

- Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.
- Treatments would strive to attain an overall stand average density of 40 to 60 square feet of BA and 15 to 25 percent of maximum SDI. Density would vary within this range depending on existing stand structure.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences
- Replacement tree density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups as follows:

***Table 86*. Stocking Guidelines for VSS 4 – 6 Tree Groups in dPFA/PFA Pine Sage Treatments**

VSS Class	DBH Class (inches)	Typical Trees Per Group Stocking					Typical Within Group Density[1]	
		1/10 ac group	1/4 ac group	1/2 ac group	3/4 ac group	1 ac group	Relative Spacing Range (feet)	Basal Area[2] (ft²/ acre)
4	12 - 17.9	7	18	35	53	70	N/A	85
5	18 - 23.9	4	10	20	29	39	N/A	90
6	≥24	3	7	14	20	27	N/A	110

Densities within the VSS 4 class are equivalent to 55 percent canopy cover.
Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover.
[1]These are typical values for the desired condition, variation can occur and is desired.
[2]Rounded to the nearest 10 square feet/acre.

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10-inch drc or larger.
- Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young and mid-aged pinyon and juniper up to 11-inch drc may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the Old Tree Implementation Strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations). Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired dPFA/PFA savanna/grassland forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.
- Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels.

Nest Area

Vegetation Management Direction: Provide unique nesting habitat conditions for goshawks. Important features include trees of mature to old age with high canopy cover. The structure of the vegetation within nest areas is associated with the forest type, and tree age, size and density, and the developmental history of the stand. Table 87 represents GTR-RM-217 attributes required for goshawks on location with “low” and “high” site productivity. The nesting area contains only mature to old forest (VSS 5 and 6) having a canopy cover (measured vertically) between 50 to 70 percent with old forest VSS 6 trees 200 to 300 years old. Non-uniform spacing of tree and clumpiness is desirable.

Desired Conditions: Even aged dominated by mature and/or old forest structural stages.

Goshawk Nest Area Burn Only Treatment Design:

- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.
- Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

- Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels. Desired goshawk nest stand structural attributes are as follows:

Table 87. Minimum Structural Attributes in Suitable Goshawk Nest Stands*

Structural Attribute	Minimum Metrics	
Site Index	<55	≥55
Trees/Acre	40	30
Mean DBH (in.)	16	22
Age (yrs.)	200+	200+
Total BA (sq. ft./acre)	120	140
Overstory canopy cover	50+	60+
VSS	5B-6	5B-6

* GTR-RM-217, southwest ponderosa pine cover types

Landscapes Outside of Goshawk Post-fledgling Areas (LOPFA) – Pinyon Juniper

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

Desired Conditions: Mosaic of young and mature, species diverse patches of trees interspersed with interspace across the landscape to promote the growth of sagebrush, oak, cliffrose, and other shrubs and herbaceous understory species. Mature patches would be structurally diverse, containing large live and dead standing trees as well as trees with dead or broken tops, gnarls, and burls. The structure and composition reflects the natural range of variation.

Pinyon Juniper (PJ) WUI Mechanical Thin and Burn Treatment Design:

- Uneven age thinning would be used to establish interspace between tree groups and thin tree groups within LOPFA PJ sites.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities and dead tops would also be favored for retention.
- Retain one to three groups per acre containing approximately 5 to 30 trees each (averaging 30 to 60 trees per acre across the site). Form groups around existing concentrations of large, mature trees. Retain additional healthy, young, free-to-grow trees within groups where possible.
- Between groups, thin-from-below to 16-inch drc for pinyon and juniper and 16-inch dbh for ponderosa pine (see next).
- Retain all pre-settlement yellow pines and one to two replacement blackjacks per existing yellow pine or pre-settlement evidence (i.e. to approximate the naturally-occurring stand composition). Replacement blackjacks should be comprised of a

variety of size classes. Blackjacks would be retained within 100 feet of the yellow pine or pre-settlement evidence they are replacing.

- Manage for large oaks by removing ponderosa pine up to 18-inch dbh that do not meet the old tree definition and do not have interlocking crown with oaks within 30 feet of base of oak 10inch drc or larger.
- Gambel oak would not be cut with the exception of when there is no other option to facilitate logging operations (skid trail and landing locations).
- Snags would be managed for one per acre over 75 percent of the area and CWD would be managed for an after treatment average of 1 to 3 tons per acre. Where available, a portion of the CWD would include two logs ≥10 inches and ≥10 feet in length.
- Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired LOPFA PJ WUI forest structure, tree densities, snag densities, and CWD levels.

Other Areas Outside MSO and Goshawk Habitats

Aspen

Vegetation Management Direction: Conifer removal, partial removal of overstory aspen, ground disturbing activities, and fire would be used to stimulate aspen sprouting in areas that have or previously had aspen.

Desired Conditions: Aspen is successfully regenerating and recruiting into older and larger size classes. Size classes have a natural distribution, with the greatest number of stems in the smallest classes. Coniferous species comprise less than 10 percent of the overstory.

Aspen Mechanical Thin and Burn Treatment Design:

- Inclusions of aspen remnants within portions of ponderosa pine stands would be regenerated by removing all post-settlement conifers from within 100 feet of the aspen clone. Some removal of aspen within the clone as well as ground disturbing activity or burning may occur to stimulate suckering.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.
- Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.
- Each clone would be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.
- Prescribed burns may be used where and when feasible to treat fuels; mitigate fuel hazards; and to produce effects that stimulate aspen suckering and regeneration, and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and

enhance desired aspen forest structure, tree densities, snag densities, and CWD levels.

Aspen Burn Only Treatment Design:

- Inclusions of aspen remnants within portions of ponderosa pine stands would be regenerated by prescribed burning to stimulate suckering.
- Prescribed burns are designed to reduce post-settlement conifer stocking within 100 feet of the aspen clone and disturb the site with sufficient intensity to encourage aspen regeneration.
- Each clone would be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Grassland

Vegetation Management Direction: Reduce conifer encroachment within grasslands as identified by mollisol soils.

Desired Conditions: Restore historic grassland/forest edge as indicated by existing pre-settlement conifers and evidence of pre-settlement conifers.

Grassland Mechanical Thin and Burn Treatment Design (Alternative C Only):

- Treatments are designed to promote and re-establish the historic meadow edge as defined by pre-settlement trees and evidences and the current forest structure of young trees encroaching on the edge of the grassland.
- Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the Old Tree Implementation Strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities and dead tops would also be favored for retention.
- Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. Ponderosa pine, pinyon, and juniper not meeting long-lived characteristics may be removed.
- Gambel oak would be retained.
- Prescribed burns may be used where and when feasible to treat fuels, mitigate fuel hazards and to produce effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired grassland conditions.

Section B – Decision Matrix

***Table 88*. Section B Decision Matrix for Establishing Tree Groups, Interspace, and Regeneration Openings**

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Strategy (LTIS) Exception Category (Alternative C)
Tree Group	#1 – Abundance of pre-settlement tree evidence #2 – Under-represented tree classes (e.g. free to grow seedling/saplings; trees of different cohort than neighboring trees) #3 – High percentage of trees exhibiting good health and vigor	#1 – Old tree characteristics (OTIS) regardless of size #2 – Oak, pinyon, and juniper with exceptions #3 – Wildlife trees (cavities, dead tops)	Tree group stocking guidelines	#1 – Trees in the dominant and co-dominant crown position exhibiting vigor relative to age regardless of size #2 – Crown ratio >40% desirable; crown ratio 25-40% acceptable #3 – Free of mistletoe or low dwarf mistletoe rating relative to neighboring trees; Free of pine beetle activity #4 – Trees >12" high percentage of interlocking crown; Trees <12" ability to develop interlocking crown	Heavily-Stocked Stands (with High Basal Area) Generated by a Preponderance of Large, Young Trees Does the decision matrix meet the conditions described by the LTIS category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____ Ponderosa Pine/Gambel Oak Forest Does the decision matrix meet the conditions described by the LTIS category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Strategy (LTIS) Exception Category (Alternative C)
Interspace	#1 – Little to no pre-settlement tree evidence #2 – Existing non-stocked openings #3 – High percentage of trees exhibiting poor health and vigor #4 - Contiguous area of well represented cohorts	#1 – Old tree characteristics (OTIS) regardless of size. #2 – Oak, pinyon and juniper #3 – Wildlife trees (cavities, dead tops)	NA	NA	Within-Stand Openings: Does the decision matrix meet the conditions described by the LTIS category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____
Regeneration Opening	#1 – Contiguous area of well represented cohort. #2 – Isolated patch of mistletoe infected trees within the well represented cohort. #3 – Adjacent to seed bearing tree groups that are free of mistletoe infection.	#1 – Old tree characteristics (OTIS) regardless of size. #2 – Oak, pinyon and juniper #3 – Wildlife trees (cavities, dead tops #4 – Largest, healthiest, seed bearing PP (within openings >1 ac)	NA	NA	NA

Section C – Old Tree Implementation Plan

Old Tree Descriptions and Illustrations

Old trees would be determined by the following characteristics described by Thomson (1940) as age class 3 (intermediate-mature) and age class 4 (mature-overmature).

- Age – Approximately 150 years and older.
- dbh – Site dependent.
- Bark – ranging from reddish brown, shading to black in the top with moderately large plates between the fissures to reddish brown to yellow, with very wide, long, and smooth plates.
- Tops – ranging from pyramidal or rounded (occasionally pointed) to flat (making no further height growth).
- Branching – ranging from upturned in upper third of the crown, horizontal in the middle third and drooping in the lower third of the crown to mostly large, drooping, gnarled, or crooked. Branch whorls range from incomplete and indistinct except at the top to completely indistinct and incomplete.

Figure 54 and figure 55 display illustrations of age class 3 (intermediate-mature) and age class 4 (mature-overmature) from Thompson 1940.

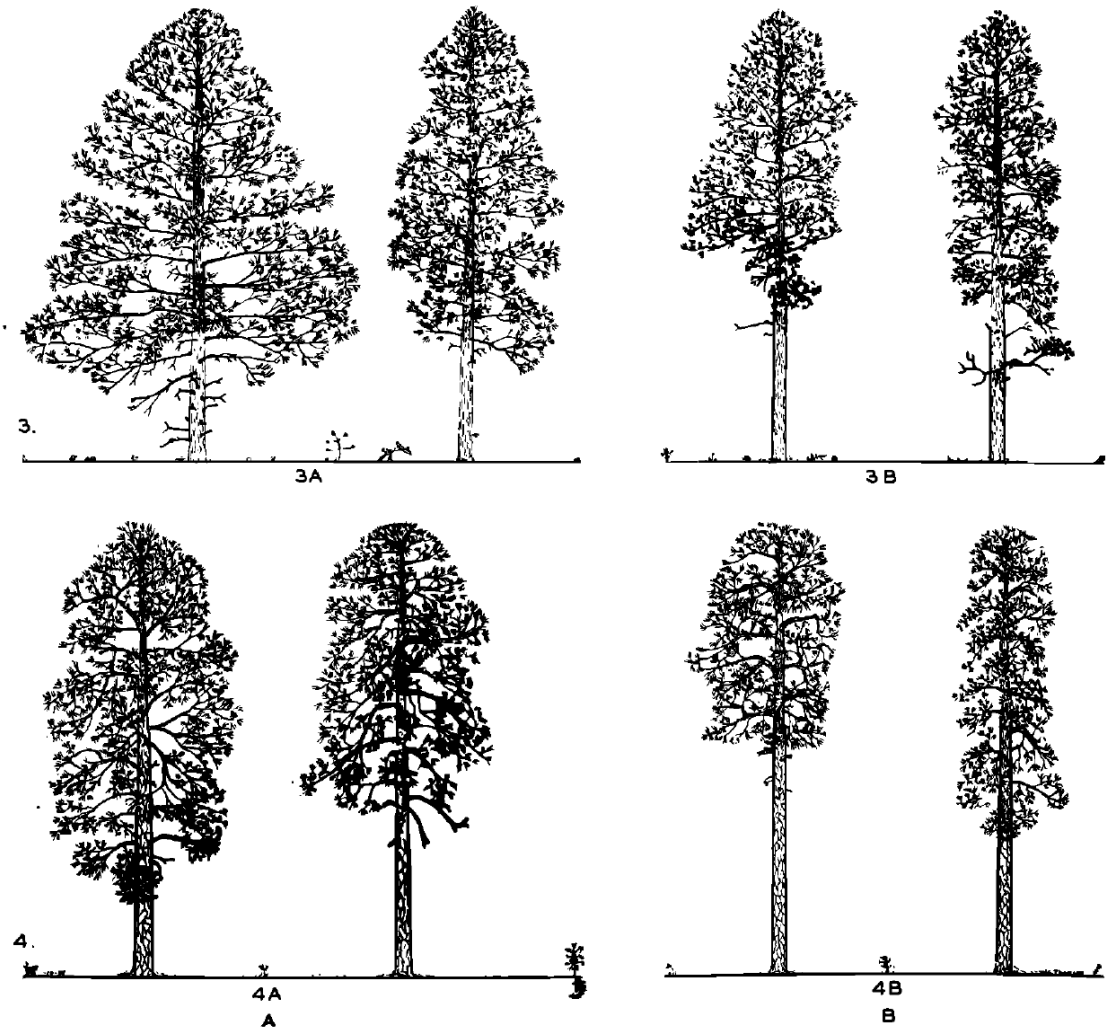

***Figure 54*. Old Tree Characteristics (Thompson 1940)**

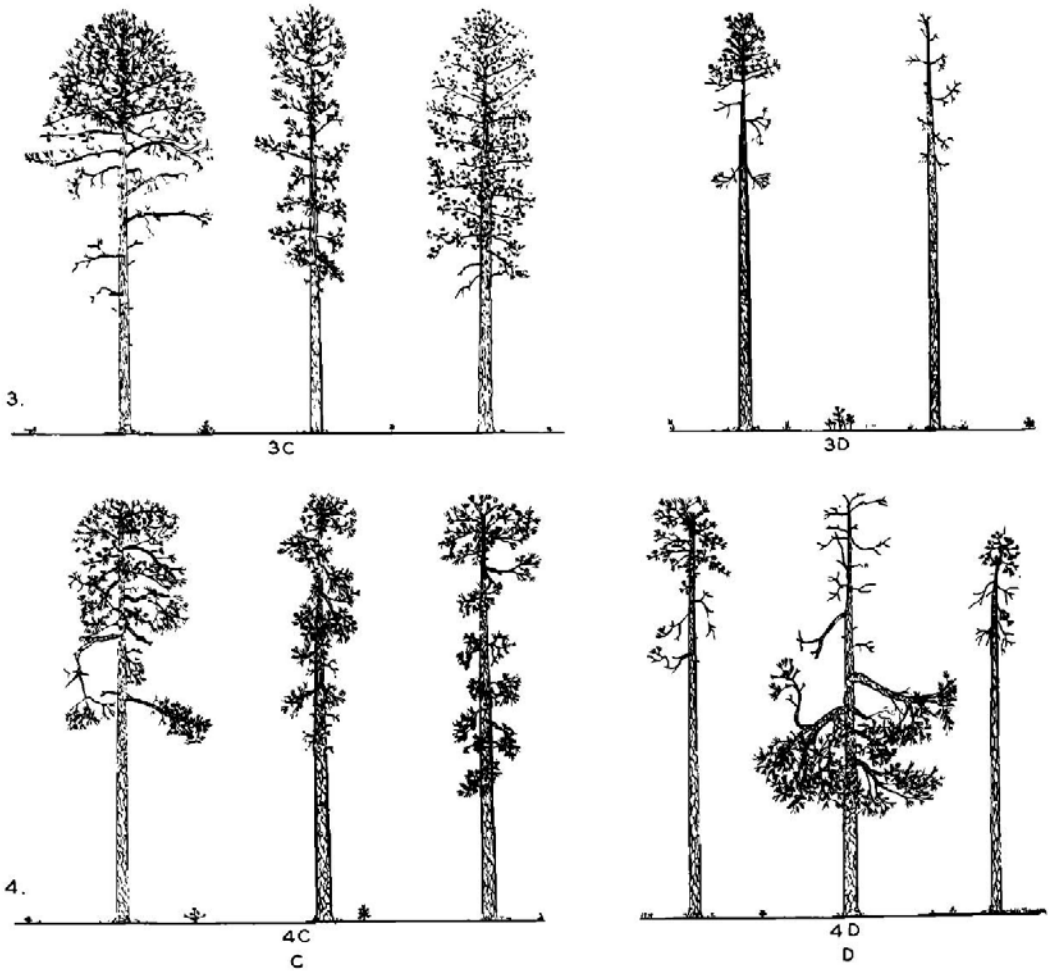

***Figure 55*. Old Age Tree Characteristics Continued(Thompson 1940)**

Attachment 2. Design Features, Best Management Practices, and Mitigation

Design features, best management practices, and mitigation for alternatives B, C, and D are incorporated by reference from appendix C into the attachment 2 of the implementation plan.

Attachment 3. Old Tree Implementation Plan

Background

Scoping for the Four-Forest Restoration Initiative on the Coconino and Kaibab National Forests has been underway since January of 2011. Several comments have been received recommending that a design feature of the proposed action be no cutting of old growth (pre-settlement trees). The recommendation specifically comes from Wally E. Covington of the Ecological Restoration Institute (ERI), the 4FRI Stakeholders, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Center for Biological Diversity, Sierra Club, and Grand Canyon Trust. The 4FRI forest supervisors have decided to implement an Old Tree Implementation Strategy that seeks to clarify the desired conditions for the ponderosa pine ecosystem and how this project would perpetuate old growth in both the short (10-year analysis window) and long term (10 years plus).

Project Objective

The objective of the 4FRI Coconino/Kaibab project is a movement towards ecological restoration of ponderosa pine systems. Ecological restoration strives to re-establish and retain ecological resilience.

Desired Conditions

The desired condition for ponderosa pine should be addressed at three scales; landscape, mid and fine:

Landscape Scale

The forest is composed of trees from structural stages ranging from young to old. Mature and old structural stages are well distributed on the landscape. Forest appearance is variable but generally uneven-aged and open. The forest spatial arrangement is in individual trees, small clumps and groups of trees interspersed within variably-sized opening of grass/forbs/shrubs similar to historic patterns. The size, shape, age, and number of trees per group are variable across the landscape.

The ponderosa pine forest vegetation is composed predominantly of vigorous trees, but declining and old trees are a component and provide for snags, top-killed, lightning, and fire-scarred trees, and coarse woody debris, all well-distributed throughout the landscape.

The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances and include snags, downed logs, and old trees.

Mid-Scale

The ponderosa pine forest is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. A mosaic of tree groups generally comprises an uneven-aged forest with all age classes present.

Fine Scale

Trees typically occur in irregularly-shaped groups and are variably-spaced with some tight clumps that consist of 2 to approximately 40 trees per group. In some cases a single large tree may have the structure necessary to act as a clump.

Scientific Basis for Old Growth

There are unique characteristics only found in old trees that provide an essential structural feature of old growth forest

Old-growth in frequent-fire ponderosa pine forests is typically uneven-aged at the fine-scale (Meyer 1934, Weaver 1951). They are composed of a mosaic of small (0.1-0.5 ac) old tree groups interspaced with similar sized groups of younger trees, seedlings to mid-aged (Cooper 1961, Morgan et al. 2002, Harrod et al. 1999).

Scientific Basis for Balance of Age Classes

Some early reports on ponderosa pine age structure demonstrated an approximate balance of age classes at the mid-scale (Woolsey 1911, Pearson 1950); this reference condition of age-balanced forests with a multitude of old growth characteristics was likely self-sustaining at the fine to mid-scales.

Vegetation dynamics, including the establishment, development, senescence (aging), and its composition, structure, and pattern, can be estimated and modeled (see Oliver and Larson 1990, Reynolds et al. 1992, Franklin et al. 2002, Reinhardt and Crookston 2003). Using the reference condition as a baseline, vegetation dynamics of SW ponderosa pine forest was used to approximate the maximum sustainable amount of mature and old vegetation structural stages (VSS). Reynolds et al. (1992) determined this would be achieved with about 20 percent of a landscape in VSS 1 and VSS 2 (grass/ forb, seedlings/saplings), 20 percent in VSS 3 (young forest), 20 percent in VSS 4 (mid-aged forest), 20 percent in VSS 5 (mature forest), and 20 percent in VSS 6 (old forest) These proportions reflect forest development from cohort establishment through canopy closure to old forests. It is unrealistic to expect the desired conditions immediately after treatment. It is important to note that movement towards balanced age class distribution is something that will, in most cases, take decades to achieve. As a comparison the estimated VSS distribution for the 4FRI Coconino/Kaibab project is 4 percent VSS 1 and 2, 37 percent VSS 3, 43 percent VSS 4, 9 percent VSS 5, and 7 percent VSS 6.

Strategy and Intent

Through the implementation of the 4FRI Coconino/Kaibab project resource specialists would strive to retain old pre-settlement trees. Recruitment and retention of old trees would, in the long term, would help to restore a balanced age class distribution at multiple scales and would help to restore the variability of structure and patter of the ponderosa pine system within the project area. Treatments would focus on the reduction of the most abundant age classes and conservation of the under-represented age classes in order to restore a balance of age classes. This would not preclude the removal of trees larger or those smaller than the most abundant size classes in order to meet restoration, resource protection, or health and human safety objectives. Each age class is important and the end result of having abundant old trees is dependent on providing conditions that allow younger trees to grow into older trees.

Movement towards a restored condition would provide greater opportunity for resource managers to restore natural fire patterns and frequency over time. Restored landscapes or those that are closer to achieving the desired condition would result in fewer uncharacteristic wildfire events, higher quality wildlife habitat, and improved hydrologic function across the landscape.

How the Project Would Meet an Objective of Recruiting and Retaining Old Trees

The temporal aspect of moving towards desired conditions is important. Most restoration objectives will not be met immediately post-treatment. The treatments proposed for the project would move the area, in the long term, towards a restored condition that more closely represents the natural range of variability with respect to the structure, pattern, and composition of the ponderosa pine system within the project area. Restoration would be a stepwise process, which in most cases would require multiple entries and decades before the desired condition is achieved.

The preceding discussion describes the importance and function of old trees in the ponderosa pine ecosystem. Old trees (approximately $\geq$ 150 years old) would be retained regardless of their diameter within the Four-Forest Restoration Initiative on the Coconino and Kaibab EIS area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation.

Old trees would be determined by the following characteristics described by Thomson (1940) as age class 3 (intermediate-mature) and age class 4 (mature-overmature). See figure 54 and figure 55 and Thompson 1940 for additional clarification. Old tree characteristics include:

- Age – Approximately 150 years and older.
- dbh – Site dependent.
- Bark – ranging from reddish brown, shading to black in the top with moderately large plates between the fissures to reddish brown to yellow, with very wide, long and smooth plates.
- Tops – ranging from pyramidal or rounded (occasionally pointed) to flat (making no further height growth).
- Branching – ranging from upturned in upper third of the crown, horizontal in the middle third and drooping in the lower third of the crown to mostly large, drooping, gnarled or crooked. Branch whorls range from incomplete and indistinct except at the top to completely indistinct and incomplete.

See figure 54 and figure 55 for old tree characteristics in VSS 3 and VSS 4 (Thompson 1940).

Attachment 4. Modified Large Tree Implementation Plan – Specific to Alternative C (Revision 5: 05-23-2012)

Introduction

This implementation strategy is specific to alternative C in the Coconino and Kaibab NFs' landscape restoration analysis (EIS). It has been incorporated into alternative C in response to comments received during scoping (August 2011). The strategy focuses on desired conditions for seeps and springs, riparian, wet meadows, encroached grasslands, aspen forest and woodland, ponderosa pine/Gambel oak forest (pine-oak), within-stand openings, and heavily stocked stands

with high basal area generated by a preponderance of large, young trees. The strategy provides direction presented as desired conditions for managing large post-settlement trees. For the purpose of this document, large post-settlement trees, as defined by the socio-political process, are those that are 16-inch diameter at breast height (dbh) or larger. Trees $\geq$ 18-inch dbh represent vegetative structural stages (VSS) 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best correspond with the successional stage classification system that was developed to address the forest dynamics of southwestern ponderosa pine.

How This Strategy Would Be Utilized

The purpose of this document is to guide implementation in alternative C. Large post-settlement trees would be targeted for removal if needed to move towards ecological desired conditions implementation. The strategy also identifies conditions in under which large, young trees would be expected to be left.

This strategy may not include every instance where large post-settlement trees may be cut. There may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in this strategy, no large trees would be cut until the NEPA decision is reviewed by the Forest Service implementation team. The team would decide whether the action is consistent with the analysis and the decision made. This information would be made part of the annual implementation plan checklist/compliance review that is recommended by the team and approved by the forest supervisor.

The forests' landscape restoration analysis does not propose to cut pre-settlement trees, except under rare circumstances as described in the Old Tree Implementation Strategy. The Old Tree Implementation Strategy has been incorporated into all action alternatives (B through D) and is provided in this document as **appendix C** for reference. VSS 5 and VSS 6 are under-represented across the project area, which is nearly one million acres in size.

How This Strategy Differs from the Stakeholder Large Tree Retention Strategy (LTRS)

During the issues and alternatives development phase of the analysis, the interdisciplinary team conducted a crosswalk to the original LTRS (appendix A) and the project's desired conditions. We found that most LTRS recommendations and desired outcomes were reflected in the project purpose and need or had been incorporated into the each action alternative (B through D) because of forest plan (Mexican spotted owl) requirements. Because the conservation of large trees was identified as a key issue for the analysis, potential impacts from removing some large, post-settlement trees are addressed in resource-specific environmental consequences including silviculture, fire, and wildlife. Incorporation of the LTRS was further enhanced by including the document's intent into alternative C design features and best management practices. The crosswalk to the LTRS is located in **appendix B**. This version differs from the original stakeholder-created LTRS in five ways:

1. The exception categories have been translated into resource-specific desired conditions. This was completed because we found that the exception categories represented the majority of our actions. An exception, by definition, is something that is not included in, or does not fit into, a general rule. As a result of spatially mapping the exception categories, we found that true exceptions were a minor component of the desired condition strategy for managing post-settlement trees. For example, a geospatial mapping

exercise found that 54,358 acres of the proposed 596,716 acres proposed for treatment did not fit an existing resource (formally exception) category. Most acreage could be classified within the large, young tree category. The 54,358 acres noted above do not necessarily mean a new category has to be developed. The acreage number reflects that vegetation and geospatial data was not able to determine in what category these acres should be placed. On-ground review and validation is planned to rectify the lack of information on these acres.

2. The original LTRS did not provide the ability to create regeneration openings using a group selection treatment method within the large, young tree category. We found that in the short term (0 to 10 years), this would result in a continued imbalance of size classes that would be contrary to the forest plan desired conditions in non-PFA goshawk habitat. In the long term (10 to 30 years), the understory would be comprised of oak and old pine. There would no movement towards maintaining the older, larger trees as the ability to provide for tree recruitment would be hindered. For this reason, the alternative C version of the LTRS includes the ability to create regeneration openings.
3. In the original LTRS, movement towards the desired condition in pine-oak was constrained to Mexican spotted owl (MSO) habitat. This would preclude moving towards desired conditions in non-MSO habitat. For this reason, the ability to move all pine-oak within the project area towards desired conditions was included.
4. The original LTRS would have required the Forest Service to consult with stakeholders should a new exception category be found during implementation. To resolve the potential for FACA issues, this consultation requirement was removed. How this situation would be addressed can be found above in the "How This Strategy Would Be Utilized" section.
5. Other minor additions or variations as disclosed in the January 23, 2012 Summary LTRS Crosswalk to desired conditions document (see project record).

Public Involvement

An update on how the LTRS was being incorporated into the EIS was discussed with the stakeholder steering committee and interested stakeholders on October 19, 2011 at the Coconino NF Supervisor's Office. A follow-up invitation to discuss the LTRS was provided by Henry Provencio at the November 2, 2011 4FRI stakeholder meeting held at the Coconino NF Supervisor's Office. On December 7, 2011, an update on the LTRS that included the geospatial map (appendix B) displaying how exception categories were represented in the project area was presented by Henry Provencio at the 4 FRI stakeholder meeting.

Desired Conditions

Seeps and springs

Seeps are locations where surface-emergent groundwater causes ephemeral or perennial moist soil or bedrock. Standing or running water is infrequent or absent. Vegetation and other biological diversity are adapted to mesic soils. Springs are small areas where surface-emergent groundwater causes ephemeral or perennial standing or running water and wet or moist soils. Vegetation and other biological diversity are adapted to mesic soils or aquatic environments (Feth and Hem 1963).

Management Issue

Seeps and springs exhibit unique, often isolated biophysical conditions that can sustain unique, mesic-adapted biological diversity and can facilitate endemism and speciation. Springs also provide water and other habitat to terrestrial wildlife. Due to the absence of frequent fires in the presence of livestock grazing, the establishment of large post-settlement trees may reduce available soil moisture (Simonin et al. 2007) and block the sunlight necessary to support the unique biophysical conditions associated with seeps and springs.

Removal of trees that have encroached upon seeps and springs may constitute a relatively small part of an overall seep and spring restoration effort, when compared to fully addressing root causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to fully restore seeps and springs (Thompson et al. 2002). However, it is a necessary step leading to the restoration of these ecologically important areas.

Desired Conditions

- The biophysical conditions in seeps and springs upon which terrestrial, mesic-adapted, and aquatic native biological diversity depend are conserved and restored.
- The integrity of the spring's unique biophysical attributes is not compromised by tree shading.
- Mesic soils associated with a seep or spring are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Riparian

Riparian areas occur along ephemeral or perennial streams or are located down-gradient of seeps or springs. These areas exhibit riparian vegetation, mesic soils, and/or aquatic environments.

Management Issue

Riparian areas exhibit unique biophysical conditions that can sustain unique, mesic-adapted, or aquatic biological diversity. Riparian areas and the streams, springs, and seeps connected to them often harbor imperiled species that can be sources of endemism. Riparian areas also provide water and other habitat to terrestrial wildlife. In the absence of frequent fires and in the presence of other competing factors, large post-settlement trees may have become established and grown within riparian areas to the point that they compromise available soil moisture or light that support the unique biophysical conditions that are associated with the riparian areas. However, it is likely to be a very rare circumstance that conifer trees of any size would need to be removed from forested riparian zones.

Desired Conditions

- The biophysical conditions in riparian habitat upon which terrestrial and aquatic native biological diversity depends are conserved and restored.

- The use of soil and water best management practices (BMPs) minimize the impacts of cutting trees within riparian areas.
- Removal of trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Riparian areas are fully restored by using an array of tools that address all sources of degradation.
- Available soil moisture or light that support that area's unique biophysical conditions is not compromised by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Post-treatment snags and logs that include large trees are available on site.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Wet Meadows

High-elevation streamside or spring-fed meadows occur in numerous locations throughout the Southwest. However, less than one percent of the landscape in the region is characterized as wetland (Dahl 1990), and wet meadows are just one of several wetland types that occur. Patton and Judd (1970) reported that approximately 17,700 hectares of wet meadows occur on national forests in Arizona and New Mexico.

Wet meadows may be referred to as riparian meadows, montane (or high-elevation) riparian meadows, sedge meadows, or simply as wet meadows. Wet meadows are usually located in valleys or swales, but may occasionally be found in isolated depressions, such as along the fringes of ponds and lakes with no outlets. Where wet meadows have not been excessively altered, sedges (*Carex* spp.), rushes (*Juncus* spp.), and spikerush (*Eleocharis* spp.) are common species (Patton and Judd 1970, Hendrickson and Minckley 1984, Muldavin et al. 2000). Willow (*Salix*) and alder (*Alnus*) species often occur in or adjacent to these meadows (Long 2000, Long 2002, Maschinski 2001, Medina and Steed 2002). High-elevation wet meadows frequently occur along a gradient that includes aquatic vegetation at the lower end and mesic meadows, dry meadows, and ponderosa pine or mixed conifer forest at the upper end. These vegetation gradients are closely associated with differences in flooding, depth to water table, and soil characteristics (Judd 1972, Castelli et al. 2000, Dwire et al. 2006). While relatively rare, wet meadows are believed to be of disproportionate value because of their use by wildlife and the range of other ecosystem services they provide. Wet meadows perform many of the same ecosystem functions associated with other wetland types, such as water quality improvement, reduction of flood peaks, and carbon sequestration.

Management Issue

Wet meadows are one of the most heavily altered ecosystems. They have been used extensively for grazing livestock, have become the site of many small dams and stock tanks, have had roads built through them, and have experienced other types of hydrologic alterations. Most notably, the lowering of their water tables due to stream down-cutting, surface water diversions, or groundwater withdrawal (Neary and Medina 1996, Gage and Cooper 2008) has occurred. In the presence of livestock grazing and hydrologic changes, large post-settlement trees may have

established and grown within wet meadows such that they compromise available soil moisture or light creating unique biophysical conditions.

Desired Conditions

- The biophysical conditions of wet meadows upon which terrestrial native biological diversity depend are conserved and restored.
- Wet meadow function is not impaired by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Removal of large trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Wet meadows are fully restored by using an array of tools that address all sources of degradation.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Encroached Grasslands

Encroached grasslands are herbaceous ecosystems that have infrequent-to-no evidence of pine trees growing prior to settlement. The two prevalent grassland categories in the 4FRI landscape are montane (includes subalpine) grasslands and Colorado Plateau (a subset of Great Basin) grasslands, with montane grasslands being most common (Finch 2004). A key indicator of grasslands is the presence of mollisol soils. Mollisol soils are typically deeper with higher rates of accumulation and decomposition of soil organic matter relative to soils in the surrounding landscape. Grasslands in this region evolved during the Miocene and Pliocene periods, and the dark, rich soils observed in grasslands today have taken more than 3 million years to produce. In addition to their association with mollic soils, grasslands in this region are maintained by a combination of climate, fire, wind desiccation, and to a lesser extent by animal herbivory (Finch 2004).

Typical montane grasslands in this region are characterized by Arizona fescue (*Festuca arizonica*) meadows on elevated plains of basaltic and sandstone residual soils. Montane grasslands are the most naturally fragmented grasslands in the region, ranging from thousands of acres in size (e.g., in the White Mountains (Baker 1983)) down to only a few acres. They generally occur in small (<100 acres) to medium-sized (100 to 1,000 acres) patches. Historic maintenance of the herbaceous condition in these grasslands is subject to some debate though appears to be primarily driven by periodic fire. The cool-season growth of Arizona fescue also plays a large role in maintenance of parks and openings by directly competing with ponderosa pine seedlings. Identification of grasslands in this region should use a combination of the Terrestrial Ecosystem Survey, Southwest Regional GAP Analysis, and Brown and Lowe Vegetation Classification (Brown and Lowe 1982, TNC GIS Layer 2006) among other existing vegetation and soils data.

Management Issue

Prior to European settlement, pine trees were rarely established in grasslands because they were either outcompeted by production of cool-season grasses or killed by frequent fire (Finch 2004). In the late 1800s, unsustainable livestock grazing practices significantly reduced herbaceous cover, reducing competition pressure on pine seedlings. Coupled with the onset of fire suppression in the early 1900s, pine trees rapidly encroached and recruited into native grasslands (e.g. Allen 1984, Moore and Huffman 2004, Coop and Givnish 2007). Pine encroachment into grasslands has contributed to a significant loss of biodiversity (Stacey 1995) and wildlife habitat particularly for grassland-dependent species such as pronghorn. Plant diversity is particularly important in grassland ecosystems. Grassland plots with greater species diversity have been found to be more resistant to drought and to recover more quickly than less diverse plots (Tilman and Downing 1994). This resilience will become even more important in a warming climate. Pine tree removal, restoration of fire, and complementary reductions in livestock grazing pressure are all necessary to restore structure and function of native grasslands.

Desired Conditions

- Grasslands are enhanced, maintained, and function with potential natural vegetation (as defined by vegetative mapping units).
- Grasslands function with a natural fire regime.
- Existing grasslands are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Aspen Forest and Woodland

Quaking aspen (*Populus tremuloides*) occurs in small patches throughout the 4FRI project area. Bartos (2001) refers to three broad categories of aspen: (1) stable and regenerating (stable), (2) converting to conifers (seral), and (3) decadent and deteriorating. Almost all of the aspen occurring within ponderosa pine forests of the 4FRI project area is seral aspen, which regenerates after disturbance through root sprouting and rarely from seed production (Quinn and Wu 2001). Favorable soil and moisture conditions maintain stable aspen over time. Aspen stands have been mapped across the entire 4FRI area and map layers are available from existing databases.

Management Issue

Aspen occurs within ponderosa pine forests. It is ecologically important due to the high concentration of biodiversity that depends on aspen for habitat (Tew 1970, DeByle 1985, Finch and Reynolds 1987, Griffis-Kyle and Beier 2003). In addition, stable aspen stands serve as an indicator of ecological integrity (Di Orio et al. 2005). Aspen is currently declining at an alarming rate (Fairweather et al. 2008).

The lack of fire as a natural disturbance regime in southwestern ponderosa pine forests since European settlement has caused much of the aspen-dominated lands to succeed to conifers (Bartos 2001). Other factors contributing to gradual aspen decline over the past 140 years include

reduced regeneration from browsing ungulates (Pearson 1914, Larson 1959, Martin 1965, Jones 1975, Shepperd and Fairweather 1994, Martin 2007). More recently, aerial and ground surveys indicate more rapid decline of aspen, with very high mortality occurring in low and mid elevation aspen sites. Major factors thought to be causing this rapid decline of aspen include frost events, severe drought, and a host of insects and pathogens (Fairweather et al. 2008) that have served as the "final straws" for already compromised stands.

Desired Conditions

- Aspen forests and woodlands are conserved and restored to their appropriate fire regime.
- Aspen is effectively being regenerated or maintained and regeneration, saplings, and juvenile trees are protected from browsing.
- There is decreased competition from ponderosa pine. Post-settlement ponderosa pine tree numbers do not exceed residual targets that have been identified using pre-settlement conifer tree evidences, site visitations, and collected data.
- Removal of large trees constitutes a relatively small part of the aspen restoration effort, when compared to the fundamental causes of overall degradation. Aspen forests and woodlands are fully restored by using an array of tools that address all sources of degradation.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Ponderosa Pine/Gambel Oak Forest (Pine-Oak)

A number of habitat types exist in the southwestern United States that could be described as pine-oak. Ponderosa pine forests are interspersed with Gambel oak trees in locations throughout the 4FRI area in a habitat association referred to as PIPO/QUGA (USFS 1997, USDI 1995).

In southwestern ponderosa pine forests, Gambel oak has several growth forms distinguished by stem sizes and the density and spacing of stems within clumps. These include shrubby thickets of small stems, clumps of intermediate-sized stems, and large, mature trees that are influenced by age, disturbance history, and site conditions (Brown 1958, Kruse 1992, Rosenstock 1998, Abella and Springer 2008, Abella 2008a). Different growth forms provide important habitat for a large number and variety of wildlife species (Neff et al. 1979, Kruse 1992). These include, including hiding cover in a landscape with limited woody shrub cover, cavity substrate for birds and bats, roost potential for bats, nest sites for birds, and bark characteristics used by invertebrates. Whether as saplings, shrubby thickets, or larger sized trees, oak adds a high value for wildlife in ponderosa pine forests.

Gambel oak provides high quality wildlife habitat in its various growth forms and it is a desirable component of ponderosa pine forests (Neff et al. 1979, Kruse 1992, Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998, USDI 1995, Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular fuelwood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

Management Issue

Although management on public lands with regard to oak has changed to better protect the species, illegal fuelwood cutting of Gambel oak and elk and livestock grazing negatively impact oak growth and regeneration (Harper et al. 1985, Clary and Tiedemann 1992, Rick Miller 1993, unpublished report). Illegal fuelwood cutting of Gambel oak continues to result in the removal of rare, large diameter oak trees (Bernardos et al. 2004).

A literature review by Abella and Fulé (2008) found that Gambel oak densities appear to have increased in many areas with fire exclusion, especially in the small and medium-diameter stems (<8-inch dbh). Chambers (2002) found that Gambel oak on the Kaibab and Coconino NFs was distributed in an uneven-aged distribution, dominated by smaller size classes (<5-centimeter dbh) and few large diameter oak trees. Because of Gambel oak's slow growth rate, there may be little opportunity for these small Gambel oak trees to attain large diameters (>85 centimeters) (Chambers 2002).

Pine competition with oak has been identified as an issue in slowing oak growth, particularly for older oaks (Onkonburi 1999). Onkonburi (1999) also found that for northern Arizona forests, pine thinning increased oak incremental growth more than oak thinning and prescribed fire. Fulé (2005) found that oak diameter growth tended to be greater in areas where pine was thinned relative to burn only treatments and controls. Thinning of competing pine trees may promote large oaks with vigorous crowns and enhanced acorn production (Abella 2008b), and may increase oak seedling establishment (Ffolliott and Gottfried 1991).

Desired Conditions

All Gambel oak

- Small oak trees develop into larger size classes.
- Fire treatments retain small and shrubby oak in numbers and distribution.
- All growth forms of Gambel oak are present and larger, older oak trees are enhanced and maintained.
- Large, post-settlement trees are not restricting oak development.
- Frequent, low intensity surface fire occurs in ponderosa pine-Gambel oak forests.
- Brushy thicket, pole, and dispersed clump growth forms of Gambel oak are present and maintained by allowing natural self-thinning, thinning dense clumps, and/or burning.
- Gambel oak growth forms are protected from damage during restoration treatments including thinning and post-thinning slash burning.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

In MSO restricted habitat:

- Within MSO habitat and designated critical habitat, the recovery plan for the MSO improves key habitat components and primary biological factors, which includes Gambel oak.

- Within 30 feet of oak 10- inch diameter root collar (drc) or larger, post-settlement mixed conifer trees up to 18-inch dbh (that do not have interlocking crowns with oak) are not restricting oak development.

Outside MSO restricted habitat:

- Large post-settlement trees' drip lines or roots do not overlap with those of Gambel oak trees exhibiting >8-inch drc.

Within-Stand Openings

Within-stand openings are small openings (generally 0.05 to 1.0 acres) that were occupied by grasses and wildflowers before settlement (Pearson 1942, White 1985, Covington and Sackett 1992, Sánchez Meador et al. 2009). For the purposes of this strategy, within-stand openings are equivalent to interspaces. The within-stand opening management approach described below is distinct from, and should not be, considered as guidance relating to regeneration openings.

Pre-settlement openings can be identified by the lack of stumps, stump holes, and other evidence of pre-settlement tree occupancy (Covington et al. 1997). These openings are most pronounced on sites with heavy textured (e.g., silt-clay loam) soils (Covington and Moore 1994). Current openings include fine-scaled canopy gaps. It is not necessary to have desired within-stand openings and groups located in the same location that they were in before settlement (the site fidelity assumption). Trees might be retained in areas that were openings before settlement, and openings might be established in areas which had previously supported pre-settlement trees.

Management Issue

Within-stand openings appear to have been self-perpetuating before over-grazing and fire exclusion (Pearson 1942, Sánchez Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1999). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

These natural openings appear to have been very important for some species of butterflies, birds, and mammals (Waltz and Covington 2004). Often the largest post-settlement trees, typically a single tree, became established in these natural within a stand opening as soon as herbaceous vegetation was removed by overgrazing (Sánchez Meador et al. 2009). Contemporary within-stand openings or areas dominated by smaller post-settlement trees should be the starting point for restoring more natural within-stand heterogeneity.

Desired Conditions

- The pattern of openings within stands that provide natural spatial heterogeneity for biological diversity are conserved.
- Openings break up fuel continuity to reduce the probability of torching and crowning and restore natural heterogeneity within stands.
- Openings promote snow-pack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale.

- The presence of such trees does not prevent the re-establishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives.
- Groups of trees typically range in size from 0.1 acre to 1.0 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Heavily-Stocked Stands (with High Basal Area) Generated By a Preponderance of Large, Young Trees

In some areas, the increase in post-settlement trees has been so rapid that current stand structure is characterized by high density and high basal area in large, young ponderosa pine trees. These stands or groups of stands exhibit continuous canopy which promotes unnaturally severe fire effects under severe fire weather conditions. At the fine scale, the management approach would apply on a case-by-case basis. The cutting of large trees may be necessary to meet site-specific ecological objectives as listed below. For example, the cutting of large trees may be necessary in order to reduce the potential for crown fire to spread into communities or important habitats that include MSO and/or goshawk nest stands. This approach would apply when other options would not alleviate severe fire effects.

Management Issue

In stands where pre-settlement evidences, restoration objectives, community protection, or other ecological restoration objectives indicate much lower tree density and basal area would be desirable, large post-settlement pines may need to be removed to achieve post-treatment conditions consistent with a desired restoration trajectory. Where evidence indicates higher tree density and basal area would have occurred pre-settlement, only a few large pines may need to be removed. Many of these areas would support crown fire, and thus require structural modification to reduce crown fire potential and restore understory vegetation that supports surface fire.

Desired Conditions

- Natural heterogeneity of forest, savanna, and grasslands occurs at the landscape scale and within stands.
- Groups are restored by retaining the largest trees on the landscape to re-establish old growth structure in the shortest timeframe possible.
- Decreased shading and interception from the canopy, decreased litter and duff, and surface fire restore and maintain a mosaic of natural vegetative communities.
- Decreased shading and interception from the canopy fuels allow the growth of continuous herbaceous surface fuels to carry surface fire.
- Horizontal and vertical canopy characteristics, which include tree groups, clumps, and openings, reduce the potential for crown fire as well as the extent of high severity fire effects.

- Fire is the principle regulator of forest structure over time.
- Regeneration openings that contribute to the ecological objective of natural heterogeneity of historical forest structure and age class diversity are not encroached upon by trees.
- The Old Tree Implementation Strategy provides direction on how pre-settlement trees would be managed.

Mapping

Assumptions used in the range of categories for the large tree implementation plan mapping exercise (figure 56): (1) Springs: this category was based on a100 meter buffer around spring locations, (2) Riparian: this category was based on a 100 meter buffer of riparian stream courses, (3) Aspen: the aspen category was based on aspen restoration treatments in aspen cover type stands, (4) Savanna: the savanna category was based on savanna restoration treatments. 4FRI savanna treatments were developed based on factors including site class, ponderosa pine open soil reference condition, proximity to grassland soil reference condition, and wildlife corridors, (5) Pine-Oak: the pine-oak category was based on MSO restricted habitat with the knowledge that oak can also occur outside of MSO restricted habitat, (6) Grasslands: the grasslands category was based on grassland soils defined by the 4FRI soil stratification, (7) Wet Meadows: the category was based on wet meadows soils defined by the 4FRI soil stratification, and (8) Preponderance of Large Young Trees: this category was only analyzed within areas managed for goshawks (PFA and non-PFA) because it was based on desired conditions. Outside PFAs, the preponderance of large young trees was defined as stands with BA of trees in size classes 4s and 5s greater than 33 and with a total stand BA greater than 70. Likewise, the preponderance of large young trees inside PFAs was defined as stands with BA of trees in size classes 4s and 5s greater than 38 and with a total stand BA greater than 80. The GIS query used to assimilate data is: “Outside PFA: [BA VSS 4] + [BA VSS 5] > 33 AND [BA All] > 70 and Inside PFA: [BA VSS 4] + [BA VSS 5] > 38 AND [BA All] > 80(The combination of BA VSS 4 and 5”.

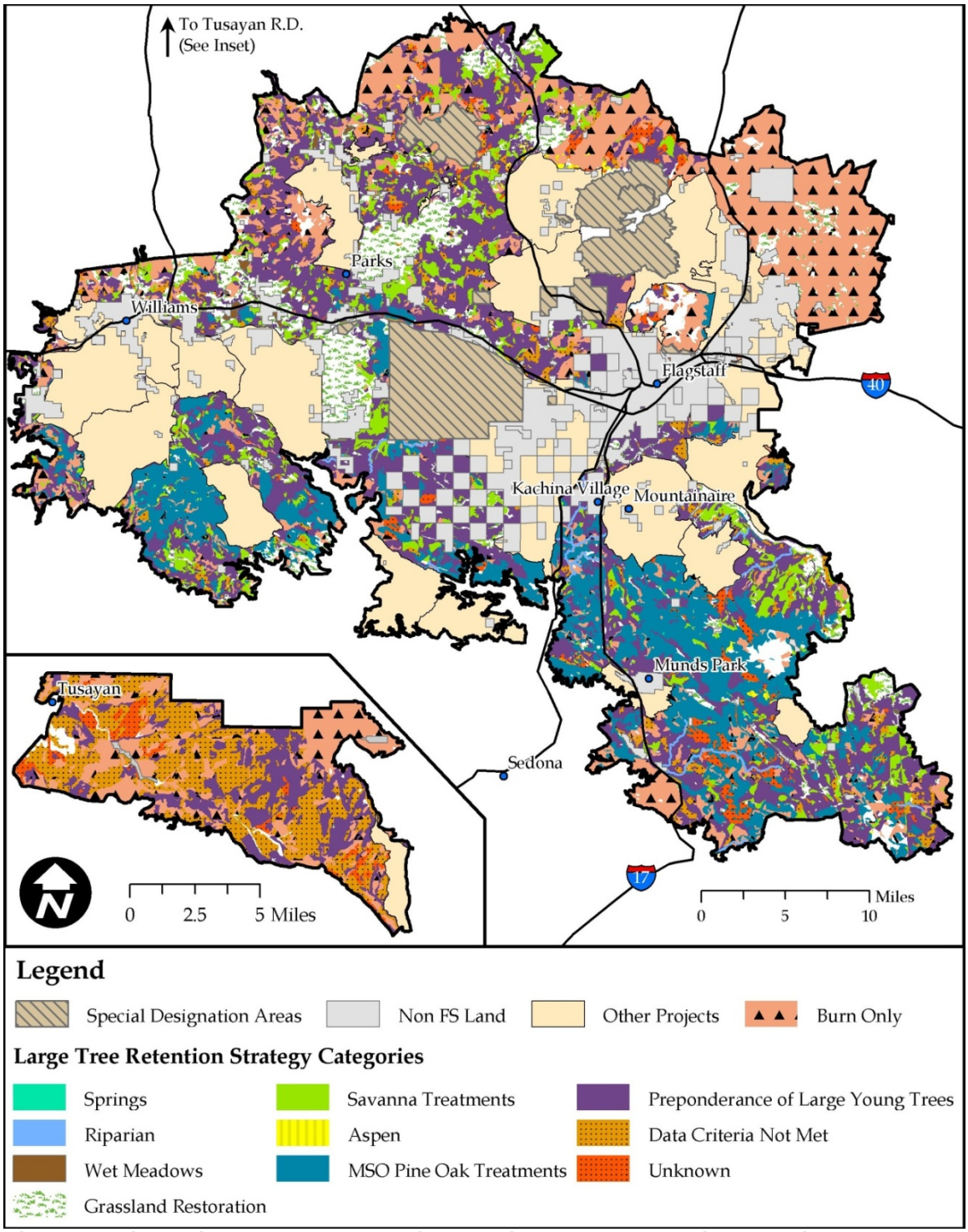

***Figure 56*. Alternative C Large Tree Implementation Strategy Mapping Exercise**

Appendix F – Alternative B through D Monitoring and Adaptive Management Plan

Introduction

Only key summaries from the comprehensive monitoring and adaptive management plan are included in the DEIS. Most details related to the multi-party monitoring plan have not been included in this summary. Multiparty monitoring is intended to meet the requirements of the Omnibus Public Land Management Act of 2009. This plan outlines who comprises the multi-party monitoring group and how the group works together to determine how data is collected, who will collect the date, where monitoring would occur, and how much will monitoring cost. The complete document can be accessed on the 4FRI website or in the project record.

The goal of this document is to (1) meet the Collaborative Forest Landscape Restoration Program (CFLRP) requirements for multiparty monitoring, (2) provide guidance for measuring physical and biophysical, social, and economic results of restoration activities across the initial 4FRI analysis area, and (3) provide a feedback mechanism that supports adaptive management. The information gained through monitoring would contribute to the science and practice of ecosystem restoration. In some cases, the results of this monitoring may not provide definitive answers to monitoring questions.

Types of Monitoring

Ecological monitoring is generally undertaken to determine whether the current state of the system matches or is trending toward some desired condition (Noon 2003). When conducted systematically, monitoring can provide valuable feedback regarding the effects of land management on resource conditions (Palmer and Mulder 1999, Lindenmayer and Likens 2010). Monitoring activities related to land management can be further classified into three categories: implementation, effectiveness, and validation (Busch and Trexler 2003). In addition to land management monitoring, monitoring is required per section 3 of the Comprehensive Forest Landscape Restoration (CFLR) Act (Pl 111-11, sec 4001, Omnibus Public Land Management Act of 2009).

Implementation monitoring is designed to determine the extent to which a management action was carried out as designed (did we do what we said we were going to do).

Effectiveness monitoring tracks the extent to which the management action achieved its ultimate objective. Effectiveness monitoring refers to an assessment of treatment effects, rather than to measuring whether they were applied as intended or whether they validate a pre-existing concept (did we increase heterogeneity).

Validation monitoring: assesses the degree to which underlying assumptions about ecosystem relationships are supported (Block et al. 2001, Busch and Trexler 2003). Validation monitoring is most closely associated with research.

CFLR Act monitoring and reporting (required monitoring and reporting) includes: (1) a description of all acres treated and restored through projects implementing the strategy; (2) an evaluation of progress, including performance measures and how prior year evaluations have contributed to improved project performance; (3) a description of community benefits achieved, including any local economic benefits; and (4) the results of multiparty monitoring, evaluation, and accountability process. Items 1 through 3 are compiled locally and sent to the USDA Forest Service's Washington Office as part of the annual reporting requirement.

Monitoring Prioritization

Though financial resources (both Forest Service and stakeholder contributions) would be dedicated to monitoring, budgetary limitations would dictate how much and what type of monitoring can be accomplished. In order to help prioritize what monitoring would be accomplished, we prioritized monitoring using a tiered system. Tier 1 monitoring would take priority over Tier 2 and prioritization within each tier is expected. Research is independent of monitoring, will require funds in addition to this monitoring plan, and Forest Service approval may be required before research is initiated. However, the results of research would be considered during implementation and the adaptive management phase of the project.

***Table 89*. Monitoring Plan Tiers**

Monitoring Tier	Priority for Completion	Who Will Complete	Type of Monitoring	Type of Funding
Tier 1	1	USFS – Contractor	Implementation	Appropriated, Implementation
Tier 2	2	Multiparty USFS Stakeholders Agency Partners	Effectiveness	Appropriated, Implementation, Partner
Tier 3	3	Multiparty USFS Stakeholders Agency Partners	Effectiveness	Implementation, Partner
Research	No priority. Occurs as approved by forest supervisors	Research Advocate	Implementation, Process, Effectiveness, Validation	Research Advocate, Partner

Monitoring Scales

Table 90 provides monitoring scales for the project. There are three sets of scales designed to incorporate work completed by the 4FRI stakeholders, scales utilized in the EIS, and scales that tier directly to the forest plans. The stakeholder-developed scales are intended to answer specific questions they may be interested in, the EIS scales are designed to provide information on movement towards the purpose and need, and the forest plan scales are designed to provide forest-wide information that can be utilized in forest plan monitoring.

The scales developed by the stakeholder reflect the landscape strategy approach which would monitor at the fine scale (group/site), at the mid-scale (site, treatment area), and at the landscape scale (treatment area, firescape, analysis area, and landscape).

For this analysis, the fine scale is the group or site, the mid-scale is the restoration sub-unit, and the landscape scale is the restoration unit and/or project area. These scales are typical of those used in forest management.

***Table 90*. Monitoring Scales**

Size (acres)	Monitoring Scales		
	4FRI Stakeholder Landscape Strategy Scale	4FRI Coconino and Kaibab EIS Coconino	Coconino and Kaibab NF Forest Plans
<1	Group		Fine/Small
1-10	Site		Fine/Small
10-100	Site		Fine/Small
100-1000	Site		Midscale
1000-10,000	Treatment Area	Sub-unit	
10K-100,000	Treatment Area /Firescape	Restoration Unit	Landscape
100k-1,000 +	Firescape, Analysis Area, Landscape	Analysis Area	Landscape

Monitoring Questions and Indicators

Quantitative measures (see table 91 through table 93) have been used wherever possible, but many of the desired conditions are qualitative and generalized. As specific treatment-level desired conditions are developed, more specific monitoring methods may be incorporated. Scales of measurement in space (scale) and time (frequency) are proposed. Wherever feasible, monitoring is proposed at scales that are large enough to match the landscape approach of the project. For many variables, this could mean using landscape-scale, remotely sensed data to gather comprehensive information, coupled with adequate ground sampling to verify image classification, develop predictive models, and measure variables that cannot be detected remotely. A very rough estimate of costs has been applied to some of the suggested indicators, but more detailed cost estimation would be needed as the monitoring designs become more specific.

Please note that desired conditions are grouped by theme (e.g. conservation of biological diversity) rather than by scale. Duplicative desired conditions were combined. Monitoring indicators, and their associated details, have been presented where possible. In some cases, the desired conditions are relatively general, context-dependent, related to policy or implementation rather than effectiveness, or aspirational in nature. These cases are indicated with a combined single column that describes the issues associated with monitoring movement towards the desired condition. Table 91 displays the implementation monitoring plan. Monitoring questions are largely grouped by treatment type or objective. Table 92 displays the effectiveness monitoring plan. Additional monitoring questions that do not correspond directly to desired conditions are listed in appendices II to IV of the comprehensive plan (see project record). Table 93 displays effectiveness monitoring with specific trigger point and potential corrective actions related to various project elements.

Adaptive Management

Adaptive management refers to a “rigorous approach for learning through deliberately designing and applying management actions as experiments” (Murray and Marmorek 2003). Monitoring of alternative management actions provides the data for the adaptive management process. As a

result of comparing monitoring results to the predicted outcomes, the plan provides a roadmap for adjusting actions or applying new science as long as the anticipated effects are within the scope of impacts analyzed and disclosed in the EIS and record of decision (ROD) as required by 40 CFR 1502.9(c) (2003 NEPA Task Force). Some of the effectiveness monitoring objectives have adaptive management actions that would be taken if the established thresholds are reached or exceeded. See table 93.

***Table 91*. Monitoring Questions, Indicators, Frequency of Measurement, Data Source, and Cost**

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Are ponderosa pine restoration treatments occurring within the project area?	Acres thinned /green tons removed, acres prescribed burned	Reported annually	Sale administration, USDA FS database of record/Restoration unit, forest/Thinning cost calculation is determined by location of treatments and amount of service work completed; fire is calculated by individual fire and averaged by fire type.
Were mechanical treatments designed in accordance with the silvicultural implementation guide (see project implementation plan)?	Acres of treatment by treatment type (see project implementation plan for metrics)	Reported annually	Sale administration, USDA FS database of record/Restoration unit, forest/Cost calculation are actual average cost for all grassland, oak, and aspen treatments by restoration unit.
Did treatments designed to naturalize non-system roads occur and were they implemented in accordance with design features, BMPs, and mitigation measures?	Miles of road effectively closed to motor vehicle traffic	Reported annually	Sale administration/Restoration unit/Average cost of each treatment type by miles of actual treatment.
Did mechanical treatment and prescribed fire actions minimize soil loss and maintain long-term soil productivity in compliance with forest plan standards?			
Did channel restoration treatments occur and were they implemented in accordance with design features, BMPs, and mitigation measures?	Miles and acres of channel restored	Reported annually	Sale administration, database of record Restoration unit/Average cost per mile and acre.
Did treatments in MSO habitat occur and were they implemented in accordance to the project biological opinion?	Acres thinned/green tons removed, acres prescribed burned, acres burned in managed fire	Reported annually	Sale administration, USDA FS database of record/ Restoration unit, forest/Thinning cost calculation is determined by location of treatments and amount of service work completed, fire cost is calculated by individual fire and averaged by fire type.

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Were design features and mitigation followed and forest plan requirements met for threatened, endangered, sensitive species?		Reported annually	
Did actions minimize impacts to water resources in a manner that adheres to the Clean Water Act and the intergovernmental agreement between the Forest Service Southwestern Region, and the ADEQ?		Reported annually	
Did actions minimize the spread of noxious weeds in compliance with the forest plans (noxious weeds and special area guidance), Forest Service Manual direction for noxious weeds and special areas (FSM 2090), FSM 2670 direction for sensitive plants, and the 1995 Arizona Bugbane Conservation Assessment and Strategy for the Coconino and Kaibab NFs?			
Did actions adequately protect Bebb's willow from fire and ungulate use in spring and riparian areas?			
Did actions minimize old and large tree mortality?			
Did actions result in acceptable old growth mortality in areas of concern (snags with known nests or roosts for herons, eagles, osprey, or other raptors and specific areas of old growth)?			
Did actions prevent damage or loss of infrastructure including historic range monitoring sites and allotment and pasture fences?			

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Were planned prescribed fires coordinated with neighboring forests and other affected agencies and communities?			
Did emission mitigation techniques minimize smoke impacts to sensitive targets and Class 1 Airsheds and meet ADEQ requirements?			
Did actions result in reduced crown fire potential and movement towards FRCC 1?			
Were scenery design features and mitigation measures incorporated into mechanical and prescribed fire treatments?			

***Table 92*. Landscape-Scale Effectiveness Monitoring Questions, Indicators, Frequency of Measurement, Data Source, and Cost**

Effectiveness Monitoring Questions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Conservation of Biological Diversity			
Ponderosa pine ecosystems provide the necessary composition, structure, abundance, distribution, and disturbance processes that contribute to the diversity of native plant and animal species at the project landscape scale.	Tier 1: Landscape-scale coverage of forest variables: composition, structure, spatial pattern	Annually	Remote sensing (RS) verified by ground sampling/Landscape scale/RS data are free but analysis is $15,000 per event, ground plots $2,000 per plot to install, $1,000 per plot re-measure.
Ponderosa pine ecosystems are composed of all age and size classes within the analysis area and are distributed in patterns consistent with the natural range of variability.	Tier 1: Age Structure: Tree diameter distribution (note that dbh is only a surrogate for age)	Immediately post-treatment and every 5 years	Remote sensing verified by ground sampling of tree point or canopy area pattern (maps)/Landscape scale/RS data are free, ground plots $40,000 to develop spatial model; analysis $5,000 per event

Effectiveness Monitoring Questions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Ponderosa pine ecosystems are heterogeneous in structure and distribution at the analysis area. Openings and densities vary within the analysis area to maintain a mosaic appropriate to support resilience of individual trees and groups of trees.	Tier 1: Spatial pattern of tree groups (requires specific thresholds for spatial statistics) using Ripley's K and/or Getis/Ord	Immediately post-treatment and every 5 years	Remote sensing verified by ground sampling of tree point or canopy area pattern (maps)/Landscape scale/RS.
	Tier 1: Canopy Openness – percent and characteristics of openings		
Natural and prescribed fires support diverse native understory communities and their associated biodiversity. Understory vegetation composition and abundance are consistent with the natural range of variability.	Tier 1: Understory vegetation diversity (% change in cover/bare ground, % change in high risk invasive species)	Every 5 years	Ground plots/Stand scale/Sample strategically to minimize cost, ground plots $2,000 per plot to install, $1,000 per plot re-measure
Forest conditions facilitate species' movement to and from adjacent landscapes, ecosystems, or habitats.	Tier 1: Spatial analysis of patches (patch area, density, size distribution), corridors, fragmentation, model movement	Every 10 years	Nearest Neighbor distance distribution, Contagion, Simpson's Diversity, and Evenness Indices Remotely sensed data/Landscape scale/RS data are free, ground plots $40,000 to develop spatial model. Analysis $5,000 per event.
	Tier 2: Songbird species richness: presence/absence Jackknife 2, Chao 2, ICE Species Richness Estimator	Immediately post-treatment and every 2 years thereafter	
Ecosystem Resilience			
A majority of the ponderosa pine ecosystems supports frequent, low-intensity fire.	Post-treatment fuel measurements (CBD, CBH, acres with crown fire potential, acres with surface fire potential, acres of FRCC 1-FRCC 3)	Annually	No numbers provided.
Water and Air Resources			
Soil productivity, watershed function, and air quality are not at risk of being degraded by uncharacteristically severe disturbances (e.g. landscape scale high- severity fire).	FRCC reporting	Annually	No numbers provided.

Effectiveness Monitoring Questions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Emissions factors, smoldering and smoke residence are reduced as fires burn more grass and less green or woody biomass over time.	Smoke emissions by acres burned	Annually	No numbers provided
Economics			
The byproducts of mechanical forest restoration offset the costs of treatment implementation The average net cost of treatment per acre is significantly reduced over the 10-year period.	Exchange of goods for services contract reporting	Annually	No numbers provided.
The economic value of ecosystem services provided by restored forests are realized and re-invested to support forest restoration and ecosystem management.	Exchange of goods for services contract reporting	Annually	No numbers provided.
Rural communities receive direct and indirect economic benefits.	CFLR business model report	No number provided	No number provided .
Sufficient harvest and manufacturing capacity exists to achieve restoration of at least 300,000 acres in the next 10 years.	Estimate of harvesting and utilization capacity	Every 5 years	Government records, inference from response to contracts, expert opinion.
Social Systems			
There is broad public support or acceptance of collaboratively-based forest restoration decisions, processes, and outcomes, including the use of fire as a management tool.	Public support/concerns assessed	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	Interviews with land managers and focus groups with community members to assess specific issues and concerns, used to develop telephone survey questions/Data analyzed: short term: within analysis area; long term: across the four forests/$30,000 each pre- and post-measures per analysis area.

Effectiveness Monitoring Questions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Social values and recreational opportunities are protected or enhanced through forest restoration activities.	Social values and recreational opportunities assessed	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	Targeted focus groups (two per organization) aimed at specific user groups (hunters, hikers, ORV, etc.) and/or telephone survey with general public/Data analyzed: short term: within analysis area; long term: across the four forests/Focus groups: $5,000 to -$10,000 per organization; telephone survey (cost as above).
Rural communities are protected from high-severity fire and their quality of life is enhanced through forest restoration.	1. Frequency and acreage of high-severity fire in and around rural communities 2. Quality of life assessed	1. As projects are completed around communities. 2. Pre- and post-treatment 3. Pre- and post-education/outreach program delivery	1. USDA FS wildfire database/Within analysis area (short term); across the 4FRI area (long term)/$500 per analysis area. 2. Telephone survey (cost as above).
Rural communities play an active part in reducing fire risk by implementing Firewise actions and creating defensible space around their property.	1. Number of households/neighborhoods that are implementing (the degree of) Firewise principles 2. Number of communities in the analysis/4FRI area	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	1. Telephone survey (cost as above) 2. Interview fire station personnel in neighborhood/home assessments and/or review fire station field.
Treatments within the analysis area minimize short-term impacts and enhance vegetation characteristics valued by forest users over the long term.	Forest user perceptions of treatments within the analysis area	1. 1 year post-treatment 2. 5 years post-treatment	Multiple field trips with forest users (random selection of participants to adequately represent general public)/Analysis area/$5,000.

Effectiveness Monitoring Questions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
There is low potential for fires to enter communities. Communities and homeowners are prepared for the undesirable case that fires that do enter communities.	1. Fire modeling 2. Number of households and neighborhoods implementing Firewise principles	1. Pre- and post-treatment in WUI communities 2. Pre- and post-education/outreach program delivery	1. 4FRI Science and Monitoring Working Group/Communities within analysis area 2. Telephone survey (cost as above). 3. Interview fire station personnel in neighborhood/home assessments and/or review fire station field survey logs/$2,000 to $5,000. 4. Number of neighborhoods certified through Firewise/Communities/ USA/$500.
Fire management costs are reduced; aggressive fire suppression is unneeded or rare.	1. Forest Service fire suppression costs 2. Number and acreage of USDA FS suppressed wildfires	Every 10 years	Forest Service records. National Interagency Fire Center records on wildfire occurrence/Analysis area/$1,000.

Table 93. **Monitoring**

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
There is reduced potential for introduction, establishment, and spread of invasive species. Existing infestations are reduced.	Invasive plants	Species cover	Field/RS	Site, SU, RU analysis area, landscape	High risk species are not reduced by 50% post-treatment over pre-treatment data within 2 years	Discontinue treatment until alternative approach is development
					Watch list species are not reduced by 90% within 1 year post-treatment	Prohibit mechanized harvest and/or other activities contributing to spread
					Target invasive species are not reduced by 20 % within 5 years	Discontinue treatment until alternative approach is development
		Cheatgrass			Cheatgrass increases above pre-treatment condition	Discontinue treatment in adjacent high risk areas until alternative approach is developed
Ponderosa pine ecosystems are heterogeneous in structure and distribution at the landscape scale. Openings and densities vary at the landscape scale and maintain a mosaic appropriate to support resilience of individual trees and groups of trees.						

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
Ponderosa pine ecosystems provide the necessary composition, structure, abundance, distribution, and disturbance processes that contribute to the diversity of native plant and animal species including common, listed, rare, and sensitive species.	Diversity (wildlife communities)	Songbird species richness	Field (RMBO songbird surveys), RS, Modeling	Measured at (1-km point grid) site, SU, RU, analysis area, landscape	5 year decrease in closed canopy, open canopy, and pine-sage species at the treatment area or larger scale	**Closed canopy species:** Increase group size for all treatments (based on AGFD experiment) Reduce intensity of all UEA 40-55 treatments Identify 25% of planned UEA 40-55 treatments and reduce intensity to 25-40
						Open canopy species: Increase the size of openings in all treatment types Identify 25% of planned UEA 25-40 treatments and increase intensity to 40-55%

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
						Pine-sage species: Alter timing of treatment to reduce impacts on sage Delay post-treatment burning to allow sage recover.
Forest conditions facilitate species' movement to and from adjacent landscapes, ecosystems, or habitats.		Changes in landscape connectivity and permeability	Movement data from transmitted black bear OR grey fox (to represent denser forest conditions) and pronghorn (to represent more open forest condition	RU, Landscape	Restriction of bear/fox movements (reduced connectivity between patches of untreated, higher density, or pine-oak) when comparing pre- to post-treatment. No increase in pronghorn movement when comparing pre- to post-treatment	Increase group size, decrease treatment intensity within known pathways Increase opening percentage Increase treatment intensity within known pathways

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
		Northern goshawk	Utilize existing framework from USDA FS National Guidelines, with proposed modifications developed by Kaibab NF staff and LLECB (B. Dickson)	RU, Landscape	Trigger points will be assessed as data from Kaibab NF Monitoring plan becomes available	Dependent on trigger points and data availability.
Understory vegetation composition and abundance are consistent with the natural range of variability.	Diversity (understory communities)	% cover native species	Field collected - quadrats	Site, SU, RU	Within 5 years of mechanical treatment, change in cover should be 20+/-5% (15- 25%) above controls (Laughlin et al. 2011)	If this threshold is not reached, then re-evaluate treatment for management change, taking into account soils and burn treatment, e.g., reduce overstory basal area.
		% bare soil within treatment blocks	Field collected - quadrats	Site, SU, RU	Within 5 years of treatment (mechanical and/or fire), bare soil should comprise less than 30% of area affected by treatment.	If bare soil exceeds 30% of area within plots, re-evaluate restoration treatment for modification.

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
		Seedlings and saplings	Field collected - quadrats	Site, SU, RU	Within 10 years of treatment, seedling, and sapling density should be within 0.4 to 3.6 plants/hectare/decade on basalt soils (Mast et al 1999)	If seedlings and saplings fall below this range across sub-units where regeneration is a desired condition, then evaluate implementation of BMPs to increase probability of successful regeneration. If regeneration falls above this range, then more aggressive prescribed burning may be necessary to reduce plant density.
A majority of the ponderosa pine ecosystems supports frequent, low-intensity fire. There is low potential for unnaturally severe fire to spread across the restoration unit.	Potential fire behavior	Crowning index, torching index, rate of spread	RS and modeling	RU	% of FR I veg types with passive or active crown potential <25% after first 5 years and < 10% after 10 years. Patch size of adjacent pixels expressing stand replacement fire sizes: max size 50 acres for first 5 years and max size 10 acres after 10 years.	Reevaluate potential causes: acres treated and/or treatment prescriptions.

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
Sensitive soils – implementation monitoring						
Tree size, snags, old trees, tree mortality - implementation monitoring						

Appendix G – Cumulative Effects

A summary of past, present and reasonably foreseeable management actions, and natural disturbances are presented here. See the project record for the comprehensive master list of all projects for additional information on each project.

Authorized Livestock Management

Livestock (sheep and cattle) grazing can be traced back to the 1800s when roads within the forests were used to drive herds between New Mexico and California. By the early 1890s, overgrazing had resulted in changes to understory vegetation by reducing grasses and forbs. This interrupted the role fire played on the forests. Livestock numbers peaked with World War II and then began to decline. By the 1970s, the forests had assigned livestock numbers to allotments and rangeland improvements had been put in place to improve livestock distribution and avoid over-utilization on sensitive areas (such as riparian). In 1987 and 1988, the forests' land management plans were put in place. The plans required grazing use to be balanced with land capacity and applied restrictions and mitigation to reduce impacts to understory conditions. Reviews of historic range monitoring data (Brewer 2011) indicate cool season species increased through the 1990s in response to an increase in cool season moisture. In the last 10 plus years, decreased cool season moisture and increased warm season moisture has increased warm season species like blue grama. Today, excessive tree density (related to past land management practices) is causing a plant conversion to more shade tolerant species (such as bromes and mountain muhly).

Timber Harvest

Past timber harvest practices influenced vegetation structure, pattern, and composition on about 90 percent of the project area. From the late 1880s to the 1940s, logging that facilitated the construction of the railroads was conducted by several lumber and timber companies in the Flagstaff and Williams area (USDA 1993). By 1940, the railroads had removed all the profitable lumber that could be easily accessed. In terms of vegetation structure, pattern, and composition, the largest and oldest tree sizes (VSS 5 and VSS 6) were removed from the project area (and across the forests in general). Historically, the herbaceous understory fueled frequent fires started by lightning, and thinned and/or eliminated thickets of small trees keeping the forest open and park-like (Allen et al. 2002). This created a mosaic of grass, forbs, shrubs and trees best characterized as areas with smaller (younger) trees with extensive regeneration with no large trees interspersed within the younger age classes. The pattern on the landscape no longer resembled the historic condition with historic tree groups and patch sizes ranging from 0.1 to 0.75 acres in size and with 2 to 40 or more trees (White 1985).

Past timber sales within the project area such as the 49'er sale, El Paso (1991), and Moritz (1985), all implemented prior to the Southwestern Region's 1996 Amendment of Forest Plans, targeted the harvest of medium and large diameter trees. In some cases, all trees over 12 inches in diameter were removed. This affected the presence of pre-settlement trees. At the landscape scale, they are rare within the project area. The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many stands are even-aged, dense, and lack age class diversity. Today, at least 83 percent of goshawk non-PFA habitat vegetation structural stage 3 (young-aged forest) and 4 (mid-aged forest) is even-aged. Approximately 74 percent of the project area is classified as having moderately-closed to closed tree canopies (4FRI Proposed Action 2011). Figure 57 displays the general location of past vegetation projects that occurred prior to 1996.

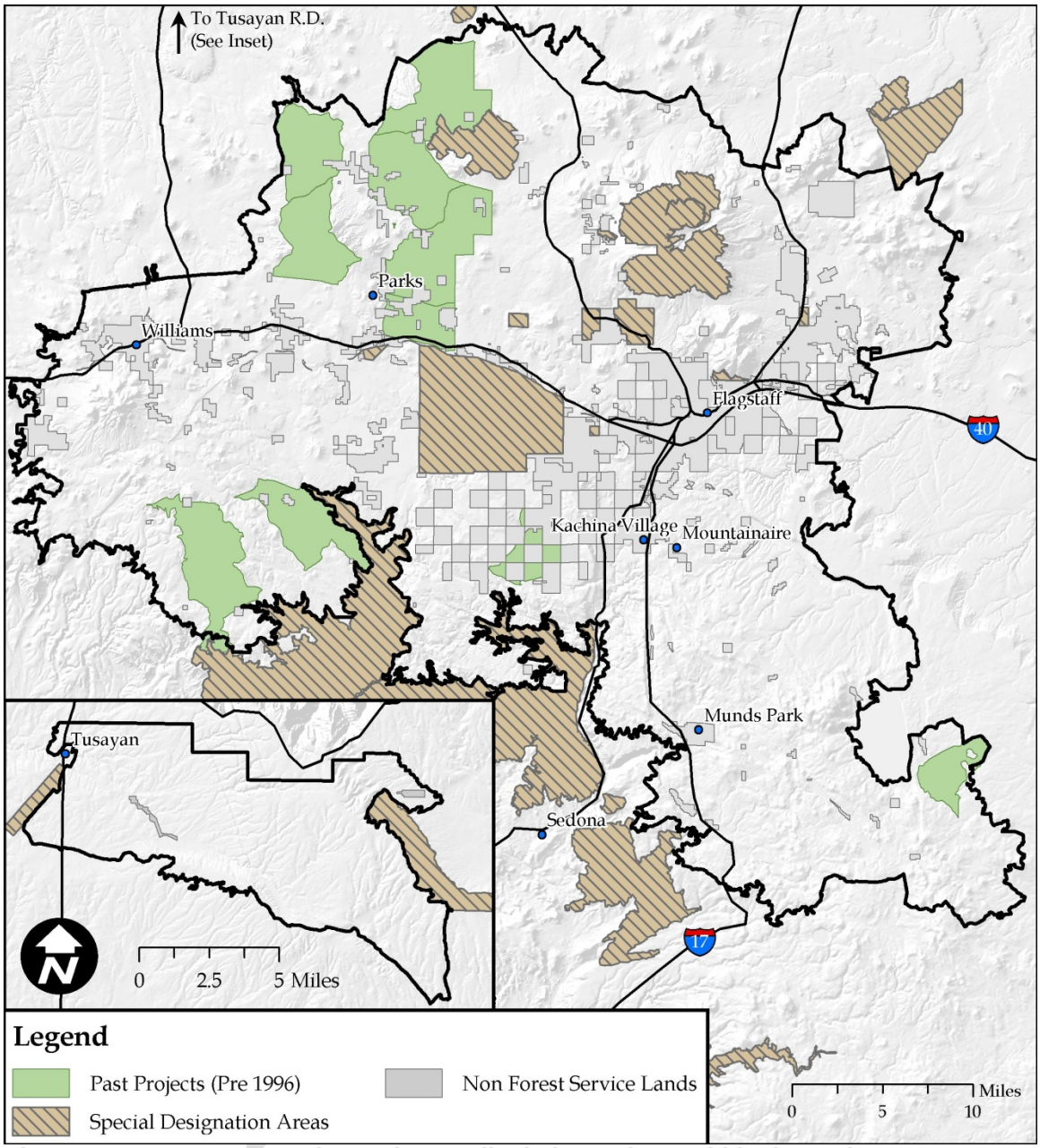

***Figure 57*. Pre-1996 Vegetation and Prescribed Fire Projects within the Project Area**

Post-1996 Vegetation Treatments – Uneven-aged management, Fire Risk, Restoration

Vegetation treatments implemented after the 1996 amendment of forest plans were designed differently in Mexican spotted owl and goshawk habitat. After the 1996 amendment, vegetation objectives moved from even-aged to uneven-aged management. A review of the FACTS timber database indicates that treatments designed to promote uneven-aged management began being recorded in 1991 on the Kaibab and as early as 1987 on the Coconino. However, acres treated in this category were small in comparison to even-aged methods until about 2005.

After 1996, the objective of most vegetation projects in the project area was to reduce the risk of high severity fire and/or improve forest health, stand and tree resilience and vigor, and improve understory diversity. Retention of snags and managing for course woody debris was further enhanced with the 1996 amendment and made part of project requirements.

The amendment also changed treatments in Gambel oak and the species was recognized for its role in managing for ecological diversity and high quality wildlife habitat. From 1996 to 2000 (table 94), at least seven projects (Spring Valley WUI, Upper Basin, Marteen, Ten X and Red Horse Mudderbach, Elk Lee, Beacon, and Parks) totaling 30,000 acres on the Kaibab NF, were treated with objectives including reduced fire risk, savanna and meadow restoration, oak improvement, improved age class structure and diversity and maintain industry. On the Coconino NF, at least 68,800 acres were planned for treatment for similar purposes (Fire Data, Vic, 2011) (FY 96 to FY99). Large projects on the Coconino NF that addressed fire risk included Mint Spring (7,778 acres of thin and 12,000 acres of prescribed burning, 1998) and the A-1 project (14,500 acres with thinning and broadcast prescribed burning, 2000).

With the exception of those projects that removed large, old trees and promoted even-aged management, most vegetation projects that contributed to the current condition within the project area are from about 2000 to 2010 (or 2011 if data was available). Since 2000, most vegetation project objectives have included reducing fire risk to communities, improving wildlife habitat in sagebrush (Tusayan district, Kaibab NF) and grasslands, improving winter range wildlife habitat, and improving forest health and diversity (moving towards a balance of age classes, reducing mistletoe infection, promoting growth in old, large ponderosa pine, promoting aspen, and restoring ponderosa pine savanna conditions).

On the Coconino NF, projects designed primarily to address fire risk in the project area include Rocky Park Fuels Reduction (13,651 acres, 2001), Kachina Village (11,029 acres, 2003), Mormon Lake Fuels Reduction (2,388 acres, 2005). Similar projects on the Kaibab NF include Williams High Risk Pre-Commercial Thin (756 acres 2001), Dogtown Fuels Reduction (8,209 acres, 2004), and Pineaire Fuels Reduction (650 acres, 2004).

Since 2000, at least 6,149 acres have been mechanically treated and prescribed burned on the Kaibab NF to improve wildlife habitat and 2,485 acres treated to improve/restore grasslands. Wildlife habitat improvement projects included Potato Hill Habitat Improvement Project (1,275 acres, 2003), Upper Basin Project (1,884 acres, 2000), and Moqui Antelope Habitat Improvement Project (2,990 acres, 2006). Grassland restoration projects include Garland Prairie (500 acres, 2005), Ida Grassland Restoration (1,800 acres, 2008), and Community Tank Grassland Restoration (185 acres, 2011). On the Coconino NF, almost 7,000 acres have been treated to directly improve wildlife habitat (habitat improvement was the treatment objective). Some of the larger projects (within the project area) on the Coconino NF designed to restore grasslands, woodlands, and wildlife habitats include Hart Prairie Fuels Reduction (9,815 acres, 2010), Elk Park Fuels Reduction (11,100 acres, 2007), and the Slate Mountain pronghorn project (2,250 acres, 2010). Projects adjacent to, but outside of, the project area include the Anderson Mesa Project.

Since 2000, over 13,829 acres of treatment on the Kaibab NF have focused on forest health and diversity objectives. Projects include Frenchy (9,319 acres of thinning that include savanna and meadow restoration and prescribed burning, 2003) On the Coconino, projects that addressed fire risk but also included restoration objectives such as meadow, riparian, and grassland restoration include Fort Valley (1,700 acres, 2000), Apache Maid Grass (54,528 acres, 2004) and Woody Ridge (8,599 acres, 2004).

However, even some of the most recent thinning projects (2000 to present) have focused thousands of acres of treatment on the removal of the smallest trees. Some of these treatments were limited in order to comply with the forest plans when treating in Mexican spotted owl protected and restricted habitats. This has produced results similar to treatments conducted in the 1980s – rapid regeneration and high tree density. Projects that focused on removing only the smallest trees (usually up to 9-inch dbh) were primarily focused on reducing fire risk adjacent to public areas such as residential areas and campgrounds. Available data was reviewed and assumptions were made on some projects where data was incomplete.

From 2000 to 2010, on the Kaibab NF about 3 percent of the project area (of the 596,000 acres proposed for treatment) has been treated in a manner that has resulted in a high regeneration of small trees that have increased in size over time.

On both forests, vegetation projects have typically included the construction (and decommissioning) of temporary roads and have decommissioned roads. Since 2000, approximately 47 miles of temporary road have been constructed (and decommissioned), 251 miles of existing road have been decommissioned (117 miles on the Kaibab NF and 44 miles on the Coconino NF), and approximately 1 mile has been relocated to reduce impacts on resources. table 94 displays projects that have influenced the existing condition. Figure 58 displays the general location of projects post-1996.

***Table 94*. Summary of Past Vegetation and Prescribed Fire project acres (2000 to 2010)**

Project Name	Year (NEPA decision)	Treatment Type	Acres* Thin/Burn	Forest/District	
				Coconino	Kaibab
Williams High Risk	2001	thin and pile burn	756/756		Williams
Potato Hill	2003	thin, lop and scatter	1,275/0		Williams
Frenchy	2003	thin and prescribe burn	9,319/9,319		Williams
Dogtown	2004	thin and prescribe burn	6,509/6,509		Williams
Clover High	2004	thin and pile burn	385/385		Williams
Pineaire	2004	thin and prescribe, pile burn	650/650		Williams
Williams Follow-Up Mistletoe	2004	thin and pile burn	368/368		Williams
Government Mountain/Coleman	2005	thin	75/0		Williams
Garland Prairie	2005	thin and lop, pile burn	500/47		Williams
City	2005	Thin and pile burn/prescribe burn	8,667/12,400		Williams

Project Name	Year (NEPA decision)	Treatment Type	Acres* Thin/Burn	Forest/District Coconino	Forest/District Kaibab
Kendrick	2005	thin and prescribe burn	unknown		Williams
Flag Tank	2007	thin and prescribe burn	22/36		Williams
IDA Grassland	2008	thin and pile burn	1,800/1,800		Williams
Bill Williams Cap	2009	thin and prescribe burn	10/10		Williams
Community Tank	2011	thin and prescribe burn	185/185		Williams
Upper Basin	2000	prescribe burn	0/1,884		Tusayan
Tusayan West	2001**	thin and prescribe burn	549/850		Tusayan
Tusayan South/Boggy Tank	2000-2002	thin and prescribe burn	2,948/2,948		Tusayan
Ten X	2004	thin and prescribe burn	1,780/700		Tusayan
Topeka	2004	thin and prescribe burn	1,100/1,100		Tusayan
Moqui Antelope	2006	thin	2,990/2,990		Tusayan
Scott	2001	thin, pile, and prescribe burn	721/9,434		Tusayan
X Fire	2009	thin	140/0		Tusayan
O'Connell	< 2009	thin	500/0		Tusayan
Arboretum WUI	2000	thin and prescribe burn	602/602	Flagstaff	
Fort Valley	2000	thin	1,700/0	Mogollon Rim/Flagstaff	
A-1 East, West	2000	thin, pile, and prescribe burn	5,517/8,638	Flagstaff	
Rocky Park	2001	thin and prescribe burn	5,651/8,000	Flagstaff	
Lake Mary	2005	thin and prescribe burn	1,845/3,245	Flagstaff	
APS Hazard Tree	2003	prescribe burn	0/315	Flagstaff	
APS Powerline	2007	thin	167/0	Flagstaff	
Blue Ridge 69kV	2005	thin and prescribe burn	50/1,300	Mogollon Rim	
Doney Park 69kV	2007	thin	9/0	Flagstaff	

Project Name	Year (NEPA decision)	Treatment Type	Acres* Thin/Burn	Forest/District Coconino	Forest/District Kaibab
Kachina Village	2003	thin and prescribe burn	3,801/2,147	Flagstaff	
Apache Maid Grass	2004	thin	54,528/0	Mogollon Rim	
Woody Ridge	2004	thin and prescribe burn	7,987/11,184	Flagstaff	
Mormon Lake	2005	thin and prescribe burn	2,388/2,388	Flagstaff	
Skunk Canyon	2005	prescribe burn	0/831	Flagstaff	
Elden	2006	thin	193/0	Flagstaff	
Eastside	2006	thin and prescribe burn	7,819/20,197	Flagstaff	
East Clear Creek	2006	thin and prescribe burn	83/14,500	Mogollon Rim	
Elk Park	2007	thin and prescribe burn	1,800/3,500	Flagstaff	
Little Draw Aspen	2009	thin	107/0	Flagstaff	
Munds Park	2009	thin and prescribe burn	990/2,950	Flagstaff	
Slate Mountain	2010	thin	2,250/0	Flagstaff	
Schultz Fire BAER	2010	thin (snag removal)	150 snags removed	Flagstaff	
Acre Summary					
Total vegetation treatment			**138,736 acres**		
Total prescribed fire			**132,158 acres**		

*Some projects are still in the implementation phase. Acres included here only include acres that have been implemented. See table 99, current and ongoing projects for those projects that are not complete.
** The decision for Tusayan West was 1998 and implementation was 2001.

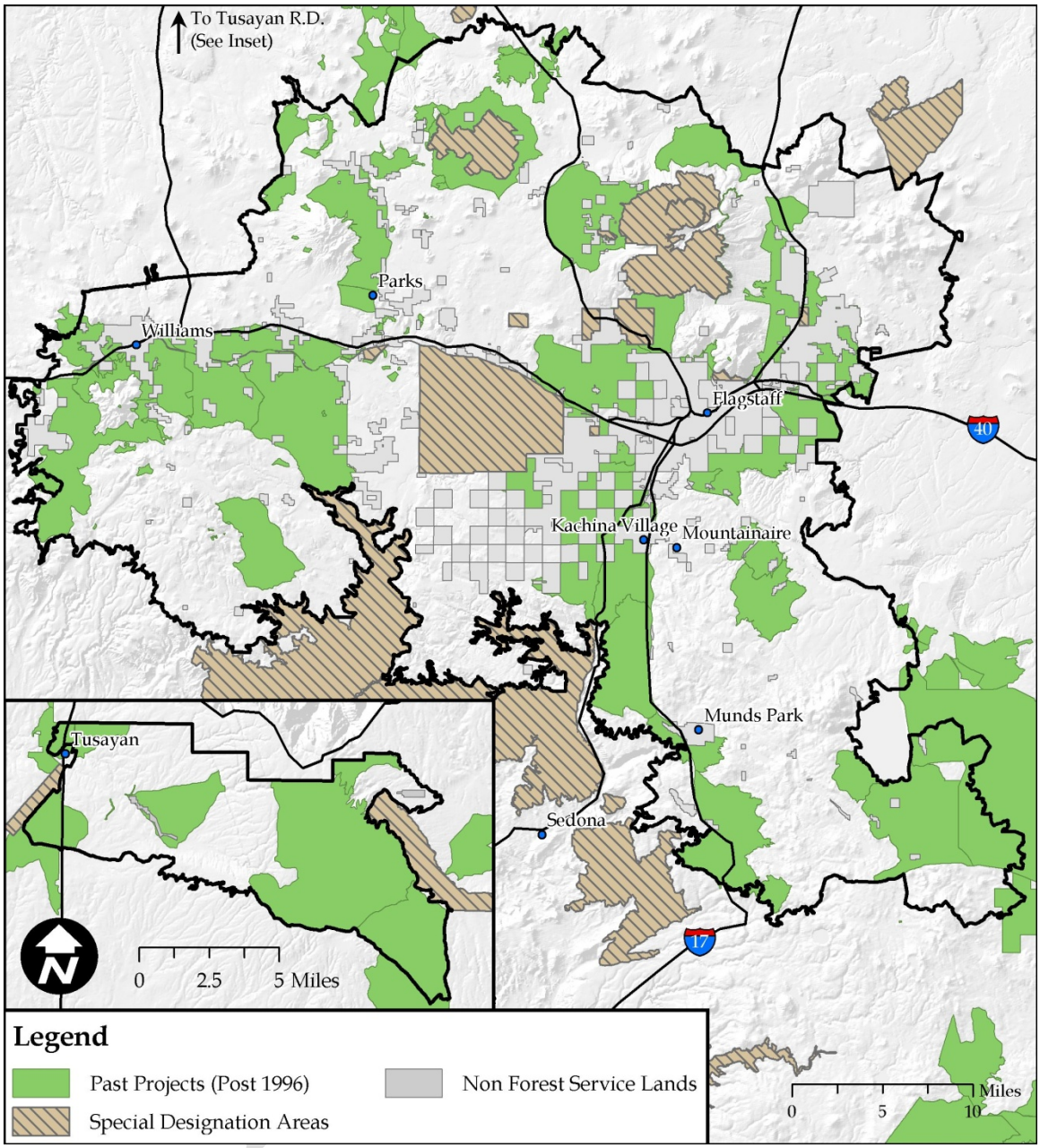

***Figure 58*. General Locations of Past Projects (Post-1996) within the Project Area**

Natural Disturbances – Fire

Most of the vegetation types on the Kaibab and Coconino NFs are adapted to the frequent, low intensity fire that occurred periodically prior to Euro-American settlement. In fire adapted vegetation types, ecosystem function is dependent on this regular disturbance. However, ceasing all fires was common practice, dating back to the late 1800s and mid-1900s. Early foresters were convinced that any wildfires were detrimental to the forest (Pyne 1982). During this time, extensive livestock grazing consumed the abundant grasses with forest reserve management plans

often urging heavy grazing to eliminate the herbaceous fuels that allowed surface fires to sweep across the land (Drake 1910). In addition to grazing, early settlers also suppressed fire to protect their livelihood and homes.

Organized fire suppression efforts by the Forest Service date back to the first decade of the twentieth century, largely in response to unacceptable fire effects due to heavy slash loads left by railroad logging, In 1935, the Forest Service further instituted a policy that all fires were to be extinguished by 10 a.m. of the day following their detection (Pyne 1982). Throughout most of the twentieth century, foresters continued to extinguish all fires regardless of ignition cause, intensity, or degree of danger to human safety or property. Widespread fire suppression efforts continue and a high percentage of federal resources are focused on suppression (Covington 2003).

As noted in the vegetation management section, without fire, understory seedlings in pine and mixed conifer forests had unprecedented survival rates. White fir, Douglas-fir, and even Engelmann spruce seedlings became established under ponderosa pine stands. Juniper and pinyon seedlings invaded former grassland savannas. The increase in tree density and resulting buildup of woody fuels led to unnaturally large and severe wildfires, insect outbreaks, and reduced biodiversity (Friederici 2004).

Data on wildfire acreages from 1940 to 1970 was derived from Covington 2003. Data on past wildfires that have occurred within the project area from 1970 to 2010 was derived from the project's fire ecologist's specialist report. Data was compiled using a Forest Service database query, Fire Family Plus, for those districts of the Coconino and Kaibab NFs that are located south of the Grand Canyon in (largely) ponderosa pine vegetation. Acres may include portions of some pinyon-juniper and some mixed conifer vegetation. In addition to this data, the each forest's FACTS database was accessed to provide a subset of individual fires and acres for each forest.

***Table 95*. Coconino and Kaibab NF Wildfire Acres 1940 to 2010**

Time Period	Project Area Wildfire (acres affected)
1940-1960	10,139 (Coconino NF only)
1960-1969	1,090 (Coconino NF only)
1970-1980	49,631
1981-1990	7,399
1991-2000	63,397
2001-2010	180,499
Total acres	**312,155**

Overall, wildfire has influenced at least 18 percent of the 988,766-acre project area since 2001. Severe effects associated with past wildfires are attributed to 20 to 30 percent (of the 18 percent) of the project area. These fires affected structure, pattern, composition, and function by creating an even-aged plantation-type tree structure with grass and brush that are no longer contributing to a forested structure. The remaining 70 percent of fires were low-to- mixed severity fires that provided beneficial impacts. These events affected structure, pattern, composition, and function by returning fire, a natural process, to the ponderosa pine system. Table 95 displays those projects where data from project records were located.

As noted in table 94 above, thousands of acres in and adjacent to the project area have (or are currently) been treated to reduce hazardous fuels. Vegetation was thinned and residual slash

reduced/removed through various methods including machine pile and burn, hand pile and burn, chipping, lop and scatter, mastication, and mowing. (See table 94 for project examples.) Since 2000 to 2010, at least 56,146 acres of Williams and Tusayan district have been treated to reduce hazardous fuels. On the Coconino NF, at least 83,979 acres[5] have been treated within the project area to address hazardous fuels.

Table 96. **Subset of Wildfire acres by Time Period within the Project Area**

Time Period	Fire Names (as available)	Acres Affected by Forest	
		Coconino	Kaibab
1940-1960	Fort Valley, A-1, Hostetter, Belle, Kelly, Kendrick (Covingon 2003)	10,139	No data available
1961-1970	Whitehorse, Hostetter (Covington 2003)	1,090	No data available
1971-1980	Kelly, Burnt, Wild Bill, Radio, Wallace, Kendrick, Curley (Covington 2003)	25,497	No data available
1981-1990	Dude Fire (Tonto NF)	24,000 (adjacent to the Coconino on the Tonto NF)	No data available
1991-2000	**Coconino**: (Bear Jaw, Trick, Hockderffer, Slate, Horsehoe, Side, Pipe, Power, Pumpkin) (Covington 2003) **Kaibab**: Pumpkin (Covington 2003)	44,843	8,759
2001-2010	**Coconino NF** **Class C: 2,205 acres**: various fires **Class D: 2,164 acres**: Cinder Hills, Clover, Fry, good, Late, OH, Reservoir, Sawmill, Tater, Trowel, Tram, Woody **Class E: 5,299 acres**: 89 Mesa, Bear, Bull Run, Five Mile, Knife, LaBarranca, Pipe, Springer, Tuba **Class F: 20,863 acres**: Brins, Golf, Hardy , Leroux, Mormon, Packrat, Power, Taylor, Webber, Willow **Class G: 45,521 acres:** Birdie, Jacket, Lizard, Schultz	76,052	

[5] Projects selected include those that had a hazardous fuels reduction component including Arboretum WUI, Fort Valley, A-1, Rocky Park, Lake Mary, Kachina Village, Woody Ridge, Mormon Lake, Skunk Canyon, Elden, Eastside, East Clear Creek, Elk Park, Munds Park, and Slate Mountain. Where both thinning and prescribed fire had been implemented, the higher,more inclusive acreage number was selected.

Time Period	Fire Names (as available)	Acres Affected by Forest	
		Coconino	Kaibab
2001-2010	**Kaibab NF** **Class C: 242 acres**: various fires **Class D: 198 acres**: Wash **Class E: 2,652 acres**: Indian, Juniper, Scott, Twin **Class F: 13,748 acres**: Anderson, Hobble, Miller, Rae, Ruby, X **Class G: 13,022 acres**: Trick, Wildhorse		29,862

Natural Disturbances – Insect and Disease

The Coconino NF experienced significant bark beetle outbreaks in the mid-1920s, late 1930s, mid-1960s, late 1970s through early 1980s, and late 1990s through the mid-2000s. The 1950s and 2000s outbreaks appear to be more extensive than other outbreaks, damaging at least 200,000 and 72,000 acres, respectively. Ponderosa pine needleminer defoliated over 9,000 acres of ponderosa pine on the Coconino NF in 1999 (USDA Forest Service 2000).

On the southern portion of the Kaibab NF, western pine beetle activity was reported in late 1970s and early 1980s. The contemporary (2000s) bark beetle outbreak is probably more severe than past outbreaks. Ponderosa pine mortality approached 100 percent in some stands (Gitlin et al. 2006), but averaged only 3.4 percent in a limited number of plots distributed across Williams Ranger District (RD) and Tusayan RD (Negrón et al. 2009).

Southwestern dwarf mistletoe is dispersed throughout the project area where 2 to 31 percent of the commercial ponderosa pine type was infected in the 1980s on the northern half of the Coconino NF and 25 to 38 percent of the commercial ponderosa pine type was infected on the Williams district (Hessburg and Beatty 1985).

Annual aerial surveys on the Coconino and Kaibab NFs in the summer of 2010 detected ponderosa pine mortality associated with bark beetles on approximately 6,500 acres within the project area. This mortality is most likely associated with the Ips beetle (USDA Forest Service Southwestern Region Insect and Disease Conditions Report 2010). This survey indicates a tenfold increase in beetle mortality from the 2008 and 2009 surveys, although bark beetle activity in ponderosa pine is currently considered to be at endemic levels. Preliminary results of the 2011 survey indicate a minor reduction in ponderosa pine mortality from 2010. In piñon-juniper woodlands, both localized and widespread mortality events have occurred over time on the Coconino and south Kaibab NFs. These events have typically been piñon Ips outbreaks associated with periods of drought, such as occurred in the 1950s, and more recently in the mid-1990s and 2001 through 2003.

Juniper mortality from wood borers and Phloeosinus beetles has occurred in areas of poor site within the project area during the recent drought (Mueller et al. 2005, USDA Forest Service 2002, 2003). Juniper mortality averaged 3.3 percent within an 80 kilometer radius of Flagstaff, with greater mortality on grassland versus non-grassland sites (Gitlin et al. 2006).

In aspen, mortality has been attributed to the severity of the 1999 frost damage, severe drought conditions, and western tent caterpillar defoliation in 2004 and 2005. Although dying trees

sprouted, survival has been very low due to browsing by elk. Mortality has been greatest in the low-elevation range. During the past 5 years, more than 50 percent of surveyed aspen sites below 7,500 feet elevation experienced 97 percent mortality (Fairweather et al. 2008).

In summary, as agents of change, forest insects and diseases have a significant role in forest ecosystem dynamics. Forest insect and disease-driven change alters forest ecological processes, forest structure, and composition. At one time or another, all of the vegetation types within the project area have incurred extensive damage by one or more agents (table 97). The transitory agents causing the most extensive and severe damage have been piñon Ips in pinyon pine, Ips bark beetle species in ponderosa pine, and multiple biotic and abiotic agents in aspen. Each of the vegetation types shows distinct periods of increased insect damage that can be associated with droughts. The most extensive and damaging persistent agent is southwestern dwarf mistletoe in ponderosa pine. More detailed information can be found in Lynch et al. 2008a and 2008b.

***Table 97*. Acres Affected by Insect and Disease Outbreaks by Forest (Within Project Area)**

Time Period	Insect/Disease Type	Acres and/or or Percent (%) of Forest Affected	
		Coconino	Kaibab
1950s	Bark beetle (ponderosa pine) damage	200,000	N/A
1950s	Wood borers and Phloeosinus beetle (juniper woodland) mortality	Unquantified – described as extensive	
1970s to 1980s	Western bark beetle (ponderosa pine)	N/A	Unquantified
1980s	Southwestern dwarf mistletoe (ponderosa pine) infection	19,773 to 306,489 (2 to 31%)	247,169 to 375,696 (2 to 38%)
1999	Needleminer (ponderosa pine)	9,000	N/A
2000s	Bark beetle (ponderosa pine) damage	72,000	N/A
2000s	Bark beetle (ponderosa pine) mortality	100% mortality in select stands	29,660 (3%)
2002-2005	Wood borers and Phloeosinus beetle (juniper woodland) mortality	3% mortality within 50 mile radius around Flagstaff*	Extensive
2005-2008	1999 frost and 2004-2005 western tent caterpillar defoliation (aspen) mortality	97% mortality in >50 percent of surveyed aspen sites below 7,500 feet (Fairweather et al. 2008).	
2010	Bark beetle (ponderosa pine) mortality	6,500	

*Accurate acreage number not feasible given the amount of non-FS lands included in the 50 mile radius.

Private Property, State, and Other Agency Activities

On the Kaibab NF, from 2001 to 2004, the Rural Communities Fuels Management Partnership thinned over 200 acres of trees on private property in the Parks, Sherwood Forest Estates, Williams, and Sherwood Forest Estates communities to reduce the risk of wildland fire and improve forest (Kaibab NF news release, August 2004).

The Camp Navajo Army Depot borders both the Kaibab and Coconino NFs and is within the project area. Camp Navajo implemented thinning on 350 acres in 2011to complete post-tornado recovery. Additionally, treating 349 acres is foreseeable in 2012 (Camp Navajo 2012 data).

Approximately 78,184 acres of fuels reduction treatments were conducted on state and/or private lands from 2000 to 2010 through the Greater Flagstaff Forest Partnership (GFFP) and Arizona State Forestry Division cost-share program (GFFP 2010 Report). Projects are conducted within the 180,000-acre GFFP boundary that is within the project area. Examples of projects include NAU (1,893 acres), Sunset Crater (316 acres), Arizona Department of Game and Fish (54,988 acres), and Flagstaff Fire Department (9,203 acres). Treatments were designed for the wildland urban interface (WUI). Current projects include vegetation thinning and prescribed fire on approximately 100 acres of private property made up of 20 parcels within the GFFP boundary in 2012.

Foreseeable fuels reduction treatment include treating (thinning/prescribed burning) 245 acres (5 private land parcels) in 2013, 190 acres (4 to 10 parcels) in 2014, and 100 acres of prescribed burning through 2014 (Flagstaff Fire Department, personal communication, February 24, 2012).

***Table 98*. Past Treatments on Private, State, and Other Federally Managed Lands**

Years	Agency/Organization	Acres Treated
2000-2004	Rural Communities Fuels Management Partnership	200
2000-2010	Greater Flagstaff Forest Partnership (GFFP)	78,184
2011	Camp Navajo Army Depot	350
Total		**78,734**

Summary of current and ongoing projects

The ongoing and current projects category focuses on those projects that have the potential to affect vegetation (structure, pattern, and composition), natural processes (such as fire), and movement towards increased forest resiliency and function. Specialists will evaluate whether additional projects (not included in this list) are relative to their cumulative effects analysis. This category includes vegetation and prescribed burning projects that still have acres remaining for implementation. The forests have been annually implementing a portion of the total acres specified in the NEPA decision. It is typical for vegetation and prescribed burning projects to be implemented over a course of 1 to 10 years, depending on size and complexity. Only those acres that remain to be implemented are reflected in this category. Projects that included periodic (maintenance) prescribed burns are included in this category. The assumption for other projects such as power line maintenance conducted by special use permit holders is that the vegetation within the entire right-of-way could be maintained annually. In summary, approximately 82,592 acres of vegetation treatments and 96,125 acres of prescribed fire are in the current and ongoing category within the project area (table 99 and figure 59).

***Table 99*. Current and Ongoing Vegetation (Mechanical) and Prescribed Fire Projects**

Project Name	Treatment Type	Mechanical /Prescribed Fire (acres)	Forest/District	
			Coconino	Kaibab
Pomeroy	Mechanical and prescribed fire	1,740/1,740		Williams
KA		1,050/1,050		Williams
Russell		5,000/5,000		Tusayan
Community Tank		865/865		Williams
Bill Williams Cap		10/10		Williams
Ten X	Prescribed fire	700		Tusayan
Airport		602		Tusayan
South Williams		290		Williams
Long Jim		1,300		Tusayan
Dogtown	Mechanical and prescribed fire	1,700/1,700		Williams
Twin	Prescribed fire	1,400		Williams
Frenchy		6,529		Williams
Tusayan South/Boggy Tank		2,948		Tusayan
Tusayan East		2,600		Tusayan
Arboretum		602	Flagstaff	
Woody Ridge		11,184	Flagstaff	
Post-Tornado	Mechanical (tree removal)	18,756	Flagstaff and Mogollon Rim	
Hart Prairie	Mechanical and prescribed fire	9,815/9,815	Flagstaff	
Munds Park	Prescribed fire	2,950	Flagstaff	
A-1 East and West		8,274	Flagstaff	
East Clear Creek	Mechanical and prescribed fire	1,562 /4,700	Flagstaff	
Mormon Lake	Prescribed fire	2,388	Flagstaff	
Skunk Canyon		831	Flagstaff	
Eastside		20,197	Flagstaff	
Power lines, oil and gas lines, natural gas/FERC, meter sites, gas compression and substation sites*	Right- of-way vegetation clearing for maintenance purposes and to reduce fire risk	30,710	Forest-wide	

Project Name	Treatment Type	Mechanical /Prescribed Fire (acres)	Forest/District	
			Coconino	Kaibab
Power lines, oil and gas lines, natural gas/FERC, meter sites, gas compression and substation sites*	Right- of-way vegetation clearing for maintenance purposes and to reduce fire risk	1,634		Forest-wide
Bobs (part of Woody Vegetation project)	Mechanical and prescribed fire	2,000/2,000	Flagstaff	
Clark's (part of Elk Park project)		1,600/1,600	Flagstaff	
Elk Park Fuels		2,900,2,900	Flagstaff	
Jack Smith-Schultz		2,000/2,000	Flagstaff	
Weatherford (part of Jack Smith Schultz and Eastside)		1,000//1,000	Flagstaff	
Railroad		250 /250	Flagstaff	
Summary of Acres				
Total vegetation treatments including maintenance		**82,592 acres**		
Total prescribed fire		**96,125 acres**		

***Table 100*. Current and Ongoing Other Projects**

Project Name	Project Purpose	Description	Forest/District	
			Coconino	Kaibab
Treatment of Noxious Weeds-3 Forests	Direction incorporated into forest plans	Encompasses project area	Forest-wide	Forest-wide
Fuelwood collection	Forest-wide policy			Williams and Tusayan
Tusayan Travel Management				Tusayan
Williams Travel Management				Williams
Coconino NF Travel Management				
Coconino and Kaibab NFs road maintenance	Annual road maintenance		500 miles per year on each forest	

Project Name	Project Purpose	Description	Forest/District	
			Coconino	Kaibab
Grazing	Continuation of authorized livestock grazing	790,985 acres/80% of project area	47 active allotments within project area, see the range report for a complete list of allotments within project area	
Wildlife waters	Water development maintenance	24 water developments		Tusayan
Little Draw	Aspen exclosure maintenance	107 acres	Flagstaff	

*The numbers in this category are for the entire permitted facility and likely include acres outside the project area. Data that would have been specific to the project area was not readily-available.

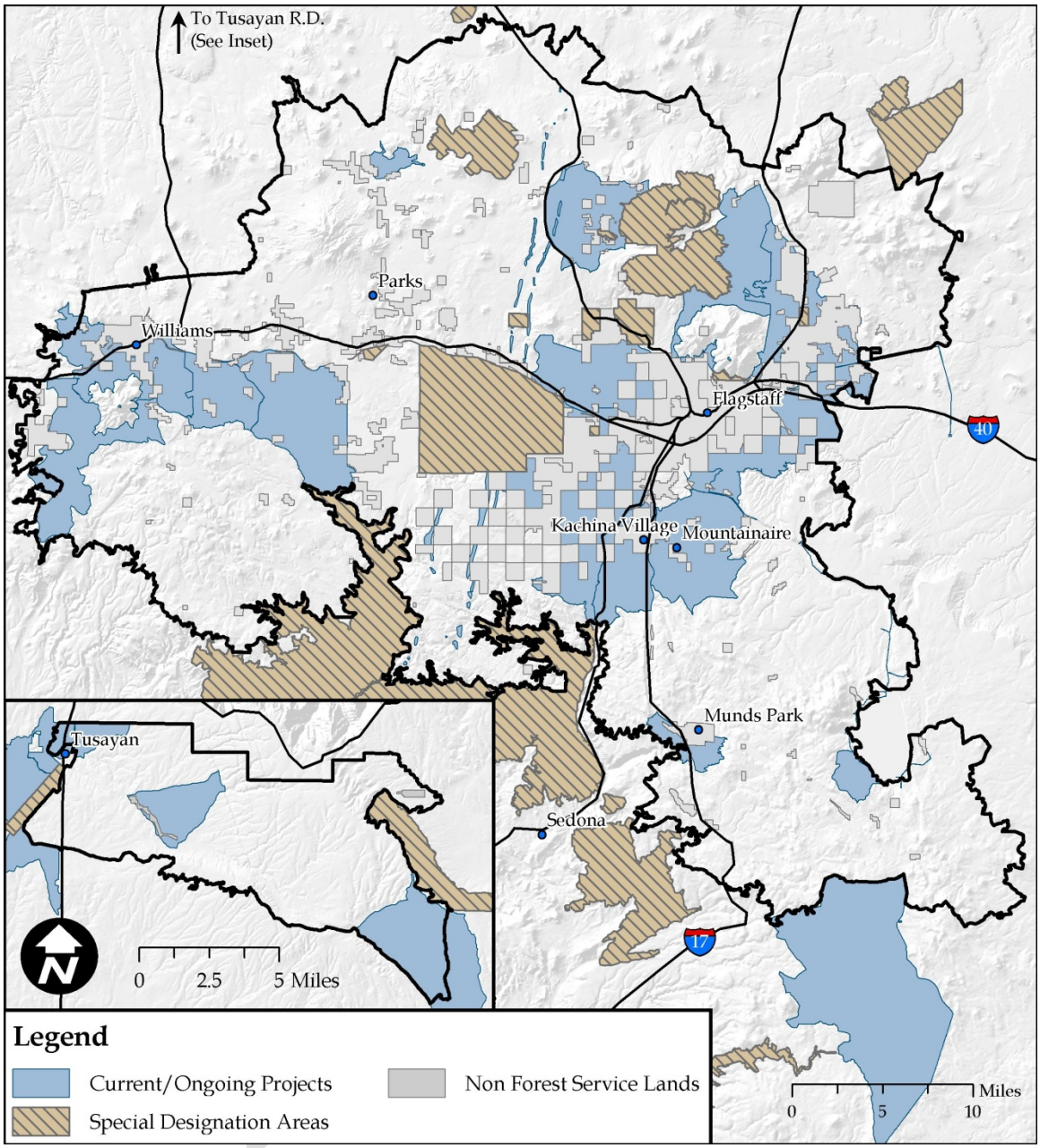

Figure 59. **General Locations of Current and Ongoing Projects Within or Adjacent to the Project Area**

Summary of Reasonably Foreseeable Projects

Reasonably foreseeable projects for this analysis (table 101 and figure 60) are defined as those Forest Service projects that have been listed in the forests' Schedule of Proposed Actions (SOPA). Decisions are imminent or decisions have been made and implementation is about to begin; or the projects are poised for implementation by other (non-FS) parties. The reasonably foreseeable category mostly focuses on those projects that have the potential to affect vegetation

(structure, pattern, and composition) natural processes, such as fire, and movement towards increased resiliency and function). Some project, such as the rock pits analysis, would not affect vegetation structure, composition, or composition. However, this project has been included as it may affect how road proposals (and their associated costs) are analyzed and implemented. Specialists will also evaluate whether additional projects (not included in this list) will be included in their cumulative effects analysis. Projects that are foreseeable but located outside of the project area are displayed in table 101.

In summary, approximately 86,771 acres of vegetation treatments/thinning and 142,869 acres of prescribed fire and maintenance burning would be implemented by the forests in the foreseeable future (within 5 years). Approximately 18,552 acres of vegetation treatments/thinning and 19,082 acres of prescribed fire and maintenance burning is expected to be implemented on state, private, and other federally managed lands within the foreseeable future (within 5 years).

***Table 101*. Reasonably Foreseeable Vegetation Management/Ground-disturbing Projects Within and Adjacent to the Project Area**

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Aspen Restoration Project	Mechanical and prescribed fire	402 acres mechanical and prescribed fire		Williams	Promote aspen by removing conifer encroachment, using prescribed fire, and protecting with fencing Status: analysis underway, decision likely in 2012
McCracken Project	Mechanical and prescribed fire	15,262 acres mechanical 17,337 acres. prescribed fire		Williams	Move towards uneven-aged forest structure, reduce mistletoe, restore meadows, savanna, and woodlands Status: decision likely in 2012
Ten X Fire Planting	Post-fire planting and fencing	12 acres		Tusayan	Restore vegetation within 815-acre high severity burn Status: analysis underway
Bill Williams Mountain Restoration	Mechanical, prescribed fire, roads	11,650 acres mechanical 15,200 acres prescribed fire 28 miles road decommission and 23 miles temp road construction		Williams	Reintroduce fire, reduce stand densities and fire potential, move towards balanced age classes, improve understory composition and productivity Status: analysis underway, decision likely in 2012
Coconino and Kaibab NFs Rock Pit Development	Existing pit expansion and new pit development	39 pits - 229 acres (new disturbance)	Forest-wide	Forest-wide	Create source of materials for road maintenance and management Status: analysis underway, decision likely in 2012

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Marshall Fuels Reduction	Mechanical and prescribed fire	10,800 acres mechanical and 6,260 acres prescribed fire	Flagstaff		Ponderosa pine, grassland, meadow, and water fowl habitat restoration (includes 900 acres of thinning up to 9-inch dbh in MSO habitat), reduce fire risk Status: decision made, 2012 implementation
Turkey/Barney Pasture Forest Health Restoration	Mechanical and prescribed fire	Potentially 17,835 acres of mechanical and prescribed fire	Flagstaff		Reduce dwarf mistletoe, tornado salvage, improve MSO habitat Status: analysis underway, decision likely in 2012
Upper Beaver Watershed Fuels Reduction (90% outside the project area)	Mechanical and prescribed fire	15,807 acres mechanical 31,162 acres prescribed fire 43,906 acres maintenance burning			Reduce fire risk within and outside of WUI Status: 2,000 acres scheduled for 2013 implementation
Western Area Power Administration Flagstaff to Pinnacle Peak	Mechanical	4,584 acres	Flagstaff		Remove trees that may impinge on power lines: 1,770 acres ponderosa pine, 8 acres aspen, 10 acres cottonwood/willow riparian, 25 acres wetland cienega, 35 acres montane/subalpine grass, 175 acres semi-desert grass, 810 acres pinyon-juniper evergreen shrub, 1,280 acres pinyon-juniper woodland Status: Analysis underway, decision likely in 2012
Wing Mountain	Mechanical and prescribed fire, road decommission	10,190 acres mechanical and 10,767 acres prescribed fire	Flagstaff		Restoration in ponderosa pine, mountain grassland, pine savanna, aspen and spring (Maxwell and Big Leroux) restoration, 8 miles of road decommission
Acre Summary					
Vegetation treatments and foreseeable ground disturbance			**86,771 acres**		
Prescribed fire including maintenance burning			**142,869 acres**		

***Table 102*. Reasonably Foreseeable Recreation Projects Within the Project Area**

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Kelly Motorized Trails	Motorized trails	73 miles of single track (motorcycles) and motorized trail (ATV, UTV)	Flagstaff district		*6 miles of road to single track trail conversion *25 miles of new construction for single track *6 miles of user created trail converted to single track system trail *17 miles of road converted to motorize trail *11 miles of level 2 road converted to motorized trail 8 miles of new motorized trail construction
Mt. Elden/Dry Lake Hills Recreation	No proposal exists at this time				The purpose of the project is to provide enhanced recreation opportunities, mitigate impacts to wildlife habitat, archaeological sites, soil, water, and address community interests. No spatial data
Highway 180 motorized trails	Motorized trail construction and conversion of user-created trails to motorized NF system trail in the White Horse Hills and Hochdeffer Hills area	Potentially up to 60 miles of motorized trail			No proposed action has been developed at this time No spatial data

***Table 103*. Other Foreseeable Vegetation and Prescribed Fire Projects Outside the Project Area**

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Clints Well Forest Restoration	Mechanical and prescribed fire	12,912 acres mechanical (includes 10,522 acres of WUI) 3,987 acres no treatment 16,467 acres prescribed fire (includes 10,522 acres of WUI)	Mogollon Rim		Fuel reduction and ecosystem restoration over approximately 16,809 acres within and adjacent to the WUI of Clints Well including: 779 acres MSO PAC thinning <9-inch dbh 3,778 acres MSO restricted habitat maintenance 1,043 acres MSO threshold habitat maintenance 412 acres goshawk PFA maintenance 184 acres goshawk PFA core nest area 225 acres insect and disease 529 acres timber stand improvement 3,448 acres uneven-aged development and 2,200 acres uneven-aged maintenance 294 acres fuelwood cutting

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Mahan-Landmark Forest Restoration	Specifics are unknown as no proposed action has been developed	33,747-acre project area	Mogollon Rim		Objectives: (1) vegetation structure and diversity with a mosaic of interspaces and tree groups of varying sizes and shapes, (2) forest structure with all age and size classes in goshawk and MSO habitat, (3) old age trees are sustained over time across the landscape, (4) improved forest health with reduced stand density-related mortality and reduced level of dwarf mistletoe infection, (5) improved vegetation diversity and composition in Gambel oak, aspen, piñon-juniper, and grasslands, (6) resilient forest - reduced potential for undesirable fire behavior and its effects, (7) maintain a mosaic of tree groups and interspaces with frequent, low-severity fire, (8) springs and seeps function at, or near, potential, (9) restore degraded ephemeral channels, (10) restore select closed and unauthorized roads
69 kV Winslow Blueridge	Construct 11 miles of corridor on NF lands and construct a new substation in Blue Ridge	55 acres of vegetation clearing 50 acres of small timber products sale	Mogollon Rim		Construct a 69 kilovolt (kV) transmission line to connect the Winslow substation in Winslow with a new substation in the Blue Ridge area
Grapevine Interconnect	9 miles of new 345kV electric transmission line	9 miles vegetation removal			Approximately 9 miles of new 345kV electric transmission line connecting a new wind park located on Flying M Ranch private property and State lands to the existing Western Area Power Authority (Western) 345kV line

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Bill Dick Springs Enhancement	No proposal at this time	Unknown No spatial data	Mogollon Rim		Enhance and restore water availability at a currently developed but marginally functioning spring to provide water for livestock, bats, amphibians, elk, and other wildlife
Blue Ridge Community Fire Risk Reduction	No proposal exists at this time, location is: Mogollon Ranch and Ponderosa Pines subdivision	50 acres – assume mechanical and prescribed fire Spatial data created	Mogollon Rim		Implement fuels reduction treatments in the Blue Ridge/Happy Jack area of Coconino County, AZ about 50 acres of subdivision lots (1-5 acres in size) for the purpose of creating defensible space and improving and protecting forest health.
Cinch Hook Rock Pit Use	Rock removal from within the existing development limits		Mogollon Rim		Located near the junction of State Highways 87 and 260 Objective: material for road maintenance, administrative site improvements and timber sale projects Incorporated into forest-wide rock pit analysis
Allen Lake Restoration	Unknown		Mogollon Rim		Proposed action not developed at this time
Pronghorn Habitat Improvements	Proposal has not been developed at this time		Red Rock		Improve habitat for pronghorn scoping began on 1/20/2012
Other Agency and Private Lands					
Camp Navajo Westside Thinning and Prescribed Fire Project	Mechanical and prescribed fire	968 acres mechanical and prescribed fire 530 acres burn-only	Flagstaff	Williams	Improve forest health, reduce fire risk Status: 2013 implementation
Department of Defense AZARNG Thin and Burn	Mechanical and prescribed fire	17,049 acres mechanical and prescribed fire			Ponderosa pine, pine-oak, and grasslands restoration to mitigate fire risk, provide diversity in forest conditions, improve ecosystem health, reduce tree density in 5-inch dbh to 18-inch dbh

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Greater Flagstaff Forest Partnership (GFFP)	Mechanical and prescribed fire	535 acres mechanical and prescribed fire	Flagstaff		Reduce fire risk on private property Status: Implement in 2013 and 2014
Acre Summary					
Vegetation mechanical treatments			**18,552 acres**		
Prescribed fire and maintenance burning			**19,082 acres**		

Note: The Long Valley Restoration Project (953 acres of thinning and 706 acres of prescribed burning) on the Mogollon Rim is in "hold" status and no decision is expected in the foreseeable future. For this reason, it was eliminated from the cumulative effects reasonably foreseeable category.

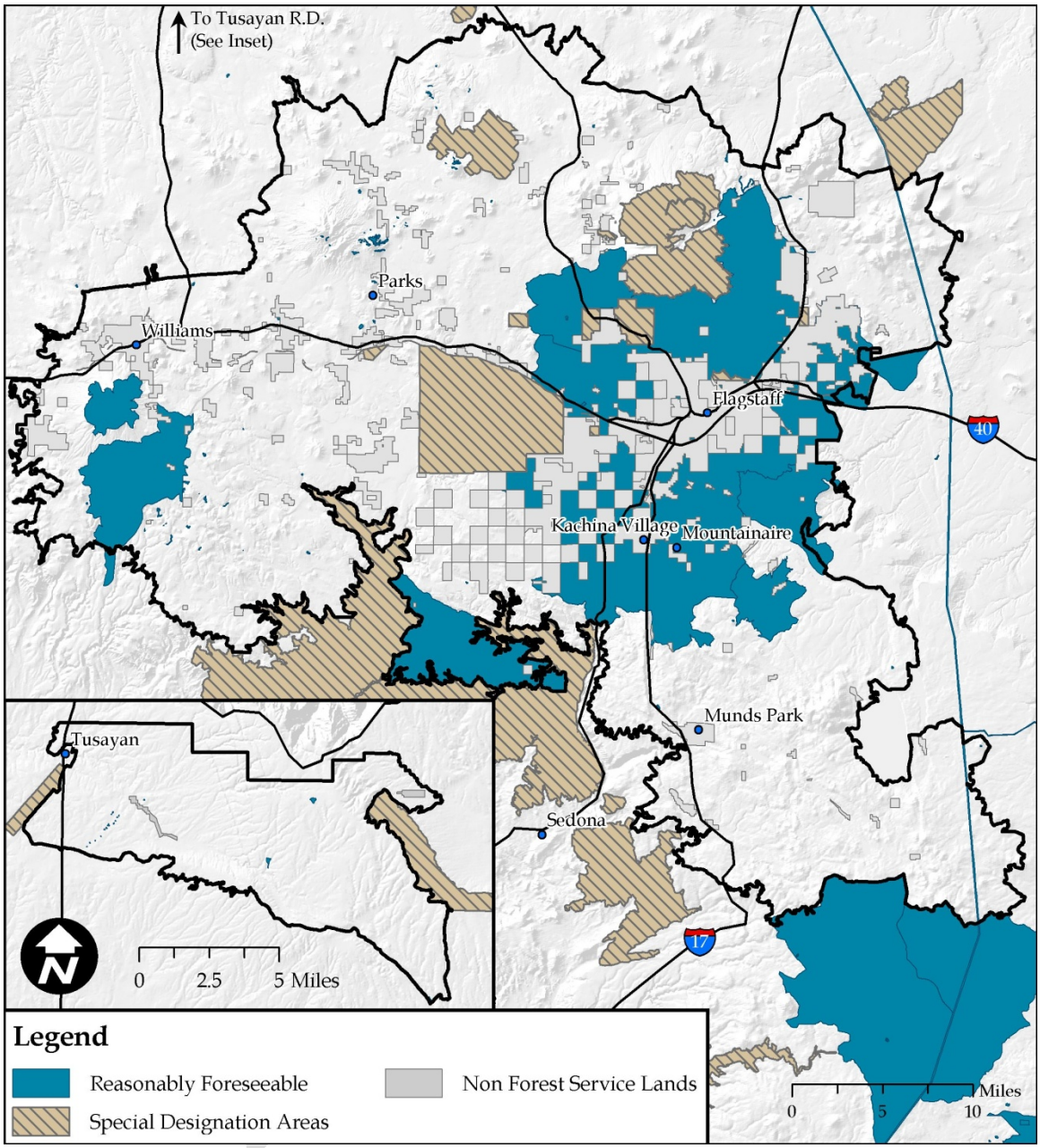

***Figure 60*. General Locations of Foreseeable Projects within or Adjacent to the Project Area**

Appendix H – Glossary of Terms

Active crown fire - a fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

Adaptive management - provides an implementation tool that goes beyond the "predict-mitigate-implement" model and incorporates an "implement-monitor-adapt" strategy that provides flexibility to account for inaccurate initial assumptions, to adapt to changes in environmental conditions or to respond to subsequent monitoring information that indicates that desired conditions are not being met (Forest Service 1909.14.1).

Age class - A distinct aggregation (grouping) of trees originating from a single natural event commonly consisting of trees of similar age.

Biomass - multiple definitions include: organic matter produced by plants and other photosynthetic organisms; total dry weight of all living organisms that can be supported at each level of a food chain or web; dry weight of all organic matter in plants and animals in an ecosystem; plant materials and animal wastes that functions as fuel for fire.

Burn - an effect produced by heating. To undergo combustion, consuming fuel and giving off light, heat and gasses. Also, an area where fire has occurred in the past.

Closed Road - Intermittent service roads that are closed to vehicular traffic. However, these roads may be available and suitable for non-motorized uses. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this maintenance level (USDA Forest Service 2005).

Clump - A tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees. A stand-alone clump of trees can function as a tree group.

Condition Class (reference FRCC) – A measure of departure from reference conditions that can be used to determine how 'at risk' key ecosystem components are in the event of a disturbance event, such as fire.

Conditional crown fire – a crown fire that is dependent on ladder fuels in adjacent stands in order for fire to access the crowns. In an area with conditional crown fire, ladder fuels are insufficient in a stand for crown fire to initiate, but canopy fuels are sufficient to support crown fire if it moves in from an adjacent stand.

Controlled burn – synonymous with Prescribed Fire.

Crown fire – a fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as independent, conditional, or dependent (active or passive) to distinguish the degree of independence from the surface fire. Crown fires are common in coniferous forests and chaparral shrublands.

Declining - The senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag-tops, large, old lightning scars and other characteristics that indicate the later life-stages.

Disturbance- any relatively discrete event or series of events—either natural or human-induced—that causes a change in the existing condition of an ecosystem, community, or population structure and alters the physical environment.

Disturbance Regime - a set of recurring conditions due to a variety of disturbances (e.g., fire, flooding, insect outbreak) and their interaction, which characterize an ecosystem within a historic, natural or human induced context, within a given climate. This set of recurring conditions includes a specific range for each of the attributes of these disturbances. These attributes include: frequency, rotation period, intensity, severity, seasonality, patch size and distribution, residual structure, casual agent, the relative influence of each causal agent and how they interact (Suffling and Perera 2004). The attributes researchers choose to represent a regime will vary depending on a researcher's area of interest (Sousa 1984, Pickett & White 1985, Agee 1993, Skinner and Chang 1996, Turner et al 2001). An accurate description of a disturbance regime must include the full range of disturbance events, including those that are rare.

Diversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Drought - periods of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, there may be a shortage of precipitation during the growing season resulting in crop damage (agricultural drought), or during the winter runoff and percolation season affecting water supplies (hydrological drought).

Duff - the fermentation and humus layer lying below the litter layer and above mineral soil; consisting of partially decomposed organic matter whose origins can still be visually determined, as well as the fully decomposed humus layer. This layer does not include the freshly cast material in the litter layer, nor in the postburn environment, ash (Brown 2000). The top of the duff is where needles, leaves, fruits and other castoff vegetative material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil. There is a gradient, not a clear division between litter and duff.

Ecological restoration - The process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions (USDA Forest Service 2008).

Erosion- the wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach and remove geologic parent material or soil from one point on the earth's surface and deposit it elsewhere.

Even-aged stand - A stand of trees composed of a single age class in which the range of tree ages is usually ±20 percent of rotation (SAF 2008).

Even-aged management -The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Evidence-based restoration - Using indicators of trees standing at the time of settlement that are no longer present as living trees – including snags, downed logs, stumps, and stump holes to guide restoration objectives (ERI 2009).

Fire Adapted Ecosystem: an associated group of plant and animals that have made long term genetic changes in response to the presence of fire in their environment.

Fire Ecology: the study of fire's interaction with ecosystems.

Fireline Intensity - rate of heat release in the flaming front.

Fire Regime - a set of recurring fire conditions that characterize an ecosystem, within a historic, natural or human induced context, within a given climate. This set of recurring conditions includes a specific range of attributes: Sugihara et al. (2006) uses the following attributes: seasonality, frequency (fire return interval), intensity, severity, size, spatial complexity, and fire type. An accurate description of a fire regime will include the full range of fire events, including those that are rare and connect to the larger disturbance regime which contains the fire regime as a subset. There are five fire regimes:

> **Fire regime I** - 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced);
>
> **Fire regime II** - 0 to 35 year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced);
>
> **Fire regime III** - 35 to 100+ year frequency and mixed severity;
>
> **Fire regime IV** - 35 to 100+ year frequency and high severity; and
>
> **Fire regime V** - 200+ year frequency and high severity.

Fire Regime Condition Class (FRCC) – an ecological evaluation protocol that uses three classes for describing the relative degree of departure from historical fire regimes.

Fire Return Interval - the number of years between two successive fires in a designated area (i.e., the interval between two successive fires); the size of the area must be clearly specified (McPherson and others 1990).

Fire Type - flaming front patterns that are characteristic of a fire.

First Order Fire Effects - effects resulting directly from the fire, such as fuel consumption and smoke production.

Forage - Browse and herbage which is available and can provide food for animals or be harvested for feeding; or (2) to search for or consume forage (ITR 1734-4).

Forest Health - The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance – note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (SAF 2008).

Group - A cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. The size of tree groups is typically variable depending on forest community and site conditions and can range from fractions of an acre (a two-tree group) to many acres. Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped (SAF 2008).

Group Selection - A cutting procedure which creates a new age class by removing trees in groups or patches to allow seedlings to become established in the new opening (SAF 1998).

Heterogeneity – for the purposes of this analysis, heterogeneity refers to having bio-diversity in terms of habitat and forest structure across the landscape.

Intermediate Thinning - The thinning or cutting of trees to improve the composition, structure, condition, health, and growth of remaining trees (SAF 1998).

Interspaces - the open space between tree groups intended to be managed for grass-forb-shrub vegetation during the long term. Interspaces may include scattered single trees.

Ladder Fuel - fuel, such as branches, shrubs or an understory layer of trees, which allow a fire to spread from the ground to the canopy.

Litter- the top layer of the forest, shrubland or grassland floor above the duff layer, including freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of accumulated dead organic matter which is unaltered, or only slightly decomposed. This layer typically does not include twigs and larger stems. One rough measure to distinguish litter from duff is that you can pick up a piece of litter and tell what it was (a leaf or leaf part, a needle, etc.). Duff is generally not identifiable. There is a gradient, not a clear division between litter and duff.

LOPFA – landscapes outside of goshawk post-fledgling family areas.

Mature Tree – A tree that has attained most of its potential height growth.

Monitoring - a systematic process of collecting and storing data related to natural systems at specific locations and times. Determining a system's status at various points in time yields information on trends, which is crucial in detecting changes in systems.

Mosaic - the spatial arrangement of habitat where there is stand heterogeneity—measured at many spatial scales from the patch, the stand, and the vegetative community

Over-mature Tree - A tree that has reached that stage of development when it is declining in vigor and health and reaching the end of its natural life span. Indications of later life stages in southwestern ponderosa pine include yellowing bark, large limbs, dead and/or dying limbs, flat tops, snag tops, lightning scars, and burn scars (cat face).

Passive crown fire – a fire in the crowns of the trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface fires.

PFA – goshawk post-fledgling family area

Pile burning – Activity fuels, once piled by machine or by hand, are burned in place.

Planned Ignition –the intentional initiation of a wildland fire by hand-held, mechanical or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects (see prescribed fire).

Pre-Commercial Thinning - The removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees (SAF 2008).

Prescribed Fire—is a wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition (see planned ignition).

Reference Condition - a range of conditions (found in the present or the past) against which the effects of past and future actions can be compared. These states can provide an explicit,

historically-based context for comparing different management effects. Examples include periods before fire suppression or the arrival of an invasive species, or a similar but "healthier" modern ecosystem. Ideally these environmental conditions are based on functioning ecosystems where natural ecosystem structure, composition, and function are operating with limited human intervention (very minor human-caused ecological effects).

Regenerate - The act of renewing tree cover by establishing young trees naturally or artificially (SAF 2008).

Residence Time - time required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The length of time the flaming front occupies one point; relates to downward heating and fire effects below the surface.

Resiliency - The capacity of a (plant) community or ecosystem to maintain or regain normal function and development following disturbance (SAF 2008).

Road and Route Obliteration - See Road Decommission

Road Decommission - Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1, Forest Service Manual 7705 - Transportation System [[USDA FS 2003]]). The Forest Service Manual (FSM 7712.11- Exhibit 01) identifies five levels of treatments for road decommissioning which can achieve the intent of the definition. These include the following: (1) Block entrance, (2) Revegetation and waterbarring, (3) Remove fills and culverts, (4) Establish drainageways and remove unstable road shoulders, and (5) Full obliteration, recontouring and restoring natural slopes.

Restoration Unit - A contiguous geographic area that ranges from 46,000 acres to 335,000 acres in size where a need for change (vegetation structure, pattern, spatial arrangement, potential for destructive fire behavior and effects) has been identified. Restoration unit boundaries are based on 6th code watershed boundaries, state and forest transportation systems, and forest administrative boundaries

Restoration Sub-Unit - A contiguous geographic area that ranges from 4,000 acres to 109,000 acres in size. Boundaries are based on 6th code watershed boundaries, state and forest transportation systems, and forest administrative boundaries.

Road construction or reconstruction - Supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a road (36 CFR 212.1).

Second Order Fire Effects - the secondary effects of fire such as tree regeneration, plant succession, and changes in site productivity. Although second order fire effects are dependent, in part, on first order fire effects, they also involve interaction with many other non-fire variables, e.g., weather.

Severity - the quality or state of distress inflicted by a force. The degree of environmental change caused by a disturbance, e.g. fire.

Stand - 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. Four classification characteristics are generally used to distinguish forest stands: bio-physical site (soils, aspect, elevation, 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 will shape structure over time). Based upon agency guidelines, the minimum stand mapping size is 10 acres.

Stand Density - A measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios, e.g., height/spacing (SAF 2008).

Stand Density Index (SDI) - A measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area. It may also be defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing. The computed value of SDI is often compared to the species maximum to determine the relative "stand density" or stocking of the stand.

Stand Structure - The horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (SAF 2008).

Surface Fire: a fire that burns over the forest floor, consuming litter, killing aboveground parts of herbaceous plants and shrubs, and typically scorching the bases and crowns of trees. See Backing Fire, Crown Fire, Fire, Flanking Fire, Ground Fire, Head Fire and Understory Fire.

Surface Fuel: fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants. See Duff, Fuel, Large Woody Debris and Litter.

Temporary road or trail - A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Torching – see Passive crown fire.
Unauthorized road - A road that is not a forest road or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Uneven-aged forests - Forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged management - The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species and the orderly growth and development of trees through a range of diameter or age classes (to provide a sustained yield of forest products). Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Wildland Fire – a general term describing any non-structure fire that occurs in the wildland. Wildland Urban Interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

Woody Debris - the dead and downed material on the forest floor consisting of fallen tree trunks and branches.

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